ATOMLAB 500 DOSE CALIBRATOR

OPERATION AND SERVICE MANUAL

086-330

BIODEX
Biodex Medical Systems, Inc.
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Atomlab 500 Dose Calibrator

This manual contains operating procedures for the following Biodex product:

#086-330 Atomlab 500 Dose Calibrator

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Definition of Symbols

The following symbols and their associated definitions are used and implied throughout this manual.

Symbol	Definition
	Carefully read these instructions prior to use
	Caution
	General Warning
	General Mandatory Action
	Dangerous Voltage
	“On” Power
	“OFF” Power
	Earth (ground)
	Alternating Current
	Fuse
	USB Connector/Cable
	Waste in Electrical Equipment
	Date of Manufacture
	Type B Applied Part
	CE Mark
	CE Mark for products with EC Certificate
	Certified for Safety by ETL Intertek

Before Proceeding

NOTE: The warnings, cautions and instructions provided in this manual must be read, followed and kept available for consultation at all times. Observing the information, instructions and procedures presented throughout this manual is essential for using the Atomlab 500 Dose Calibrator both properly and safely.

Specific Cautions

- *Allow only qualified, trained personnel to operate or service the Atomlab 500.*
- *If the equipment is used in a manner other than specified in this operation manual, the protection provided by the equipment may be impaired and results could be compromised.*
- *The display operates on low voltage and the power supply auto-ranges from 100 to 240 volts input current. The detector steps up the current to increase the high voltage required to operate the detector. (Never open the detector. The detector should only be opened by experienced, qualified personnel.)*
- *Except when using the Moly Shield, the well liner and dipper must be used for all Atomlab 500 Dose Calibrator measurements.*
- *The Moly Shield is used with the supplied metal shield for proper placement within the dose calibrator detector. Always use the well liner.*
- *The Atomlab Dose Calibrator is designed for use with specific printers. Contact Biodex for compatible printers.*
- *Never store sources in the dose calibrator except during a linearity test, as the sources will lengthen the time needed to perform a Zero Background once the source is removed from the detector.*
- *The pre-set dial values noted in Appendix E are password protected but can be changed by the user. Multipliers are not used with the Atomlab dose calibrators.*
- *Leave the Atomlab Dose Calibrator power on so that the detector remains stable and can quickly provide accurate measurements.*
- *A sealed source should be used to check the constancy of the system each day.*

Prudences Spécifiques

- *Permettez au personnel seulement autorisé, entraîné de faire marcher ou assurer l'entretien de l'Atomlab 500.*
- *Si l'équipement est utilisé dans une manière autre qu'indiqué dans ce manuel d'opération, la protection fournie par l'équipement peut être diminuée et les résultats pourraient être compromis.*
- *L'étalage opère sur le voltage bas et les auto-gammes d'alimentation électrique de 100 courant de contribution de volts au courant de contribution de 240 volts. Le détecteur augmente le courant jusqu'à ayez le haut voltage pour faire marcher le détecteur. N'ouvrez jamais le détecteur. Cela devrait être fait seulement par le personnel de service expérimenté, qualifié.*

- *Sauf lorsque en utilisant le Bouclier de Moly, Bien le Paquebot et le Cincle doivent être utilisés pour tous Atomlab 500 Dose mesures de Calibrator.*
- *Le Bouclier de Moly est utilisé avec le bouclier en métal fourni pour le placement Nécessaire dans la dose détecteur de calibrator. Utilisez toujours Bien le paquebot.*
- *la dose Atomlab calibrator est conçue à l'utilisation avec les imprimantes spécifiques. Contacter Biodex pour les imprimantes compatibles.*
- *ne conservez jamais des sources dans la Dose Calibrator sauf pendant une Épreuve de linéarité, comme le les sources s'allongeront le temps devait exécuter un fond zéro une fois la source est enlevé du détecteur.*
- *les valeurs de cadran programmées notées dans l'Appendice E sont le mot de passe protégé, mais peuvent être changé par l'utilisateur. Les multiplicateurs ne sont pas utilisés avec la Dose Atomlab Calibrators.*
- *Quittez la Dose Atomlab le pouvoir de Calibrator SUR pour que le détecteur reste ferme et peut vite fournir des mesures exactes.*
- *une source cachetée devrait être utilisé pour vérifier la Constance du système chaque jour.*

WARNING: *The unit contains lead for shielding the detector from background radiation. Additional lead shielding can be used outside the detector to further reduce background radiation. The lead should be disposed of in accordance with local and national regulations when disposing of the unit.*

AVERTISSEMENT: *l'unité contient l'avance pour protéger le détecteur du rayonnement ambiant. Le premier fait de protéger supplémentaire peut être utilisé à l'extérieur du détecteur pour davantage réduire le rayonnement ambiant. L'avance devrait être disposée conformément à local et national les règlements en se débarrassant de l'unité.*

WARNING: *All activities and count values on the sample reports in this manual are for illustration purposes only. They do not represent actual study values.*

AVERTISSEMENT: *Toutes les activités et les valeurs de compte sur les rapports de promotion dans ce manuel sont pour les buts d'illustration seulement. Ils ne représentent pas de valeurs d'étude réelles.*

CAUTION: *Unauthorized modifications to this product are not permitted and will void the manufacturer's warranty. Unauthorized modification of the product may result in a hazard to the user and/or patient. Do not modify this equipment without authorization from the manufacturer.*

ATTENTION: *Les modifications faites sans autorisation à ce produit ne sont pas permises et va faire le vide la garantie du fabricant. La modification faite sans autorisation du produit peut s'ensuivre dans un hasard à l'utilisateur et-ou le patient. Ne modifiez pas cet équipement sans autorisation du fabricant.*

CAUTION: *The Atomlab Dose Calibrator is intended to measure the activity of a radioactive source of a known isotope. This measurement may be for purposes of determining or verifying a radiopharmaceutical dose for nuclear imaging or nuclear medicine. This measurement may also be for the purpose of determining the radioactivity of a sample for dose calibrator constancy and Accuracy Testing or to measure other non-medical radioactive samples.*

ATTENTION: *La Dose Atomlab Calibrator est destinée pour mesurer l'activité d'une source radioactive d'un isotope connu. Cette mesure peut être pour les buts de détermination ou du fait de vérifier une dose radiopharmaceutical pour le fait de refléter nucléaire ou la médecine nucléaire. Cette mesure peut aussi être pour le but de déterminer la radioactivité d'un échantillon pour la dose calibrator la constance et la mise à l'essai d'exactitude ou mesurer d'autres échantillons radioactifs non-médicaux.*

Training

On-site installation and training is optional. The operation manual includes assembly and operating instructions. An applications training webinar is available on the internet at no charge; application questions can be directed to our service department during business hours.

Product Certifications And Classifications

This product has received the following certifications and falls within the following classifications:

- ETL Listed Electrical Equipment, Laboratory Use; Part 1, General Requirements for Safety conforms to UL 60601-1, CAN/CSA C22.2 No: 601-1-M90, IEC 60601-1, IEC 60601-1-4 and IEC 60601-1-2 and CE Marked.
- FDA Class II Equipment
- EC Certificate: EC #4132458

- Type B Applied Part 

CE 0413

- Electromagnetic Compatibility: This equipment complies with the Medical Equipment ICC 60601-2 EMC Standard.

NOTE: *Circuit diagrams for this product are provided in the Schematics section at the back of this manual.*

Authorized European Community Representative:

EC REP

Emergo Europe
Molenstraat 15
2513 BH, The Hague
The Netherlands

Important Safety Information

CAUTION: *Federal Law restricts this device to sale by or on the order of a physician, pharmacist or other licensed professional.*

ATTENTION: La Loi Fédérale restreint cet artifice à la vente par ou sur l'ordre de un docteur, le pharmacien ou d'autre professionnel agréé.

Follow the unpacking and assembly instructions document.

Before using this device, read the entire operation manual carefully. Failure to read the manual may result in user error or inaccurate data. Be sure to save all provided documents for future reference.

Make certain to understand all warning and caution labels as explained in the Before Proceeding section of this manual.

This product should be used only as specified in this operation manual.

For product specifications, refer to the table of contents.

This medical electrical equipment required special precautions regarding EMC and Needs to be installed and placed into service according to EMC information provided in this manual. Electromagnetic compliance definition is provided in Appendix H.

It is recommended that the Quality Assurance Testing of Atomlab Dose Calibrators be performed as presented in Appendix J.

For cleaning and maintenance instructions, refer to Table of Contents.

CAUTION: *Operation for: 100-240 VAC, 50/60 Hz.*

ATTENTION: *Opération pour: 100-240 VAC, 50/60 Hz.*

WARNING: *Only use approved power supplies.*

AVERTISSEMENT: *Utilisez Seulement des alimentations électriques approuvées.*

CAUTION: *To avoid risk of electric shock, this equipment must only be connected to supply mains with protective earth.*

ATTENTION: *Pour éviter le risque de choc électrique, cet équipement doit uniquement être connecté à un approvisionnement conduites avec la terre protectrice.*

CAUTION: *The plug is considered the method of disconnecting the product from mains power. Do not place the product in a position where the plug is not easily accessible.*

ATTENTION: *Le bouchon est considérée comme la méthode de déconnexion du produit d'alimentation. Ne placez pas le produit dans une position où le bouchon n'est pas facilement accessible.*

CAUTION: *The product is intended to remain in one location during operation.*

ATTENTION: *Le produit est voulu rester dans un emplacement pendant l'opération.*

Unpacking Instructions

Shipping Cartons

The Atomlab 500 Dose Calibrator and its respective components are carefully packed in two cartons. One carton contains the display unit and accessories; the other carton contains the detector unit. Both are shipped in an over-pack.

***NOTE**: Prior to removing any of the cartons from the shipping box, visually inspect the box and the inside packing for damage. If any damage is noted, do not unpack the contents. Notify the carrier immediately so that a claim can be made if necessary, and contact your Biodex Medical Systems Sales Representative. If there is no visible damage, remove the cartons and place them on a table or to the side. We suggest removing the display unit carton first.*

***NOTE:** Before deciding on a location to set up your Atomlab for operation, be sure to read Chapter 2 on installation. This chapter notes operating and environmental requirements, and offers several tips on choosing a location for your dose calibrator.*

The Display Unit Carton:

In addition to the display unit itself, this carton contains the Atomlab's Operation Manual, all the necessary connection and power wires needed to run the system, and a report of calibration.

The Detector Unit Carton:

***CAUTION:** The carton labeled DETECTOR UNIT is very heavy, ~38 pounds. Severe damage to the unit may result if this carton is dropped. Remove the detector from the carton and carefully place it on the table or other counter where you will set up and use your Atomlab unit. Make certain the tabletop will support a minimum of 300 pounds. We suggest that you place the carton on its side so that you can slide the Detector Unit out of the carton onto its side. Now, stand the detector up onto its base. Inserted into the Detector Well should be a Detector Well Liner.*

***ATTENTION:** Le carton étiqueté UNITÉ DE DÉTECTION est très lourd, ~38 livres. Cet appareil Peut subir de sérieux dommages s'ii est échappé. Retirez le détecteur de son carton et utiliserez le avec prudence sur la table ou le computoir où vous installerez et utiliserez l'unité Atomlab. Assurezvous que la table supportera un minimum de 300 livres. Nous suggérons que vous placiez le carton sur son côté afin que vous puissiez faire glisser L'UNITÉ DE DÉTECTION du carton à sa base. Dans la chambre du calibrateur vous devriez trouver un manchon protecteur. Un échantillon en plastique est emballé avec l'unité de présentation.*

Save The Packing Material

Do not discard the packing materials, cartons or shipping boxes.

This material was designed especially for the safe shipment of your Atomlab 500 Dose Calibrator. You will need them to return any of the Atomlab components in the future for updates, calibration or repair.

Atomlab 500 Dose Calibrator Warranty

1. Instrumentation

A. This equipment and its accessories are warranted by BIODEX MEDICAL SYSTEMS, INC., against defects in materials and workmanship for a period of two years from the date of shipment from BIODEX MEDICAL SYSTEMS, INC. During the warranty period, BIODEX MEDICAL SYSTEMS, INC. will in its sole discretion, repair, recalibrate or replace the equipment found to have such defect, at no charge to the customer.

EXCEPT AS STATED ABOVE, THERE ARE NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION WARRANTIES OR MERCHANTABILITY OR FITNESS FOR USE. BIODEX DOES NOT ASSUME LIABILITY FOR INCIDENTAL, CONSEQUENTIAL OR INDIRECT DAMAGES INCLUDING LOSS OF USE, SALES, PROFITS OR BUSINESS INTERRUPTION.

B. This warranty ***does not*** apply if the product, as determined by BIODEX MEDICAL SYSTEMS, INC., is defective due to abuse, misuse, modification or service performed by other than a BIODEX MEDICAL SYSTEMS, INC. Authorized repair and calibration facility. Misuse and abuse include, but are not limited to, subjecting limits and allowing the equipment to become contaminated by radioactive materials.

C. In order to obtain warranty repair service, the equipment must be returned freight pre-paid to one of our facilities. The return material authorization (R.M.A. #) should be included, along with a statement of the problem. Equipment will be returned transportation prepaid.

2. Calibration

A. Instruments are warranted to be within their specified accuracy at the time of shipment. If a question arises and BIODEX MEDICAL SYSTEMS, INC. determines that the initial calibration is in error, the instrument will be recalibrated at no charge.

B. Mechanical products are warranted to meet written specifications and tolerances at the time of shipment.

3. Warranty Is Non-Transferable.

4. Non-Warranty Service

A. Repairs and/or replacements not covered by this warranty may be performed by BIODEX MEDICAL SYSTEMS, INC. At a factory authorized service location. Estimates of repair charges may be requested, however, a charge for estimate preparation may apply if the repair is later not authorized by the customer.

B. The cost of transportation into and out of the service location will be the responsibility of the customer.

Service Procedure

If you think you have a service problem, take the following action.

1. Check to see that the problem occurs more than once.
2. Check the instruction manual and operations procedure.
3. Check the instruction manual troubleshooting Guide.

If you still think you have a service problem, call BIODEX MEDICAL SYSTEMS, INC., Service Department at (800) 224-6339.

Keep Yourself And The Phone Next To The Equipment.

1. Service will ask you for a brief description of the problem. We will ask specific questions about the malfunction that occurred. This diagnostic process may take a few minutes, so call us when you have time to spare.
2. After taking the information, we will advise on the action we will take.
3. Sometimes service personnel must consult with engineering and it may take time to get back to you. Be sure to let the service representative know your schedule so that we can call at a convenient time.
4. The return call may be from a person other than whom you first reported the problem to.
5. After analyzing the problem, we will decide if the unit must be returned to us for repair, or replacement parts will be sent.
6. If unit must be returned, it will be given a return material authorization (R.M.A. #) number by us. Pack the system in the carton that it was originally shipped in, or pack it safely and securely to avoid shipping damage. It is the customer's responsibility for any damage that occurs during shipping.
7. Non-warranty/non-service contract charges for repair are as follows:
   A. Materials
      +
   B. Time
      Service
      +
   C. Shipping Charges

Contact Information

Biodex Medical Systems, Inc.
20 Ramsey Road, Shirley, New York, 11967-4704
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Email: Info@biodex.com, www.biodex.com

1. Introduction

Intended Use

The Atomlab Dose Calibrator is intended to measure the activity of a radioactive source of a known isotope. This measurement may be for purposes of determining or verifying a radiopharmaceutical dose for nuclear imaging or nuclear medicine. This measurement may also be for the purpose of determining the radioactivity of a sample for dose calibrator constancy and Accuracy Testing or to measure other non-medical radioactive samples.

Indications For Use

The Atomlab Dose Calibrators are used in nuclear medicine departments, clinics and nuclear pharmacies to measure radioactive doses for administration to patients. The system is used to verify the radioactivity of a radionuclide before administration to the patient.

Atomlab Dose Calibrators use an argon gas filled pressurized detector to measure the activity of a radionuclide source of a known isotope. Their primary application is the measurement of the dose administered to a patient in nuclear imaging or nuclear medicine. Additionally, there are advanced, but easy-to-use programs for Nuclear Pharmacy, radiochemistry and radiochromatography.

Figure 1.1. *The Atomlab 500 features large, easy to read icons, prompts and values on a touch-screen display.*

The system consists of a low pressure ionization chamber, electrometer with extraordinary Linearity and an auto-ranging touch-screen color display. It provides fast, accurate radionuclide measurements with performance that easily complies with the most stringent regulatory requirements.

Activity measurements are performed by the microprocessor controlled electrometer located within the chamber assembly. The chamber is shielded with .25" (6.3 mm) lead. It can be located up to eight feet away from the display unit. Chamber bias is generated by an electronic high voltage supply, eliminating the need for expensive battery changes. The display can rest on a bench or mount on a wall.

Description

There are 12 isotope selection touch keys pre-programmed for the most commonly used radionuclides. Any of those keys can be reprogrammed by the user for a desired isotope. There are 88 isotope-specific dial values listed in the library. Dial values can easily be changed if required.

Activity is displayed on the touch-screen color display in either Curie or Becquerel units. Background correction is performed at the touch of a button. Range selection is automatic from .01 microcurie to 100 curies of Tc-99m or 25 curies of F-18.

The Detector

The Atomlab detector unit is a well type ionization detector capable of measuring activity as low as 0.01 µCi and as high as 100 curies of Tc-99m or 25 curies of F-18. The detector is surrounded on all sides and on the bottom with .25-inch lead to both shield you from the source you are measuring and shield the dose calibrator from any ambient radiation. The well type detector was carefully selected to provide a nearly "4 pi" measuring geometry which means that the radiation detector nearly surrounds the radionuclide. This allows the Atomlab Dose Calibrator to measure the activity of a sample no matter what its volume or shape, as long as it fits into the detector well. This is necessary, for example, when measuring syringe doses when the volume is unimportant. The detector has electronics and the calibration built into it (the calibrator is built into the detector.) Therefore, you can connect any Atomlab 500 display to a detector and have a calibrated system.

Detector Well Liner

Placed within the well is a plastic liner to protect the detector from contamination in the event of the source leaking during measurement. The dose calibrator should always be used with the well liner.

Source Holder

Radioactive sources are measured by placing them within the well opening of the ionization detector using the geometry within the detector. Samples contained within vials should be held in the bottom cup of the sample holder sample holder or syringe/vial dipper. The sample holder places the radioactive source in the location which is at the proper measurement. Samples within syringes should be placed in the syringe holder ring on the sample holder. Sources should be orientated vertically in the source holder. Sources should be placed in the dose calibrator well within 5 to 15 cm from the bottom of the detector well, as measured without the well liner in place. The response of the dose calibrator varies +/-0.5% within this region.

Current Measurement

The ionization current is measured by a microprocessor-controlled high impedance electrometer located within the base of the detector unit.

Rear Panel

On the rear connector panel of the detector unit are two connectors. One is for power and data communication with the display unit. The other is used to connect to a second detector. The detector unit can be located up to 20 feet (6.09 meters) away from the display unit. The standard cable measures eight feet (2.43 meters) in length.

Response

The response of this type of ionization detector has been carefully studied using radionuclides calibrated at the National Institute of Standards & Technology. The result is a well-defined energy response curve which is used to determine the calibration values for many different isotopes with high accuracy. Each detector has been calibrated with a national institute of standards & technology traceable source. The corresponding calibration value has been stored in the memory of the detector unit. After calibration, the detector's accuracy is tested with several sources of differing gamma energies whose activity values are traceable to the National Institute of Standards & Technology.

The Display Unit

The Atomlab 500 Dose Calibrator display unit consists of function keys and an LCD display that allows you to make activity measurements. A built-in microprocessor executes commands input via the touch panel and computes activity values from detector data.

The display unit, with a molded plastic case housing the electronics, has been specifically designed to perform activity measurements in a laboratory setting. To allow easy fingertip control of the button the front panel slopes gradually, providing an optimum viewing angle. On the rear panel of the unit are the power and communication connectors, which remain out of the way as they are infrequently adjusted.

Measurement Method

The current from the detector is measured in one of three ways, depending upon the order of magnitude of the current. At low currents, the current from the detector is collected upon a capacitor in the feedback loop of the electrometer whose capacitance is stable and measured to a high degree. Voltage measurements are made upon this capacitor many thousands of times per second. The time period between measurements is accurately calibrated. The second of two successive values is subtracted from the first, which yields the net voltage change of the capacitor over that short period of time. Thousands of successive differences are averaged over the course of one second in order to determine the detector current during that second. After a sufficient rise in voltage, the charge on the capacitor is emptied, reducing the charge and voltage by a calibrated amount.

At medium currents, the capacitor will reach its maximum voltage value very quickly, and the capacitor must be emptied quite often. At these currents, the number of times the capacitor is emptied per unit time is used to calculate the current from the detector.

At high currents, the capacitor cannot be emptied fast enough. Instead, the switch which controls when the capacitor is emptied is closed, and the electrometer is nulled. The value of The DAC which is used to null the electrometer is used to determine the detector current at high currents. During calibration, multiple measurements are made at current values at which two modes of current measurement can be used effectively. These calibration measurements are used to set the calibration parameters of the medium and high current modes so as to meet the linearity required of the electrometer.

Display Units

When you set your dose calibrator to display activity values in Ci (curies), the system of units, either µCi, mCi or Ci, will be indicated next to the numeric display. The prefix micro or µ (10-6), or milli or m (10-3) or curies is automatically selected by the system's microprocessor. For example, if the numeric value displayed is 12.03, and µCi is indicated, the activity will be 12.03x10-6 ci or 0.00001203 curies; if 63.9 is displayed and mCi indicated, the activity is 63.9x10-3 ci or 0.0639 curies.

In the same manner, when you set the dose calibrator to the international system of units, Becquerels, either MBq or GBq will be indicated, where the prefix m represents Mega (106) and G represents Giga (109). The absolute measurement range of the Atomlab Dose Calibrator is from 0.01 µCi to 100.00 ci of Tc-99m or 25 curies of F-18 (and the equivalent in becquerels). For example, 12.03 µCi = .445 MBq and 63.9 mCi = 2.36 GBq. If the numeric display reads 0.445 and MBq is indicated, the activity value is 445,000 becquerels; if 2.36 is displayed and GBq indicated, the activity is 2,360,000,000 becquerels.

Routine Isotopes

The routine radioisotope (isotope selection) keys for the Atomlab 500 include: Tc-99m, TI-201, I-123, I-131, Cs-137, Co-57, Xe-133, Ga-67, In-111, F-18, Y-90s, and Ba-133. The Co-57, Ba-133 and Cs-137 buttons are primarily used for accuracy and constancy tests.

Atomlab Dial Values

Equal activities of two different isotopes will generate different amounts of current in the ion detector due to differences in the energy and particle emitted by the isotopes. Dial values are a means of calibrating the source activity measured for an isotope due to these differences in detector current. The amount of current which is produced by a Co-60 source is defined as a dial value of 5.0; all other isotopes are defined relative to the Co-60 value. Co-60 was chosen as the defining isotope due to its high energy photon emission and long half-life. The high energy reduces the effect of container geometry (syringe, vial, etc.) and the long half-life ensures that a single calibrated source can be used for many calibrations.

The dial value for certain isotopes have been directly measured using NIST calibrated sources provided from the NIST standard reference materials program. These isotopes include Ga-67, Y-90, Tc-99m, Mo-99, In-111, I-125, I-131, Xe-133, and TI-201. In addition the Cs-137 dial value has also been measured directly using a NIST calibrated source. Using the measured detector response for the isotopes listed above in conjunction with a Monte Carlo model of the ion detector, detector response curves have been generated. Using information on photon, electron and positron emission (from Table of Radioactive Isotopes, by Browne and Firestone, verified with the Nuclear Data Center's Nudat 2.2 Database), calculated dial values have been generated for those isotopes for which direct measurement of the dial value was not possible.

2. Installation

Operating Requirements

Prior to installing your equipment, plan a layout for your Atomlab unit that will ensure it is convenient for measuring radionuclides and will not cause undue radiation exposure because of extra handling of high activity sources. There should be ample room to place a vial shield on the work surface (preferably behind an l-Block shield), open the shield and remove the vial using tongs, quickly place the vial into the sample holder and then place both into the detector well.

Remember that to make radioisotope measurements you will have to place the clear plastic detector well liner into the detector well and lower the plastic sample holder into the liner. Make sure there will be no obstructions, such as wall cabinets, above the detector unit. Such obstacles may make it difficult to insert and remove the sample holder.

NOTE: *You must use a well liner at all times.*

Work Surface

Choose a table or other counter which is free of vibration, does not wobble, and will easily support 300 pounds.

The surface area of the tabletop should provide ample area to accommodate the detector unit, display unit, the L-Block shield, the shielded radionuclide preparation area, and room for writing.

Suggested dimensions of the table top are:

- 30 in. deep
- 48 in. wide
- 36 in. high

Physical Location And Environment

Frequently, dose calibrators are located in areas called hot labs in which there is a wet sink with plumbing. Do not locate your dose calibrator on a table or other counter which can become wet or is subject to splashing or spraying.

Avoid areas which have drafts caused by heating or air conditioners, or are in direct sunlight. Electronics work best when constant temperature is maintained.

The temperature range is from 10 to 30° C, and the relative humidity range from 0 to 90%.

Choose a location for your dose calibrator which is not frequently used by other personnel — one where the table on which it lies will not be bumped.

In general, make sure your work area is clean, dry, and dust free.

Avoid locating your dose calibrator near a radioactive materials storage area. The .25-inch lead shield around the detector shields it from changes in radiation levels from diagnostic energy radionuclides (i.e., Tc-99m); however, the high energy radiation from sources such as Cs-137, F-18 and Co-60 will easily penetrate the shield and change the background radiation level. The lower the ambient radioactivity, the less background activity for which the Atomlab Dose Calibrator must compensate, and the greater the accuracy and reliability of the readings.

Positioning

After you have chosen a suitable location for your Atomlab Dose Calibrator and familiarized yourself with its components, position the various units. Make sure the detector and display units have been positioned to where they will not have to be moved prior to connecting the cables.

Environmental Operating Conditions

Temperature: 10 to 30˚C
Humidity: 0 to 90% rh, non-condensing

For optimum performance, the Atomlab 500 Dose Calibrator should be operated in a normal laboratory environment where the temperature and humidity are maintained for normal human comfort and the ambient radiation level is low and constant.

Environmental Shipping And Stowage Conditions

Temperature: 0 to 40˚C
Humidity: 0 to 90% rh, non-condensing

For optimum performance, the Atomlab 500 should be operated in a normal laboratory environment where the temperature and humidity are maintained for normal human comfort and the ambient radiation level is low and constant.

Power Requirements

Choose a line power source with a socket which mates securely with the power plug provided.

Verify that the power line is properly grounded.

Do not choose an outlet that has a wall switch control.

WARNING: *Before inserting or removing connectors, turn power OFF.*

AVERTISSEMENT: *Avant le fait d'insérer ou le fait d'enlever des connecteurs, éteignez le pouvoir.*

This system uses an XP Power Supply for Medical Use, model #PDM60US15, or the alternate ICC Nexergy (PEI Genesis) model MWA065015A-11A (modified).

Line Voltage

100 to 240 VAC, auto selectable by the power supply (1.5 to 0.75 amps).

Line Frequency

50/60 Hz.

Cable Connections

(See Figures 2.1 – 2.2.)

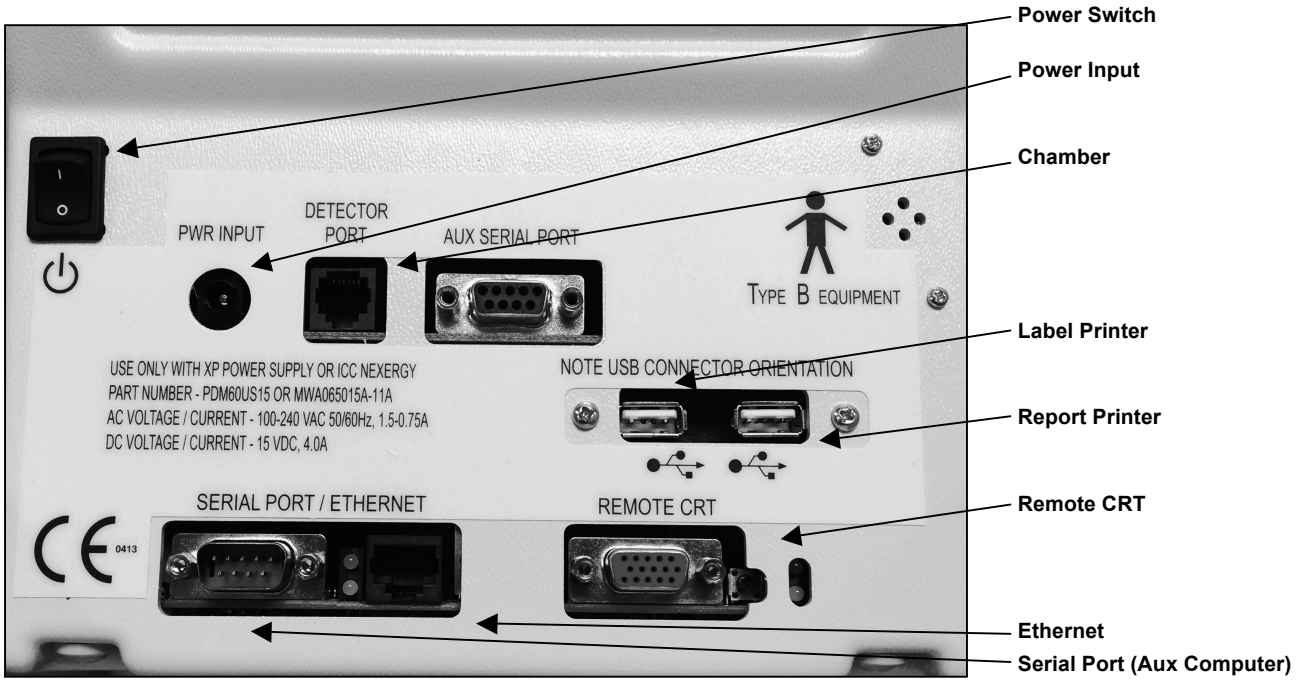


Figure 2.1. *The Atomlab 500 cable connections (on back of unit.)*

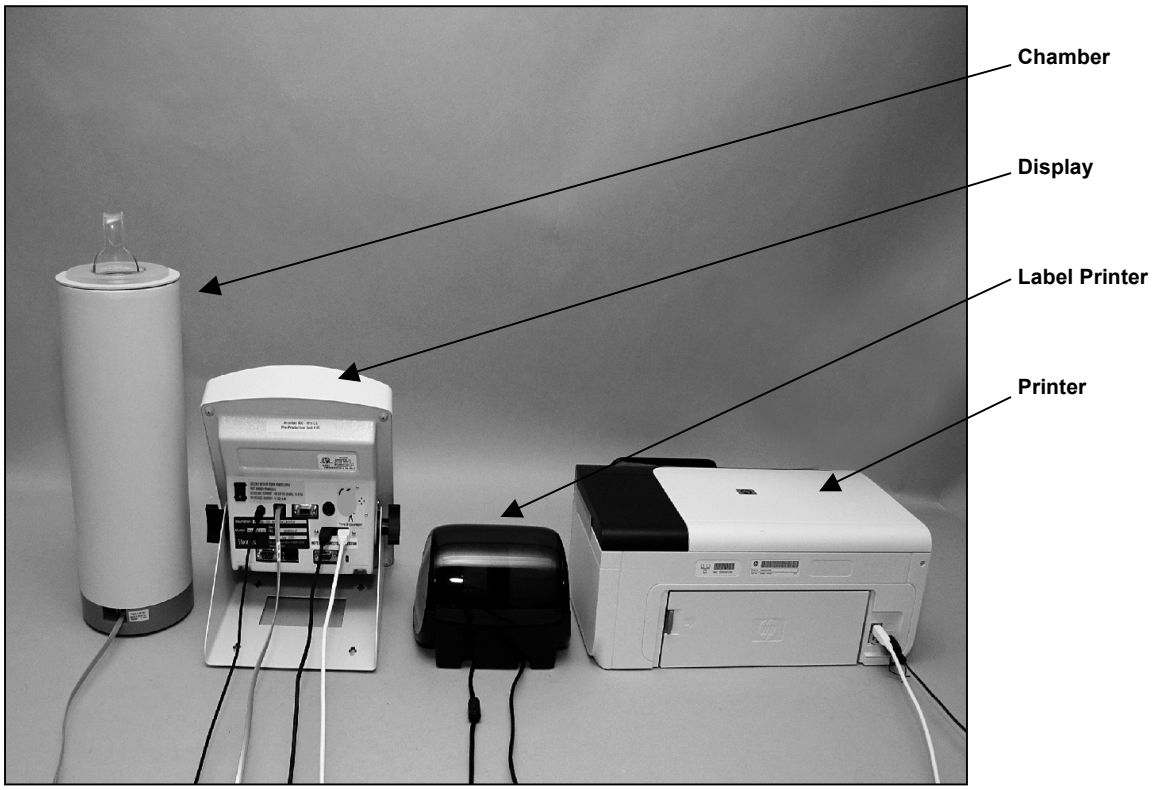


Figure 2.2. *The Atomlab 500 Display connected to a detector, label printer and printer.*

1. Rotate the detector unit to access the connector on the base of the detector.
2. Insert one end of the RJ12 detector cable into the mating detector port.
3. Rotate the detector unit to its normal position so that the detector jack is facing away from the work area.

   NOTE: *If you have more than one detector, use a second RJ-12 cable to connect the two detectors in a serial fashion. It does not matter which RJ-12 port is used on a detector.*

4. Rotate the display unit to access the connection ports located on the display back panel.
5. Insert the free end of the detector cable into the mating display port (there are two RJ-12 ports on the detector).
6. If you would like to connect a computer to the Atomlab 500, attach a null modem RS-232 Cable (or USB/RS-232 converter cable) with a DB9 connector to the computer serial port and then attach the opposite end of the cable to the appropriate port on the display.
7. Insert the round end of the power supply or power pack into the power port on the display unit.

8 Insert the female end of the power cord into the black, rectangular power pack. Turn the display ON once the cord is plugged into the wall. The system will power-up and run a self-test.

NOTE: *As long as the Atomlab 500 is plugged in and power turned ON, the system will be functioning. Depending on the Backlight Time setting, the display screen will eventually turn OFF. Simply touch the screen to reactivate.*

NOTE: *If more than two USB ports are needed, a USB expansion hub (not included) can be used to provide additional USB ports.*

NOTE: *The display can sit on the countertop or be mounted on the wall. Use the holes in the base to mount to the wall.*

Power Up And System Test

(See Figure 2.3.)

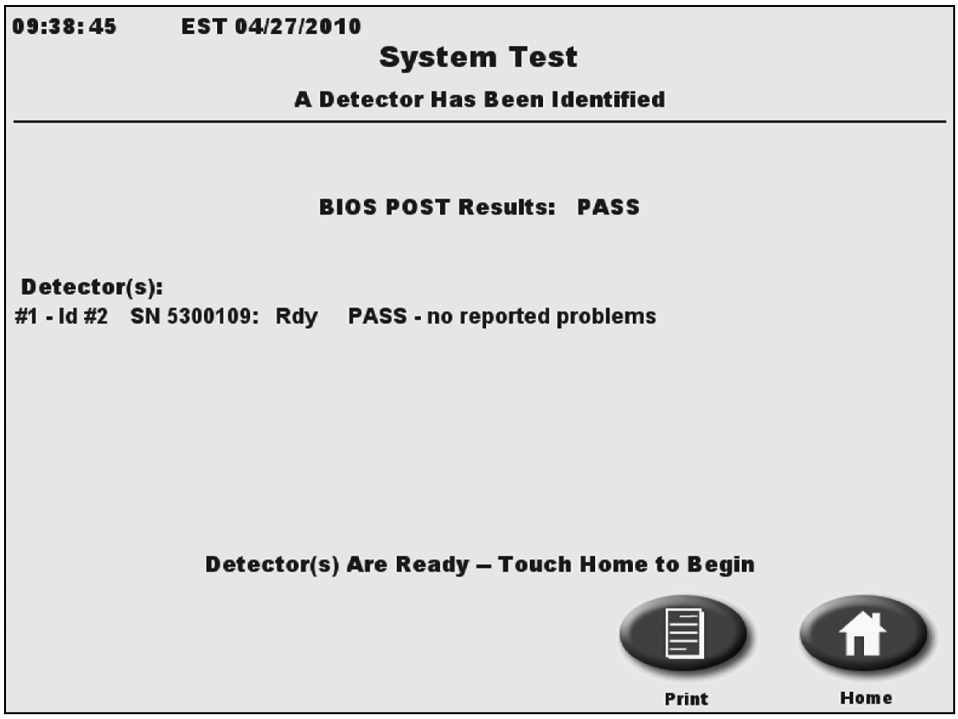


Figure 2.3. *The Atomlab 500 System Test screen.*

Connect the power cable to the back of the display unit and then plug the power supply into a wall socket. Toggle the power switch, located on back of the display, to the “ON” (I) position. The green power on led on the display will light and the system automatically performs a background count and system-test as part of the power-up process.

NOTE: *Be sure there is no source of activity in the detector, or nearby, which can cause the initial background measurement to be incorrect.*

The system test includes the following checks,

Display:

- CPU functions
- RAM memory (RAM diagnostics)

Detectors:

- Communication with all detectors
- High voltage readings to be in range
- All detector firmware checksums
- Validity of calibration factor values
- Background factor for an excessively negative or large value
- Detector memory integrity
- Electrometer failure status
- Detector gas pressure

Following the power-up system test, a screen is displayed showing the components and detector status. If all items pass, “Pass” is displayed at the completion of the test. Should any aspect of the self-test fail, “Fail” is displayed, along with an accompanying error code and optional description of the problem.

Once the system check is completed, touch <Print> to generate a printout of the system test results and/or touch <Home> to advance to the Atomlab 500 Home screen.

Save The Packing Material

Now that you have set up your Atomlab dose calibrator, and everything is intact and functioning properly, take a few moments to repack the packing material. This material was especially designed for safe shipment of the Atomlab dose calibrator and should be considered part of the instrument. Place the shipping material in the appropriate boxes and put the boxes back into the shipping carton. Label the carton and store it in a safe, out-of-the-way location. If you ever need to return your dose calibrator for updates, calibration, or repair, use the original shipping carton, boxes, and shipping material.

Maintenance

General Cleaning Instructions

As required, wipe down the exterior of the unit using a soft rag slightly dampened with alcohol. Use neutral detergent or isopropyl alcohol on a clean soft cloth to clean the panel surface. Do not use any kind of chemical solvent, acidic or alkali solution.

NOTE: *To properly maintain your Atomlab Dose Calibrator, quality assurance should be performed as suggested in Appendix J: Quality Assurance Testing of Atomlab Dose Calibrators.*

Password Protection

There are several program setups that require the use of a password for access to make changes. The default password is: 123, followed by <Enter>.

If you need to change the password, contact **Biodex Customer Service at 800-224-6339**.

3. Dose Calibrator Operation

Basic Key Functions

(See Figure 3.1 and 3.2.)

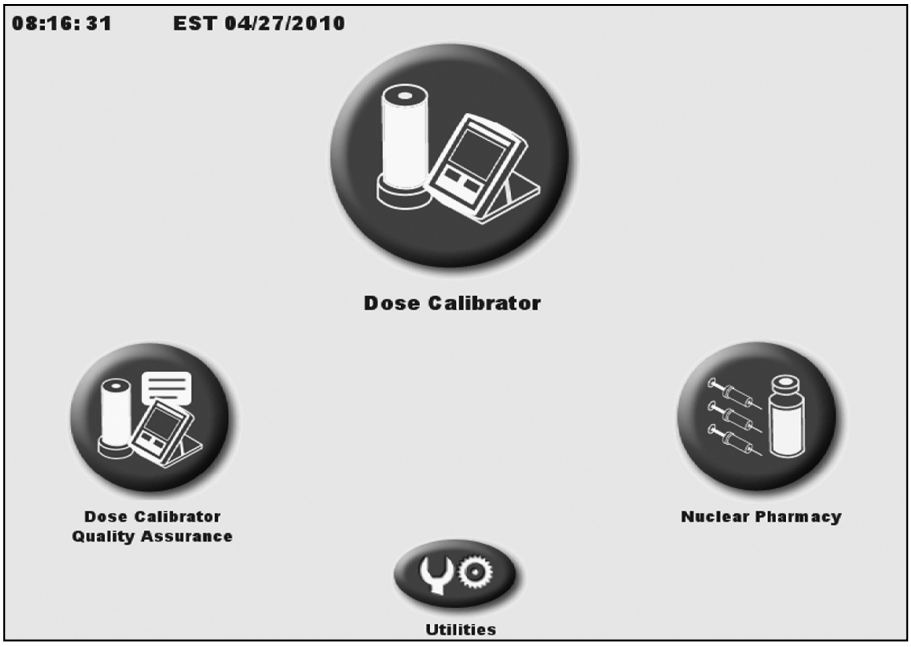


Figure 3.1. *The Atomlab 500 Home screen.*

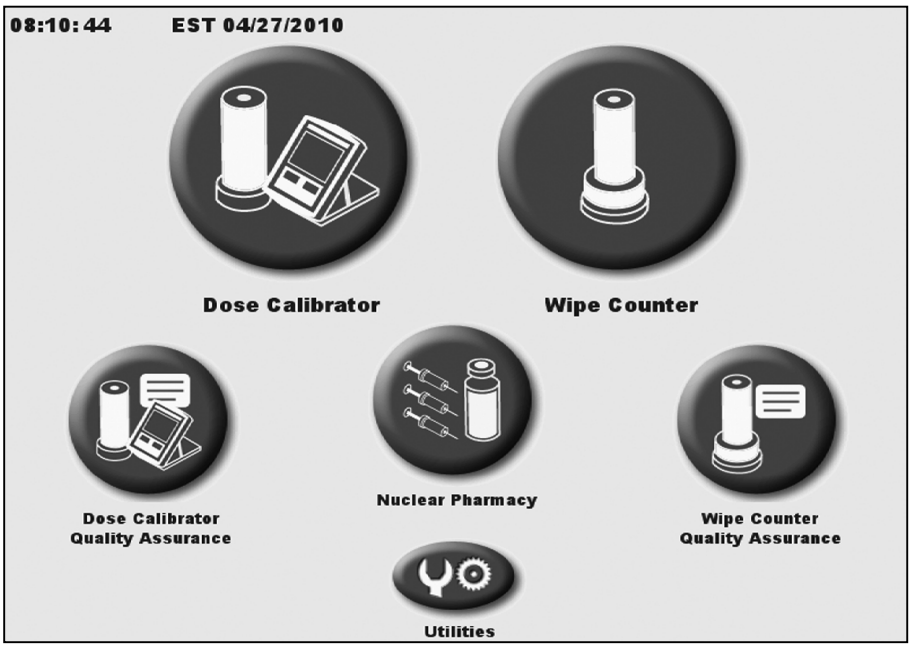


Figure 3.2. *When a Wipe Test Counter is attached, the Atomlab 500 system displays the Home page icon for both the detector and well counter.*

Easy to read and intuitive to use, the Atomlab 500 touch screen display prompts users to Advance effortlessly and logically though the Dose Calibrator (Chapter 3), Utilities (Chapter 4), Nuclear Pharmacy (Chapter 5), and Dose Calibrator Quality Assurance (Chapter 6) programs. The following basic prompts appear throughout the program and, unless otherwise noted, always perform the following functions:

- <Home> Returns the system to the Home screen.
- <►> Advance one screen.
- <◄> or <Back> Returns to the previous screen.
- <▲> Scroll Up (On some screens, holding on this icon increases scroll speed.)
- <▼> Scroll Down (On some screens, holding on this icon decreases scroll speed.)
- <Clear> Erases all user entries to fields on the current screen.
- <Cancel> or <X> Cancels any entry and returns the user to the previous screen.
- <Enter> , <Yes> or <√> Confirms any entry and advances to the next screen.
- <BS> Moves the cursor one space back, deleting the previous keystroke, on any keypad.
- <Print> Prints the currently displayed screen or report.
- <Print Labels> Prints various labels based on the function currently selected.

NOTE: *When a Wipe Test Counter (#086-331) is added to the Atomlab 500, the system automatically recognizes the additional detector and displays the Home screen for both the detector and the wipe counter.*

The Dose Calibrator Program

From the Home screen, touch <Dose Calibrator> to access the Dose Calibrator screen. At this screen the system operates as a dose calibrator. A list of isotopes is displayed along with time, date, detector #, measured activity, and Activity Units. The measured activity is the real time activity being measured in the detector for the first (most left) isotope displayed.

The Dose Calibrator screen activity reading defaults to the last selected isotope, or to Tc-99m if no isotope has been previously selected. The system selects the most recently used units of measure (*mCi* or Becquerels,) or defaults to *mCi* if units have not been previously selected.

In addition to counting isotopes, the Dose Calibrator screen allows the user to <Zero Background>, <Select Detector> if multiple detectors are connected, <Select Isotope>, perform <Dose Calculation>, or <Print Labels> for the current activity in the detector. There are two types of labels that print.

Counting An Isotope

(See Figures 3.3 and 3.4.)

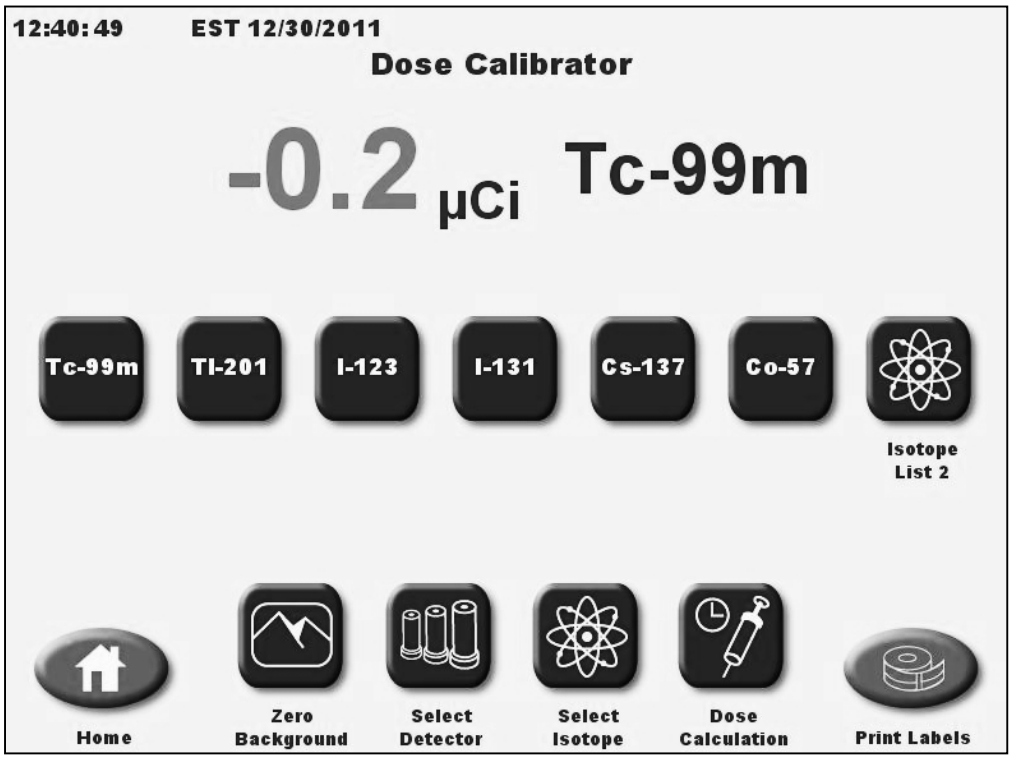


Figure 3.3. *The Dose Calibrator screen with List 1 Button Isotopes displayed.*

To Measure An Isotope:

1. Touch the appropriate <Isotope> key. This tells the detector which dial value to use in the calculations.
2. Place the isotope in the detector. The activity level is immediately displayed.
3. Touch <Print Labels> to print out an activity label, or <Home> to return to the System Home screen.

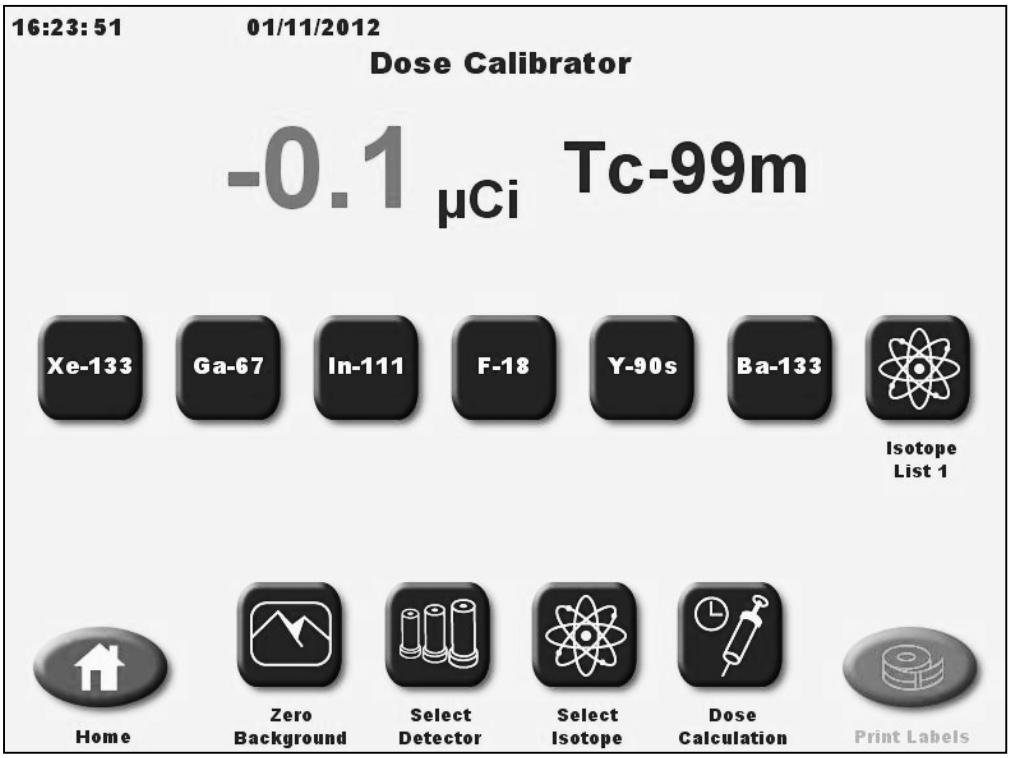


Figure 3.4. *The Dose Calibrator screen with List 2 Button isotopes displayed.*

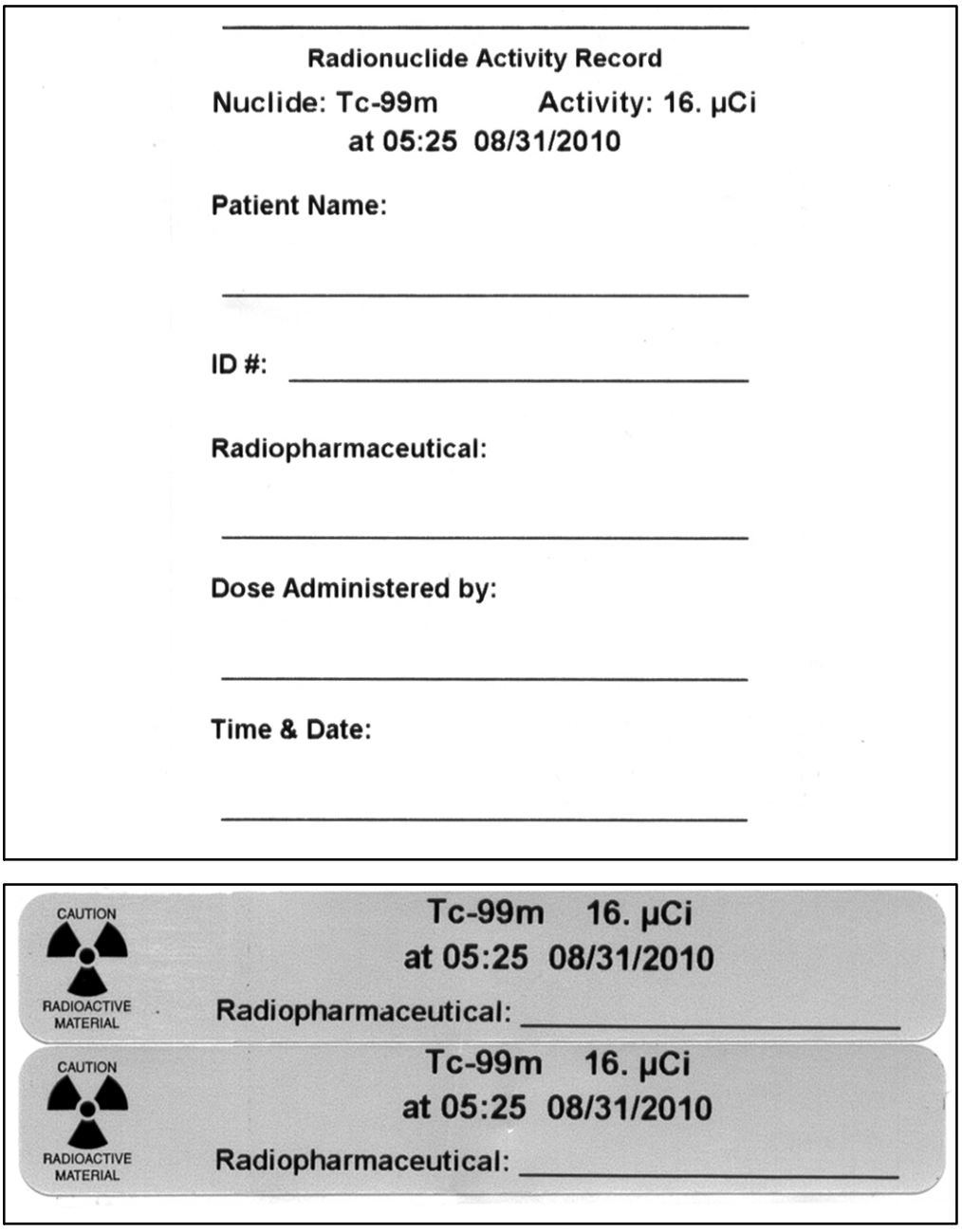


Figure 3.5. *A Measure screen label.*

Changing The Selected Isotope

The selected isotope can be changed at any time with the activity for the new isotope displayed within one second. There are two button lists from which isotopes can be selected. These buttons offer quick access to commonly used isotopes. Select <Isotope List #> to toggle between buttons on List 1 and List 2. List 1 isotope buttons include: Tc-99m, Tl-201, I-123, I-131, Cs-137 and Co-57. List 2 isotope buttons include: Xe-133, Ga-67, In-111, F-18, Y-90s and Ba-133.

The Routine Isotopes List, which displays up to 19 routine isotopes, is accessed by touching <Select Isotope>. Scroll down the Routine Isotope List to access the Custom Isotopes List and full Alphabetical Isotopes List.

Isotope Response Time

The Atomlab 500 normally settles within three seconds as long as the minimum threshold level is exceeded. When you first lower the source into the well, the activity value quickly jumps to the final value. For a few seconds the value may fluctuate, but then the value settles down to a small variation. As soon as the source is removed from the detector Well, the activity display will drop down to a near zero value.

NOTE: *Both the Detector Well Liner and Sample Holder should be periodically checked for contamination as described in Appendix J under Records and Maintenance, Dipper and Well Liner. (The more your dose calibrator is in use, the greater the frequency of contamination checks required.)*

Zero Background

(See Figure 3.6 and 3.7.)

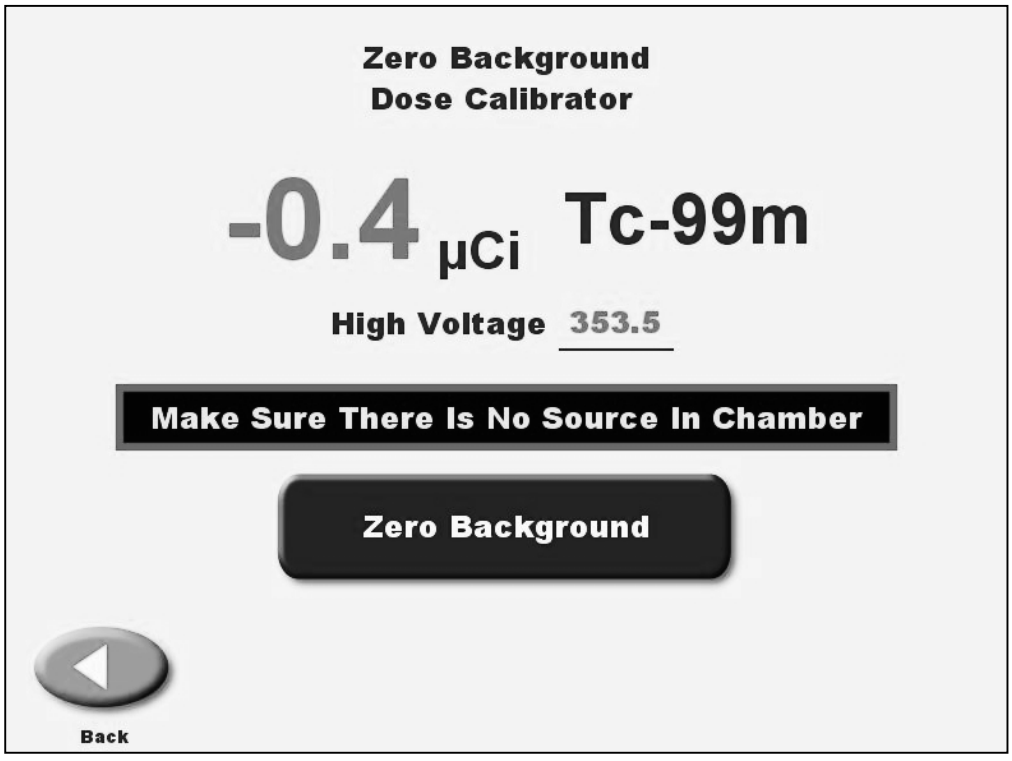


Figure 3.6. *The Zero Background screen.*

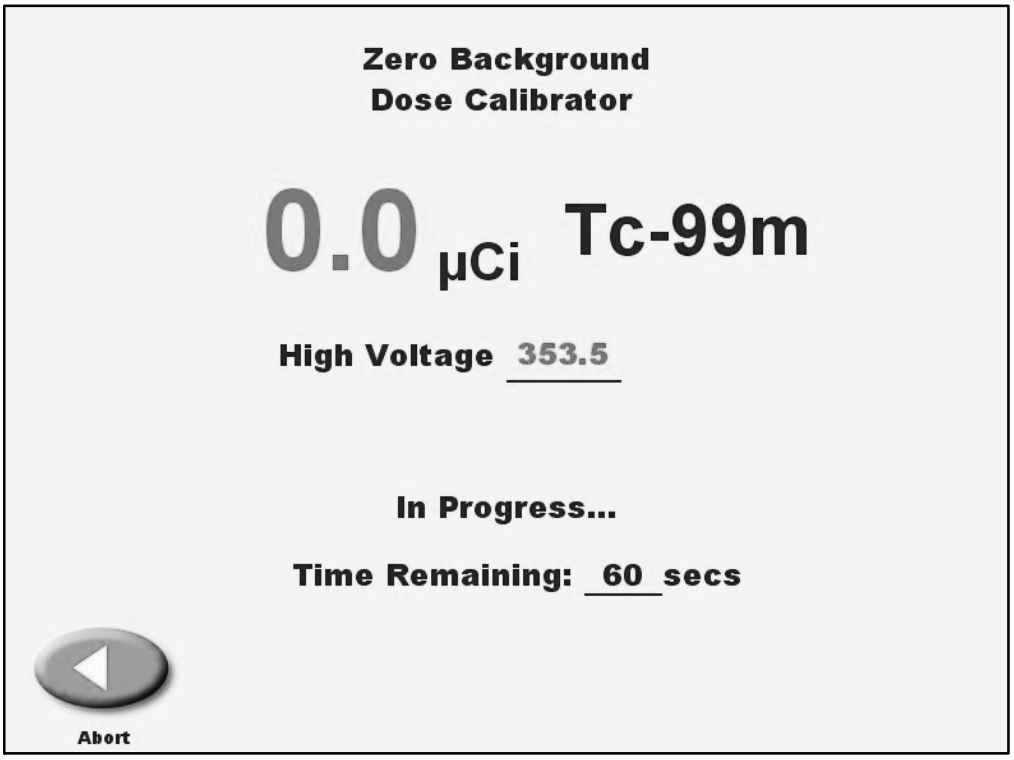


Figure 3.7. *A Zero Background count in progress.*

The Zero Background feature is used to zero the background reading before performing a measurement. The Zero Background screen is accessed by simply pressing <Zero Background> on the display. The isotope displayed is always the last one selected, or Tc-99m if no isotope has been selected. Measurement units default to the last selected (curies or Becquerels,) or to curies if no measurement units have been selected.

To Zero Background:

1. Ensure that no isotopes are in or near the detector.
2. Touch the <Zero Background> icon. The Zero Background screen is displayed showing the current isotope activity.
3. Touch the <Zero Background> prompt. The message "in progress… time remaining XXX seconds" is displayed with the time counting down to zero from the point the isotope was actually removed.
4. When the countdown is completed, the system always returns to the screen from which <Zero Background> was selected.

NOTE: *If there has been no change in activity within the detector for more than 100 seconds, the system will quickly zero the background when <Zero Background> is selected.*

Large Transition During Initialization

If a large transition is detected during background initialization or during a Zero Background procedure, the following prompt will appear:

"An Unusually Large Change In Activity Of nn.n pA
Has Been Detected During Background Initialization.
It Is Recommended To Redo The Background Initialization
(takes 100 readings)"

From this screen, the user can choose to <Ignore and Continue> the Zero Background procedure, or <Redo Background Initialization>. Choosing to continue will return to the screen from which <Zero Background> was selected (either System Test or Zero Background).

If <Redo Background Initialization> is selected, the unchanged Zero Background count down Screen will be displayed. Touch <Abort> to abort the Zero Background procedure and return to the original screen. If the user allows the countdown to complete, the <Abort> button label changes to <Back>, and the system automatically returns to the original screen.

Select Detector

The <Select Detector> icon allows the user to choose a different detector when more than one detector is connected to the system. The Atomlab 500 can accommodate up to seven dose calibrator detectors (or six dose calibrator detectors and one wipe detector).

To Select A New Detector:

Note: *If only one detector is connected, the system will not allow the following procedure.*

1. Touch <Select Detector> to scroll through detectors 1, 2 and 3. Each time you touch <Select Detector> the system selects the next detector. Press <Cancel> to return to the Home screen.
2. If you have four or more detectors, touch <Select Detector> again. A list of all the present detectors with detector number, type of detector and location is displayed. The last detector used is highlighted.
3. Touch to highlight any detector displayed, or touch <More Detectors> to view additional detectors on the list. Use <More Detectors> to continue scrolling through the detectors list if necessary. Touch <Previous Detectors> to return to the previous detector list.
4. Touch <Enter> to select the new detector and return to the Home screen, or press <Cancel> to return to the Home screen without selecting a new detector.

Select Isotope

(See Figure 3.8.)

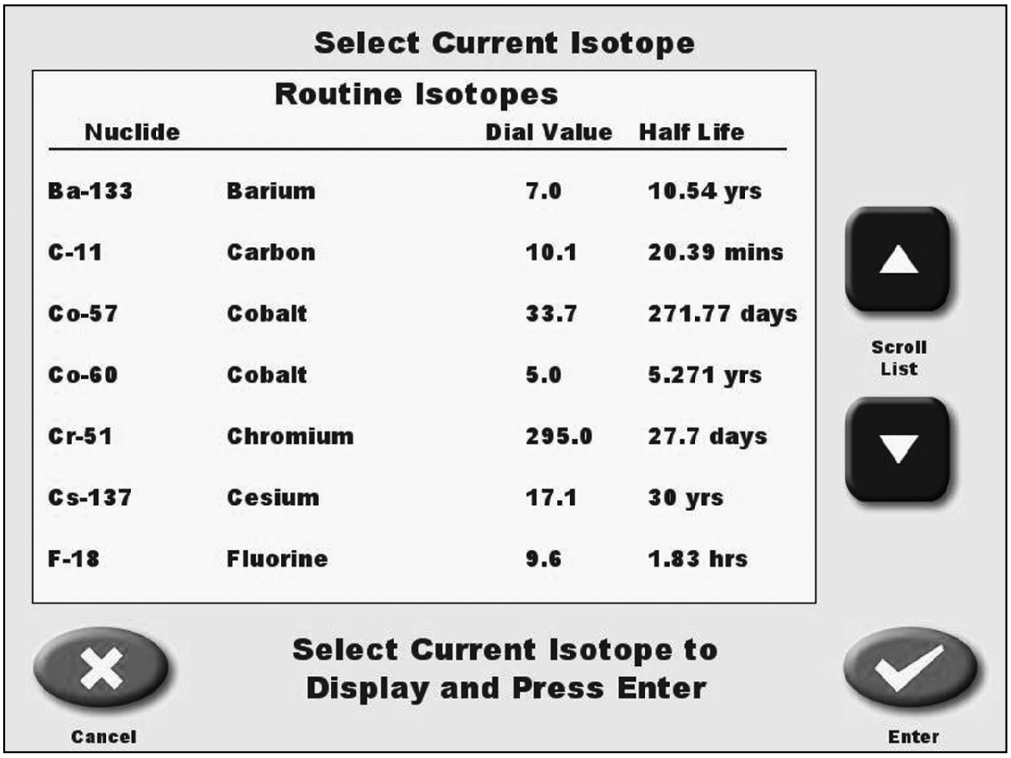


Figure 3.8. *The Select Current Isotope screen with Routine List.*

If the desired isotope is not displayed on List 1, List 2, choose <Select Isotope> to access the Routine Isotope List, Custom Isotope List or a full Alphabetical list of isotopes. Scroll down the list if necessary to find the desired isotope.

To Select Any Isotope From The Full Alphabetical List:

1. Touch <Select Isotope>. The select current isotope screen, with the routine list, followed by the custom Isotope List, and then the full Alphabetical list of isotopes, will be displayed.
2. Use the <S> or <T> keys to scroll through the lists until the desired isotope is displayed.
3. Touch the desired isotope to highlight your selection.
4. Touch <Enter> to select the desired isotope and return to the Measure screen with the new isotope selected, or touch <Cancel> to return to the Measure screen without making a new selection.

Determining Dial Value Adjustments

(See Figure 3.9).

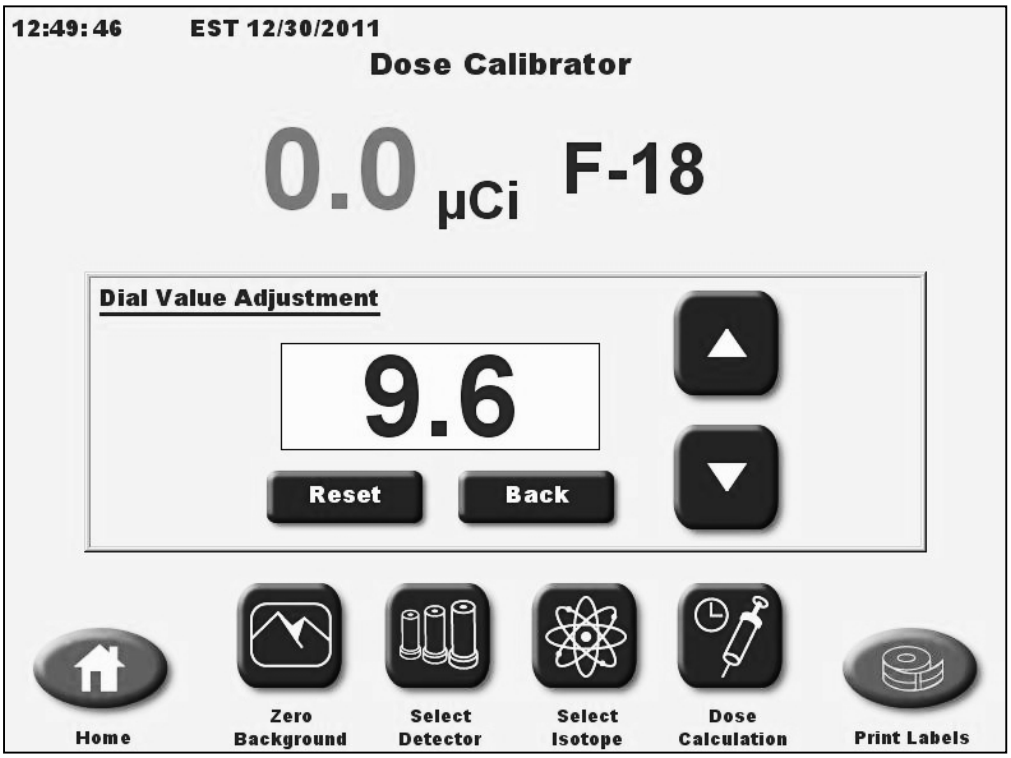


Figure 3.9. *The Dial Value Adjustment screen.*

The dial value adjustment screen allows the user to easily determine a modified dial value for an isotope when a sample of a known activity is available. This adjustment is ideal for Beta isotope samples that come in different configurations from different pharmacies. The user can determine the proper dial value for the specific syringe or vial that is being used. Note that the wall thickness and material can greatly affect the activity for a Beta sample.

This screen is also helpful if modifying the F-18 dial setting for a NIST traceable Ge-68/F-18 source. It can also be used for determining the dial value of any other isotope.

To Adjust The Dial Value:

1. From the measurement screen, touch the displayed isotope name next to the activity measurement. The dial value adjustment screen is displayed.
2. Place the known activity isotope sample into the detector. The activity is displayed on the screen.
3. Use the <▲> and <▼> arrows to increase or decrease the dial value setting. Holding the button increases the scroll speed.
4. When the live activity reading matches the known activity of the sample, the dial value displayed is the dial value that should be used for this isotope and container configuration.

   NOTE: *Write down the dial value you have determined before exiting this screen as the dial value will not be saved.*

5. The <Reset> button sets the dial value back to the default value. <Back> returns the user to the measurement screen, sets the dial value back to the default value, and closes the dial value adjustment screen. You can also touch the isotope name to return to the measurement screen and the default isotope value.

   NOTE: *The dial value adjustment is not stored when you exit the Dial Value Adjustment screen. You must go to Utilities to change and save a dial value.*

4. Atomlab 500 Utilities

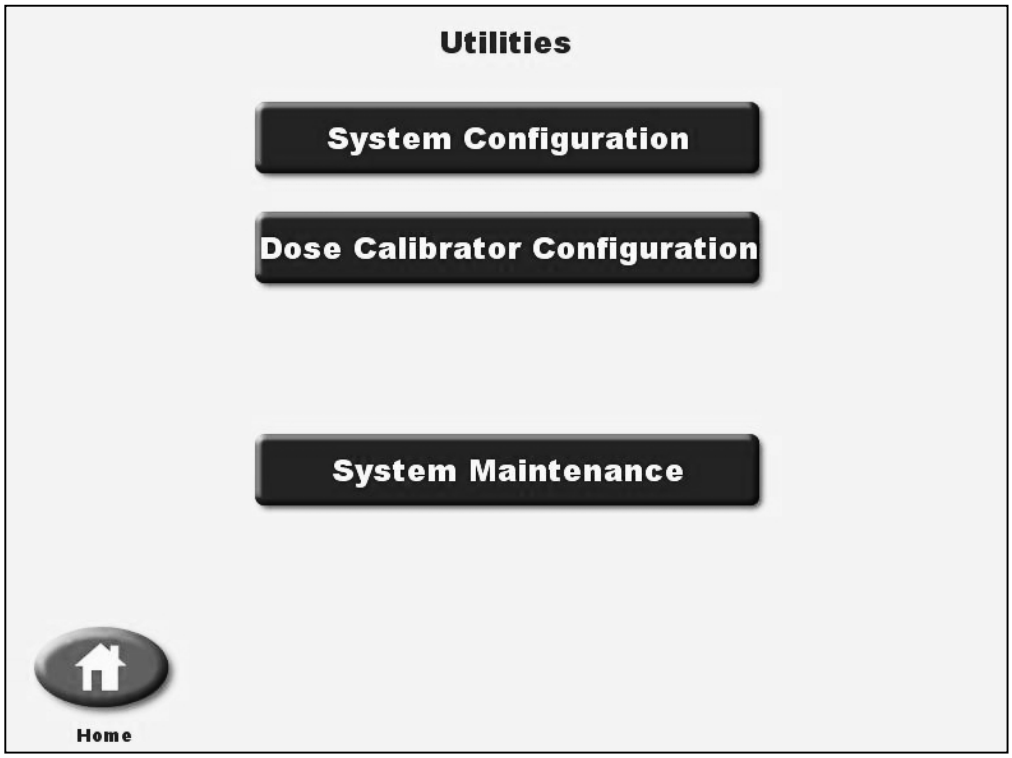


Figure 4.1. *The Utilities menu .*

Selecting <Utilities> from the Home screen allows access to the Utilities menu. Touch the appropriate screen icon to choose the desired function.

Utilities Menu Options Include:

- System Configuration
- Dose Calibrator Configuration
- System Maintenance

System Configuration

(See Figure 4.2.)

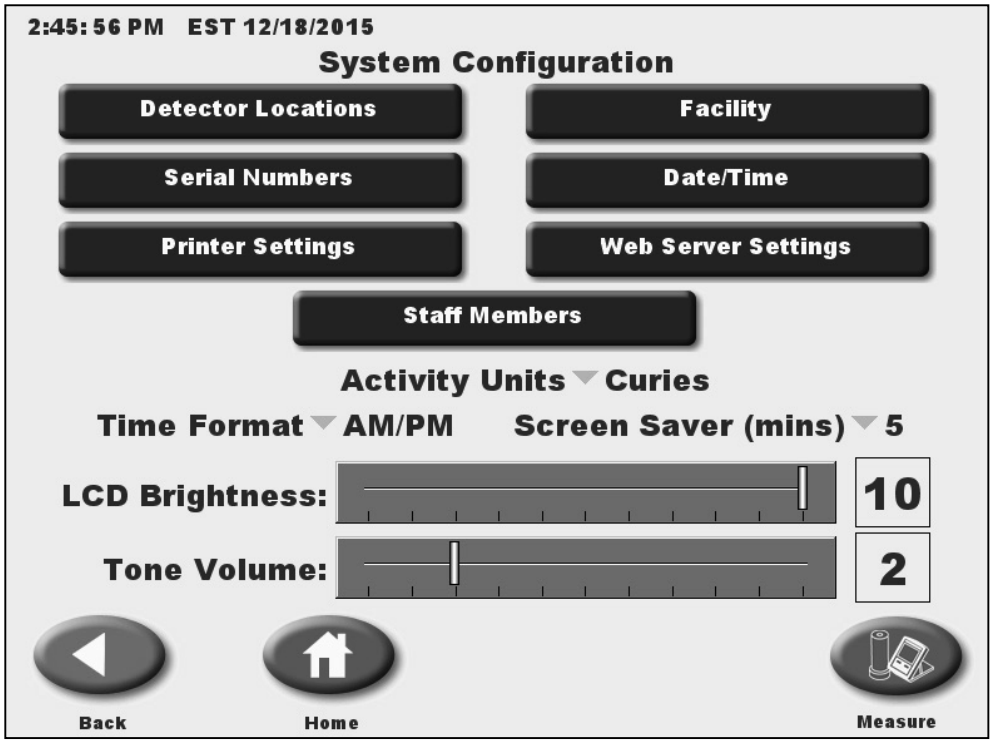


Figure 4.2. *The System Configuration Menu.*

The System Configuration options allow the user to enter or customize various system-wide Parameters. Any changes made to the configuration settings are permanently saved when exiting the Configuration screen.

Touch <System Configuration> on the Utilities menu to access the System Configuration screen.

Detector Locations

(See Figure 4.3.)

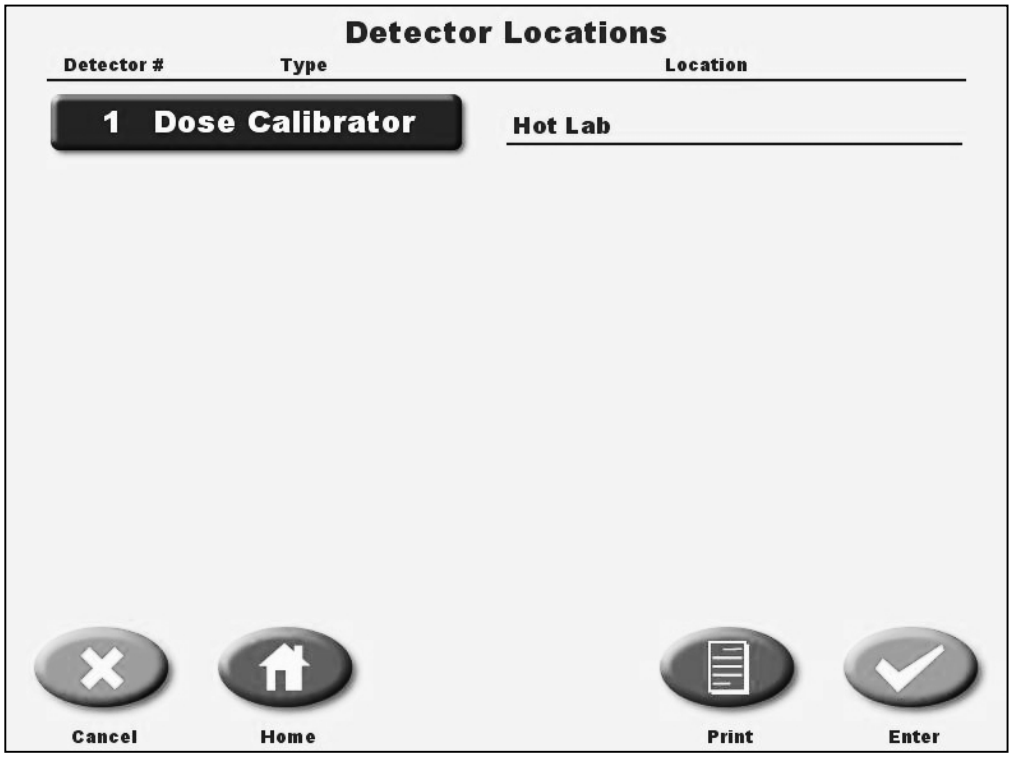


Figure 4.3. *The detector locations screen.*

The Atomlab 500 display automatically senses every detector connected and can tell what type it is. Detectors are listed numerically with detector # 1 being the lowest ID number. <Detector Locations> allows the user to specifically label the location of any connected detector.

To Label A Detector:

1. Touch <Detector Locations> on the System Configuration screen. The Enter Password screen is now displayed.
2. Enter your password and touch <Enter>. The Detector Locations List is displayed.
3. Touch the detector to label. The Enter Location screen is displayed.
4. Key in the detector location and touch <Enter> to return to the detector locations screen. If desired, repeat the process for any other detector. Touching <More Detectors> will advance You to the next page of listed detectors if there are more detectors connected than listed on The screen. The <More Detectors> prompt will not show unless enough detectors are connected.

Note: *each detector connected to a display must have a different ID number. ID number can be changed, see "Detector Management".*

- Touch <Print> to generate a printout of the detector location.
- Touch <Enter> to record the detector location and return to the System Configuration screen.
- Touch <Cancel> to return to the System Configuration screen without recording a new detector location.

Serial Numbers

(See Figure 4.4.)

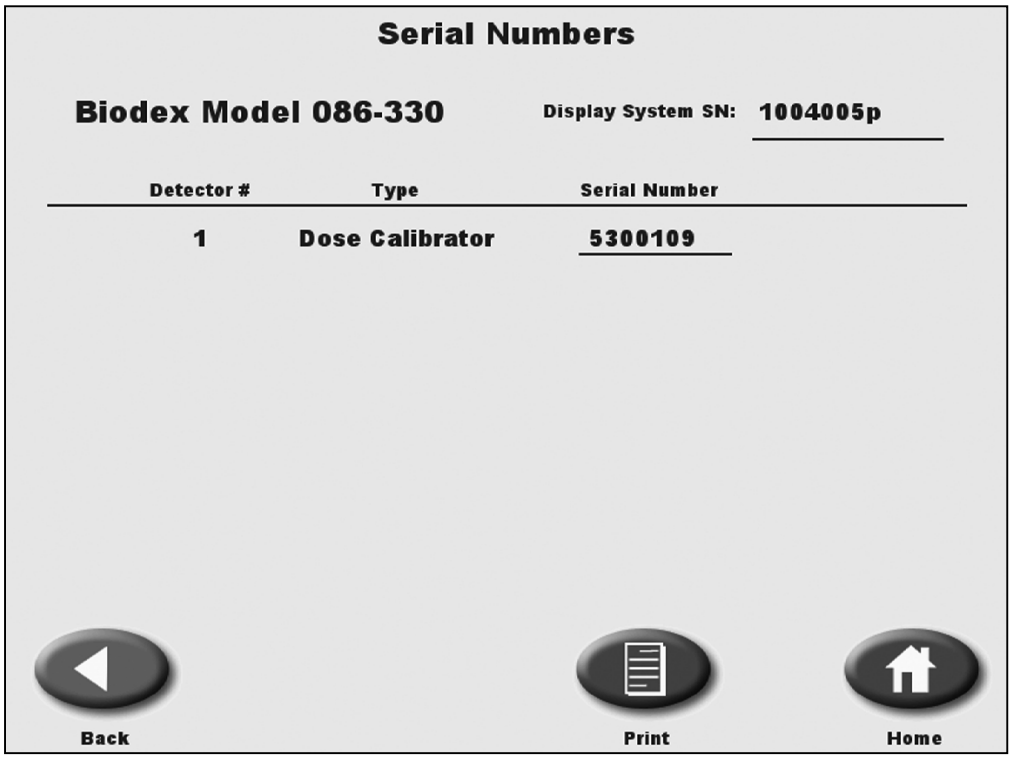


Figure 4.4. *The Serial Numbers screen.*

This option displays a list of all entered serial numbers for the display and detectors. The detector serial numbers are recorded in the detector and automatically communicated to the display.

To View Serial Numbers:

1. Touch <Serial Numbers>. The Enter Password screen is displayed.
2. Enter your password and touch <Enter>. The Serial Numbers screen is displayed with a listing of all serial numbers recorded for the system.
3. Touch <◄> to return to the System Configuration screen.

NOTE: *Serial numbers can only be viewed on this screen. You cannot change the serial number.*

Facility

(See Figure 4.5.)

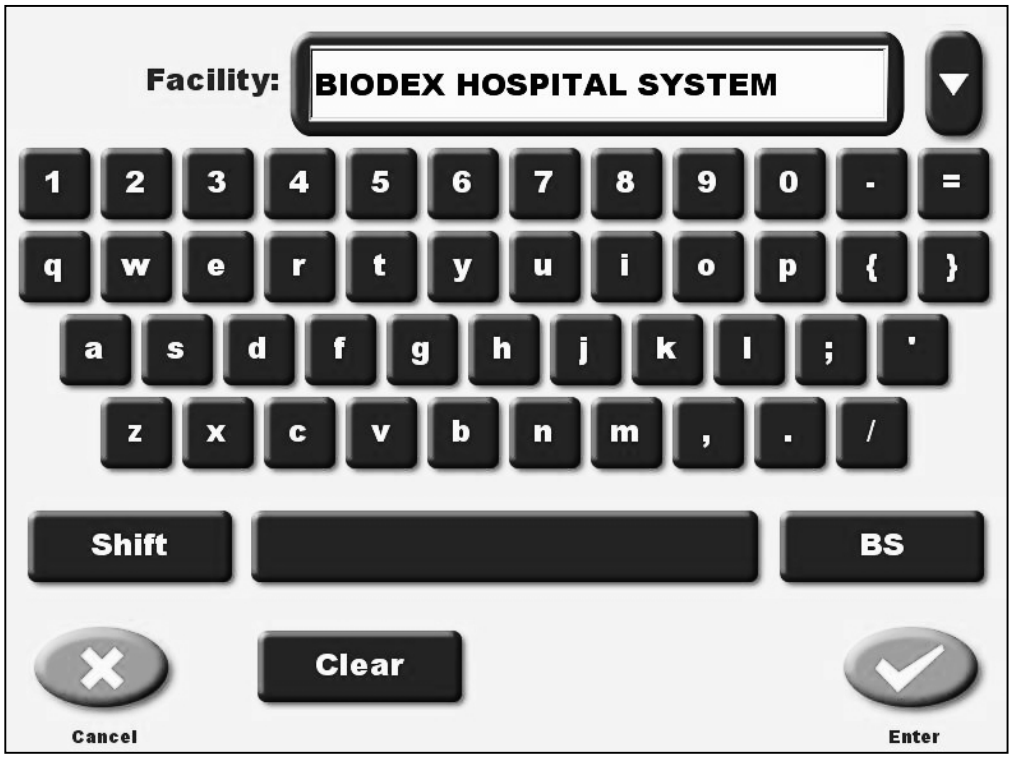


Figure 4.5. *The Enter Facility screen.*

This option allows the user to enter or change the facility name and address. You can enter up to four lines of text for this parameter. The facility name and address entered will appear on some printed reports.

To Enter Or Change The Facility Name:

1. Touch <Facility>. The Enter Password screen is displayed.
2. Enter your password and touch <Enter>. The Enter Facility screen is displayed.
3. Key in the new facility name and address, then touch <Enter> to return to the System Configuration screen with the new name selected, or <Cancel> to exit without updating the facility name.
4. Use the <▼> at the top right of the screen to move to each line of the address. You can add the phone number if desired as part of the address.

   NOTE: *There are a maximum of 4 lines to the address. You can enter your phone number as part of the address.*

Set Date/Time

(See Figure 4.6.)

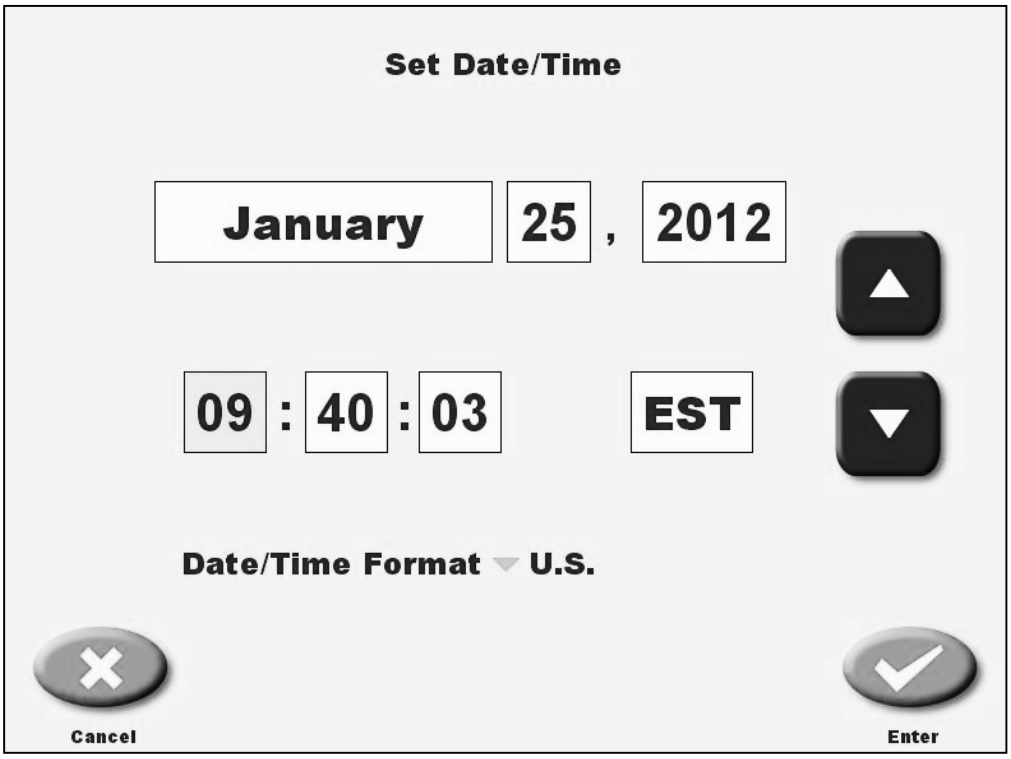


Figure 4.6. *The Set Date/Time screen.*

This option allows the user to enter or change the system clock and calendar, select the desired time format and, if in the USA region, select standard or daylight savings time.

To Set Date/Time:

1. Touch <Date/Time>. The Enter Password screen is displayed.
2. Enter your password and touch <Enter>. The Set Date/Time screen is displayed.
3. Touch to highlight the time or date component to change and then use the <▲> or <▼> keys to scroll to the desired setting. For time Zone, choose from EST, EDT, CST, CDT, MST, MDT, PST, PDT or blank.
4. If you need to change the date/time format, touch the current country to access the country list. Touch the desired country to select. Not all countries are listed. Select a country with the same time format you require.
5. Touch <Enter> to return to System Configuration screen with the new time/date, or <Cancel> to exit without updating the date/time entry.

Activity Units

Accessed from the Dose Calibrator Configuration screen, this option is used to change from the default Activity Units (curies). To change to Becquerels, touch the Activity Units value current setting and then touch your selection from the pop-up list. Touch any part of the screen while the pop-up list is displayed to cancel without making any changes.

Time Format

The Time Format option allows the user to select from a 24-hour clock or a.m./p./m. clock format. Simply touch the <Time Format> value to make the change. Touch <Back> to return to the Utilities menu.

Screen Saver (Mins)

The display screen can be set to stay on continuously, or to turn OFF after 5, 10, 20 or 30-minute intervals. Allowing the screen to turn OFF does not turn the system OFF - it turns OFF only the display screen.

To Change Screen Saver Time:

1. Touch the <Screen Saver> value to view a listing of settings.
2. Touch the desired setting to select. The system returns to the System Configuration screen with new selected setting.

NOTE: *If the screen turns OFF at any time, touch the screen to reactivate the display.*

LCD Brightness

The display's LCD brightness can be set from 1 (least bright) to 10 (brightest.) Touch the desired value on the LCD brightness scale to set.

Tone Volume

The system volume can be from 1 (lowest) to 10 (loudest) touch the desired value on the tone scale to set.

- Touch <Home> to return to the Home screen.
- Touch <Back> to return to the Utilities screen.
- Touch <Measure> to return to the <Count> screen.

Printer Settings

(See Figure 4.7.)

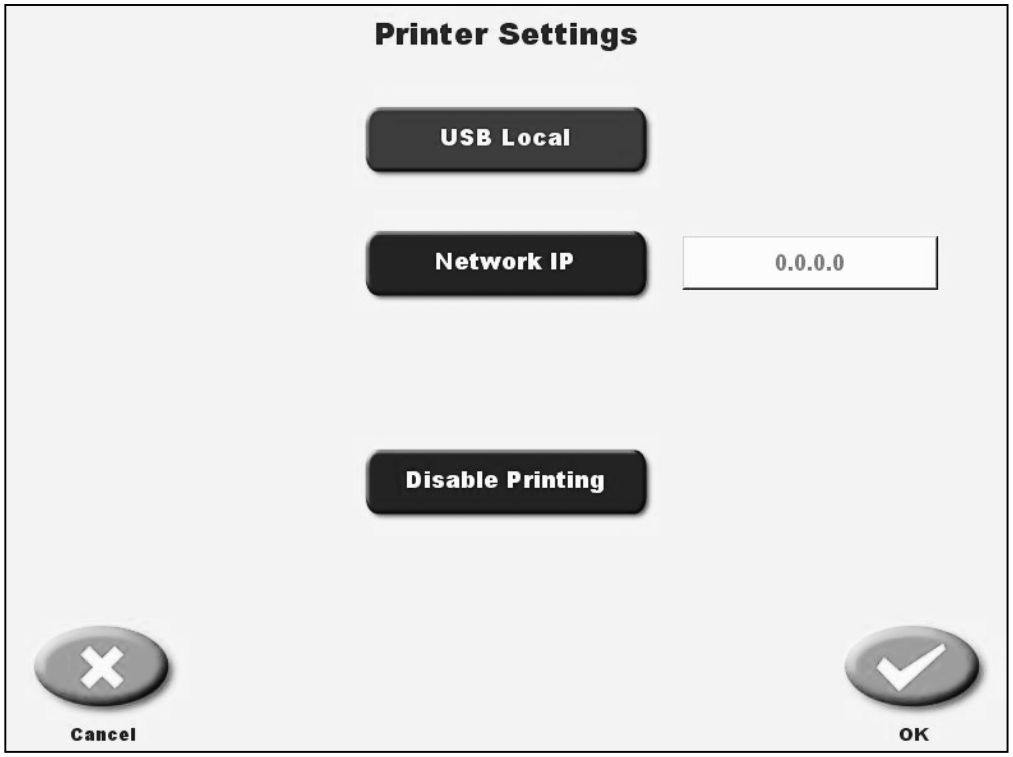


Figure 4.7*. The Printer Settings screen.*

Printer settings can be set to allow for a USB local printer, network IP address, or to disable printing.

To Select USB Local Printing:

1. From the <Home> screen, touch <Utilities>. The Utilities screen is now displayed.
2. Touch <System Configuration>. The System Configuration screen is now displayed.
3. Touch <Printer Settings>. The Printer Settings screen is now displayed.
4. Touch to highlight <USB local>.
5. Touch <OK> to select USB local printing and return to the System Configuration screen, or <Cancel> to return to the System Configuration screen without changing the current printer setting.

To Select Network IP Printing:

1. From the <Home> screen, touch <Utilities>. The Utilities screen is now displayed.
2. Touch <System Configuration>. The System Configuration screen is now displayed.
3. Touch <Printer Settings>. The Printer Settings screen is now displayed.
4. Touch to highlight <Network IP>.
5. Enter the IP address and touch <Done>. The IP address entered should now be displayed next to the network IP button.
6. Touch <OK> to select the displayed IP address and return to the System Configuration screen, or <Cancel> to return to System Configuration screen without changing printer setting.

To Disable Printing:

1. From the <Home> screen, touch <Utilities>. The Utilities screen is now displayed.
2. Touch <System Configuration>. The System Configuration screen is now displayed.
3. Touch <Printer Settings>. The Printer Settings screen is now displayed.
4. Touch to highlight <Disable Printing>.
5. Touch <OK> to select disable printing and return to the System Configuration screen, or touch <Cancel> to return to the System Configuration screen without changing the current printer setting.

Staff Members

(See Figure 4.8.)

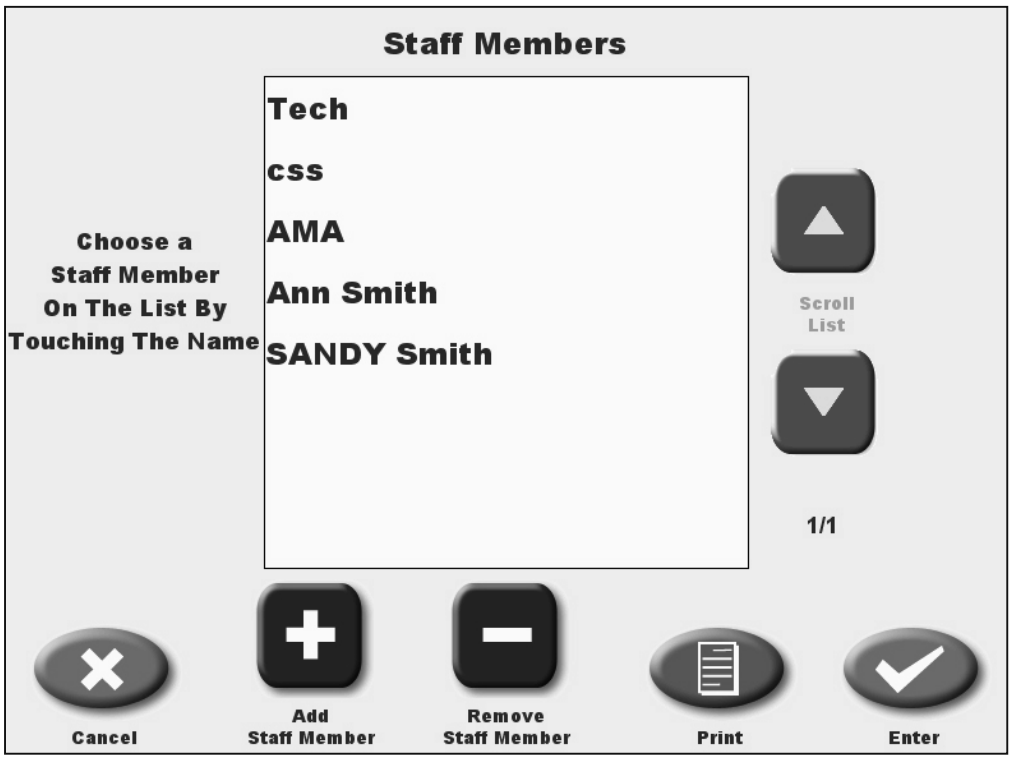


Figure 4.8. *The Staff Members List screen.*

The Staff Members List allows a specific staff member to be associated with any Atomlab 500 QA test. Staff are listed in the order entered. New staff may be added to the list and staff members may also be removed. Staff can also be added to the Staff Members List as part of the save procedure after performing any QA test.

To Access The Staff Members List:

1. From the <Home> screen, touch <Utilities>. The Utilities screen is now displayed.
2. Touch <System Configuration>. The System Configuration screen is now displayed.
3. Touch <Staff Members>. The Staff Members List is now displayed.

To Select A Staff Member From The Staff Members List:

1. Touch to highlight the desired person on the Staff Members List. If necessary, use the <▲> and <▼> arrows to scroll up and down the Staff List until the desired person is displayed.
2. Touch <Enter> to record your selection and return to the System Configuration screen, or <Cancel> to return to the System Configuration screen without changing the selected staff member.

Figure 4.9. Web Server Settings for JSON programming interface only.

To Add A Staff Member To The Staff Members List:

1. Touch <Add Staff Member> and then enter the staff's name in the Staff Member field. The person's name entered now appears at the bottom of the Staff Members List.
2. Touch <Enter> to record your selection and return to the System Configuration screen, or <Cancel> to return to the System Configuration screen without adding a new name to the Staff Members List.

To Remove A Person From The Staff Members List:

1. Touch to highlight the person to remove from the Staff Members List. If necessary, use the <▲> and <▼> arrows to scroll up and down the Staff Members List until the desired person is displayed.
2. Touch <Remove Staff Member>. The highlighted staff name is removed from the Staff Members List.
3. Touch <Enter> to record your selection and return to the System Configuration screen, or <Cancel> to return to the System Configuration screen without deleting the highlighted staff name.

To Print The Staff Members List:

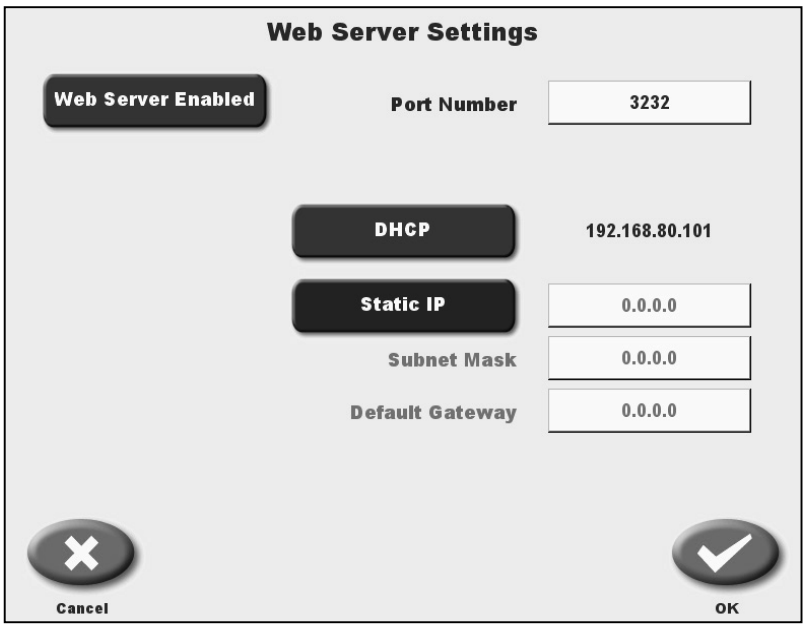
1. At the Staff Members List, touch <Print>. The Staff Members List will print to the currently selected printer.

Web Server Settings

(See Figure 4.9.)

***NOTE:** For JSON programming interface only.*

Select <Web Server Settings> from the System Configuration screen.



Dose Calibrator Configuration

(See Figure 4.10.)

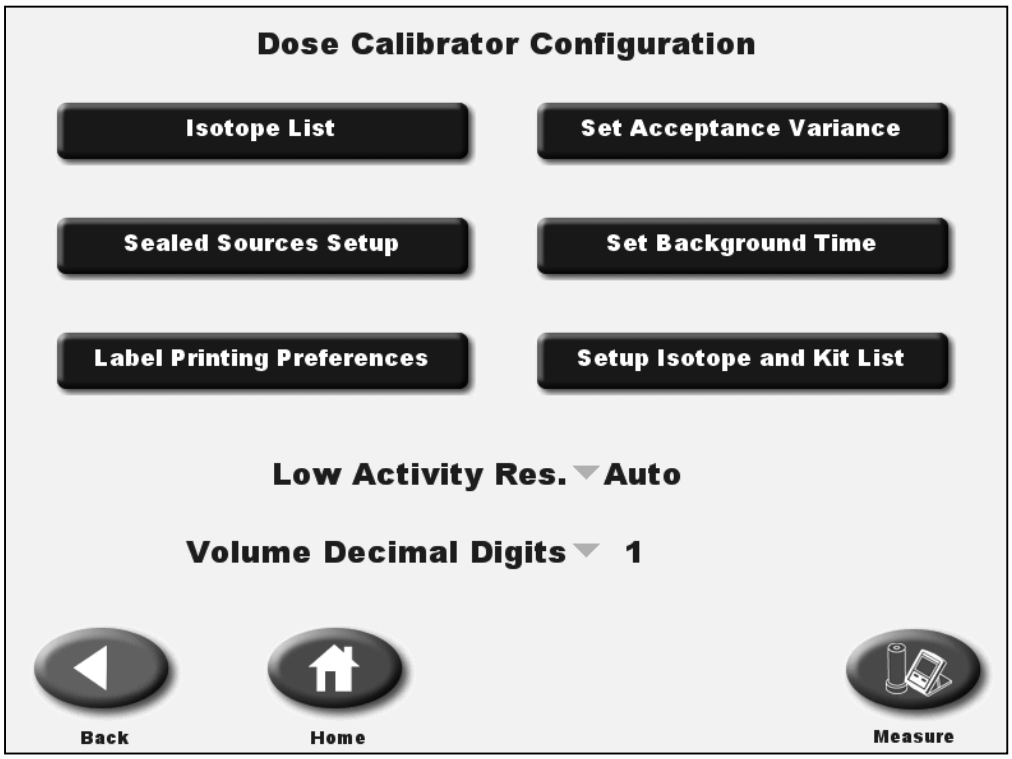


Figure 4.10*.The Dose Calibrator Configuration screen.*

The Dose Calibrator Configuration screen options allow the user to update isotope information, set acceptance variances, access the Sealed Source List, set Label Printing Preferences, set-up inventory isotopes and kits, set the low activity response, and select the Volume Decimal Digits. Any changes made to the configuration settings are permanently saved when exiting the Dose Calibrator Configuration screen.

To access the Dose Calibrator Configuration screen:

1. Select <Utilities> from the Home screen. The Utilities screen is now displayed.
2. Select <Dose Calibrator Configuration> from the Utilities menu. The Dose Calibrator Configuration screen is now displayed.

Isotope List

(See Figures 4.11 and 4.12.)

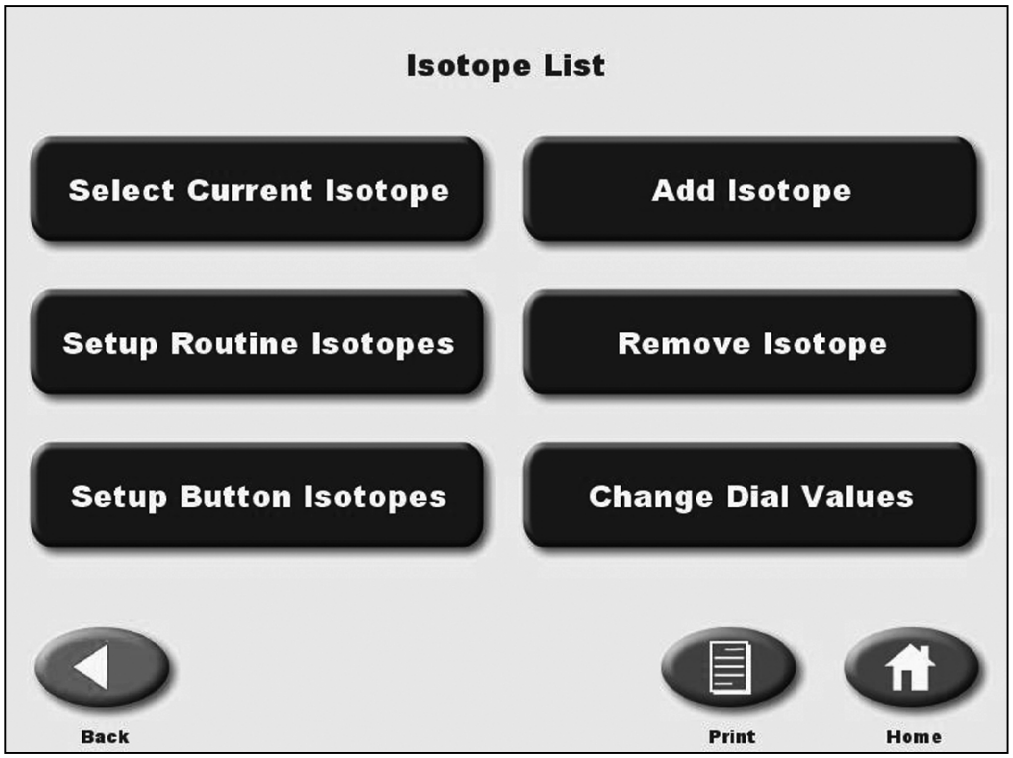


Figure 4.11. *The Isotope List screen.*

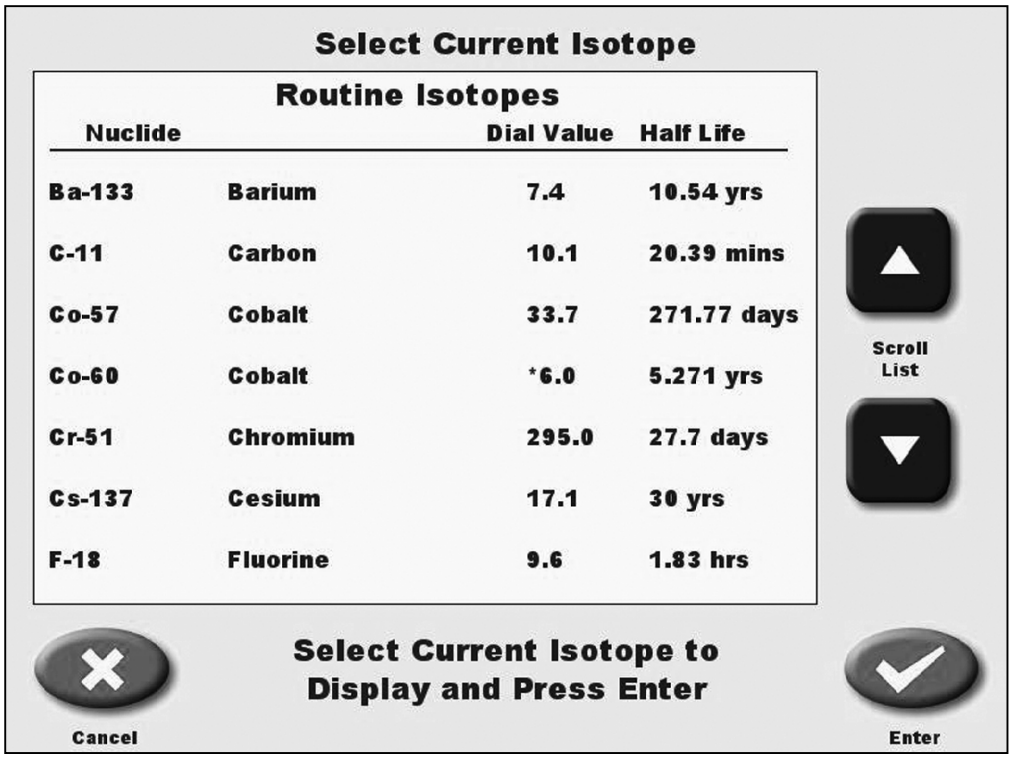


Figure 4.12. *The Select Current Isotope screen with Routine List displayed.*

The Isotope List screen offers six functions related to the maintenance of the list of isotopes. From the Dose Calibrator Configuration screen, touch <Isotope List> and enter your password to display the Isotope List screen. At this screen you can Select Current Isotope, Setup Routine Isotopes, Setup Button Isotopes, Add Isotopes, Remove Isotopes and Change Dial Values.

Select Current Isotope

This option can be used to select an isotope that is not displayed on the Measure screen List 1 or List 2. A full Alphabetical list of Isotopes, the Routine Isotopes List, and Custom Isotopes with which the Atomlab 500 is designed to work, is provided on the Select Current Isotope screen.

To Select Any Isotope From The Full Isotope Lists:

1. From the <Home> screen, select <Utilities>. The Utilities screen is now displayed.
2. Select <Dose Calibrator Configuration>. The Dose Calibrator Configuration screen is now displayed.
3. Select <Isotope List>.
4. Enter your password and touch <Enter>. The Isotope List screen is now displayed.
5. Touch <Select Current Isotope>. The Select Current Isotope screen is displayed.
6. Use the <▲> or <▼> keys to scroll through the list until the desired isotope is displayed.
7. Touch the desired isotope to highlight your selection.
8. Touch <Enter> to select the desired isotope and return to the Isotope List screen with the new isotope selected, or touch <Cancel> to return to the Isotope List screen without making a new selection.

Setup Routine Isotopes

(See Figure 4.13.)

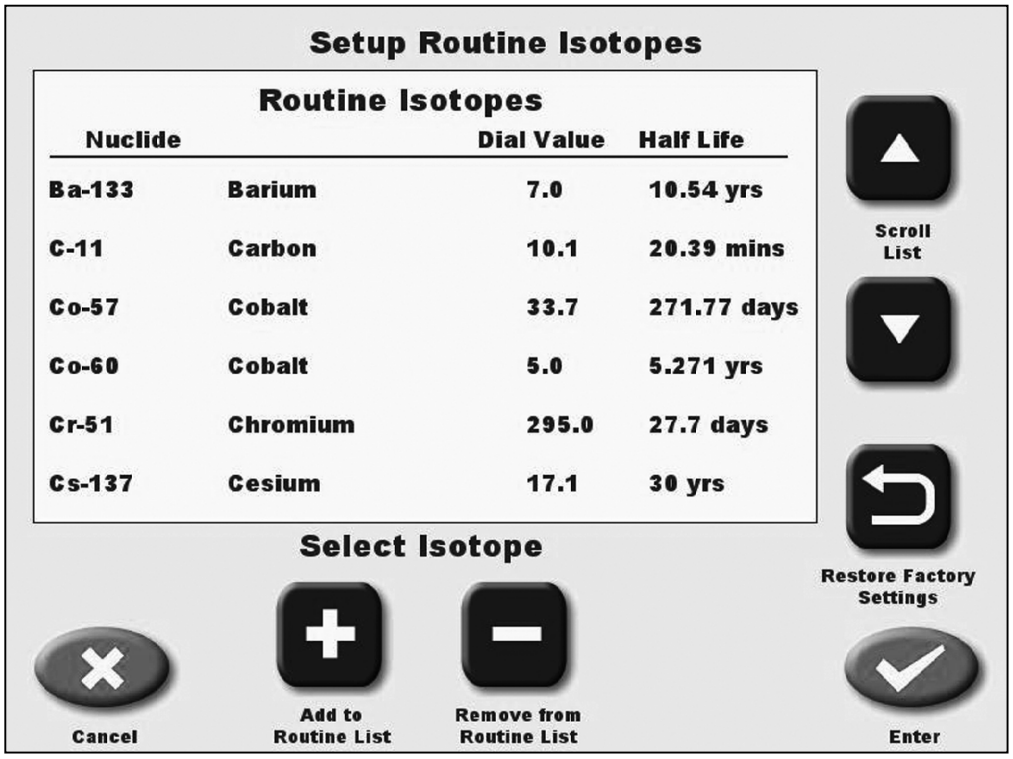


Figure 4.13. *Setup Routine Isotopes screen.*

Setup Routine Isotopes allows the user to add or delete isotopes to the Routine Isotope List. It also allows for restoration of factory isotope settings. You can organize the routine list in the order you wish.

NOTE: *The Routine Isotope List can be setup for the isotopes you use in the department that are not on the buttons displayed on the measuring screen. This makes it easy to change the isotopes that you use without scrolling through the full Alphabetical List.*

To Add Isotopes To The Routine List:

1. From the Isotope List screen, touch <Setup Routine Isotopes>. The Setup Routine Isotopes screen is displayed.
2. Use the <▲> or <▼> keys to scroll through the full Alphabetical or Custom Isotope List until the isotope to add is displayed.
3. Press the isotope name to highlight it. If you press the isotope name again the highlight turns OFF. The highlighted isotope is the only isotope that will be changed.
4. Touch <Add To Routine List>.
5. Use the <▲> or <▼> keys to scroll through the Routine Isotope List until the ruling line is positioned at the point on the list where you want the isotope to be added.
6. Touch <Insert> to place the isotope where desired.
7. Touch <Enter> to save the updated Routine Isotope List, or <Cancel> to return to the Setup Routine Isotopes screen without making changes.

To Remove Isotopes From The Routine List:

1. From the Isotope List screen, touch <Setup Routine Isotopes>. The Setup Routine Isotopes screen is displayed.
2. Use the <▲> or <▼> keys to scroll through the Routine Isotope List until the isotope to remove is displayed.
3. Press the isotope name to highlight it. If you press the isotope name again the highlight turns OFF. The highlighted isotope is the only isotope that will be changed.
4. Touch <Remove From Routine List>. The highlighted isotope is removed from the list.
5. Touch <Enter> to save the updated Routine Isotope List, or <Cancel> to return to the Setup Routine Isotopes screen without making changes.

   NOTE: *If you make changes and press <Cancel>, a "Modifications have been made, are you sure you want to lose the changes?" prompt is displayed. Press <No> to keep the changes, followed by <Enter> on the Setup Routine Isotope screen. Press <Yes> if you do not want to make the changes and the system returns to the Isotope List screen.*

To Restore Factory Isotope Settings:

1. From the Isotope List screen, touch <Setup Routine Isotopes>. The Setup Routine Isotopes screen is displayed.
2. Touch <Restore Factory settings> and touch <Yes> to revert to the factory defaults, or <No> to return to the Setup Routine Isotopes screen without making changes.

Setup Button Isotopes

(See Figure 4.14.)

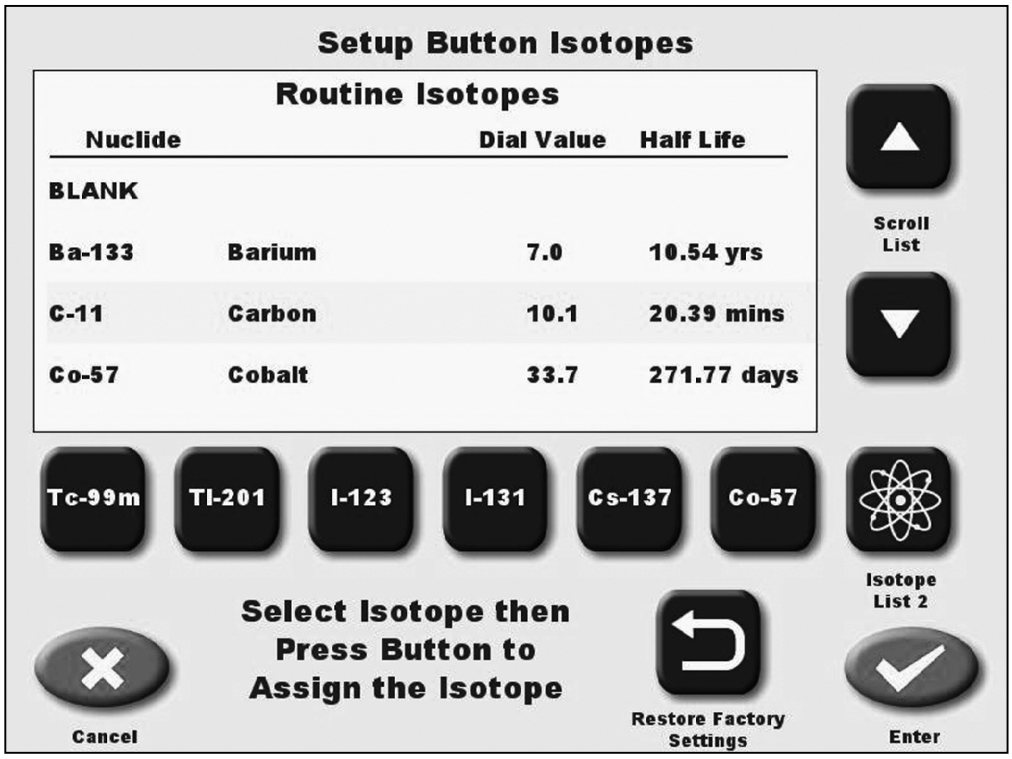


Figure 4.14. *The Setup Button Isotopes screen.*

Setup Button Isotopes allows the user to assign any selected isotope to the buttons on Isotope List 1 or List 2, displayed on the Measure screen.

1. From the Isotope List screen, touch <Setup Button Isotopes>. The Setup Button Isotopes screen is displayed.
2. Use the <▲> or <▼> keys to scroll through the Isotope Lists until the isotope you want to assign to a button is shown (toggle to List 2 to display the List 2 buttons.) touch to highlight the isotope.
3. Touch the button to which the isotope should be assigned. The isotope currently assigned to the button is removed and the new isotope is now displayed on the button.

   NOTE: *If you make changes and press <Cancel>, a "Modifications have been made, are you sure you want to lose the changes?" prompt is displayed. Press <No> to keep the changes, followed by <Enter> on the Setup Button Isotope screen. Press <Yes> if you do not want to make the changes and the system returns to the Isotope List screen.*

4. Touch <Enter> to save the updated Isotope Buttons, or <Cancel> to return to the Setup Routine Isotopes screen without making changes.
5. If desired, touch <Restore Factory Settings> and touch <Yes> to revert to the factory defaults, or <No> to return to the Setup Button Isotopes screen without making changes.

Add Isotope

(See Figure 4.15.)

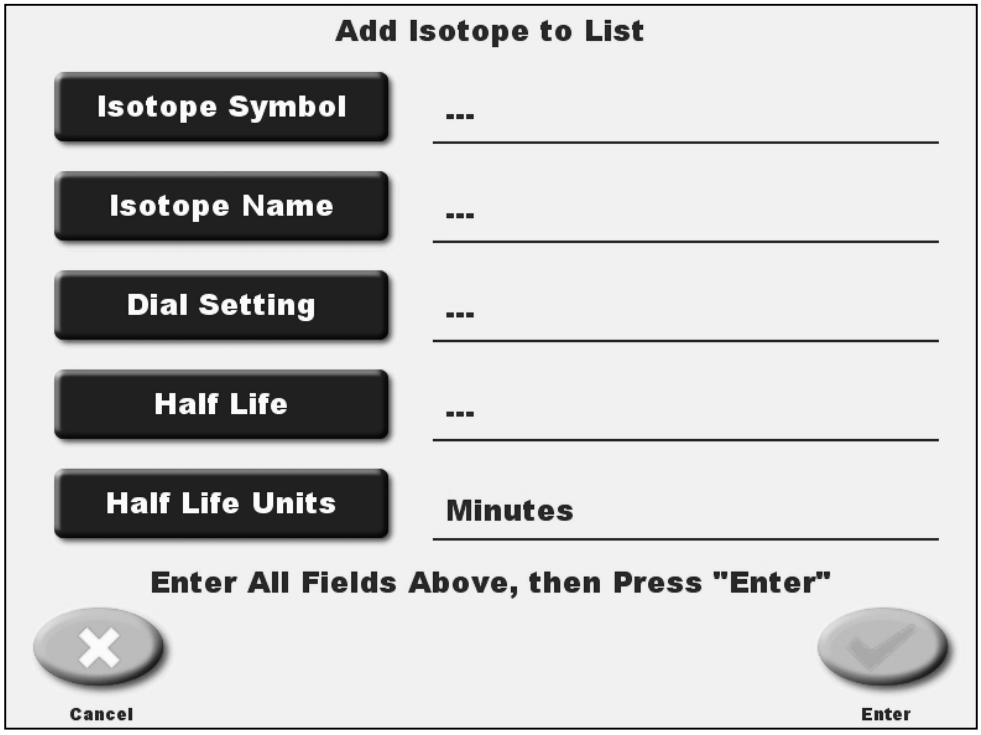


Figure 4.15. *The Add Isotope To List screen.*

Add Isotope allows the user to add isotopes to the "new isotopes" area of the Isotope List. The individual aspects for the new isotope are input under the provided fields.

To Add An Isotope To The Isotope List:

1. From the Isotope List screen, touch <Add Isotope>. The Add Isotope to List screen is displayed.
2. Touch to access the entry screen for each available field. Enter the value using the keypad provided. For the name field, if the isotope name entered matches one that is currently on the list, a message will appear noting such. In this case, you will need to enter a slightly different name of the isotope (i.e., add a number to the end of the isotope name.)

   NOTE: *You must enter the information for all items: Isotope Symbol, Isotope Name, Dial Settings, Half-Life, and Half-Life Units.*

3. Touch <Half-life Units> to scroll though the choices provided: seconds, minutes, hours, days or years.
4. Touch <Enter> to add the new isotope to the Isotope List, or <Cancel> to return to the Isotope List screen without making changes. If adding an isotope, a "Do you want to save isotope XXX" prompt is displayed. Touch <Yes> to save or <No> to abort without saving.

NOTE: *If you make changes and press <Cancel>, a "Modifications have been made, are you sure you want to lose the changes?" prompt is displayed. Press <No> to keep the changes, followed by <Enter> on the Setup Routine Isotope screen. Press <Yes> if you do not want to make the changes and the system returns to the Isotope List screen.*

Remove Isotope

(See Figure 4.16.)

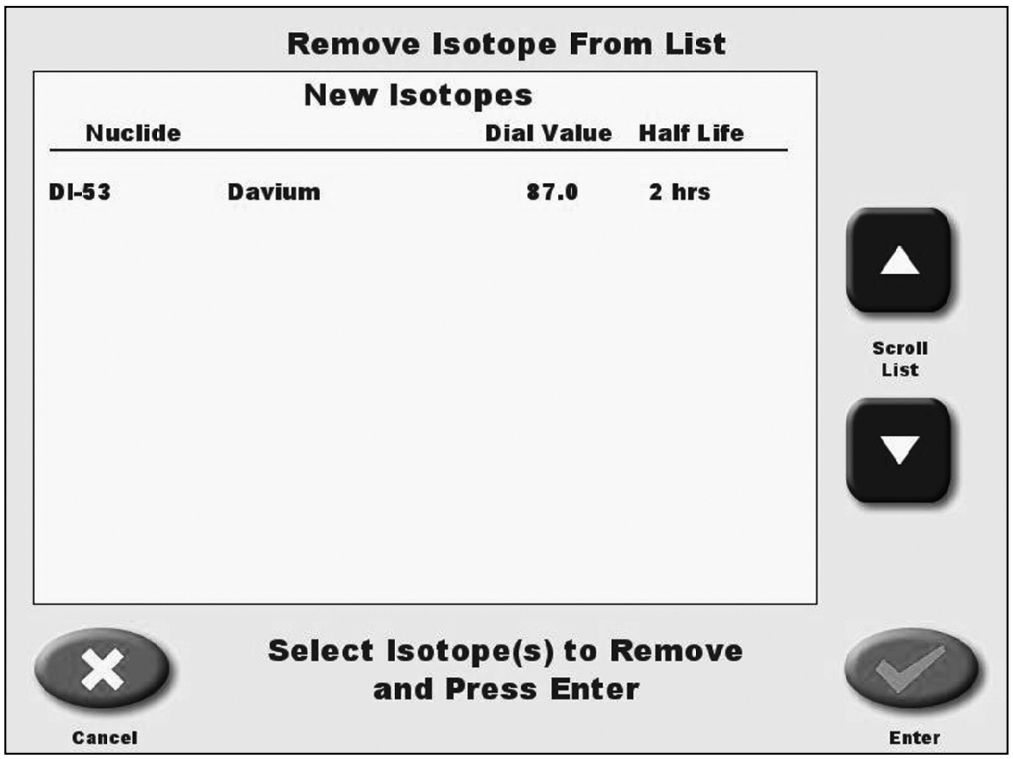


Figure 4.16. *The Remove Isotope From List screen.*

Remove Isotope allows the user to remove a selected isotope from the Isotope List.

To Remove An Isotope From The Isotope List:

1. From the Isotope List screen, touch <Isotope List>.
2. Enter your password and touch <Enter>. The Isotope List screen is displayed.
3. Touch <remove isotope>. The Remove Isotope From List screen is displayed.
4. Use the <▲> or <▼> keys to scroll through the New Isotopes List until the isotope you want to delete is shown. Touch to highlight the isotope you want to remove.
5. Touch <Enter> to remove the selected isotope. A prompt is displayed asking if you are sure you want to remove the selected isotope. Touch <Yes> to remove the isotope or <Cancel> to not remove the isotope and return to the Isotope List screen.

NOTE: *Only new isotopes added to the system by the user can be removed.*

Change Dial Values

(See Figure 4.17.)

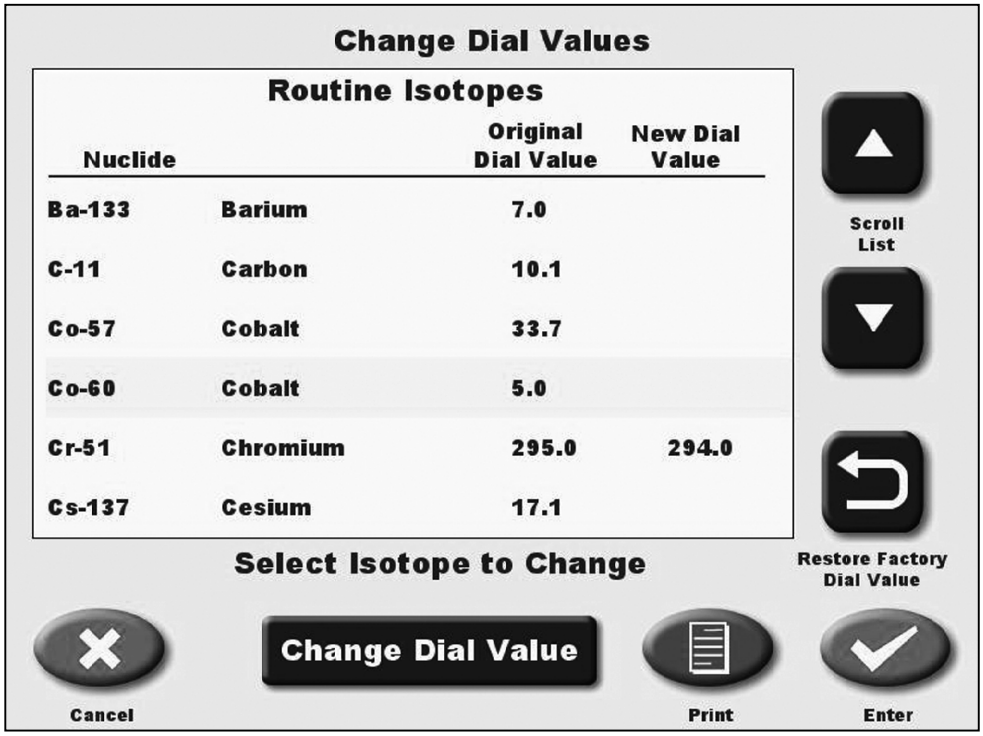


Figure 4.17. *The Change Dial Values screen.*

This option is used to change the dial value of any isotope on the Isotope Lists. The entire list can be scrolled through, showing the original dial value for all isotopes and the new dial value for any that have been changed.

New dial values are preceded by an * when viewed on the Dose Calibrator Measurement screen after pressing <Select Isotope>.

To Change An Isotope Dial Value:

1. From the <Home> screen, select <Utilities>. The Utilities screen is now displayed.
2. Select <Dose Calibrator Configuration>. The Dose Calibrator Configuration screen is now displayed.
3. Select <Isotope List>.
4. Enter your password and touch <Enter>. The Isotope List screen is now displayed.
5. Touch <Change Dial Values>. The Change Dial Values screen, with a listing of Routine Isotopes, new isotopes and an Alphabetical list of isotopes will be displayed.
6. Use the <▲> or <▼> keys to scroll through the list until the desired isotope is displayed.
7. Touch the desired isotope to highlight your selection.
8. Touch <Change Dial Value> to display the dial setting entry screen and enter the new value.
9. Touch <Enter> to record the new dial value and return to the Change Dial Values screen with the new dial value now highlighted.

10. Touch <Cancel> if you have changed a dial setting and do not want to save the change. The system returns to the Change Dial Values screen.
11. If desired, touch <Restore Factory Dial Values> and then touch <Yes> to revert to the factory defaults, or touch <No> to cancel restoring the factory defaults.

    · Touch <Print> to print out the updated Routine Isotope List.

    · Touch <Enter> to return to the Isotope List screen with the new entry selected.

    · Touch <Cancel> to return to the Isotope List screen without making a new selection.

NOTE: *After restoring factory dial values, scroll the Isotope List and verify that no new dial values are listed.*

Set Acceptance Variance

(See Figure 4.18.)

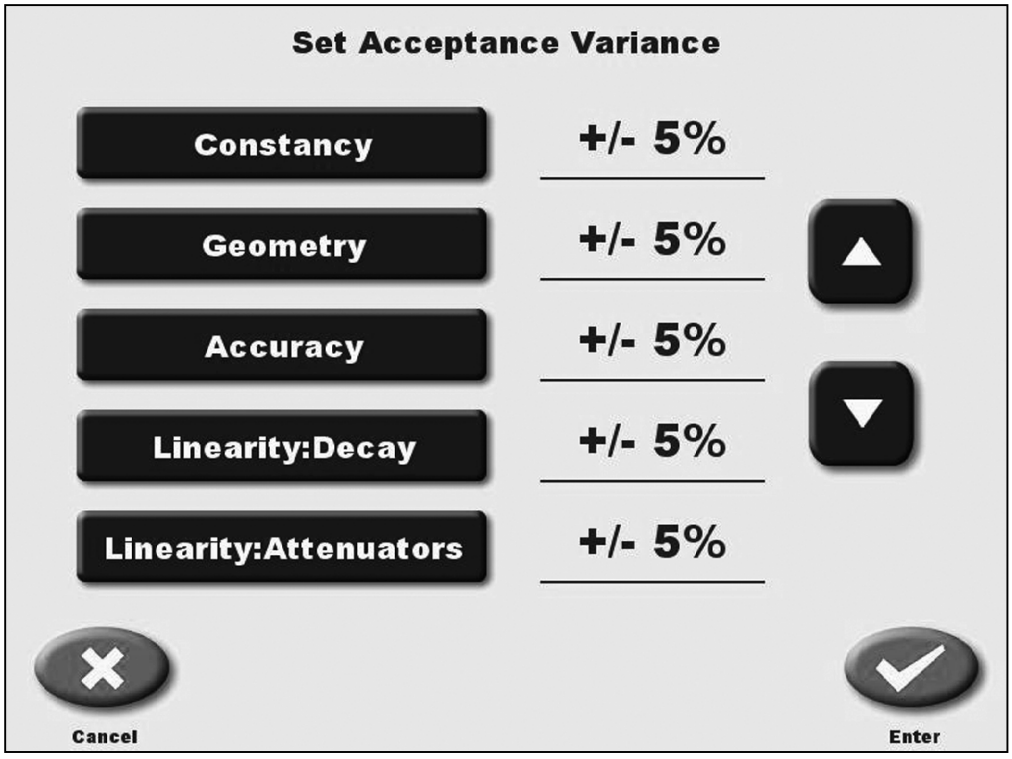


Figure 4.18. *The Set Acceptance Variance screen.*

Set acceptance variance is used to program allowable variances for each of the Individual QA tests.

To Set Acceptance Variance:

1. From the Dose Calibrator Configuration screen, touch <Set Acceptance Variance>.
2. Enter your password and touch <Enter>. The set Acceptance Variance screen is displayed.
3. Touch to highlight the test for which you wish to change the default variance. Then use the <▲> or <▼> keys to increase or decrease the value. Variance is expressed as +/- % for Constancy, Geometry, Linearity, Decay and Attenuator tests.
4. Touch <Enter> to confirm your changes and return to the dose calibration configuration screen, or touch <Cancel> to return to the dose calibration configuration screen without making changes.

NOTE: *If you make changes and press <Cancel>, a "Modifications have been made, are you sure you want to lose the changes?" prompt is displayed. Press <No> to keep the changes, followed by <Enter> on the Set Acceptance Variance screen. Press <Yes> if you do not want to make the changes and the system returns to the Dose Calibrator Configuration screen.*

Sealed Sources Setup

(See Figures 4.19 - 4.21.)

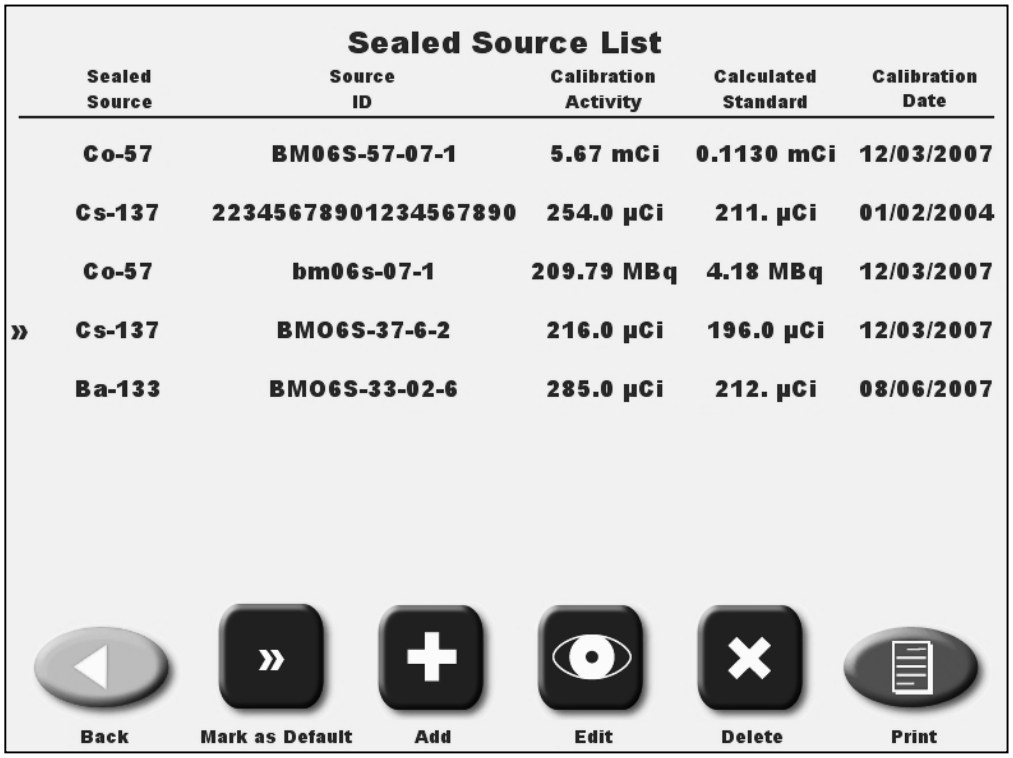


Figure 4.19. *The Sealed Source List. Note that Cs-137 is marked as the default (>>) in this example.*

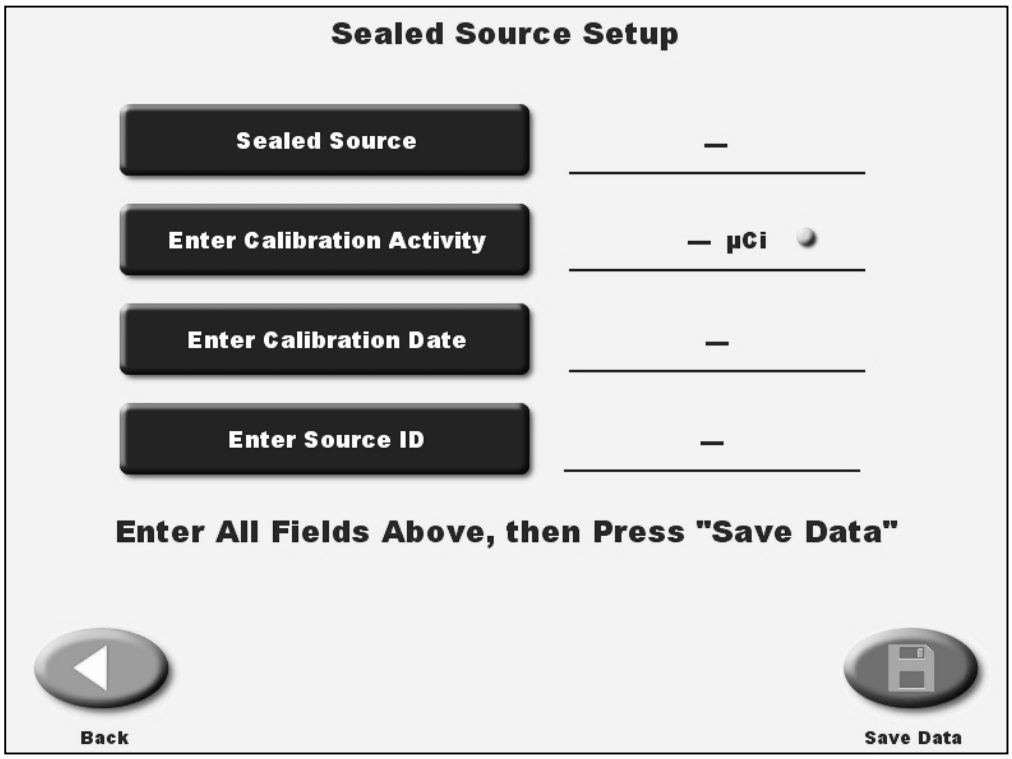


Figure 4.20. *The Sealed Source Setup screen.*

The Sealed Sources List screen is used to enter data to add to sealed sources. Up to eight sealed sources, including multiple sources for the same isotope with different source ID #s can be entered. You can also mark a selected sealed source as a default. This will be the first source displayed when you enter the constancy and accuracy screens.

To Access The Sealed Source List:

1. From the <Dose Calibrator Configuration> screen, touch <Sealed Sources Setup>. The Sealed Source List screen is now displayed.

To Enter A Sealed Source:

1. From the Sealed Sources List screen, touch <Add> to access the Sealed Source Setup screen.
2. Touch <Sealed Source>. The select current isotope screen is now displayed. Select the desired isotope and touch <Enter>. The display returns to the Sealed Source Setup screen with the new sealed source selected.
3. Touch <Enter Calibration Activity>. The Enter Calibration Activity screen is now displayed. Key in the activity for the date of calibration for the source and touch <Enter> to return to the Sealed Source Setup screen. The calibration activity is now displayed. If necessary, touch the Activity Units to toggle between µCi and *mCi* (MBq and GBq for Becquerels.)
4. Touch <Enter Calibration Date>. The Enter Calibration Date screen is now displayed. Enter the desired date and touch <Enter> to return to the Sealed Source Setup screen. The Calibration Date is now displayed.
5. Touch <Enter Source ID>. The source ID keypad is now displayed. Key in the source ID and touch <Enter> to return to the Sealed Source Setup screen.

6. Once all fields have been entered, touch <Save Data> to save the new Sealed Source entry. Touch <Back> to return to the Sealed Source List and verify that the new source is now listed.

To Edit A Sealed Source:

1. At the Sealed Sources List screen, touch to highlight the isotope to edit.
2. Touch <edit>. The Sealed Sources Setup screen is now displayed.
3. Touch to highlight each field to edit on the Sealed Source Setup screen.
4. Make the appropriate edits, touching <Enter> to save each one. When edits to all fields to which changes are desired, touch <Save Data>. The system saves the changes made and displays a note stating that sealed source changes have been saved.
5. Touch <Back> to return to the Sealed Source List.

To Delete A Sealed Source:

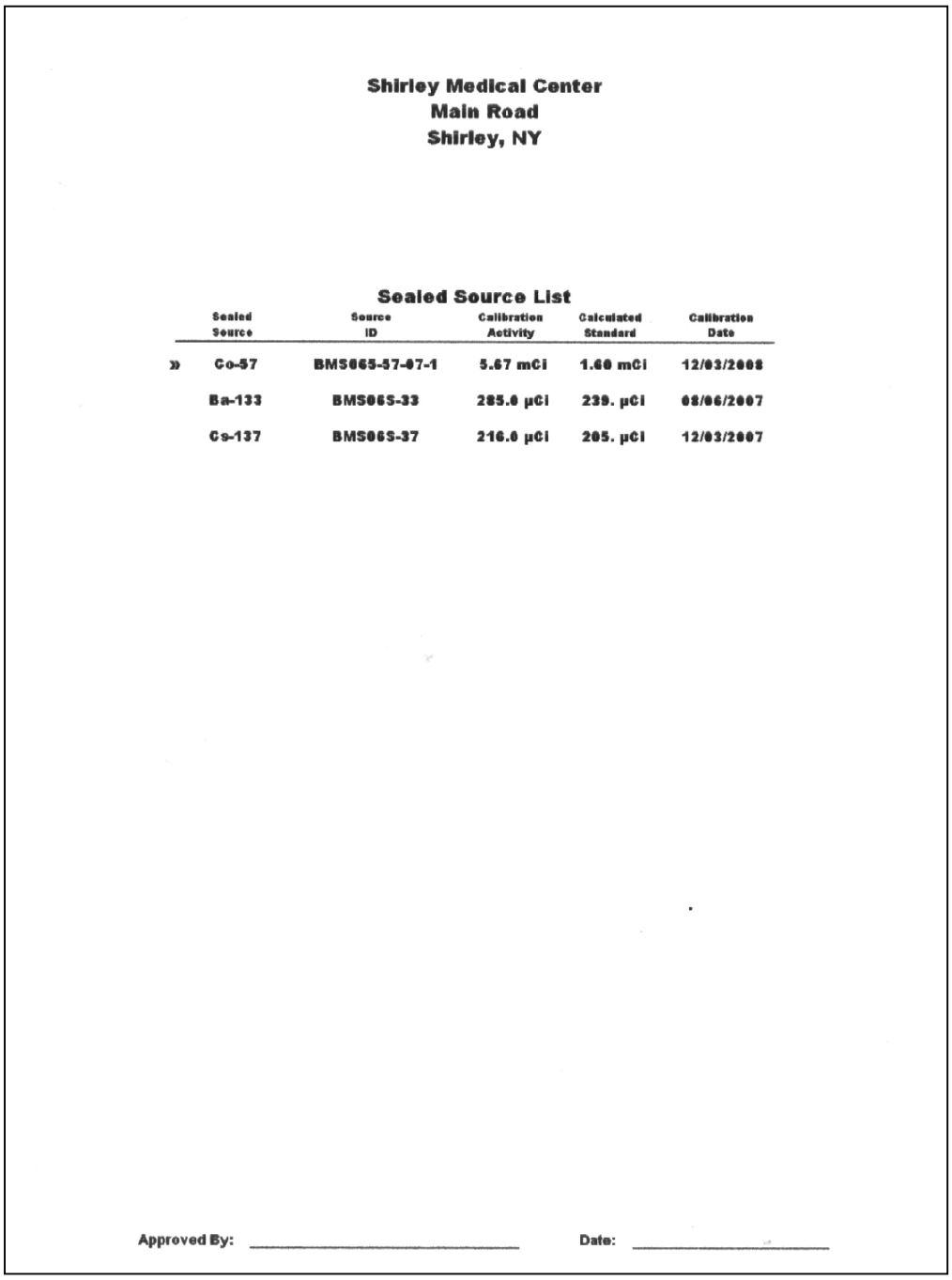
1. At the Sealed Sources List screen, touch to highlight the sealed source to delete.
2. Touch <Delete>. The system will note that the sealed source selected will be deleted and prompt "Are you sure?"
3. Touch <OK> to delete the sealed source selected and return to the Sealed Source List, or <Cancel> to abort the deletion and return to the Sealed Source List without making changes.

To Mark A Sealed Source As Default:

1. At the Sealed Sources List screen, touch to highlight any listed sealed source and then touch <Mark as Default> to mark it as the default. The default symbol (>>) will now show to the left of the selected sealed source denoting that it has been marked as the default. This will be the first source displayed when you enter the constancy and accuracy screens.
2. Touch <Back> to return to the Dose Calibrator Configuration screen.

To Print A List Of Sealed Sources:

1. At the Sealed Sources List screen, touch <Print>. The entire Technologist List will print to the currently selected printer.
2. Touch <Back> to return to the Sealed Source List.



Shirley Medical Center
Main Road
Shirley, NY

Sealed Source List

	Sealed Source	Source ID	Calibration Activity	Calculated Standard	Calibration Date
»	Co-57	BMS065-57-07-1	5.67 mCi	1.60 mCi	12/03/2008
	Ba-133	BMS06S-33	285.0 µCi	239. µCi	08/06/2007
	Cs-137	BMS06S-37	216.0 µCi	205. µCi	12/03/2007

Approved By: _____ Date: _____

Figure 4.21. *A Sealed Source List print out.*

Set Background Counting Time

(See Figure 4.22 – 4.23.)

The background counting time used for the dose calibrator and Zero Background can be set for 30, 60 or 100 seconds.

This background counting time is used for the dose calibrator Zero Background and Moly Assay Background counting time.

Adjusting The Background Counting Time:

1. At the Home screen, select <Utilities>.
2. On the Utilities screen, select <Dose Calibrator Configuration>.
3. On the Dose Calibrator Configuration screen, select <Set Background Time>.

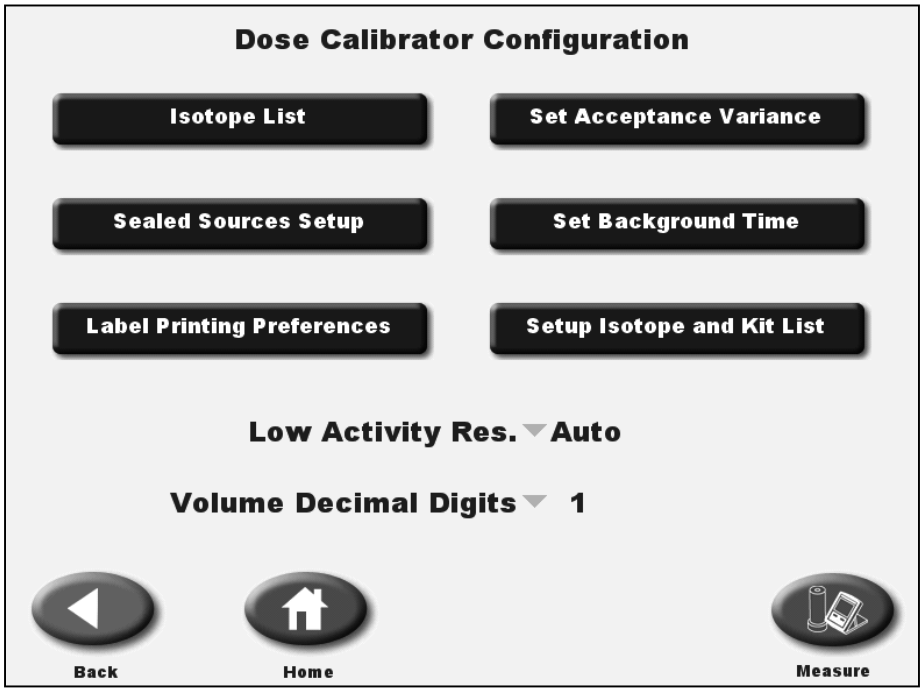


Figure 4.22. *Dose Calibrator Configuration screen.*

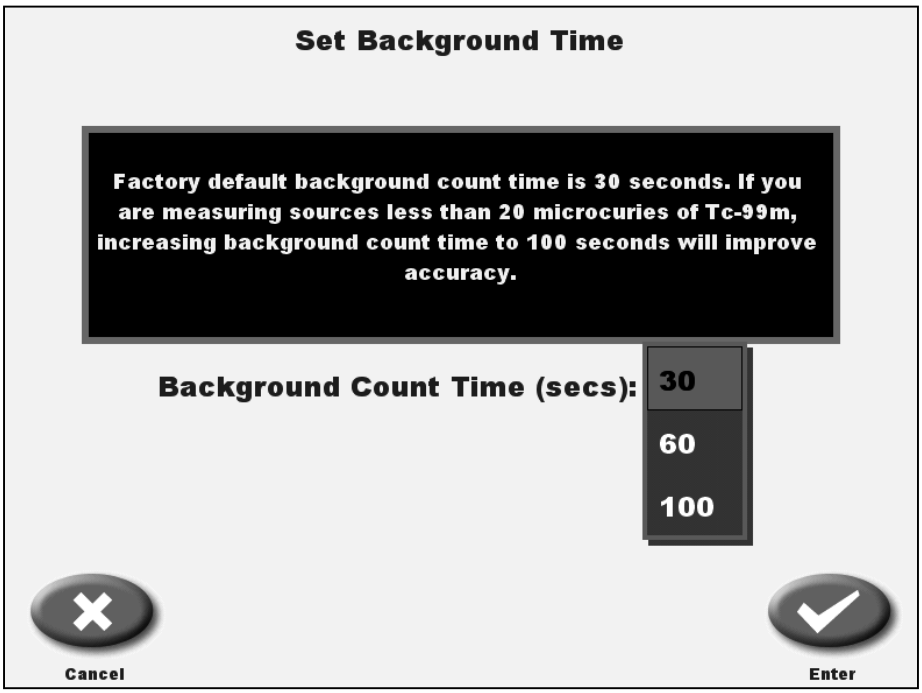


***Figure 4.23**. Set Background Time.*

4. You will now have to enter the system's password to proceed.
5. Set Background Time screen is now displayed. The center of the screen displays the current Background Time in seconds (30, 60 or 100). By selecting the current setting a pull down menu is displayed and you can choose a new background counting time. Then select <Enter>.

   ***NOTE:** The factory default background count time is 30 seconds. If you are measuring sources less than 20 µCi of Tc-99m, increasing background count time to 100 seconds will improve accuracy.*

6. Select <Enter> to return to the Dose Calibration Configuration screen. The background counting time is now changed. Select <Home> to return to the Home screen.

Label Printing Preferences

(See Figure 4.24.)

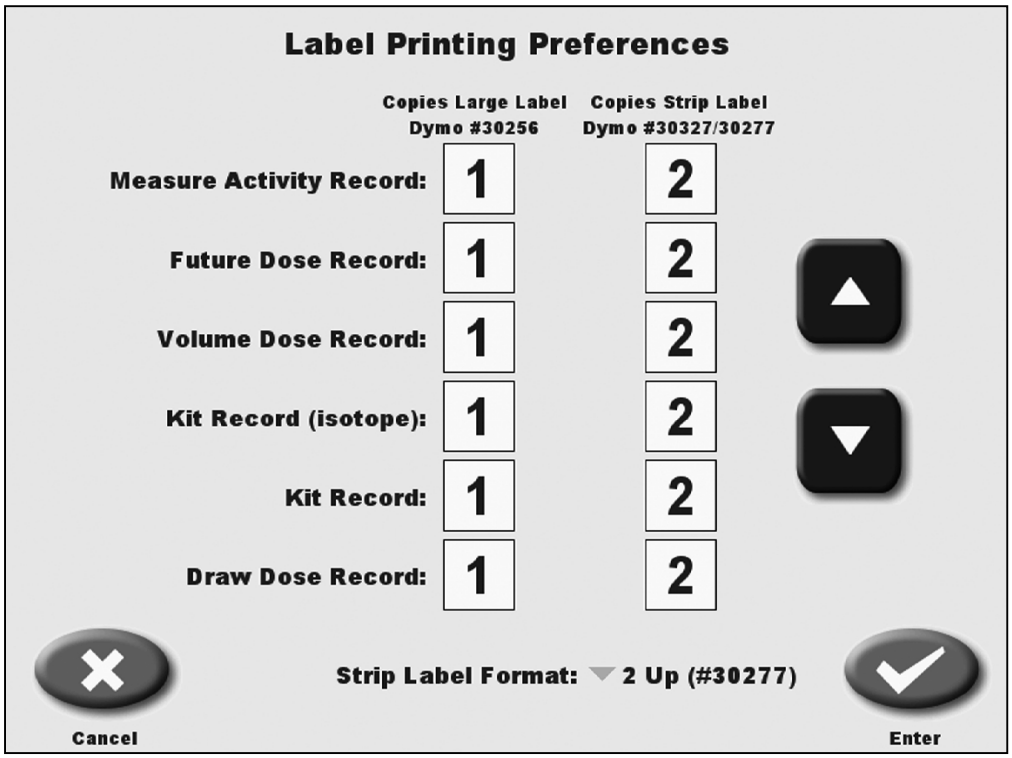


Figure 4.24. *The Label Printing Preferences screen.*

The Label Printing Preferences screen allows users to set the number of copies of the large label and small labels that will be printed. The standard small strip label (2 up) has two labels on each printout. These labels feature the radiation warning symbol and the word caution printed in the left corner. The 2 up label can be replaced with a 1 up label (not supplied by Biodex).

The small strip label can be used to label syringes, syringe shields, etc. Both the large and small label styles print different information depending on the function from which you are printing. labels can be printed from the following records:

- Measure Activity Record
- Dose Calculation
- Future Dose Record
- Kit Record (Isotope)
- Kit Record
- Draw Dose Record

Sample labels are presented throughout this manual with the specific function instructions.

The number of labels can be set from zero, if you do not want one of the labels to print, to as many as six copies. You only need to touch <Print Labels> once from the specific function selected to generate all the labels.

To Set Label Printing Preferences:

1. At the Dose Calibrator Configuration screen, touch <Label Printing Preferences> and enter your password. The Label Printing Preferences screen is now displayed.
2. Touch to highlight any record field and use the <▲> and <▼> arrows to increase or decrease the number of copies to print for the highlighted record. Holding the button increases the scroll speed.
3. Touch <Enter> to record all settings and return to the Dose Calibrator Configuration screen.

Setup Isotope And Kit List

(See Figure 4.25. - 4.27.)

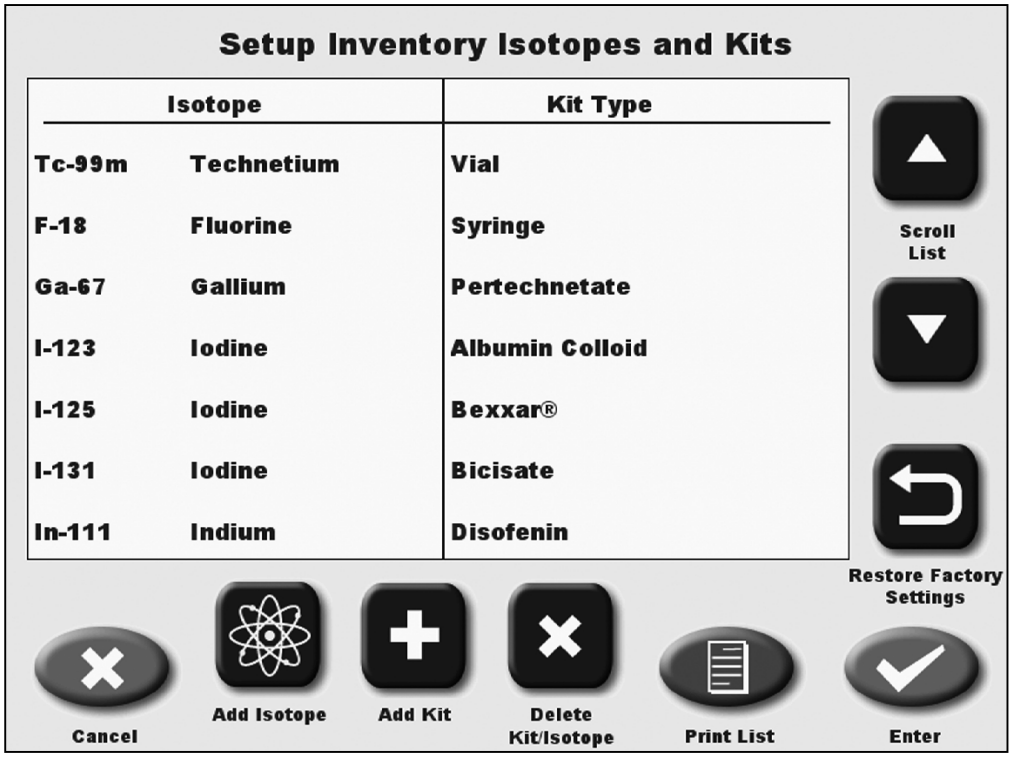


Figure 4.25. *The Setup Inventory Isotopes and Kits screen.*

The Setup Isotope and Kit List screen is used to maintain the isotopes and kit types used for inventory, and for Tec-Control Paper Chromatography testing.

NOTE: *Tec-Control Paper Chromatography requires a selection of the type of calculation used for counting the sections of the Tec-Control strips. See Appendix K for formulas. You must select a Tec-Control formula when entering a new kit into the list. If there is not a Tec-Control formula, select N/A.*

It is important to input the correct formula selection for the type of kit and strips to be used. Certain kits use one strip, others use two strips. Each strip is cut and the two sections are counted separately. Different formulas are used depending on the kit selected.

To Add An Isotope:

1. From the Dose Calibrator Configuration screen, touch <Setup Isotope and Kit List>. The Setup Inventory Isotopes and Kits screen is displayed.
2. Touch <Add Isotope>. The select current Isotope List is displayed.
3. Use the <▲> or <▼> keys to scroll through the Isotope Lists (Routine Isotopes, Custom Isotopes and the full Alphabetical list of Isotopes) and touch to highlight the selection desired.
4. Touch <Enter> to select the desired isotope and return to the Nuclear Pharmacy screen, or touch <Cancel> to return to the <Count> screen without adding the new isotope.

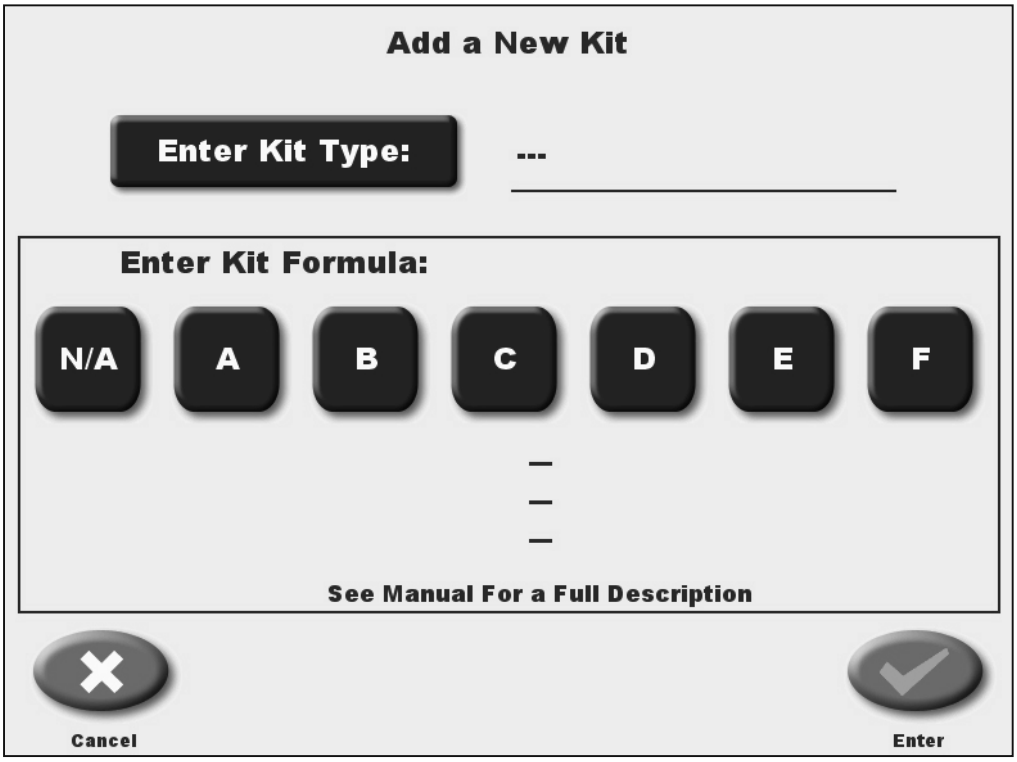


Figure 4.26. The Add a New Kit screen.

To Add A Kit:

1. From the Dose Calibrator Configuration screen, touch <Setup Isotope and Kit List>. The Setup Inventory Isotopes and Kits screen is displayed.
2. Touch <Add Kit>. The Add a New Kit screen is displayed.
3. Touch <Enter Kit type>. Key in the kit type on the enter Kit type screen and touch <Enter> to return to the Add a New Kit screen.
4. Enter the kit formula by touching the corresponding letter button. The kit formula is now displayed. You must select a kit type before you can save the kit. You can select N/A if there is no formula available.

   NOTE: *See Appendix K for a listing of kit types and formulas programed into the system.*

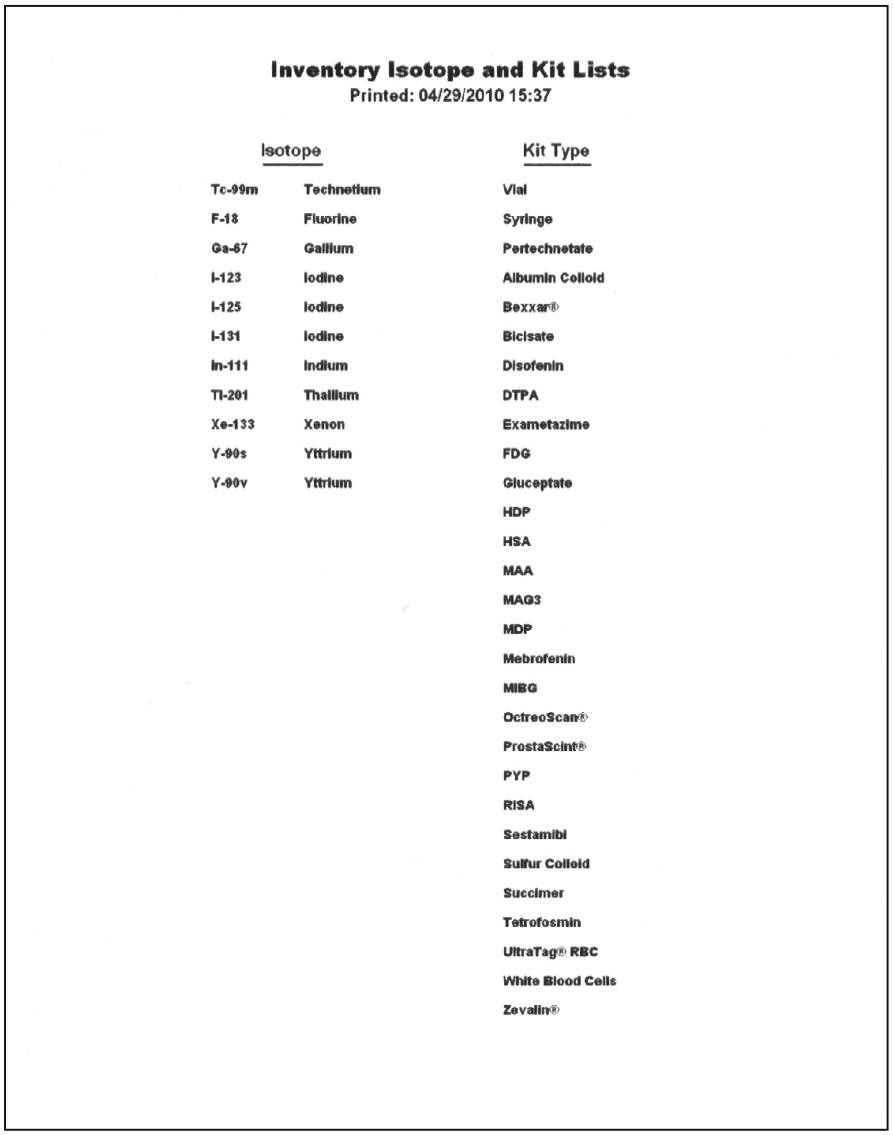
5. Touch <Enter> to save the kit and return to the Setup Inventory Isotopes and Kits screen, or <Cancel> to discard the kit type just created.

To Delete An Isotope Or Kit Type:

1. From the Dose Calibrator screen, touch Setup Isotope and Kit List>. The Setup Inventory Isotopes and Kit screen is displayed.
2. Touch to highlight the isotope or kit to delete. Touch <Delete Kit/Isotope>. The system prompts: “Are you sure you want to delete these items?”
3. Touch <Cancel> to cancel the deletion, or <OK> to delete the selected isotope or kit and return to the Setup Inventory Isotopes and Kits screen.

To Print The Setup Inventory Isotopes and Kits List:

1. To print the Setup Inventory Isotopes and Kits list at any time, touch <Print List>. The complete list is printed.



Inventory Isotope and Kit Lists
Printed: 04/29/2010 15:37

Isotope		Kit Type
Tc-99m	Technetium	Vial
F-18	Fluorine	Syringe
Ga-67	Gallium	Pertechnetate
I-123	Iodine	Albumin Colloid
I-125	Iodine	Bexxar®
I-131	Iodine	Bicisate
In-111	Indium	Disofenin
Tl-201	Thallium	DTPA
Xe-133	Xenon	Exametazime
Y-90s	Yttrium	FDG
Y-90v	Yttrium	Gluceptate
		HDP
		HSA
		MAA
		MAG3
		MDP
		Mebrofenin
		MIBG
		OctreoScan®
		ProstaScint®
		PYP
		RISA
		Sestamibi
		Sulfur Colloid
		Succimer
		Tetrofosmin
		UltraTag® RBC
		White Blood Cells
		Zevalin®

Figure 4.27. *An Inventory Isotope and Kit Lists printout.*

Restore Factory Settings:

1. To restore the factory settings to the Setup Isotopes and Kits screen at any time, touch <Restore Factory Settings>. The system will prompt confirmation.
2. Touch <Yes> to restore the factory settings and return to the Setup Isotopes and Kits screen with factory settings restored for the isotopes and kit types used for inventory and Tec-Control. It does not restore factory defaults for other functions within the system.
3. If you have made changes to the inventory isotopes and kits and touch <Enter> the changes will be recorded and the system returns to the Nuclear Pharmacy screen. If you touch <Cancel>, the changes are discarded and the system returns to the Dose Calibrator Configuration Screen.

Low Activity Resolution

Accessed from the Dose Calibrator Configuration screen, this option is used to define the default display resolution of activity readings. “Auto” is the default setting. To change the resolution, touch the current setting and then touch your selection from the pop-up list. Touch any part of the screen while the pop-up list is displayed to cancel without making any changes. The “Higher” and “Highest” resolution add digits to the activity measurement.

Volume Decimal Digits

This setting is used to determine the number of decimals points, one or two, displayed in inventory volume readings.

To Toggle Between The One- And Two Decimal Settings:

1. At the Dose Calibrator Configuration screen, touch the Volume Decimal Digits value displayed and then select either 1 or 2.
2. Touch anywhere on the screen display to enter your selection.

System Maintenance

(See Figure 4.28.)

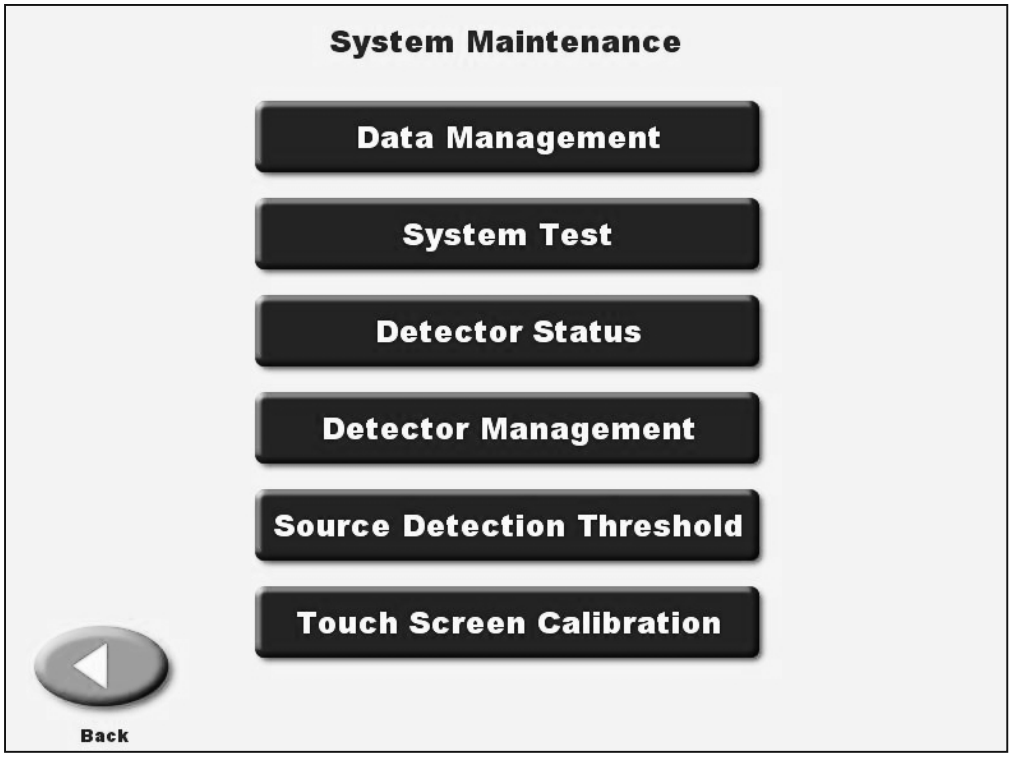


Figure 4.28. *The System Maintenance screen.*

This option is used to address various system maintenance functions including:

- Data Management
- System Test
- Detector Status
- Detector Management
- Source Detection Threshold
- Touch Screen Calibration
- Updating The System Firmware

To access the System Maintenance screen, from the Dose Calibrator Utilities screen, touch <System Maintenance>.

Data Management

(See Figures 4.29. - 4.30.)

Figure 4.29. *The summary View of All Stored QA Data.*

QA Data Management allows the user to view, delete, export and import the results of QA tests to a thumb drive for a selected detector or all detectors. The user can select from all tests, tests prior to or after a specified date, or within a specific date range. To choose data for a specific detector, toggle the <Select Detector> button at the bottom of the screen until the desired information is displayed.

NOTE: *Be sure to install the thumb drive in one of the USB ports, located on the back of the display panel, before attempting to export, import or back up QA and system data.*

To Export QA Data Management:

1. On the System Maintenance screen, touch <Data Management>.
2. Enter your password and touch <Enter>.
3. Select <QA Data Management>. The summary view of Stored QA Data screen is displayed with results for all tests on all detectors listed (or results for a specific detector, if selected.)
4. Touch <Export>. The QA Data Export screen is displayed.
5. Touch <Option> to select the date range for the data to export. Choose from All, Prior To, From/To, From or Only New by continuing to touch <Option> to advance through the choices.
6. For all choices other than All and Only New, touch the date to change it.
7. Touch the date segment to change and use <▲> or <▼> to scroll to the date desired.
8. Touch <Enter> to confirm the new date and return to the QA Data Export screen.

9. Touch <QA>Database to view the dataset options. Choose from “All” datasets, or continue touching <QA Dataset> to scroll through the list of individual datasets: Daily Constancy, Expanded Constancy, Geometry, Accuracy, Decay, Lineator and Calicheck.
10. Touch <Export Prep> to export the selected dataset and return to the summary view of Stored QA Data screen, or <Back> to return to the summary view of Stored QA Data screen without exporting data.
11. Select <Export USB> or <Export Serial>. The system exports the data, notes that the export has been completed, and returns to the QA Data Export Prep screen.

To Import QA Data:

1. On the System Maintenance screen, touch <Data Management> and enter your password. The Data Management screen should now be displayed.
2. Touch <QA Data Management>. The summary view of Stored QA Data screen is now displayed with results for all tests on all detectors listed (or results for a specific detector, if selected.)
3. Make sure a thumb drive containing data is plugged into one of the USB ports on the back of the display.
4. Touch <Import>. The QA Data Import screen is now displayed with the drive from which to import data noted at the top of the screen.
5. Use the up and down arrows to scroll to the data you wish to import. Touch the data name to highlight and advance to the Okay To Proceed screen.
6. Touch <Yes> to import the data selected. The system shows an export screen while the data is transferred. Once the data transfer is complete, the import completed successfully screen is displayed. Touch <No> to return to the QA Data Management screen without importing data.
7. At the Import Successfully Completed screen, touch <OK> to return to the Summary View of Stored QA Data screen.

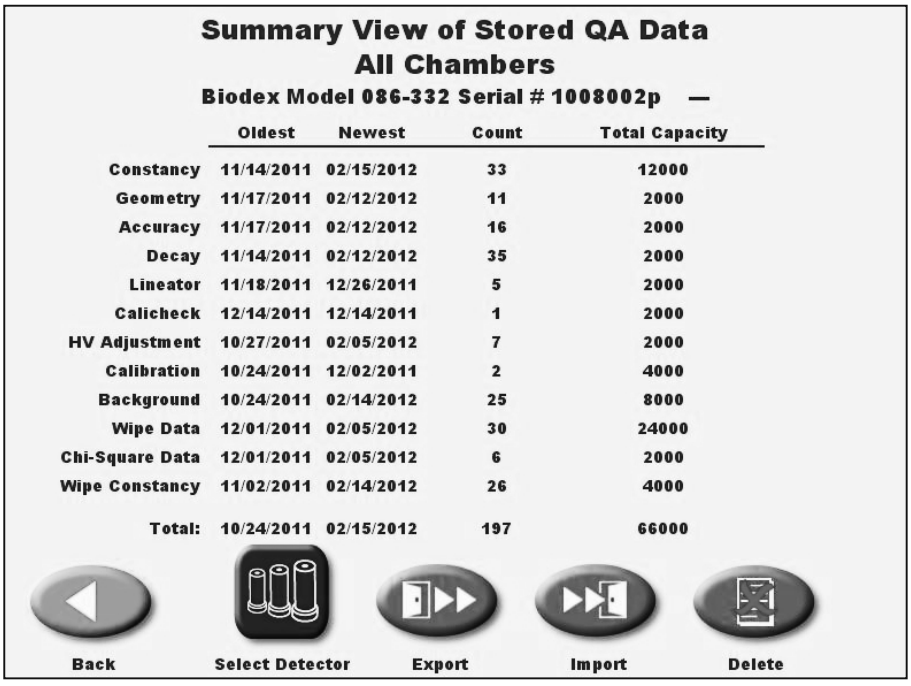


Figure 4-30. *The summary view of All Stored QA Data.*

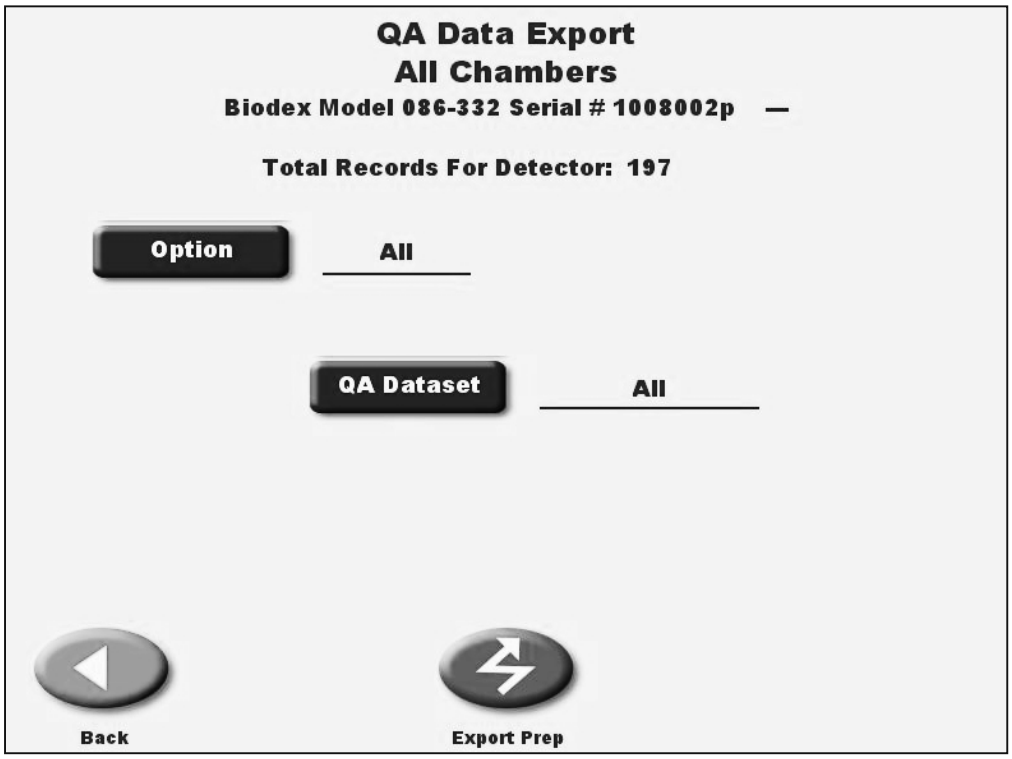


Figure 4.31. *The QA Data Export screen.*

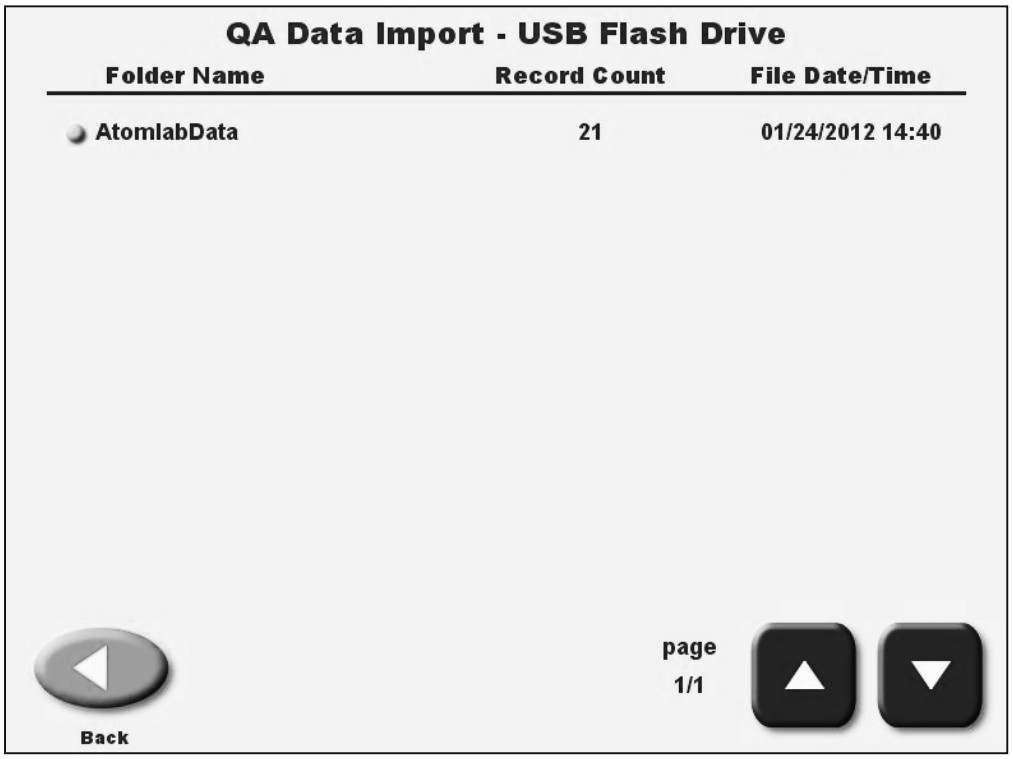


Figure 4.32. *The QA Data Import screen.*

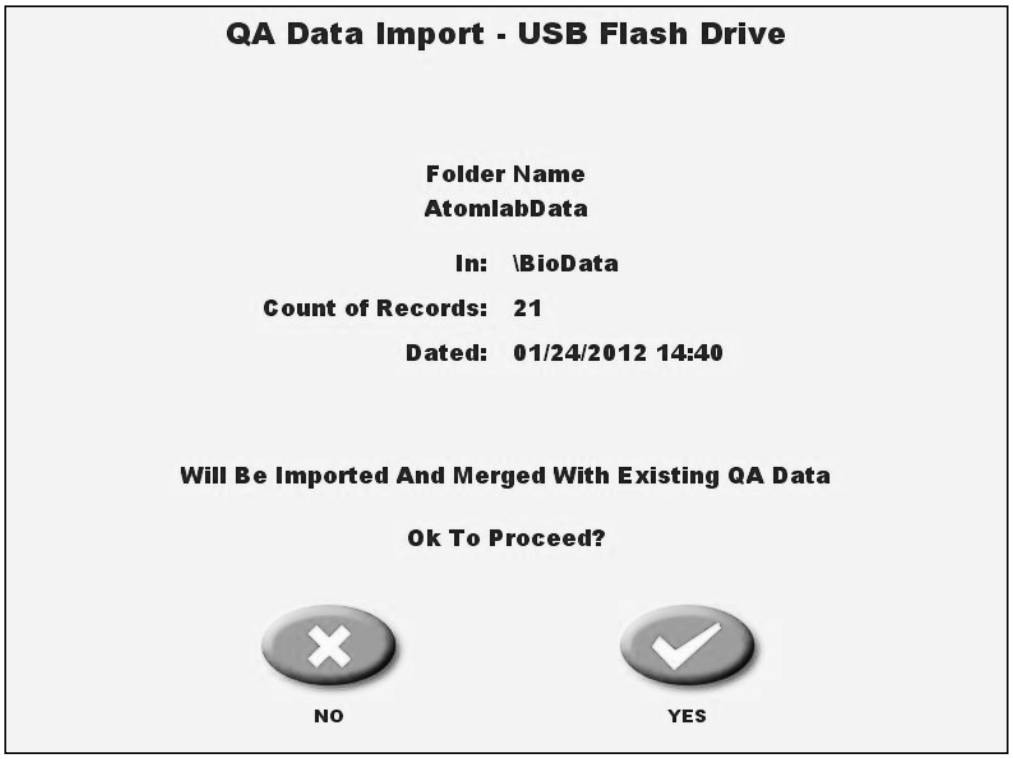


Figure 4-33. *The QA Data Import Okay to Proceed screen.*

To Delete QA Data:

1. On the System Maintenance screen, touch <Data Management> and enter your password. The Data Management screen should now be displayed.
2. Touch <QA Data Management>. The summary view of Stored QA Data screen is now displayed with results for all tests on all detectors listed (or results for a specific detector, if selected.)
3. Touch <Delete>. The QA Data Delete screen is displayed.
4. Touch <Option> to select the date range for the data to export. Choose from All, Prior To or From/To by touching <Options> to advance through the choices.
5. For all choices other than all and only new, touch the date to change. The QA Data Delete screen is displayed.
6. Touch the date segment to change and use <▲> or <▼> to scroll to the date desired.
7. Touch <Enter> to confirm the new date and return to the QA Data Delete screen.
8. Touch <QA Dataset> to view the dataset options. Choose from “All” datasets, or continue touching <QA Dataset> to scroll through the list of individual datasets.
9. Touch <Delete Now> to delete the selected dataset and return to the summary view of stored QA Data screen.

USB System Backup

(See Figure 4.34.)

Figure 4.34. *The System Backup screen with a "successful backup" message displayed.*

This function allows the export of all Atomlab files and data to a thumb drive, providing a means of backing-up the system when needed or desired.

To Backup The Atomlab 500 QA Data:

1. Insert a thumb drive into one of the USB ports on the back panel of the display.
2. At the Data Management screen, touch <USB System Backup>. A message will display noting that the backup is in progress.
3. When a message showing that the backup has completed successfully is displayed, touch <OK> to return to the Data Management screen. All data is now backed-up on the thumb drive.

System Restore

(See Figure 4.35.)

Figure 4.35. *The System Restore operation will overwrite all current stored data, settings, event log and firmware. They system will prompt you to confirm before proceeding with this function.*

This function allows the user to restore all Atomlab 500 files from a thumb drive backup.

NOTE: *Restoring the data will overwrite all current stored data, settings, event log and firmware information.*

To Restore All Atomlab Files From A Backup Thumb Drive:

1. Insert a thumb drive into one of the USB ports on the back panel of the display.
2. At the Data Management screen, touch <USB System Restore>. A message will display noting that this procedure will overwrite all of the Atomlab 500's files.
3. If you are sure you want to restore all files, touch <OK> to proceed, or touch <Cancel> to return to the Data Management screen without restoring files.
4. If restoring, a message will be displayed noting that the system files are being restored. Touch <Reset> when a message appears stating "Restore Completed Successfully." The system returns to the Data Management screen with the restored files now working.

Event Log Viewer

(See Figure 4.36.)

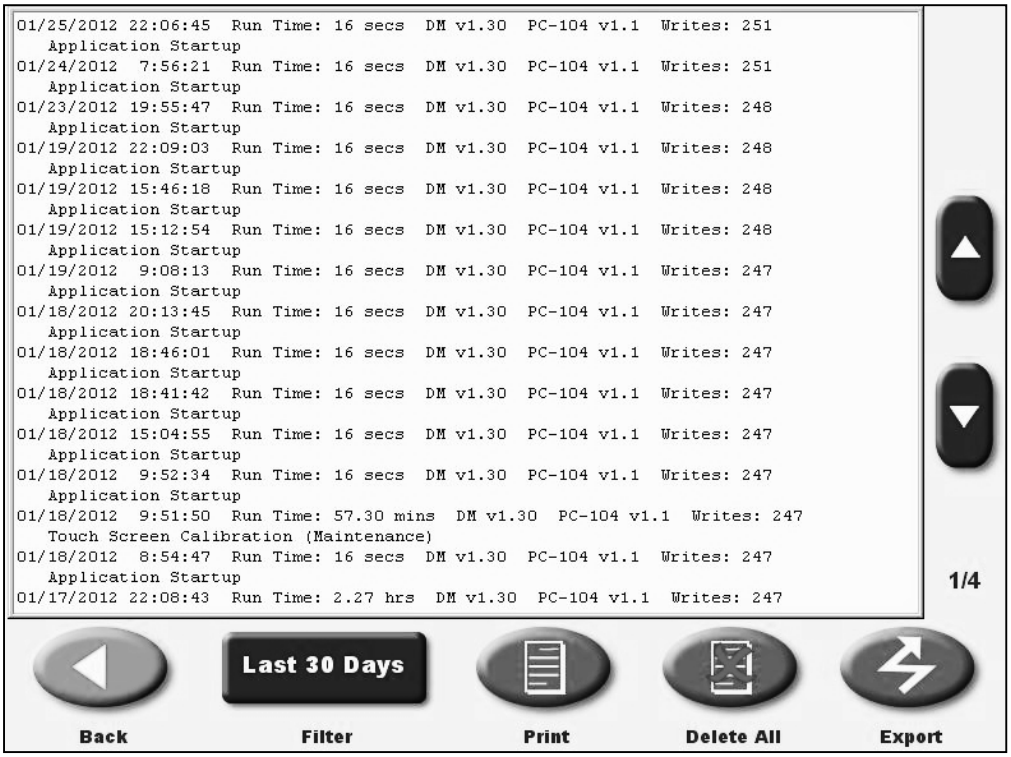


Figure 4.36. *The Event Log screen with all events listed for the past 30 days.*

This shows all events recorded in the dose calibrator for use in determining problems encountered with the system. If needed, this function will be explained by a Biodex Service Representative.

System Test

(See Figure 4.37.)

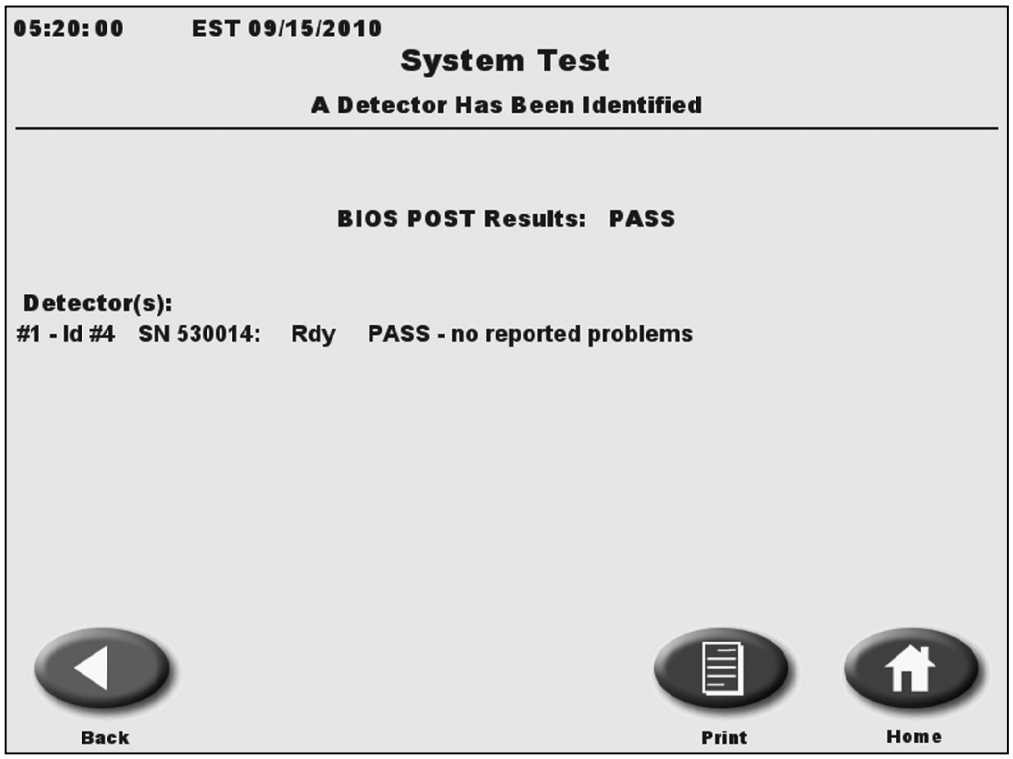


Figure 4.37. *The System Test screen.*

Touch <System Test> to display a system-wide diagnostics test, performed at power-up, which covers the following, although not all tests are displayed on the screen following power-up.

- BIOS POST
- Detector(s): (Detector status information is continually monitored.)

During the Power ON test, the display will show a "Detector Warm-Up Initialization In Progress," message. If all tests are completed without errors, the system will note that there are no reported problems. If a problem is discovered, the system will note the failure with an error message and, depending on the problem, possible solutions.

- If a printed System Test Report is required, touch <Print> to print the System Test screen following the test.
- Touch <Home> to return to the System Home page.
- Touch <Back> to return to the System Maintenance screen.

To Change I.D.

1. Touch to highlight the detector for which to change I.D.
2. Touch <Change I.D.>.
3. The current detector ID is listed as “From”. Use <▲> or <▲> to scroll to the appropriate new ID besides the “To” prompt.
4. Touch <Enter>. The system will prompt “are you sure?” Touch <Yes> to confirm or <No> to return to the change hardware detector ID screen without making changes.
5. If you have elected to change the detector ID, the system will automatically reset at this point and run a new power on self-test. Touch <Home> to return to the System Home page.

NOTE: *Each detector connected must have a different ID number. You cannot have two detectors with the same ID. ID numbers available are 2, 4, 6, 8, 10, 12 and 14. Biodex uses I.D. #14 for a wipe detector.*

Detector Status

(See Figure 4.38.)

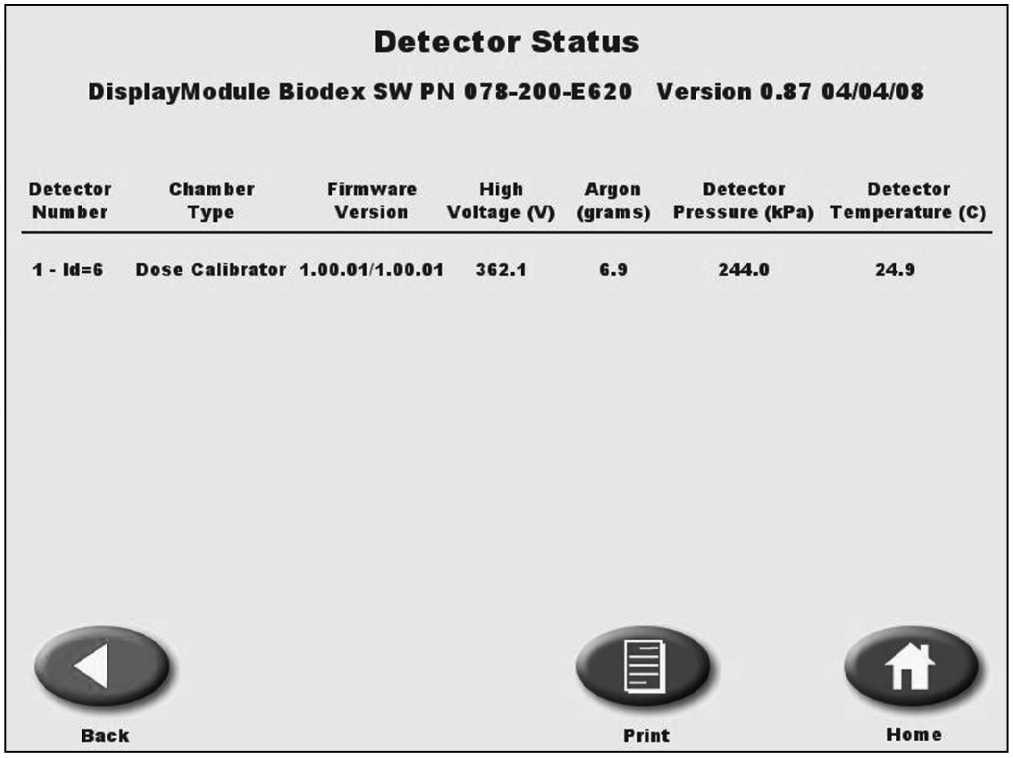


Figure 4.38. *The Detector Status screen.*

The Detector Status screen lists all the detectors present by number and id, type, firmware versions on the detector pc board, the high voltage reading (V) and on dose calibrator detectors: Argon (grams), detector pressure (kPa,) and detector temperature (C-degrees) are also noted.

To view the Detector Status screen, from the System Maintenance screen touch <Detector Status>.

If a printed Detector Status report is required, touch <Print> to print the Detector Status screen. Touch <Home> to return to the System Home page, or <Back> to return to the System Maintenance screen.

NOTE: *The gas pressure measurement is 150 kPa gauge. The system displays the kPa absolute pressure which adds atmospheric pressure to the gauge pressure. The absolute kPa pressure is approximately 250 kPa absolute at 20° C. This means the dose calibrator detector is exempt from hazardous materials shipping requirements.*

Detector Management

(See Figure 4.39.)

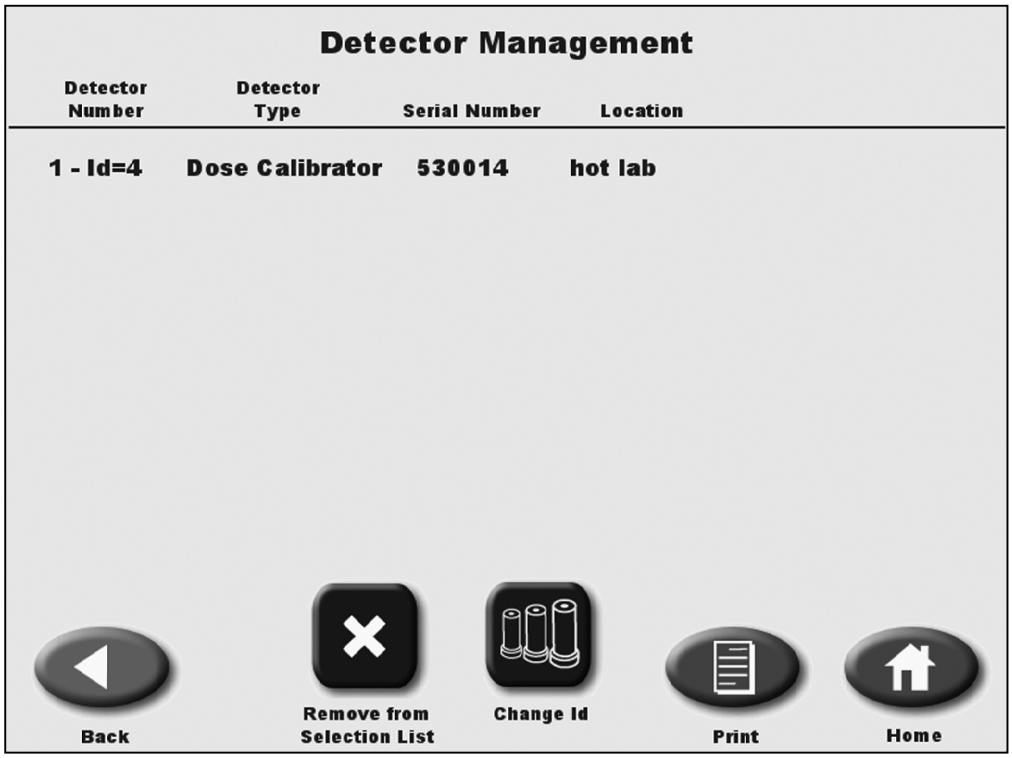


Figure 4.39. *The Detector Management screen.*

Detector Management allows the user to remove detectors from the selections list and change detector ID numbers.

To Access The Detector Management screen:

1. On the System Maintenance screen, touch <Detector Management>.
2. Enter your password and touch <Enter>. The Detector Management screen is displayed with detector I.D. numbers, detector types, serial numbers and detector locations. The <Remove From Selection List> button toggles with an <Add to Selections List> button on the Detector Management screen.

To Remove A Detector:

1. Touch to highlight the detector to remove.
2. Touch <Remove From Selection List>. A red “X” appears next to the detector to remove.

To Add A Detector:

1. Touch to highlight the detector to add.

   NOTE: *The detector must be currently shown on the list with a red X.*

2. Touch <Add To Selection List>. The red “X” disappears from next to the detector to remove.

Source Detection Threshold

(See Figure 4.40.)

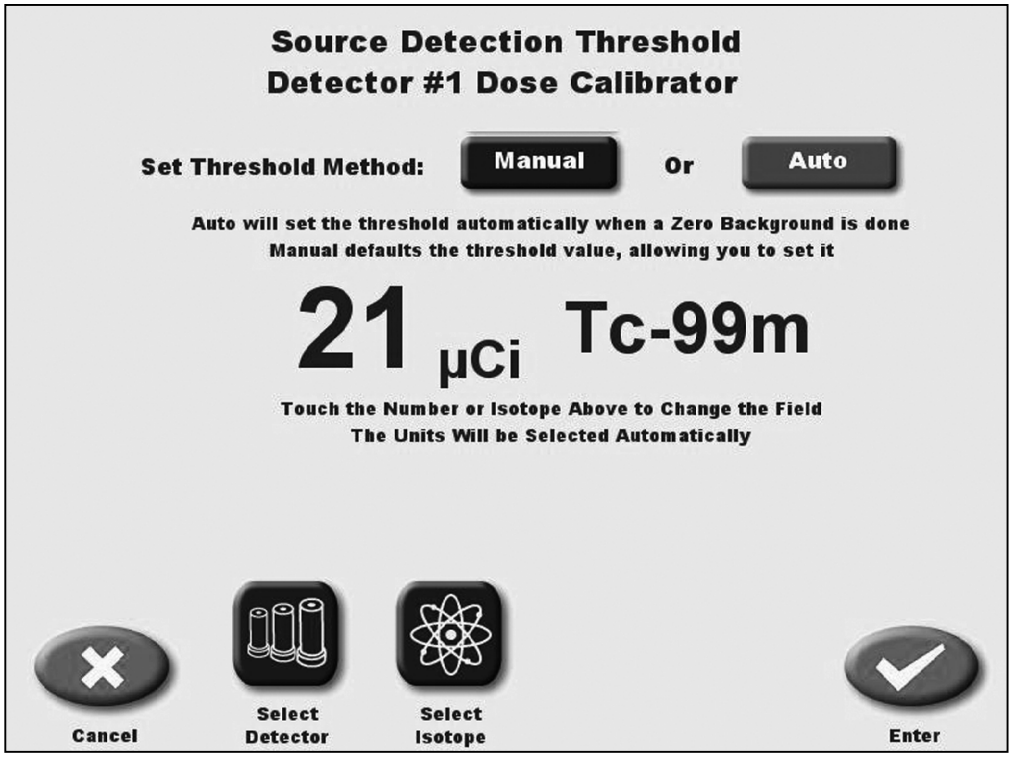


Figure 4.40. *The Source Detection Threshold screen.*

The Source Threshold value determines the system’s response time. Above the threshold, response time is quick. Below the threshold, response time is significantly slower.

To Change The Source Threshold:

1. From the Utilities menu, touch <System Maintenance>. The System Maintenance screen is displayed.
2. Touch <Source Detection Threshold>. The Source Detection Threshold screen is displayed. At this screen you can choose to have the source detection threshold set automatically when a Zero Background is performed, or set the threshold manually.

To Set Source Detection Automatically:

1. Touch <Auto>. The system automatically sets the source detection when a Zero Background is performed.

To Set Source Detection Manually:

1. Touch <Manual>. You can now change the threshold value or the isotope selected.
2. To change the threshold value, touch the value displayed. Enter the new value and touch <Enter> to record and return to the Source Detection Threshold screen with the new value displayed.
3. To change the isotope, touch the isotope displayed and select a different isotope from the select current isotope screen. Touch <Enter> to return to the source Detection Threshold screen with the new isotope selected.

Touch Screen Calibration

(See Figure 4.41.)

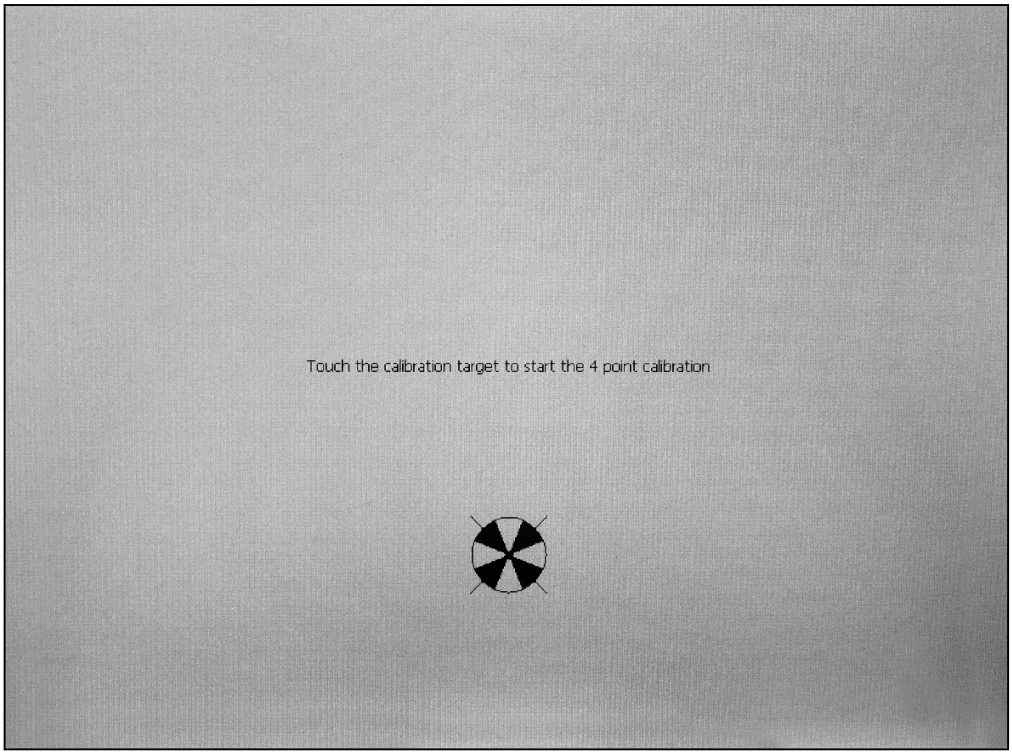


Figure 4.41. *The Touch Screen Calibration screen.*

Touch Screen Calibration allows the user to calibrate the position of the screen on the display.

1. From the Utilities menu, touch <System Maintenance>. The System Maintenance screen is displayed.
2. Touch <Touch Screen Calibration>. The <Enter Password> window is displayed. Enter your password and touch <Enter>. The Calibrating Touch screen message is displayed.

3. Touch and hold your finger on the calibration target to begin the four-part calibration alignment. Then touch and hold your finger over the target as it moves to each corner of the screen.

   NOTE: *If you do not touch the calibration target within 15 seconds, the Calibration screen will time out and return to the System Maintenance screen.*

4. Select <accept> to save the new calibration and return to the System Maintenance screen, or touch <Cancel> to return to the System Maintenance screen without making changes.

NOTE: *If you do not touch the calibration target within 15 seconds, or do not accept or cancel a new calibration within 90 seconds, the Calibration screen will time out and return to the System Maintenance screen.*

Updating The System Firmware

Figure 4.42*. The Firmware Update Available screen.*

The Atomlab 500 system is easy to update should new firmware be required.

To Update The Atomlab 500 Firmware:

1. At the Home screen or Measure screen, place the new firmware thumb drive into one of the USB ports on the back of the display.
2. The system will automatically search the inserted thumb drive and then display both the new and old firmware versions on the Firmware Update Available screen.

NOTE: *If the new firmware is older than, or an exact match of the new firmware available, the system will not display the Firmware Update Available screen. The Home screen or Measure screen will remain unchanged.*

3. If you choose to update the firmware now, touch <Yes> to begin the upload.
4. The upload will complete after several seconds, and the system will then automatically reboot. Remove the thumb drive only after the system reboots and begins to initialize background.

5. Nuclear Pharmacy

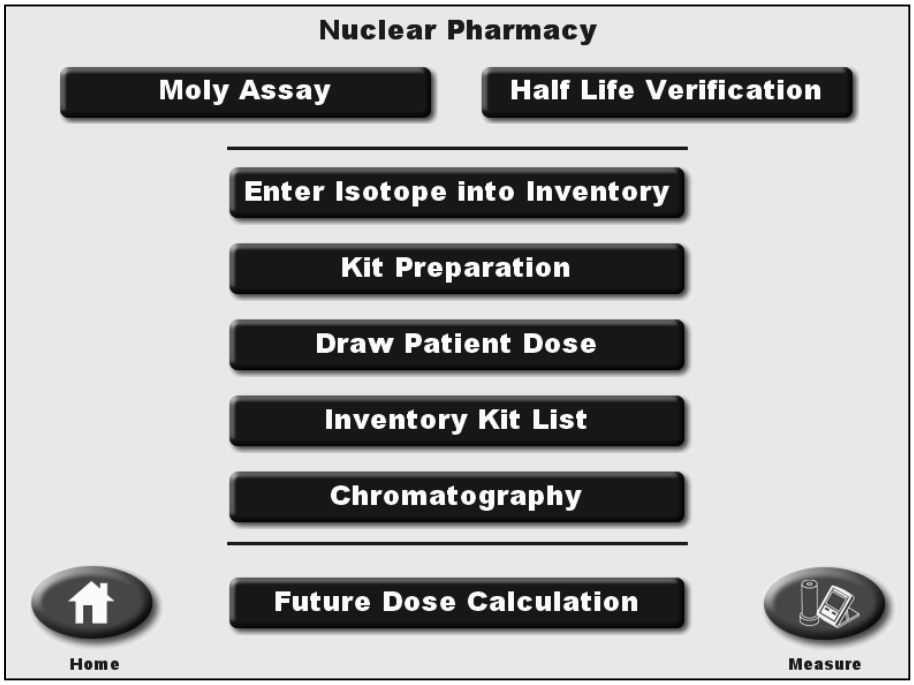


Figure 5.1. *The Nuclear Pharmacy screen.*

The Nuclear Pharmacy functions allow the system to perform inventory and chromatography operations including:

- Moly Assay (also known as Moly Breakthru)
- Half-Life Verification
- Enter Isotope into Inventory
- Kit Preparation
- Draw Patient Dose
- Inventory Kit List
- Chromatography
- Future Dose Calculation

The Nuclear Pharmacy screen is accessed by touching <Nuclear Pharmacy> on the Home screen. There is a separate Moly Assay program that calculates the Moly concentration without entering any isotope into inventory. Before proceeding with the other Nuclear Pharmacy options presented, select <Enter Isotope into Inventory> and use the keys at the bottom of the screen to select the appropriate detector or Zero Background, if necessary.

NOTE: *For some products, the next logical button function will flash on the display.*

NOTE: *Although Moly Assay appears as the first choice on the Nuclear Pharmacy screen, this is not for isotopes put into inventory. The Enter Isotope into Inventory procedure has a function that includes the Moly Assay procedure when putting Tc-99m into inventory. When entering an isotope other than Tc-99m the Moly Assay selection is not provided.*

Moly Assay (Moly Breakthru)

(See Figures 5.2 - 5.8.)

The Moly Assay test measures the amount of Mo-99 in a syringe or vial of Tc-99m. To perform this test, an empty Moly Shield is used to perform a background count. The syringe or vial of Tc-99m is added to the Moly Shield. A count is then taken for the activity of the Moly counted through the lead Moly Assay Shield. The vial or syringe is then removed from the lead shield and placed into the dose calibrator. The system calculates the activity of Moly and the µCi of Moly per *mCi* of Tc-99m.

If the Moly concentration is above the regulatory limit of 0.15 µCi of Mo-99 per mCi of Tc-99m, the number is shown in red.

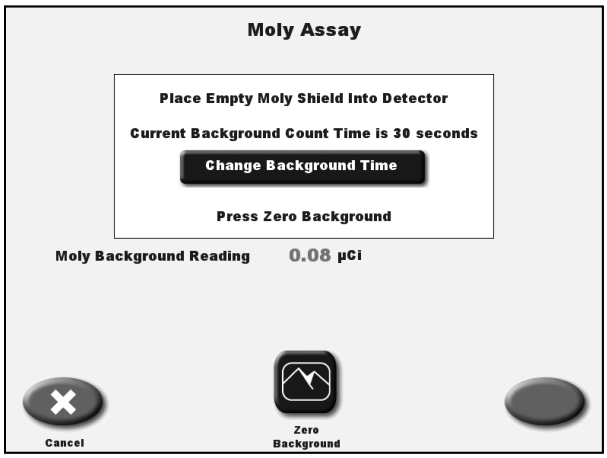


Figure 5.2. *The Moly Assay Zero Background screen.*

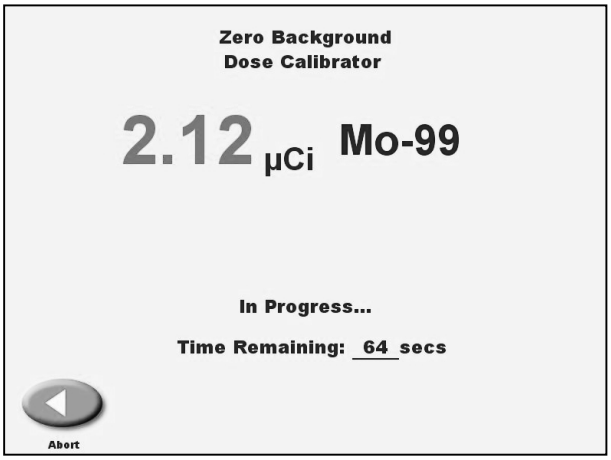


Figure 5.3. *The Moly Assay Zero Background reading.*

To Perform A Moly Assay:

1. At the Home screen, touch <Nuclear Pharmacy>. The Nuclear Pharmacy screen is now displayed.
2. Touch <Moly Assay>. The Moly Assay Zero Background screen is displayed.
3. The Moly Assay Background screen allows the user to change the background counting time. The screen displays the current background time. To change the background counting time, select <Change Background Time>. A message will be displayed stating, "Changing Background, Time Will Be Retained And Have A Global Effect Throughout The System." Select <Continue>.

   NOTE: *When you change the background counting time it changes the Moly Background Time and the Dose Calibrator background counting time. If you do not want to change the background time, select <Cancel> and go to Step 5.*
4. The Set Count Background Time screen is displayed. Select the number after Background Count Time. A pull-down menu is displayed with 30, 60 or 100 seconds. Select to highlight the time that you desire and select <Enter>. The Moly Assay Background Counting screen will be displayed with the new background counting time.
5. Make sure there is no source in the detector. Place the empty Moly Shield into the detector and touch <Zero Background>.

Figure 5.4. *Set Background Time screen.*

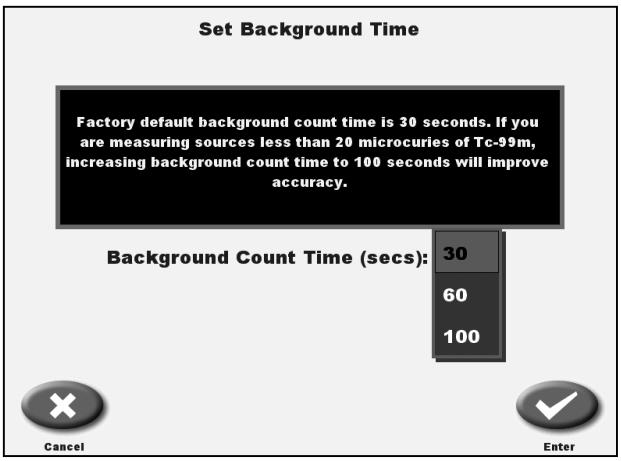


Figure 5.5. *Set Background Time.*

NOTE: *You must perform a Mo-99 background count using the empty Moly Shield before performing a Moly Assay.*

6. Select <Zero Background> to begin a background count time lasting 30, 60 or 100 seconds depending on what you have selected for your background time.

   NOTE: *You must perform a Mo-99 background count using the empty Moly Shield before performing a Moly Assay.*

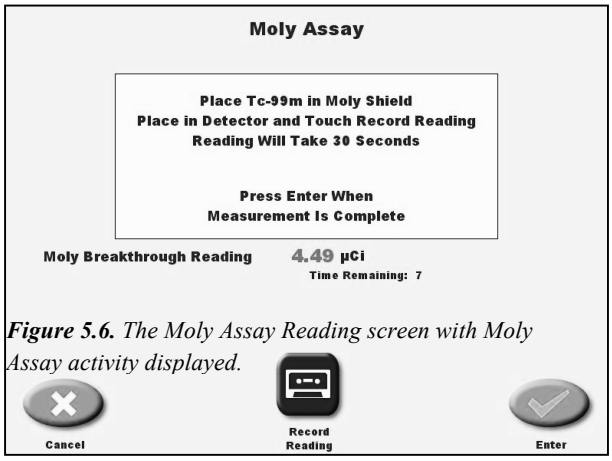


Figure 5.6. *The Moly Assay Reading screen with Moly Assay activity displayed.*

7. Select <Enter> to record the Moly backkground.
8. Place the vial or syringe of Tc-99m into theMoly Shield and place it into the detector.
9. Press <Record Reading>. The system will prompt you to wait 30 seconds for the activity reading.

   NOTE: *You can press <Record Reading> to recount the Moly if desired.*

10. Press <Enter> to return to the Moly Assay screen to count the vial or syringe of Tc-99m without the Moly Shield.
11. Remove the Tc-99m vial or syringe from the Moly Shield and place a vial or syringe into the detector.
12. Touch <Record Reading> to record the Tc-99m activity. The Moly Assay Results screen is now displayed giving the Moly concentration of µCi Mo/mCi Tc-99m.

NOTE: *You must manually record this information. When you leave this screen, it is not saved.*

13. Touch <Back> to return to the Nuclear Pharmacy screen or <Measure> to advance to the Measure screen.

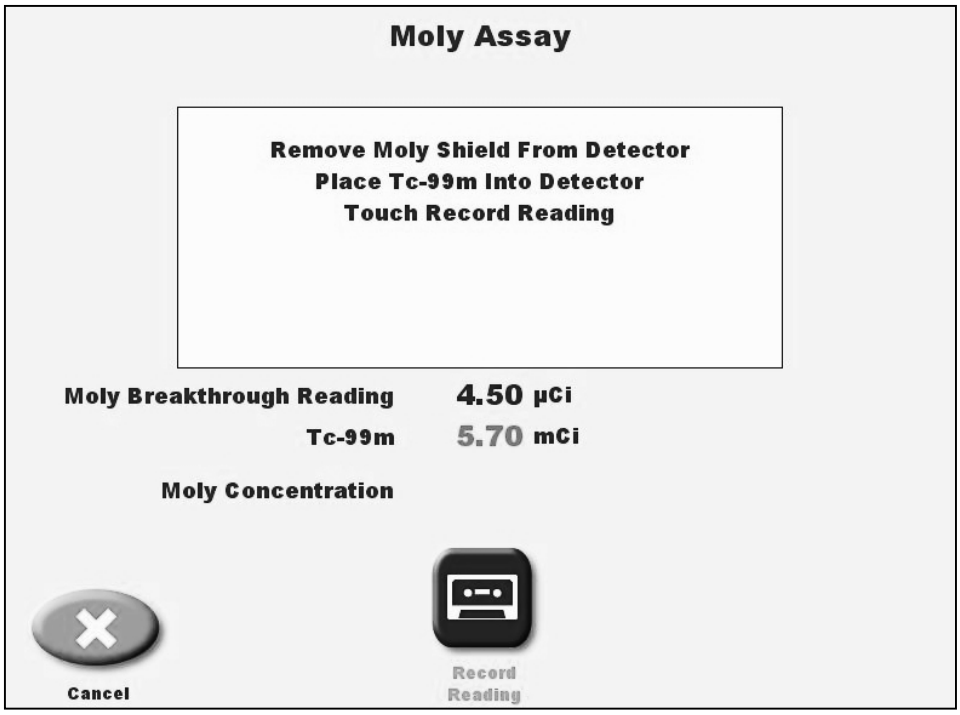


Figure 5.7. *The Moly Assay Tc-99m Record Activity screen with Moly Assay activity displayed.*

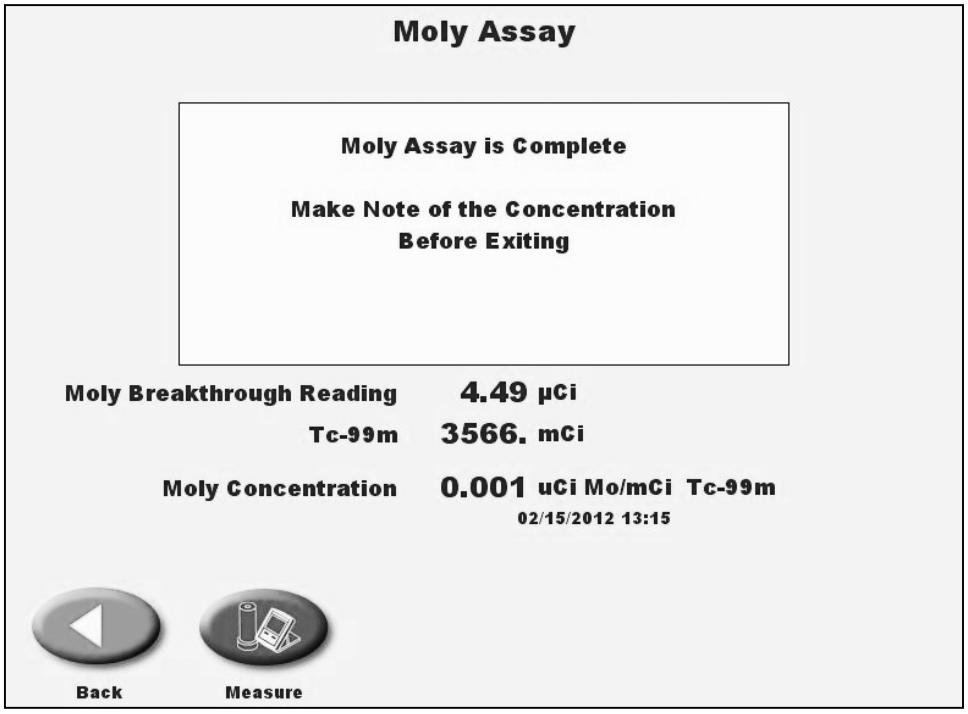


Figure 5.8 *The Moly Assay Results screen showing activities and Moly concentration.*

Half Life Verification

Intended Use

The Half Life Verification APP is intended to check a radioactive isotope to determine the actual Half Life of the isotope sample.

Indications For Use

In a Nuclear Pharmacy it is common practice to test certain isotopes for contamination from other isotopes before use. This test is typically performed for PET isotopes such as F-18. The Half Life is calculated from either two or three timed activity readings in the dose calibrator. The system then calculates the actual Half Life of the sample and shows the variance percentage to the system listed isotope Half Life. It is the user's responsibility to determine if this variance is acceptable.

Half Life Verification App

(See Figures 5.9 – 5.17.)

The Half Life Verification APP allows the user to select the isotope, set test parameters; select either 2 or 3 readings and set the elapsed time between the readings. The time can be set between 1 minute and 60 minutes. You can also enter the lot number. When the test is complete, print your results. The results show the preset Half Life for the isotope selected and the calculated Half Life from the two or three activity readings.

NOTE: *The dose calibrator does not store the Half Life calculation. You can print the results.*

NOTE: *It is up to the user to decide if this variance is acceptable or if there are too many contaminants in the isotope to use it.*

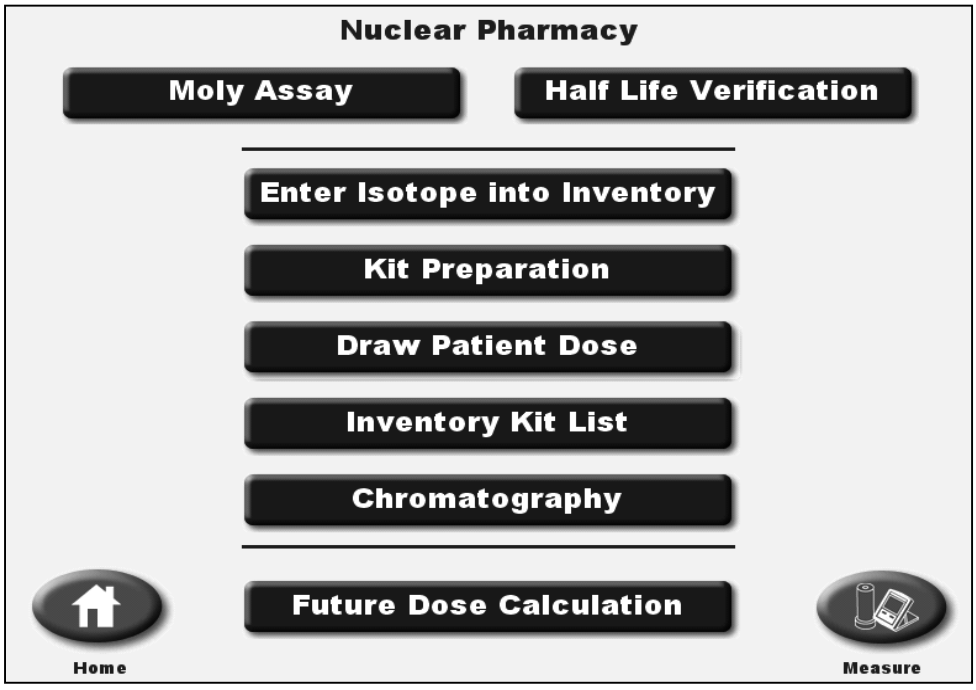


Figure 5.9. *The Nuclear Pharmacy screen.*

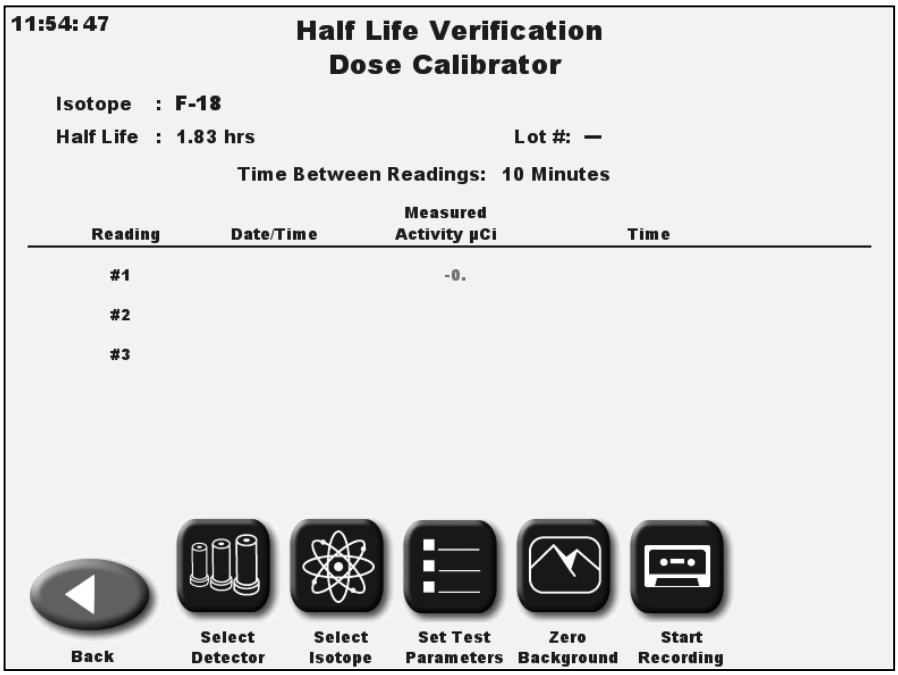


Figure 5.10. *Half Life screen.*

To Perform A Half Life Verification:

1. At the Home screen, select <Nuclear Pharmacy>. The Nuclear Pharmacy screen is now displayed.
2. Select <Half Life Verification>. The Half Life Verification APP is now displayed.
3. Make sure there are no sources near the dose calibrator chamber.
4. Press <Select Isotope> to change the isotope from the isotope displayed at the top of the screen. You can select any isotope from the isotope list that is in the dose calibrator.
5. To select the isotope use the scroll arrows to display the isotope you want, touch the isotope name to highlight it and then select <Enter>. The isotope you have selected is now displayed on the Half Life Verification screen, including the system defined Half Life.
6. Select <Set Test Parameters> to display the Half Life Verification parameters.
7. Select either <2> or <3> for the number of readings. If the number is already highlighted, you do not need to select it.

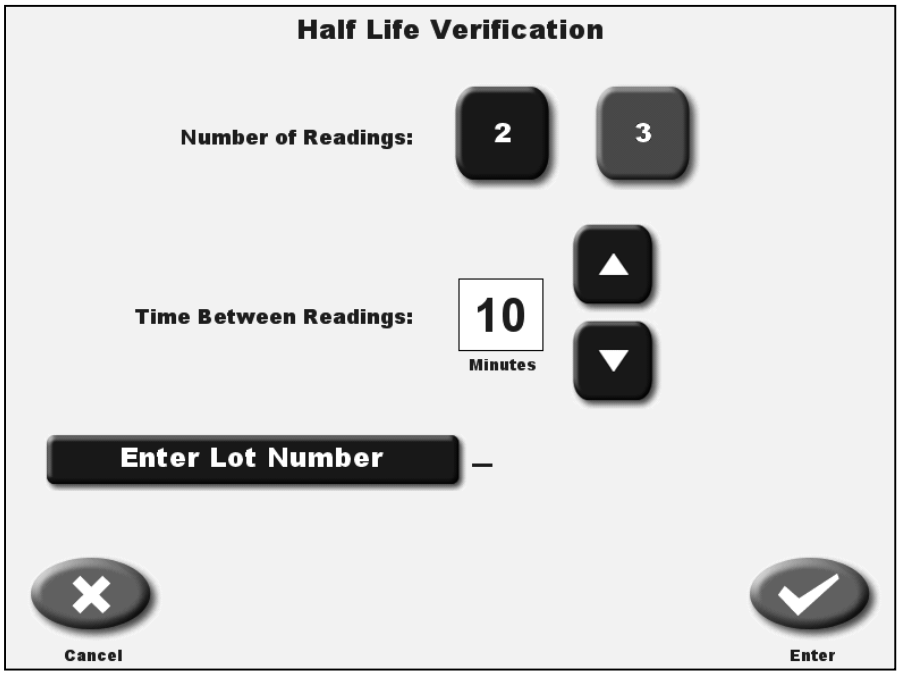


Figure 5.11. *Half Life Verification Setting Parameters screen.*

8. Use the <▲> or <▼> arrows to set the time between readings. If the number displayed is what you desire for your test, you do not have to adjust it. The time can be adjusted between 1 minute and 60 minutes. Select <Enter Lot Number> if you want to enter a lot number for this test. When you select <Enter Lot Number>, the alpha numeric keyboard is displayed. Once you have entered the desired lot number, select <Enter>.
9. The Half Life Verification screen is displayed with the parameters you have selected. Select <Enter> to proceed to the screen to start the verification test.
10. If desired, select <Zero Background> along the bottom menu. This brings you to the Zero Background screen. Select <Zero Background> and the background count will begin. If there has been no activity in the chamber, it will immediately say "completed" and take you back to the Half Life Verification screen.
11. Place the isotope sample into the dose calibrator chamber.
12. Select <Start Recording> to take the first reading. The program will automatically record the first activity and record the next activity reading at the time you have programmed. Leave the source in the chamber and the system will complete the test. The time remaining is displayed for each reading.
13. If you select <Abort Recording> the test you have started counting will be aborted and take you back to the Half Life Verification screen. You can restart the test by selecting <Start Recording>. If you need to change your test parameters or isotope, you can do it at this point.
14. When ready select <Start Recording>. The Half Life Verification APP will begin.

NOTE: *If you select <End Recording>, the Half Life Verification APP will end and use the elapsed time for the calculation. If the counting time is not long enough, it could affect the results. It is recommended to have the count complete the preset time.*

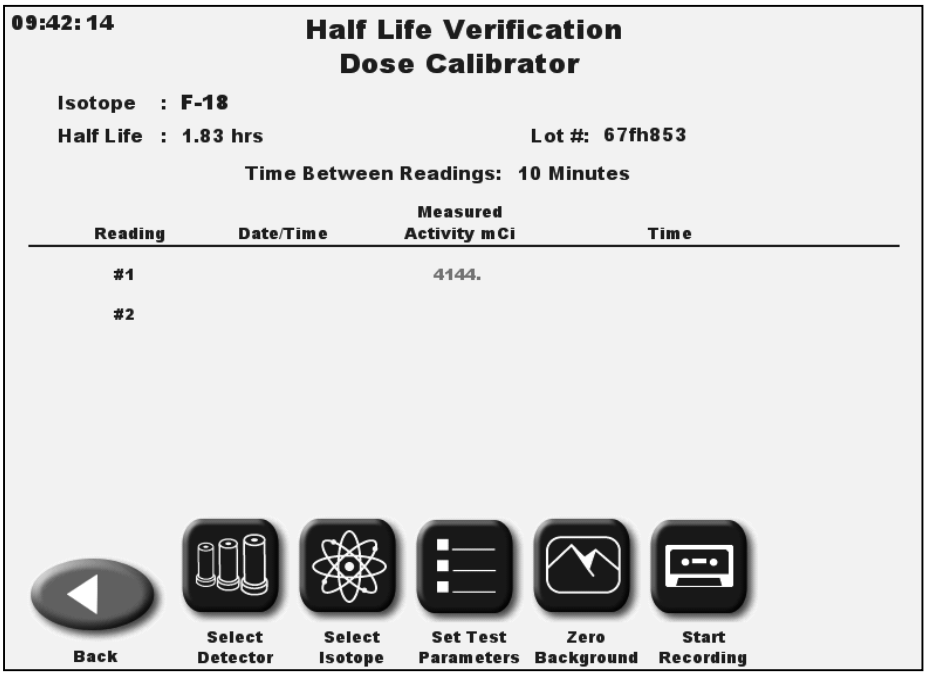


Figure 5.12. *Two Reading Half Life Verification screen.*

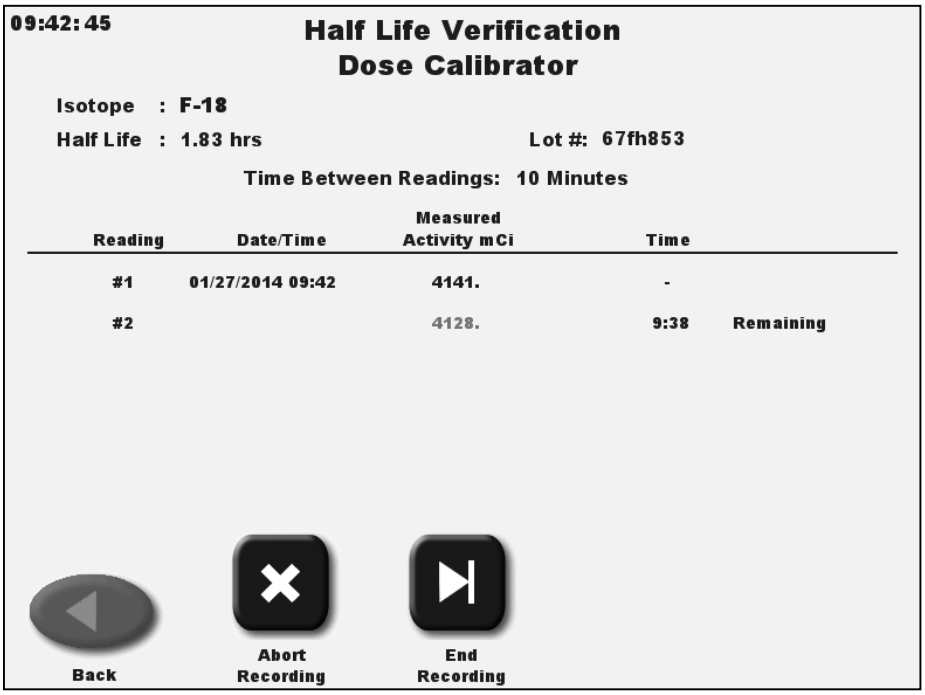


Figure 5.13. *Half Life Verification Counting screen.*

15. When the test is complete, the results are shown on the screen. The results include the calculated Half Life and the variance percent from the published Half Life of the isotope. Select <Print> to print your results. If you select <Back>, a message will be displayed that if you proceed your data will be lost. Select <No> not to exit; select <Yes> to exit and lose the test data.

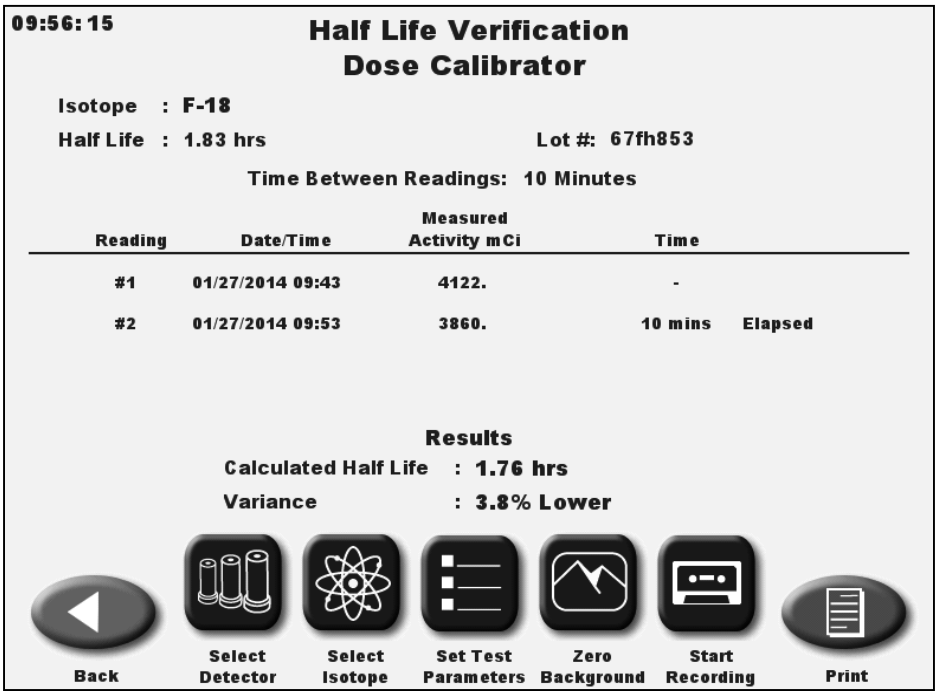


Figure 5.14*. Two Reading Half Life Verification Results screen.*

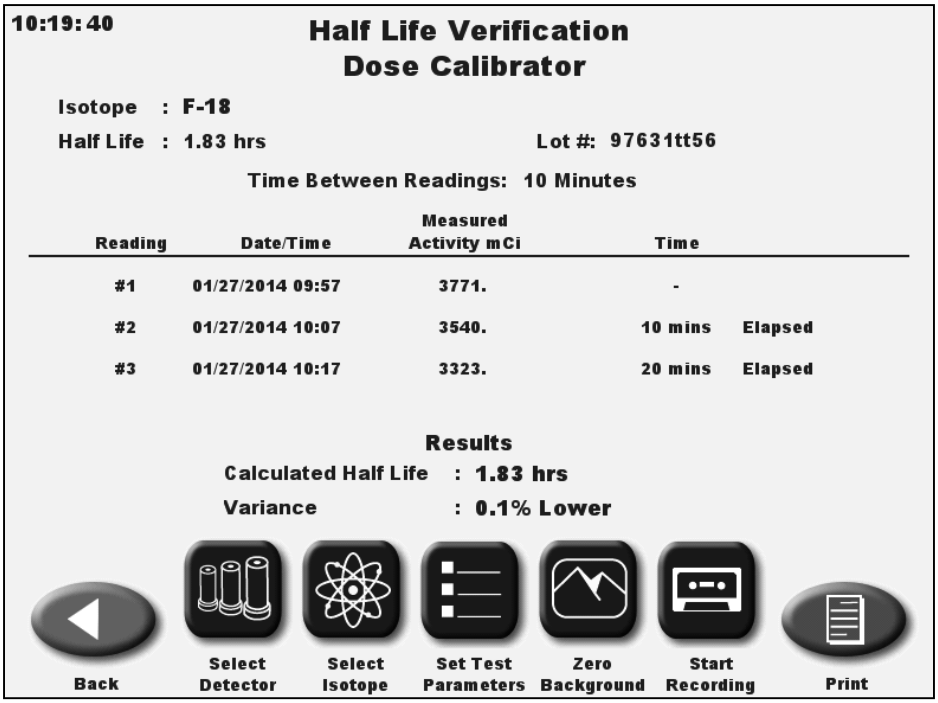
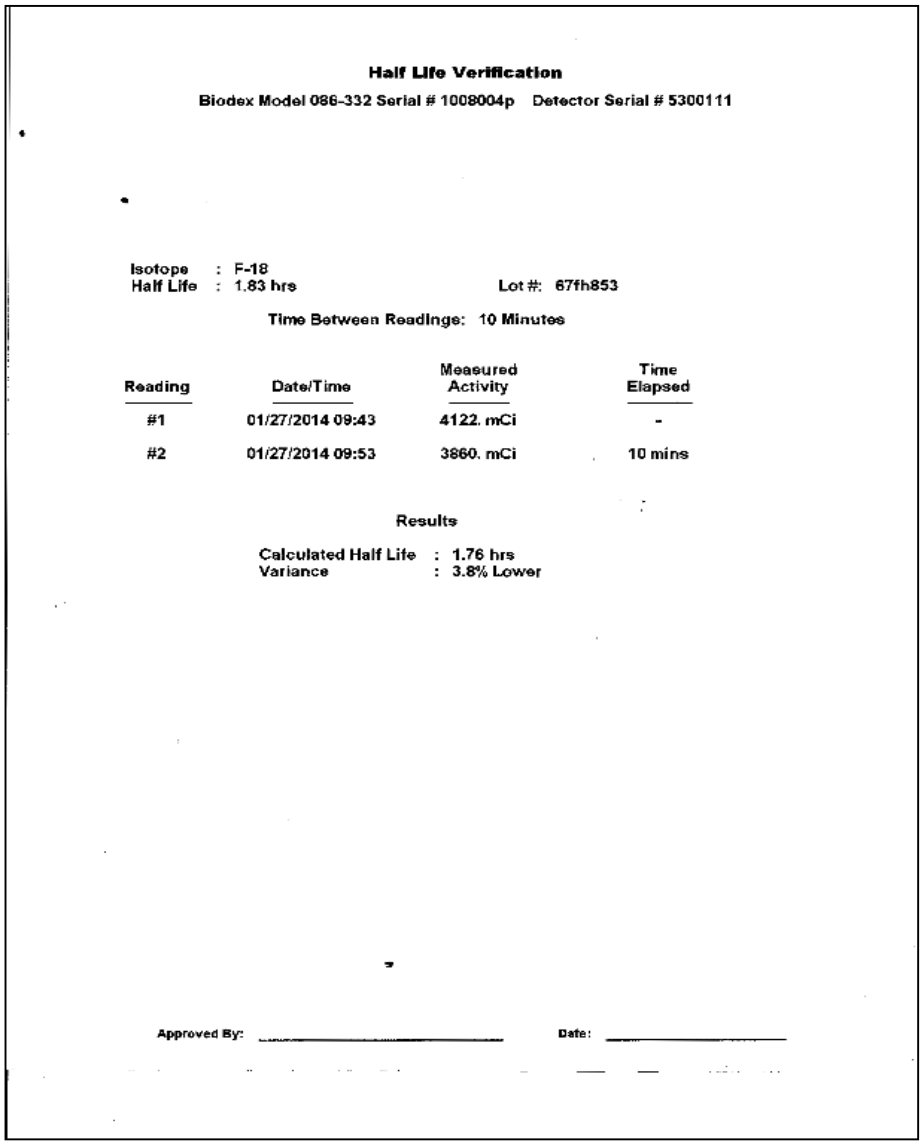


Figure 5.15. *Three Reading Half Life Verification Results.*

16. If you desire to start another Half Life Verification, you must select <Set Test Parameters> and review the parameters and then select <Enter>. At this point you can start another test.



Half Life Verification

Biodex Model 086-332 Serial # 1008004p Detector Serial # 5300111

Isotope : F-18
Half Life : 1.83 hrs Lot #: 67fh853

Time Between Readings: 10 Minutes

Reading	Date/Time	Measured Activity	Time Elapsed
#1	01/27/2014 09:43	4122. mCi	-
#2	01/27/2014 09:53	3860. mCi	10 mins

Results

Calculated Half Life : 1.76 hrs
Variance : 3.8% Lower

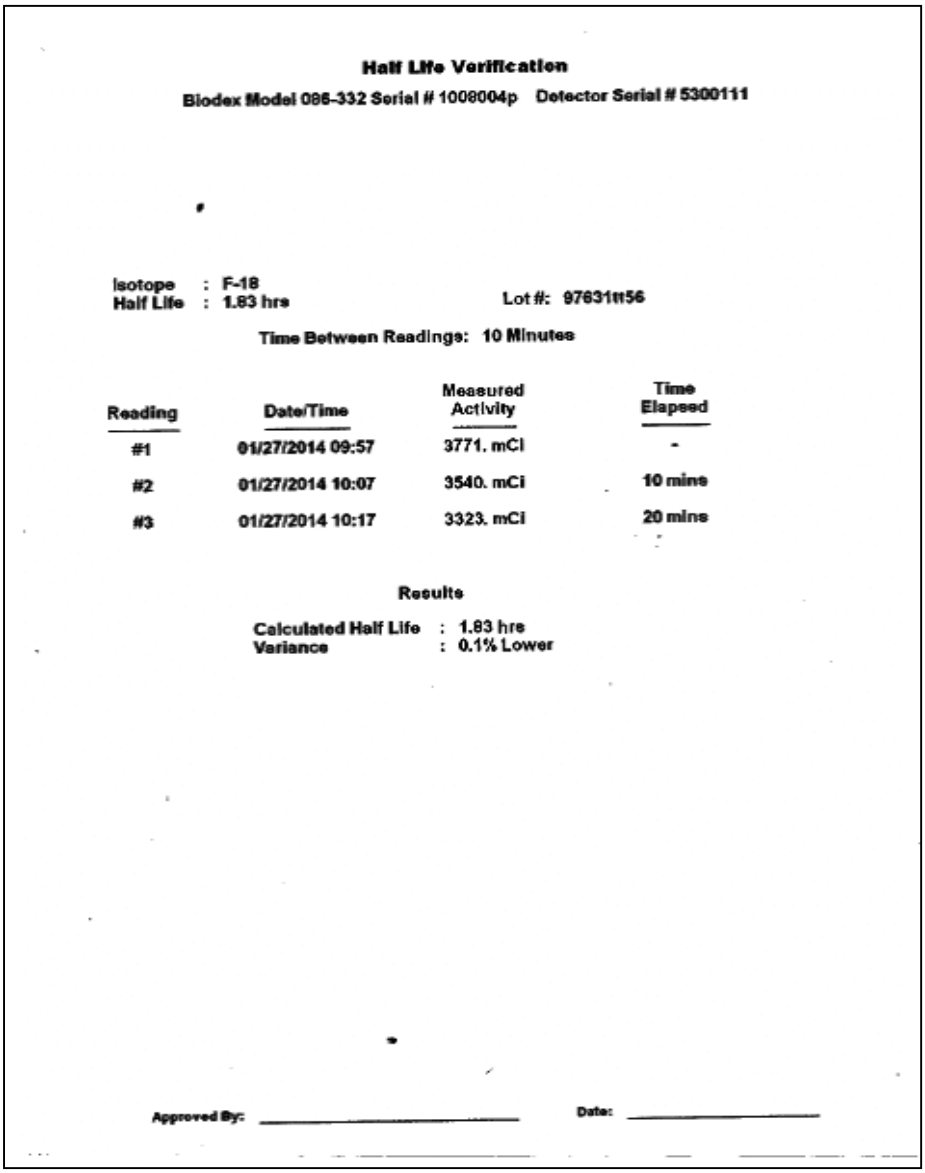
Approved By: _____ Date: _____

Figure 5.16. *Printout for Two Reading Half Life Verification Results.*

17. To perform a three reading test, it is performed the same way as the two reading test except that three readings will be taken at the time interval you have set. When the test is complete, the system calculates the Half Life between the first and second reading, between the second and third reading, and between the first and third reading and shows the average Half Life for the readings. The variance to the listed preset isotope Half Life is calculated. To return to the Home screen, select <Back> and then <Home>.

18. After the APP ends you can print the report for the half life verification. Select <Print> and the three reading print reports.

    NOTE: *The system does not store the half-life calculation. You must print the results.*



Half Life Verification

Biodex Model 086-332 Serial # 1008004p Detector Serial # 5300111

Isotope : F-18
Half Life : 1.83 hrs Lot #: 97631tt56

Time Between Readings: 10 Minutes

Reading	Date/Time	Measured Activity	Time Elapsed
#1	01/27/2014 09:57	3771. mCi	-
#2	01/27/2014 10:07	3540. mCi	10 mins
#3	01/27/2014 10:17	3323. mCi	20 mins

Results

Calculated Half Life : 1.83 hrs
Variance : 0.1% Lower

Approved By: _____ Date: _____

Figure 5.17. *Printout for Three Reading Half Life Verification Results.*

x 100

x 100

Formula for Calculating Half Life

d = measurement
d start = starting measurement
d end = ending measurement

$$\text{calculate Half Life} = \frac{\log 10\ (2.0) \times \text{d time}}{\log 10\ (\text{d start}/\text{d end})}$$

Example for F-18:
starting measurement: 4122
ending measurement: 3860
counting time: 10 min

$$\text{calculate Half Life} = \frac{\log 10\ (2.0) \times 10\ \text{min}}{\log 10\ (4122 / 3860)}$$

$$= \frac{3.0103\ \text{min}}{0.0285207}$$

$$= 105.54796\ \text{min} / 60$$

calculate Half Life = 1.759 hr

Variance Formula

$$\text{Half Life Variance} = \frac{\text{calculated Half Life} - \text{isotope Half Life}}{\text{Isotope Half Life}}$$

Example for F-18:

$$\text{Half Life Variance} = \frac{1.76 - 1.83}{1.83}$$

Half Life Variance = 3.8% lower

Enter Isotope Into Inventory

(See Figures 5.18 - 5.21.)

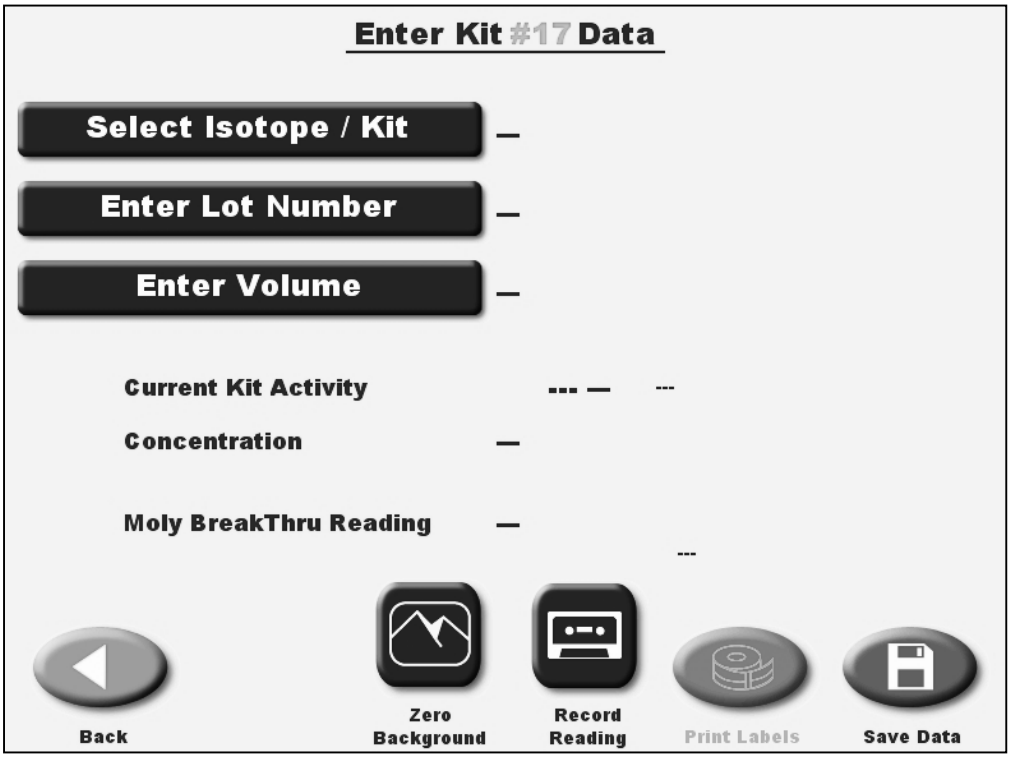


Figure 5.18. *The Enter Kit Data screen.*

Enter An Isotope Other Than Tc-99m Into Inventory

1. From the Nuclear Pharmacy screen, select <Enter Isotope into Inventory>. The Enter Kit # Data screen is displayed for the currently selected dose calibrator detector. Touch <Select Detector> if you have multiple detectors and need to change detectors.

   NOTE: *The kit number is automatically assigned to the lowest number available.*

2. Touch <Select Isotope/Kit>. The Select Inventory Isotope And Kit screen is displayed. Touch to highlight the isotope in the Isotope List and kit type. If necessary, use <▲> or <▼> to scroll to the appropriate isotope/kit type.
3. Touch <Enter> to return to the Enter Kit # Data screen with the new isotope and/or kit selected.
4. If a kit has been selected, touch <Enter Lot Number>. Enter the Kit Lot # with the on-screen key pad and touch <Enter> to record the lot # and return to the Enter Kit # Data screen. This could also be the generator lot number.
5. Touch <Enter Volume>. Enter the volume with the on-screen key pad. Touch <Enter> to record the volume and return to the Enter Kit # Data screen.
6. Look at the current sample activity reading, displayed in red. This is the current background reading. If it is too high, touch <Zero Background> and then zero the background reading if necessary. Touch <Back> to return to the Enter Kit # Data screen.

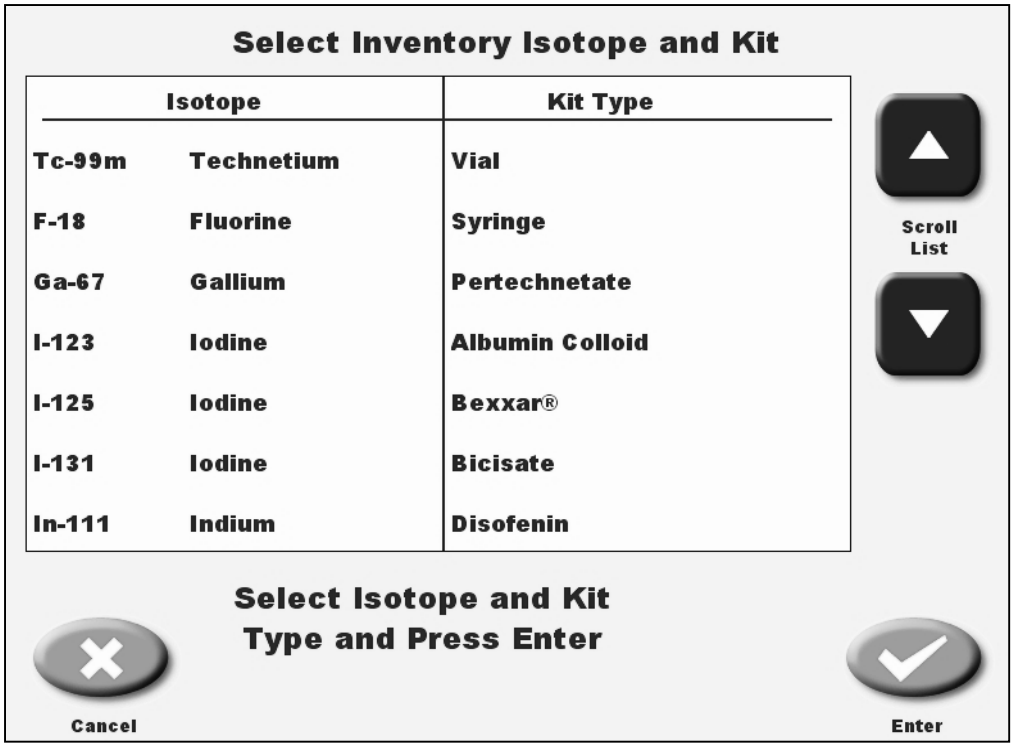


Figure 5.19. *The Select Inventory and Isotope Kit screen.*

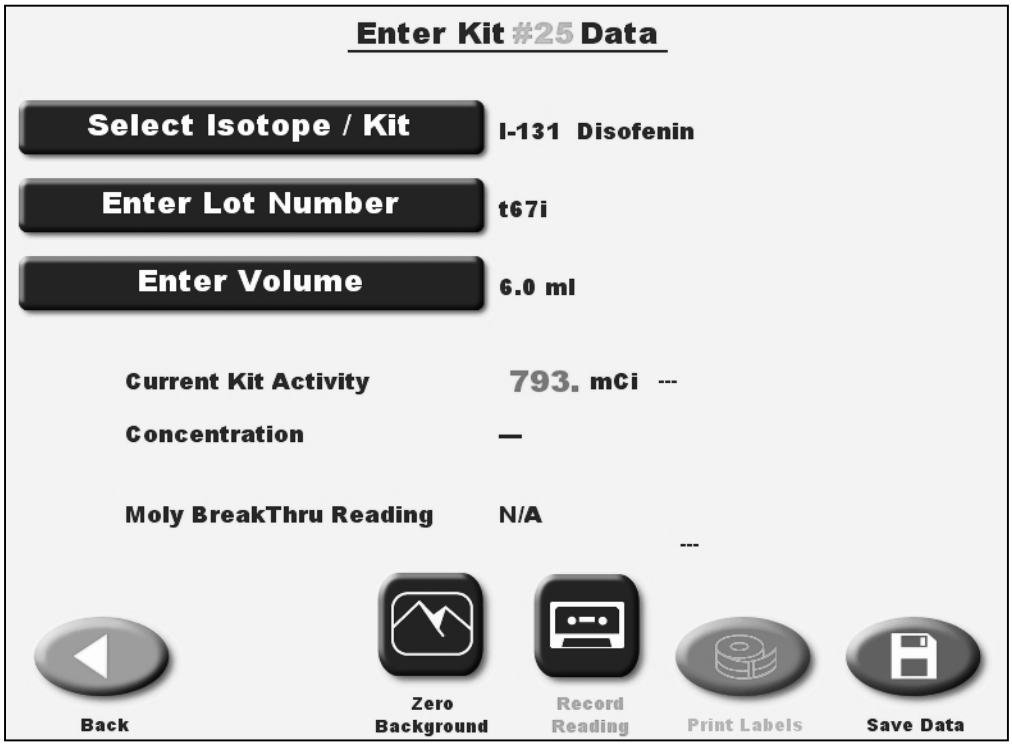


Figure 5.20. *Enter Kit # and Data screen.*

7. Place the isotope in the detector and allow the reading to settle. Current Activity displayed on the screen is a live reading. The current activity is displayed in red.
8. Touch <Record Reading> to enter the activity of the sample. The time and date are now displayed to the right of the activity reading. From this point forward, the current sample activity is based on half-life. The concentration displayed is based on the current sample activity and the volume entered. Both the current sample activity and concentration are continually updated for the sample based on the isotope's half-life.

   NOTE: *Press <Print Label> if a label is desired. To save, touch <Save Data>. Press <OK> to confirm and return to the Nuclear Pharmacy screen.*

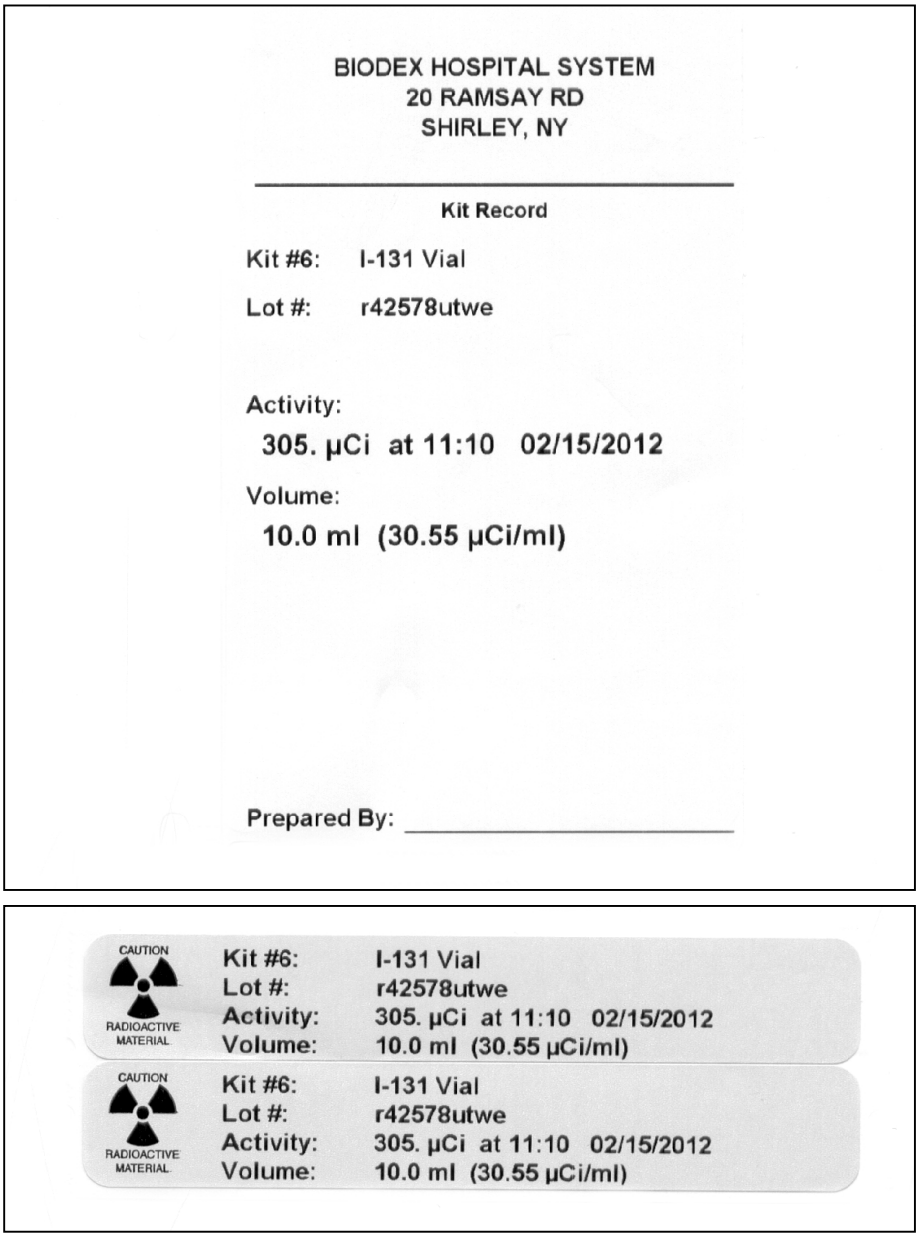


Figure 5.21. *Kit labels without Moly.*

Enter Tc-99m Into Inventory With Moly

1. From the Nuclear Pharmacy screen, select <Enter Isotope into Inventory>. The Enter Kit # Data screen is displayed for the currently selected dose calibrator detector. Touch <Select Detector> if you have multiple detectors and need to change detectors.

   NOTE: *The kit number is automatically assigned to the lowest number available.*

2. Touch <Select Isotope/Kit>. The Select Inventory Isotope And Kit screen is displayed. Touch Tc-99m to highlight the isotope in the Isotope List. Select the appropriate kit type.
3. Touch <Enter> to return to the Enter Kit # Data screen with the new isotope and kit selected.
4. If a kit has been selected, touch <Enter Lot Number>. Enter the kit lot number with the on-screen key pad and touch <Enter> to record the lot number and return to the Enter Kit # Data screen. This could be the generator lot number.
5. Touch <Enter Volume>. Enter the volume with the on-screen key pad. Touch <Enter> to record the volume and return to the Enter Kit # Data screen.
6. Press <Yes> to perform the Moly Assay. The Moly Assay reading screen is now displayed.

   NOTE: *If you press <No>, you cannot perform a Moly Assay test.*

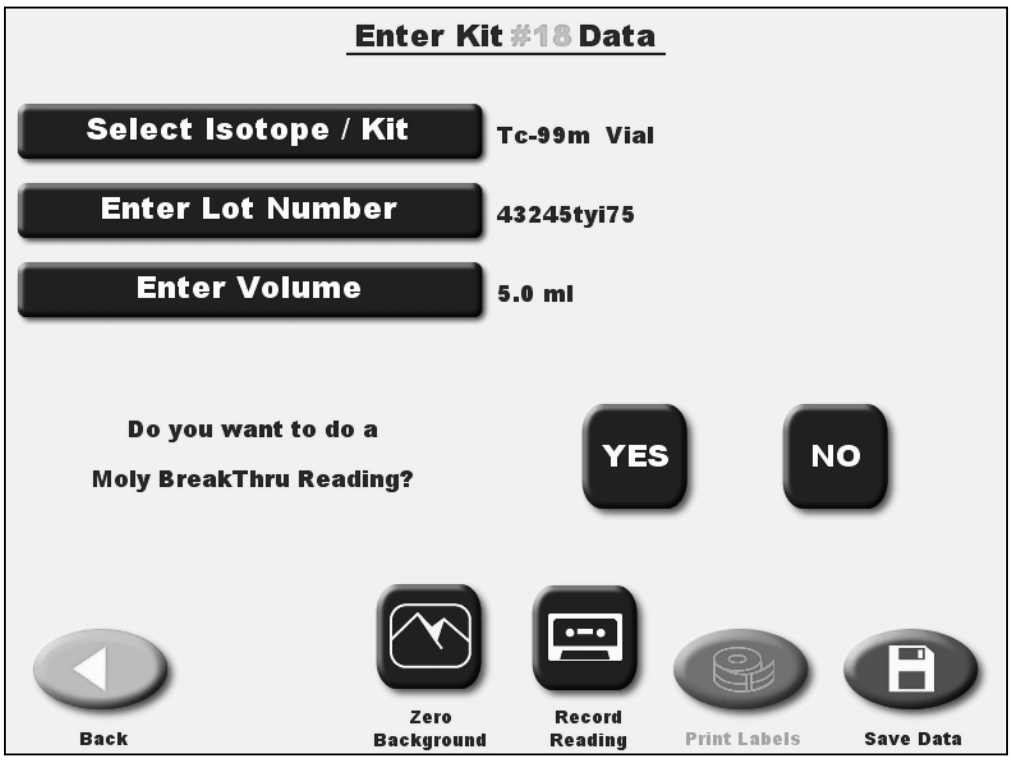


Figure 5.22. *The Enter Kit # Data screen for Tc-99m.*

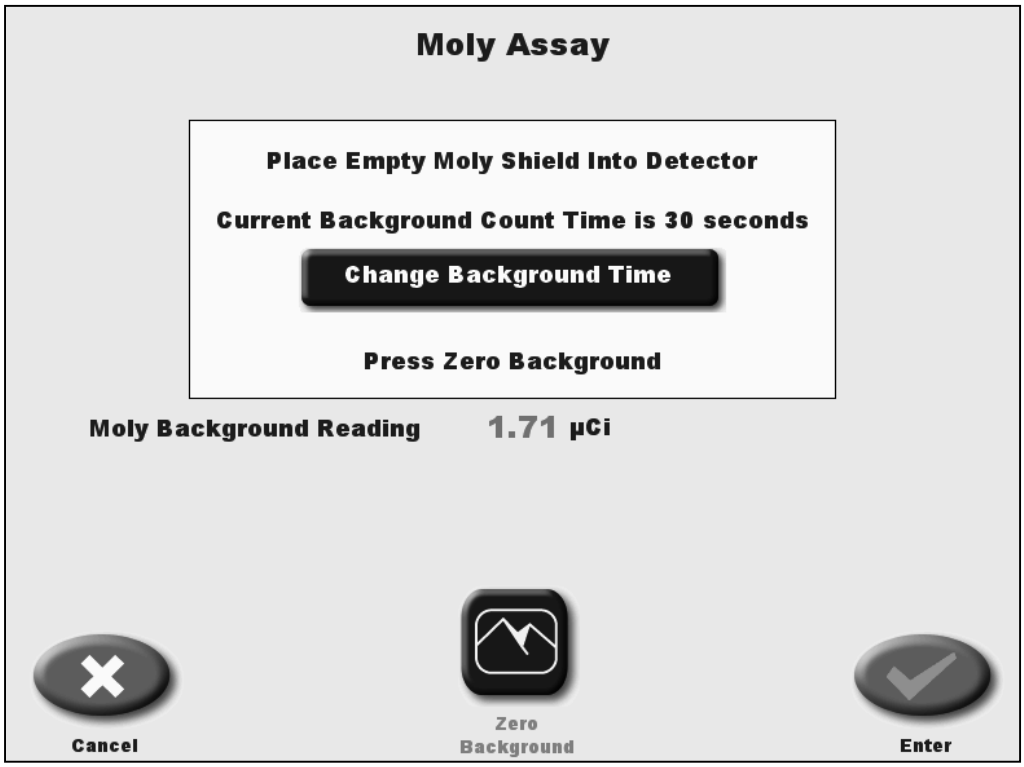


***Figure 5.23**. Moly Assay Reading screen.*

7. The Moly Assay Background screen allows the user to change the background counting time. The screen displays the current background time. To change the background counting time, select <Change Background Time>. A message will be displayed stating, "Changing Background, Time Will Be Retained And Have A Global Effect Throughout The System." Select <Continue>.

   ***NOTE:** When you change the background counting time it changes the Moly Background time and the Dose Calibrator background counting time. If you do not want to change the background time, select <Cancel> and go to step 9.*

8. The Set Count Background Time screen is displayed. Select the number after Background Count Time. A pull-down menu is displayed with 30, 60 or 100 seconds. Select to highlight the time that you desire and select <Enter>. The Moly Assay Background Counting screen will be displayed with the new background counting time.

   ***NOTE**: You must perform a Mo-99 Background count using the empty Moly Shield before counting the Moly Assay.*

9. Make sure there is no source in the detector. Place the empty Moly Shield into the detector and touch <Zero Background>.

10. Select <Zero Background> to begin a background count lasting up to 100 seconds.

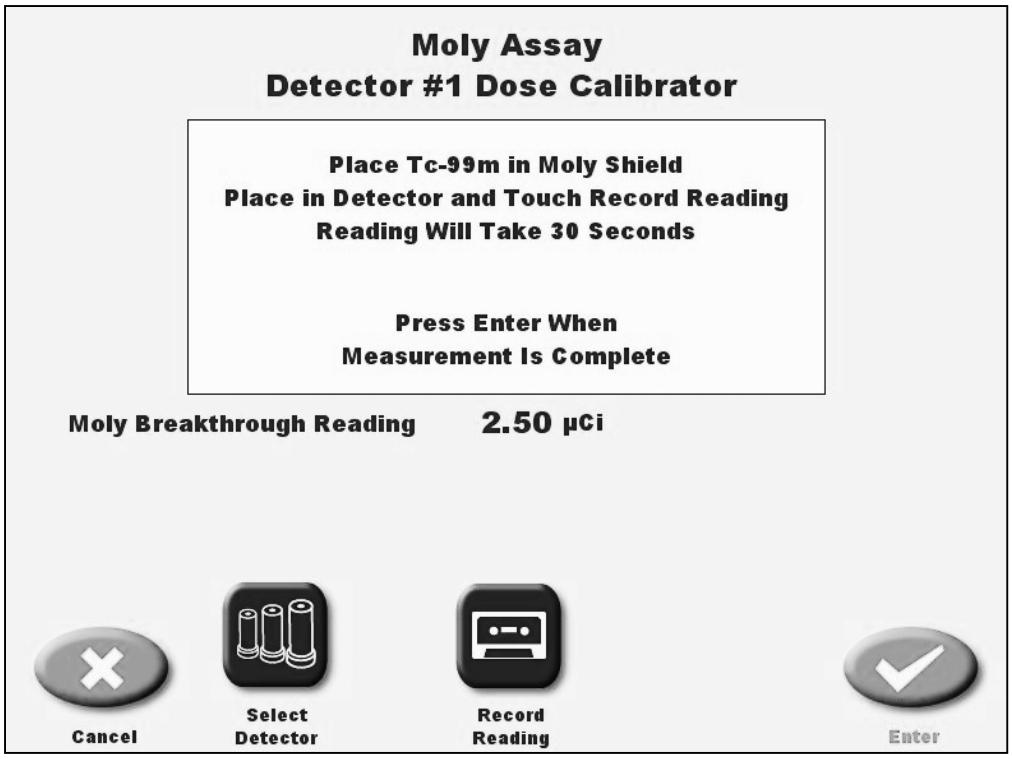


Figure 5.24. *The Moly Assay reading screen with Moly Background Reading Activity displayed.*

11. Select <Enter> to record the Moly Background.

12. Place the vial of Tc-99m into the Moly Shield and put it into the detector.

13. Select <Record Reading>. The system will prompt you to wait 30 seconds the activity reading.

    NOTE: *You can select <Record Reading> to recount the Moly if desired.*

14. Select <Enter> to return to the Moly Assay screen to count the vial or syringe of Tc-99m in the Moly shield.

15. Remove the Tc-99m vial or syringe from the Moly Shield and place the vial or syringe into the detector.

16. Select <Record Reading> to record the Tc-99m activity. The Moly Assay results screen is now displayed giving the Moly concentration of µCi Mo/mCi Tc-99m.

17. Touch <Enter> to return to the Enter Kit # Data screen.

    NOTE: *Touch <Print Label> if a label is desired.*

18. To save the data, touch <Save Data> and then <OK> to confirm. If you have printed a label already, the system returns to the Nuclear Pharmacy screen.
19. If you have not yet printed a label, a screen is displayed at this point allowing you to print a label or skip printing. Touch <Print Label> if a label is desired or <Skip Printing> if you do not want to print a label. After printing or skipping the label, the system returns to the Nuclear Pharmacy screen.

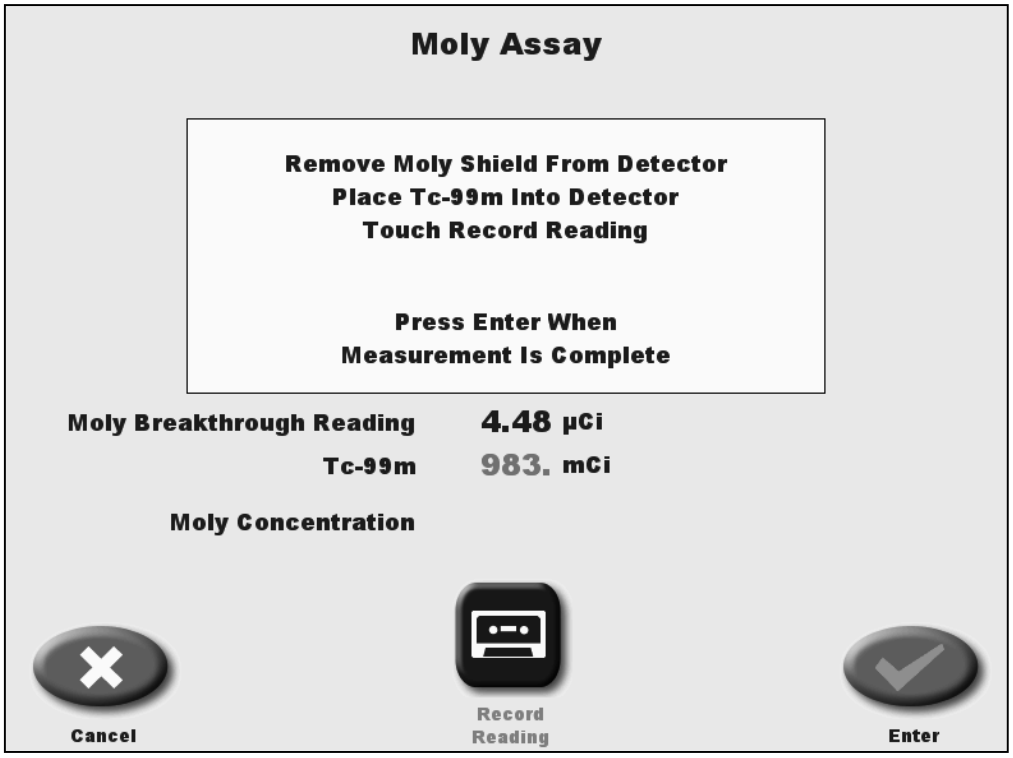


Figure 5.25. *The Moly Assay reading screen counting Tc-99m.*

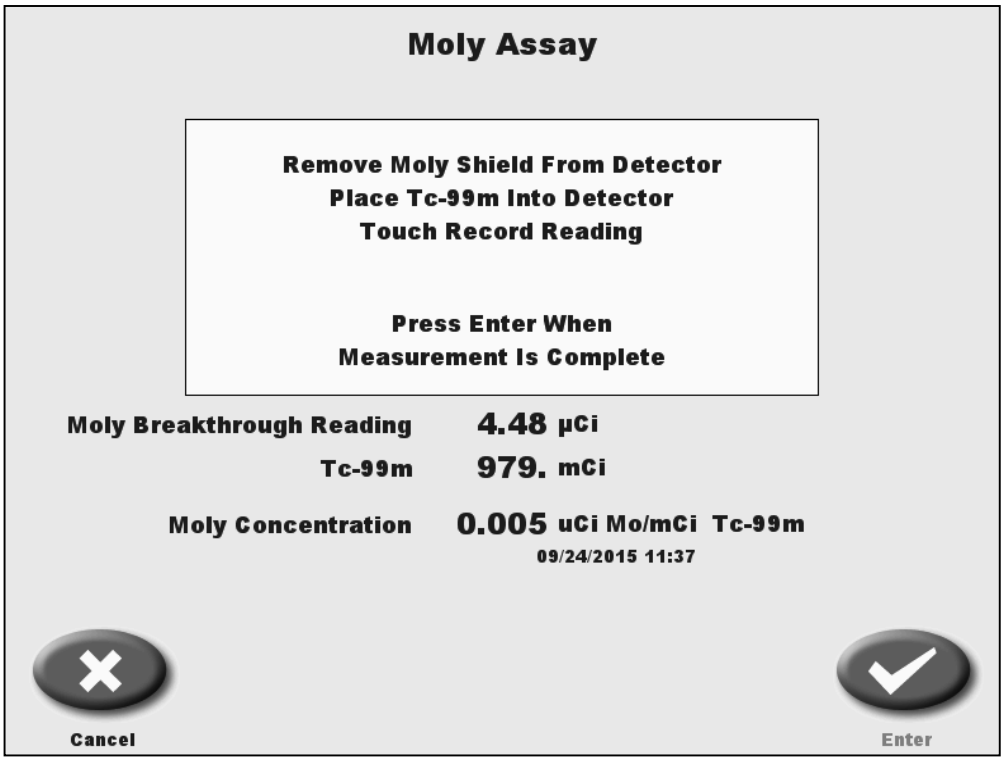


Figure 5.26. *The Moly Assay reading screen showing the Tc-99m and Moly Assay activity along with the concentration of Moly.*

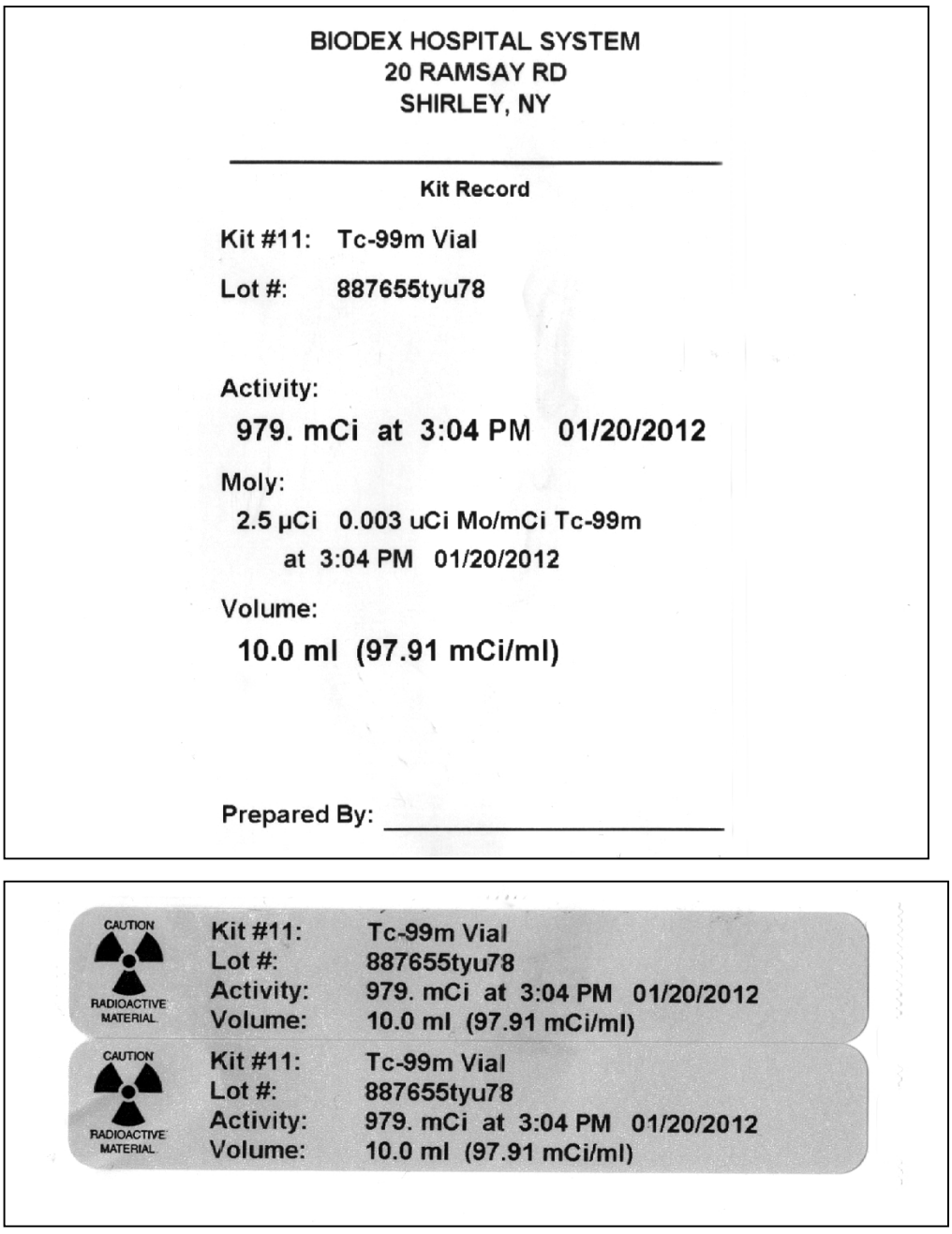


Figure 5.27. *Kit labels with Moly.*

Enter Tc-99m Into Inventory Without Moly

1. From the Nuclear Pharmacy screen, select <Enter Isotope into Inventory>. The Enter Kit # Data screen is displayed for the currently selected dose calibrator detector. Touch <select detector> if you have multiple detectors and need to change detectors.

   NOTE: *The kit number is automatically assigned to the lowest number available.*

2. Touch <Select Isotope/Kit>. The select inventory and isotope and Kit screen is displayed. Touch Tc-99m to highlight the isotope in the Isotope List. Select the appropriate kit type.
3. Touch <Enter> to return to the Enter Kit # Data screen with the new isotope and/or kit selected.
4. After selecting the isotope and kit, touch <Enter Lot #>. Enter the kit lot number with the on-screen key pad and touch <Enter> to record the lot number and return to the Enter Kit # Data screen. This could be the generator lot number.
5. Touch <Enter Volume>. Enter the volume with the on-screen key pad. Touch <Enter> to record the volume and return to the Enter Kit # Data screen.

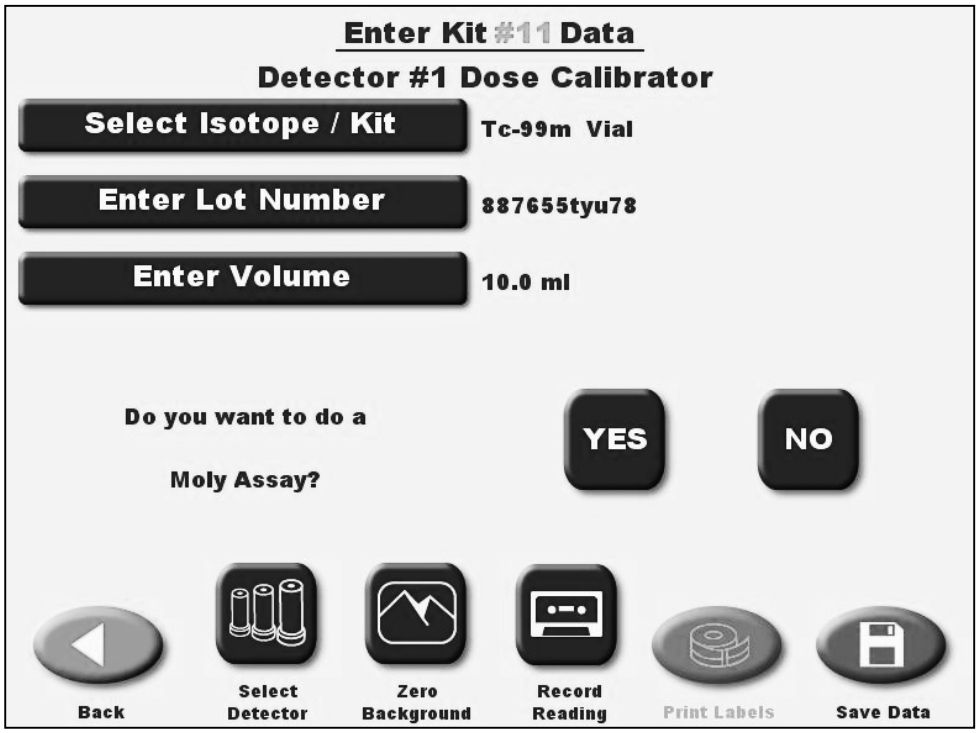


Figure 5.28. *The Enter Kit # Data screen for Tc-99m.*

6. Press <No> to proceed without performing a Moly Assay.
7. Touch <Zero Background> to begin a background count lasting up to 100 seconds if necessary.
8. When the background time reaches zero, the system returns to the previous screen.
9. The <Record Reading> button should now begin to flash. Place the vial or syringe of Tc-99m into the detector and touch <Record Reading>.

NOTE: *Touch <Print Label> if a label is desired.*

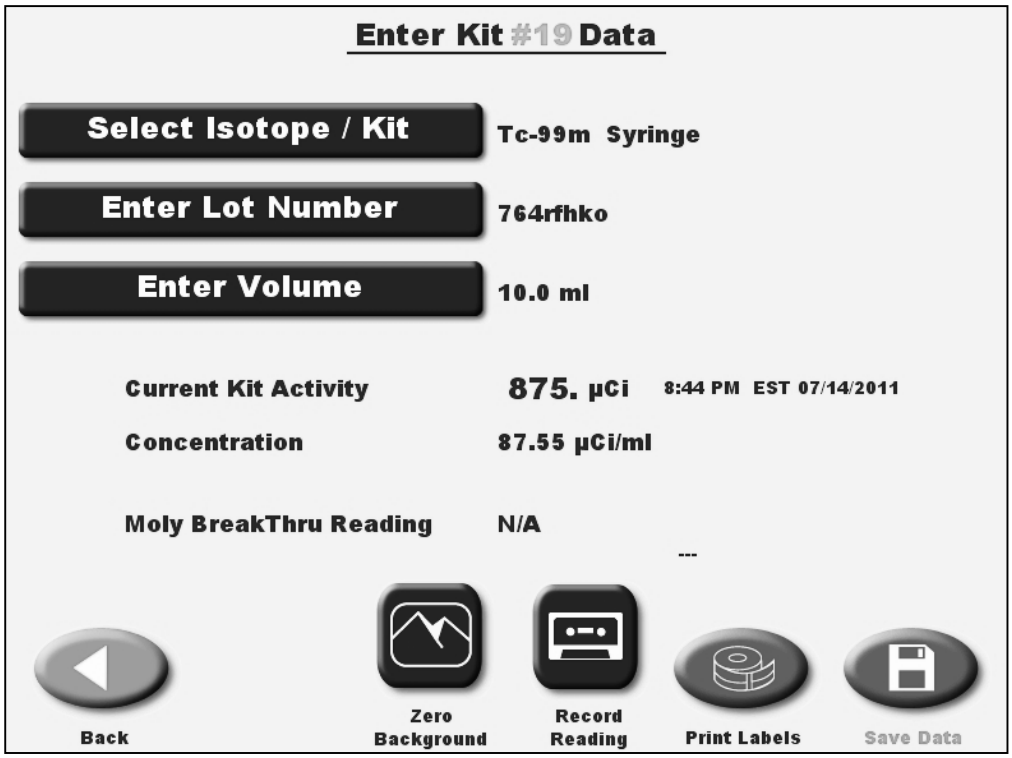


Figure 5.29. *The Enter Kit # Data screen results without Moly.*

11. To save the data, touch <Save Data> and then <OK> to confirm. If you have printed a label already, the system returns to the Nuclear Pharmacy screen.
12. If you have not yet printed a label, a screen is displayed at this point allowing you to print a label or skip printing. Touch <Print Label> if a label is desired or <Skip Printing> if you do not want to print a label. After printing or skipping the label, the system returns to the Nuclear Pharmacy screen.

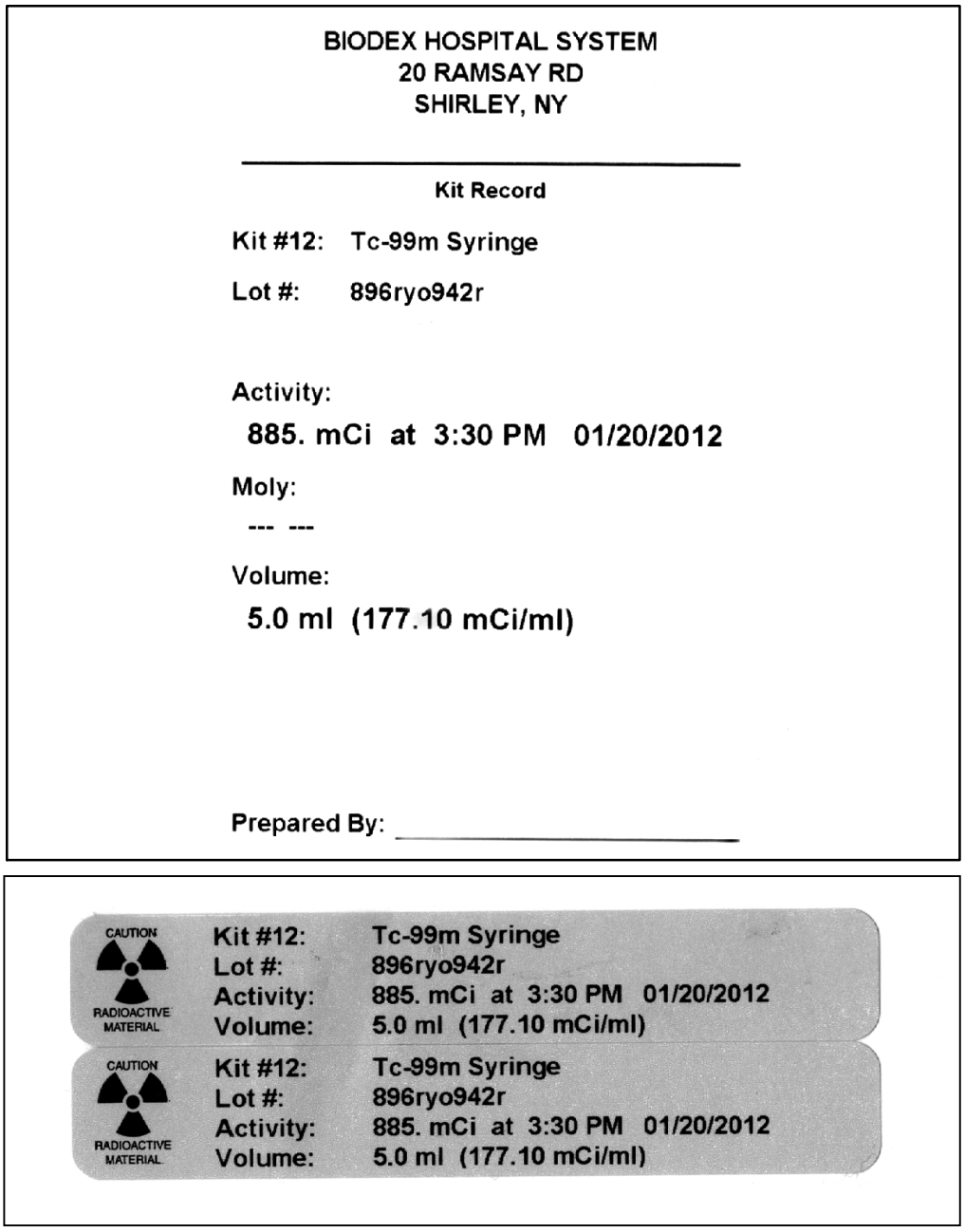


Figure 5.30. *The Kit labels with without Moly.*

Kit Preparation

(See Figures 5.31 - 5-35.)

Figure 5.31. *The Enter New Kit Sample Data screen.*

This procedure is normally used to prepare (create) a new kit from an inventory sample of Tc-99m.

To Prepare A New Kit From An Existing Sample:

1. From the Nuclear Pharmacy screen select <Kit Preparation>. The Inventory Kit List screen is displayed with listings in sample number order. All sample data is current, with the volumes, Moly readings and activity adjusted when a dose is drawn. The activities are constantly updated using half-life calculations. If the activity is close to zero for any sample, the sample line is displayed in red to remind the user to delete it.
2. Press to highlight the isotope/kit from which to draw activity to prepare a new kit. Select <Enter> to display the Kit # preparation screen.

   NOTE: *The system automatically assigns a kit number for the new kit preparation and transfers the Moly concentration information if there was Moly information in the original kit.*

3. Touch Select Inventory Kit>. The Select Inventory Kit screen is displayed. Highlight the kit type desired. If necessary, use <▲> or <▼> to scroll to the appropriate kit type you are making.

Figure 5.32. *The Select Inventory Kit screen.*

4. Select <Enter> to return to the Enter Kit # Preparation screen with the new kit selected.
5. Select <Enter Lot Number> to display the keyboard. Now enter the cold kit's lot number. Select <Enter> to return to the Kit # Preparation screen.
6. Select <Enter Kit Activity> to display the keypad. Enter the desired activity of the kit you are making and press <Enter>.

   NOTE: *Make sure the unit of measure is correct. Press the displayed µCi to change to mCi and vice versa.*
7. The system now displays the volume of activity to draw to make a kit of the desired activity. Draw the activity and place in the dose calibrator. The display shows the current activity in red. When the activity is correct, put it into the kit and bring the new kit to the total desired volume by adding sterile saline.
8. Select <Enter Kit Total Volume> and using the keypad enter the total volume of the kit created. Select <Enter>.
9. Select <Record Reading>. The new kit information is now displayed. The kit concentration is now shown, along with the new kit just created information.
10. Select <Save Data>, then touch <OK> to save the kit just created into inventory. The Saving a Kit From Another Kit screen is displayed. To save and update the new kit data, select <OK>, or select <Cancel> to discard.
11. The Kit # Data screen is now displayed. Select <Print Labels> to print this screen if desired, or <Back> to return to the Kit # Preparation screen to create a new kit.
12. To draw a patient dose from this kit, select <Draw Patient Dose>. You can now draw a dose from the kit just created as described in the following section.

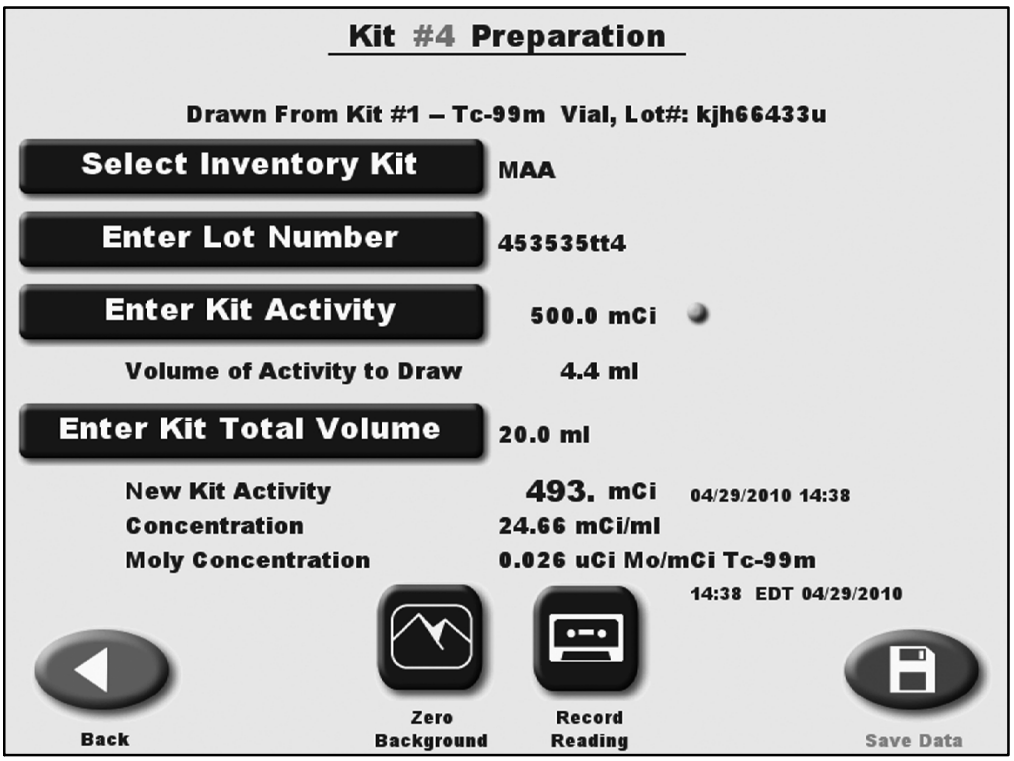


Figure 5.33. *The Kit # Preparation screen.*

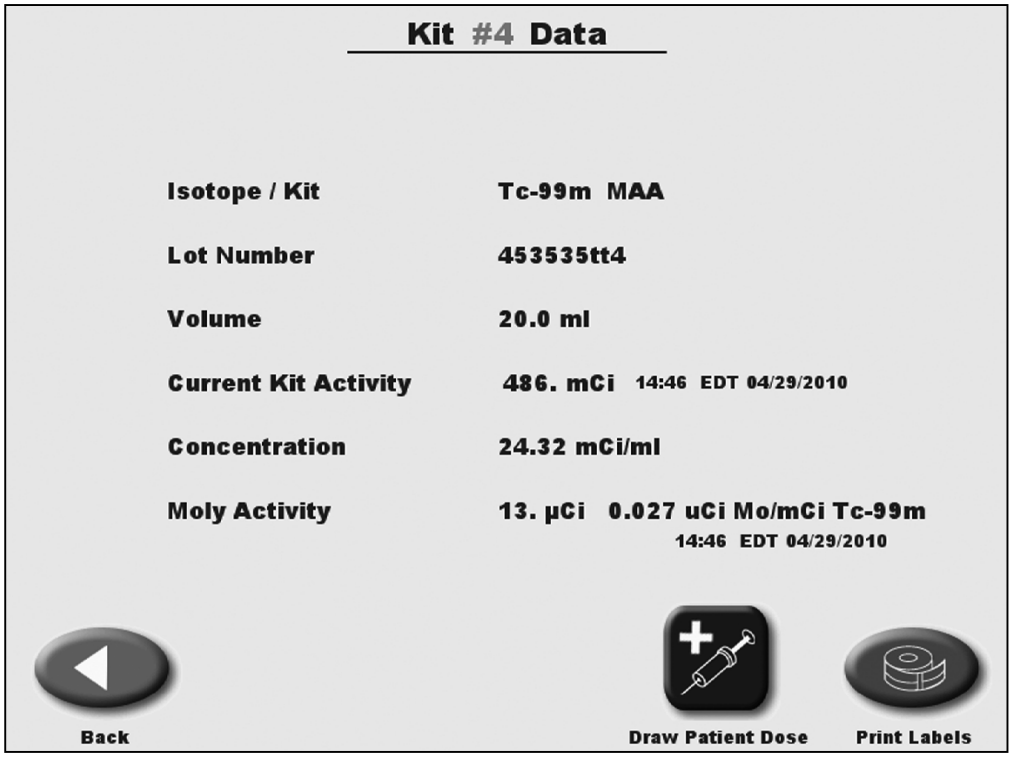


Figure 5.34. *The Kit # Data screen.*

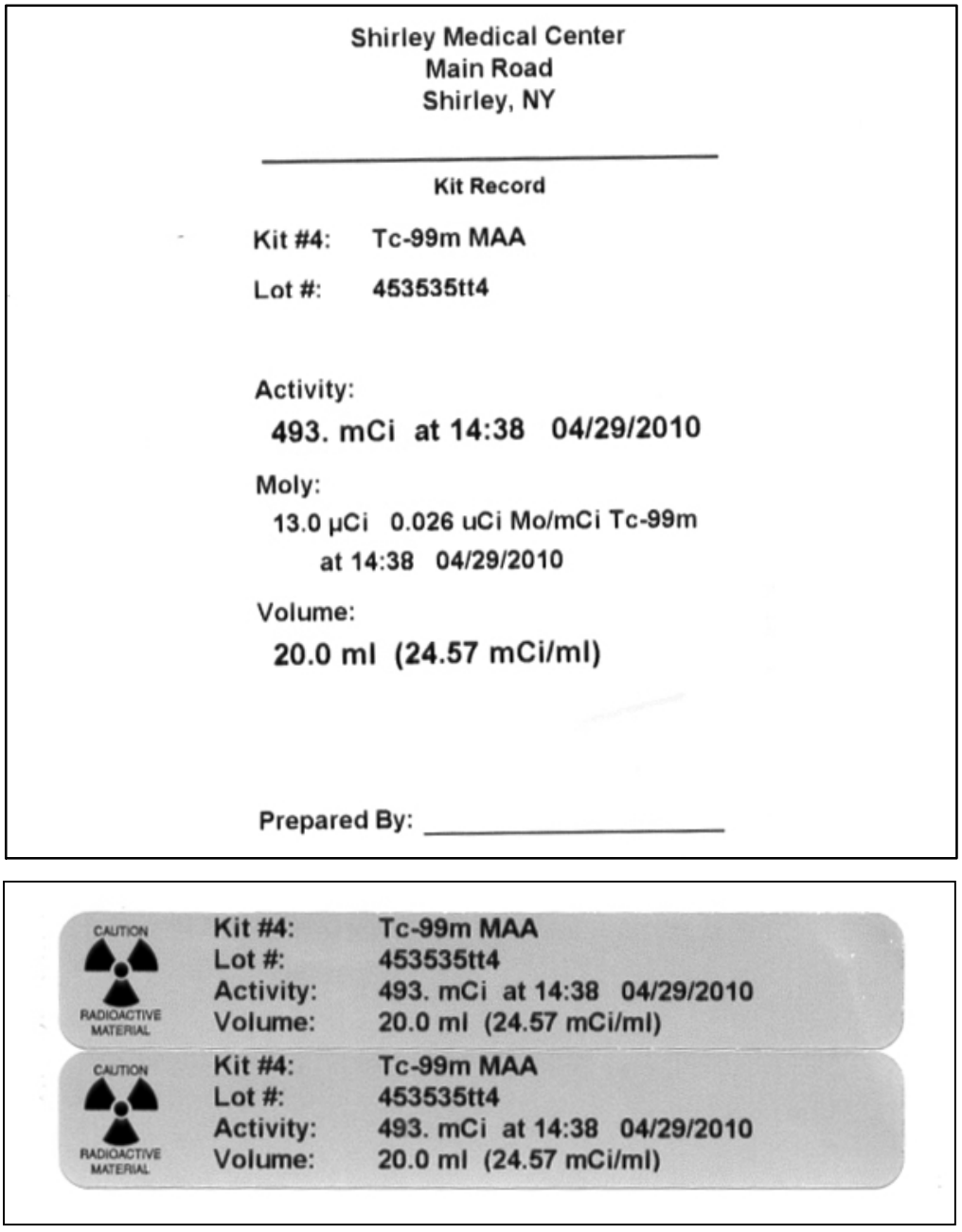


Figure 5.35. *A kit label from a level 2 kit.*

Draw Patient Dose

(See Figures 5.36 - 5.40.)

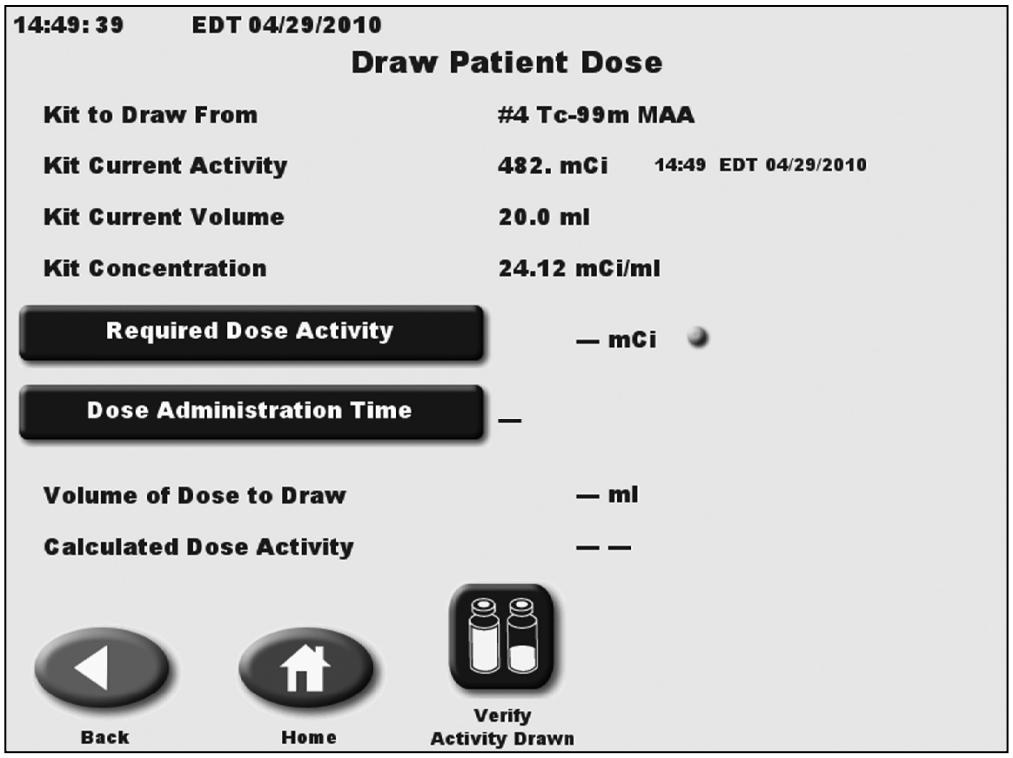


Figure 5.36. *The Draw Patient Dose screen.*

To Draw A Patient Dose From The Newly Created Sample:

1. From the Kit # Data screen, select <Draw Patient Dose>. The draw patient dose screen is displayed showing all the sample data just created.
2. Select <Required Dose Activity> and use the keypad to enter the desired activity of the dose to be administrated at a future time.
3. Select <Enter> to return to the draw patient dose screen. If necessary, touch to toggle between <µCi> or <mCi> administered dose Activity Units.
4. Select <Dose Administration Time> to access the Dose Administration Time screen. This screen displays the required dose activity, the current dose required to be drawn now to administer the desired dose, and the volume to draw for your required dose.

Figure 5.37. *The Dose Administration Time screen for future dose.*

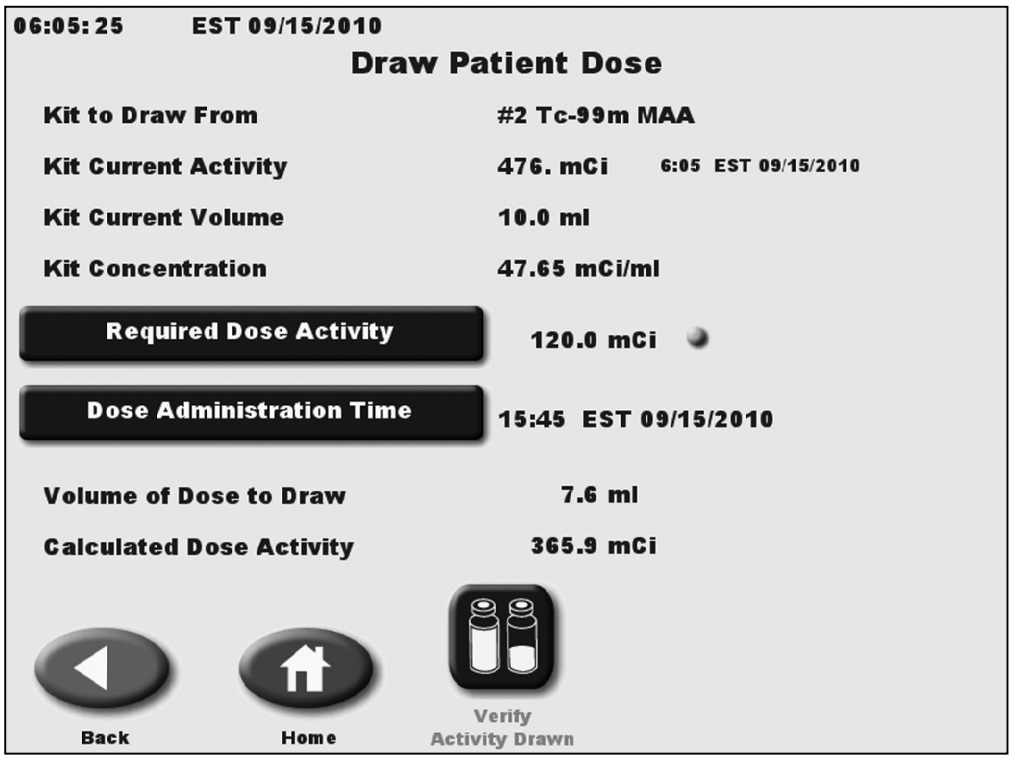


Figure 5.38. *The Draw Patient Dose screen with information displayed.*

5. Touch the values to change using the <▲> or <▼> arrows or key pad to enter the time and date the dose is to be administrated. Both hours and minutes must be entered if using the keypad. Touch <Enter> to return to the draw patient dose screen.

NOTE: *If the administration time has already passed, you must advance the administration time to a point in the future. To do this, proceed to the Draw Patient Dose screen and change the dose administration time.*

6. To get a live reading of the dose drawn, select <Verify Activity Drawn>. The updated Original Kit screen is now displayed.

   NOTE: *The Administer Dose activity will be displayed in becquerels if this measurement unit has been previously selected and set up.*

   NOTE: *If you select <Home>, a confirmation screen is displayed noting that data entries will be lost. Select <Yes> to abort the data without saving. Select <No> to return to the Draw Patient Dose screen with the patient dose previously entered displayed.*

7. Place the drawn dose into the detector. A live reading is now displayed in red showing the current activity of the patient dose.

   NOTE: *You can adjust the activity and volume in the syringe, if necessary, and put it back into the detector to see if you have the correct patient dose. The Administered Dose Activity for the drawn dose is displayed on the screen. The Administered Dose activity is the decayed dose activity calculated for what the patient dose will be at the time of administration.*

8. If you did not print a label before saving, the screen will now prompt to <Print Label> or <Skip Printing>. Touch the appropriate choice to proceed.
9. Select <Cancel> to return to the draw patient dose screen without deducting the drawn dose from inventory. This allows corrections to be made to required dose activity or dose administration time.
10. Select <Enter> to record the reading and deduct the drawn dose from the original kit.
11. The draw patient dose screen is now displayed. If desired, you can now draw another patient dose from the kit. Select <Back> to return to the Kit # Data screen (where you can print a new label for the kit). you can now select <Back> to return to the Kit number preparation screen.
12. Select <Back> to return to the Nuclear Pharmacy screen.

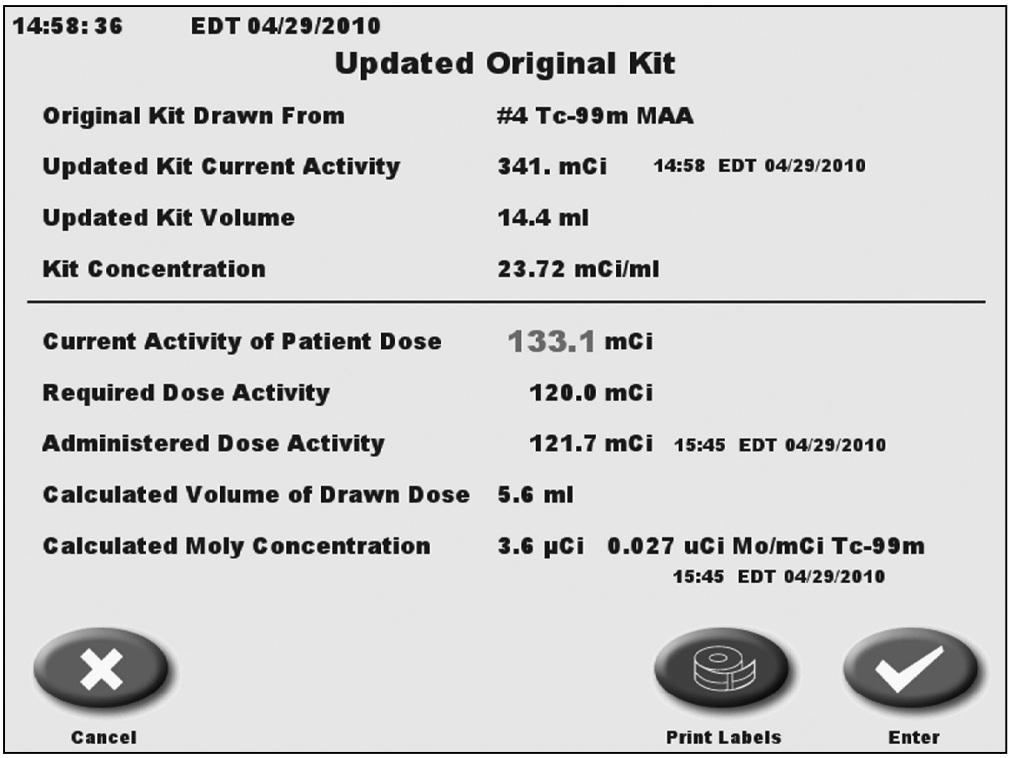


Figure 5.39. *The Updated Original Kit screen.*

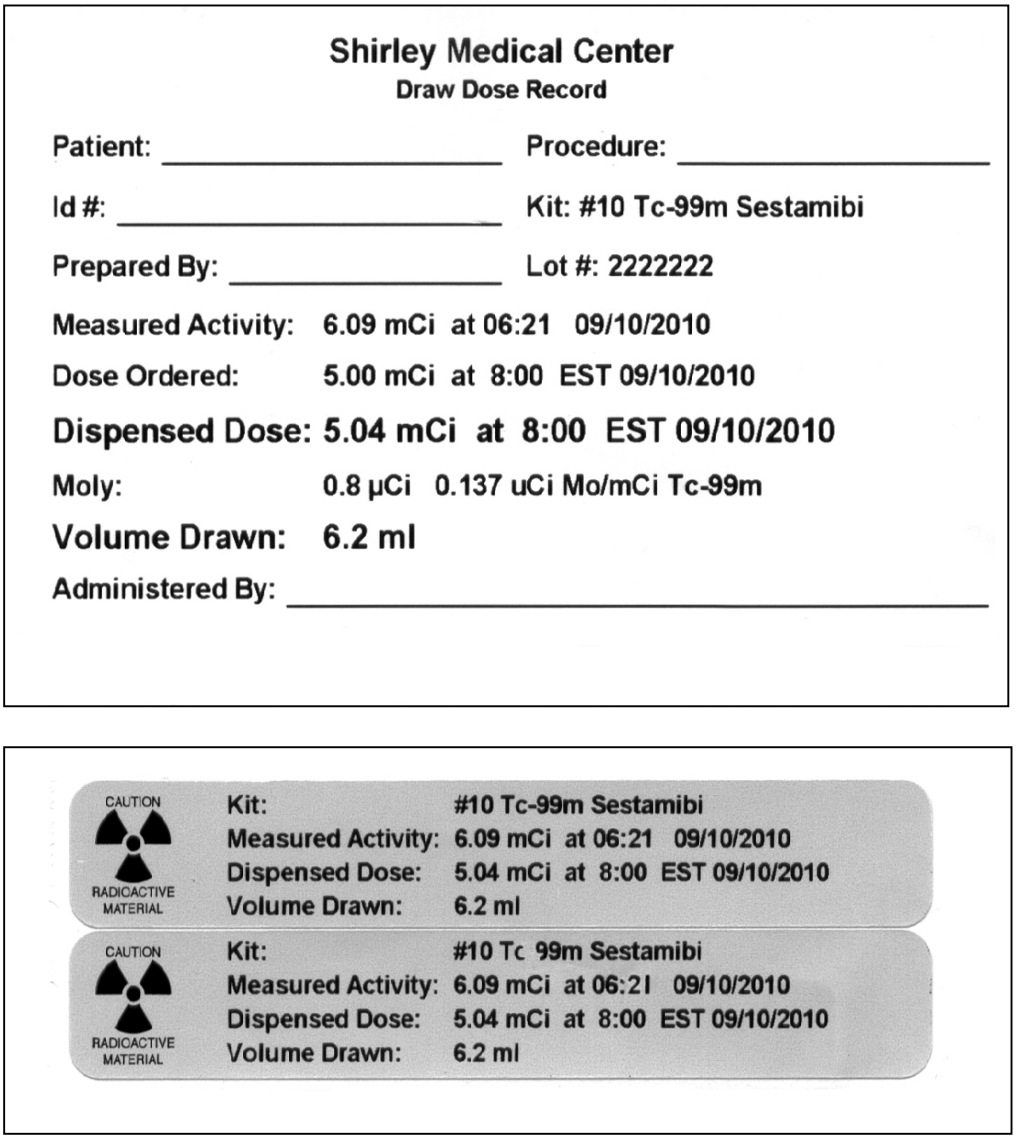


Figure 5.40. *A Drawn Dose Record.*

Moly Transfer

Moly Transfer (transfers Moly readings from a previous Moly reading to another sample or dose) is done automatically when you create a new kit or draw a dose from a kit. The original kit must have a Moly reading in order for later kits or doses to have Moly readings associate with them.

Draw Patient Dose From Inventory

(See Figure 5.41)

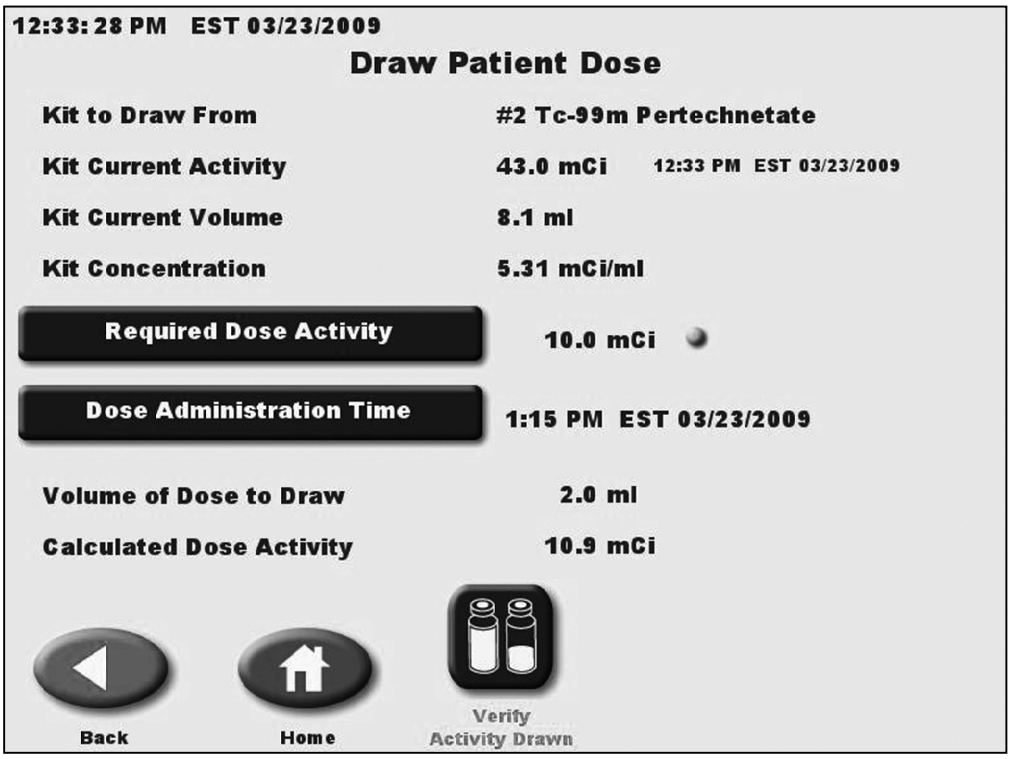


Figure 5.41. *The Draw Dose From Sample screen.*

To Draw A Patient Dose From An Existing Kit:

1. From the Nuclear Pharmacy screen, select <Draw Patient Dose>. The Inventory Kit List screen is displayed with listings in Kit number order. All kit data is current with the volumes, Moly readings and activity are adjusted when a dose is drawn. The activities are constantly updated using half-life calculations. If the activity is close to zero for any kit, the kit line will be shown in red to remind the user to delete it.
2. Highlight the sample from which to draw, then touch <Enter> to select the sample. The draw patient dose screen is displayed.
3. Proceed as previously explained for draw patient dose when creating a kit.

Inventory Kit List

(See Figure 5.42 – 5.43.)

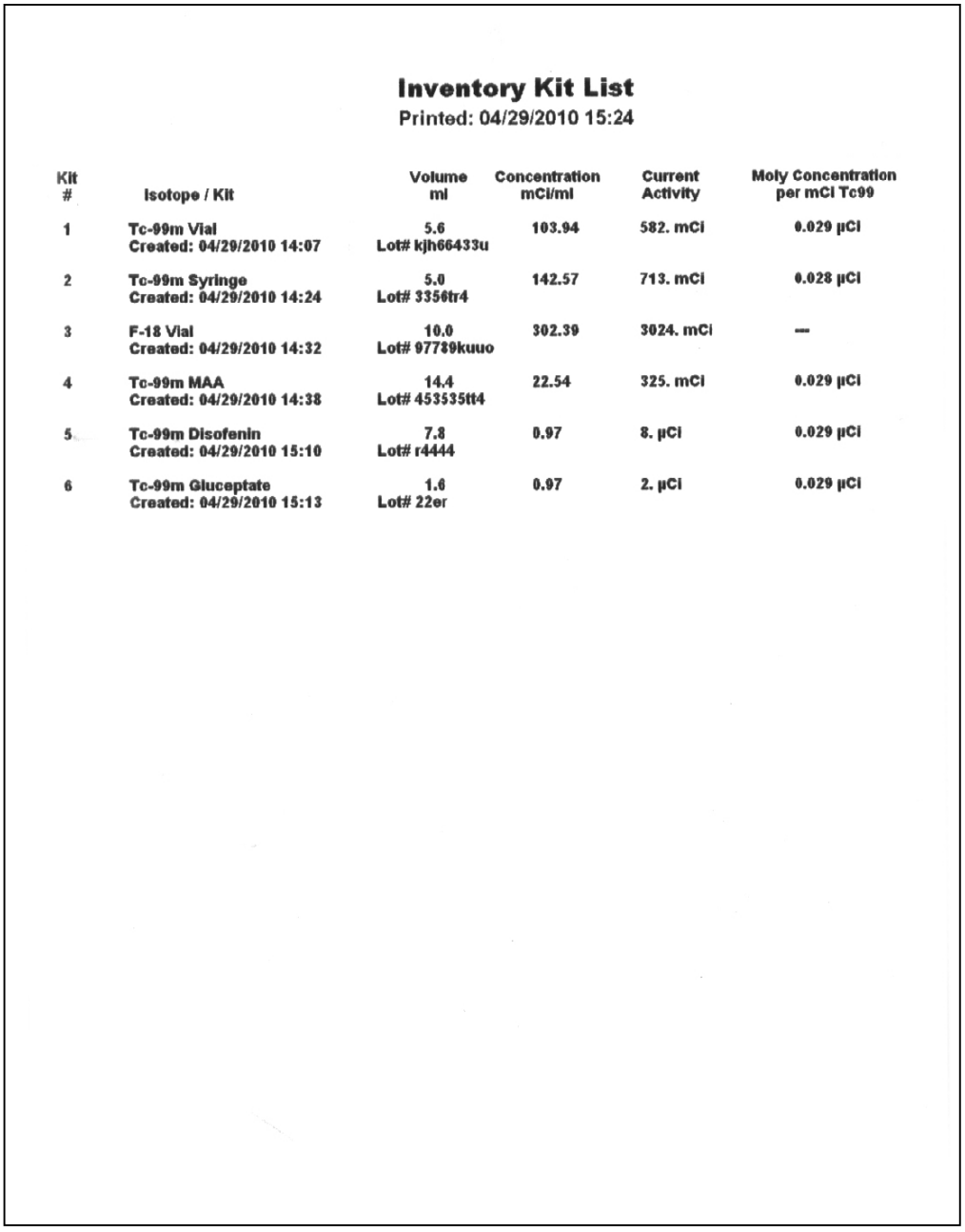
Figure 5.42. *The Inventory Kit List.*

The Inventory Kit List screen displays listings in sample number order. All sample data is current with the volumes, Moly readings and activity are adjusted when a dose is drawn. The activities are constantly updated using half-life calculations. If the activity is close to zero for any sample, the sample line will be in red.

To View Or Edit The Inventory Kit List:

1. From the Nuclear Pharmacy screen, touch <Inventory Kit List>. The Inventory Kit List is now displayed.
2. If desired, touch <Print List> to print the Inventory Kit List. The complete list is printed.
3. Touch the desired sample to highlight. You can highlight multiple sample numbers. Touch the sample again to remove any highlight.
4. Touch <Delete> to remove any highlighted sample from the list, or touch <Delete All> to remove all samples from the list. Touch <OK> to confirm deletion, or <Cancel> to cancel the deletion and return to the Inventory Kit List without deleting.
5. Touch <Cancel> to exit the Inventory Kit List and return to Nuclear Pharmacy screen without updating the sample list.

6. If you have deleted any samples from inventory and touch<Cancel> to exit the inventory Kit list and return to the Nuclear Pharmacy screen, a confirmation prompt will be displayed asking if you want to lose the changes made. Touch <Yes> to discard the changes, or <No> to keep the changes and remove the items from inventory. The system now returns to the Nuclear Pharmacy screen.
7. If you exit the inventory sample screen after deleting samples from inventory, the system returns directly to the Nuclear Pharmacy screen with those samples deleted from inventory.



Inventory Kit List

Printed: 04/29/2010 15:24

Kit #	Isotope / Kit	Volume ml	Concentration mCi/ml	Current Activity	Moly Concentration per mCi Tc99
1	Tc-99m Vial Created: 04/29/2010 14:07	5.6 Lot# kjh66433u	103.94	582. mCi	0.029 µCi
2	Tc-99m Syringe Created: 04/29/2010 14:24	5.0 Lot# 3356tr4	142.57	713. mCi	0.028 µCi
3	F-18 Vial Created: 04/29/2010 14:32	10.0 Lot# 97789kuuo	302.39	3024. mCi	---
4	Tc-99m MAA Created: 04/29/2010 14:38	14.4 Lot# 453535tt4	22.54	325. mCi	0.029 µCi
5	Tc-99m Disofenin Created: 04/29/2010 15:10	7.8 Lot# r4444	0.97	8. µCi	0.029 µCi
6	Tc-99m Gluceptate Created: 04/29/2010 15:13	1.6 Lot# 22er	0.97	2. µCi	0.029 µCi

Figure 5.43. *The Inventory Kit List printout.*

Tec-Control Paper Chromatography

(See Figures 5.44 - 5.47).

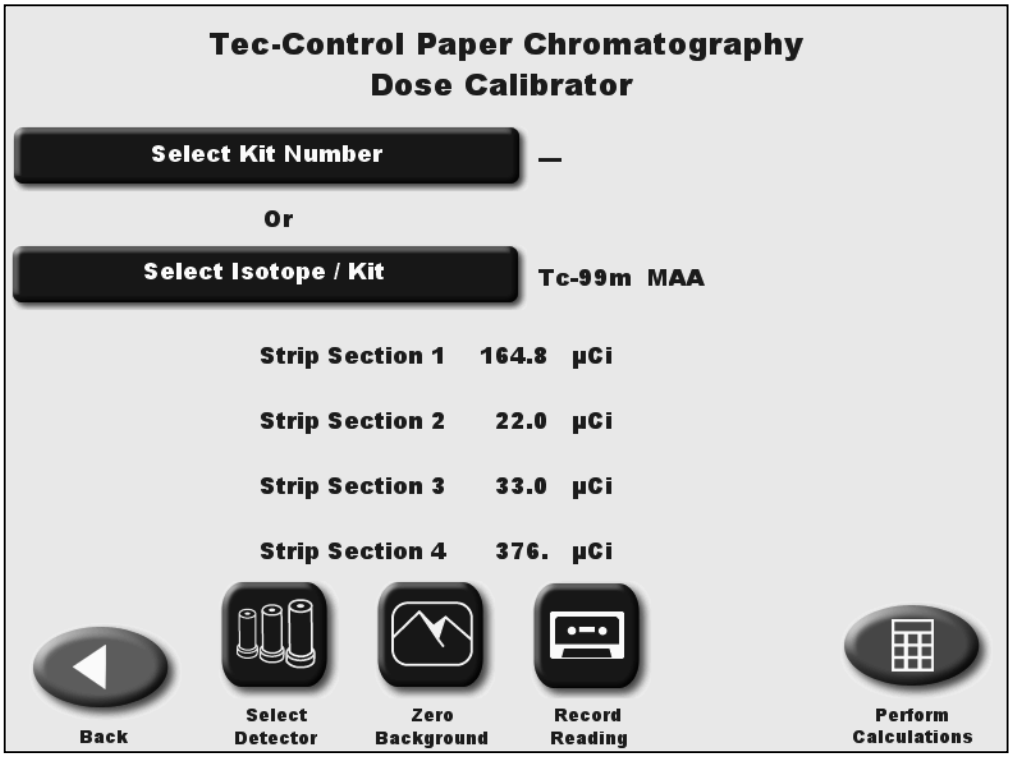


Figure 5.44. *The Tec-Control Paper Chromatography screen.*

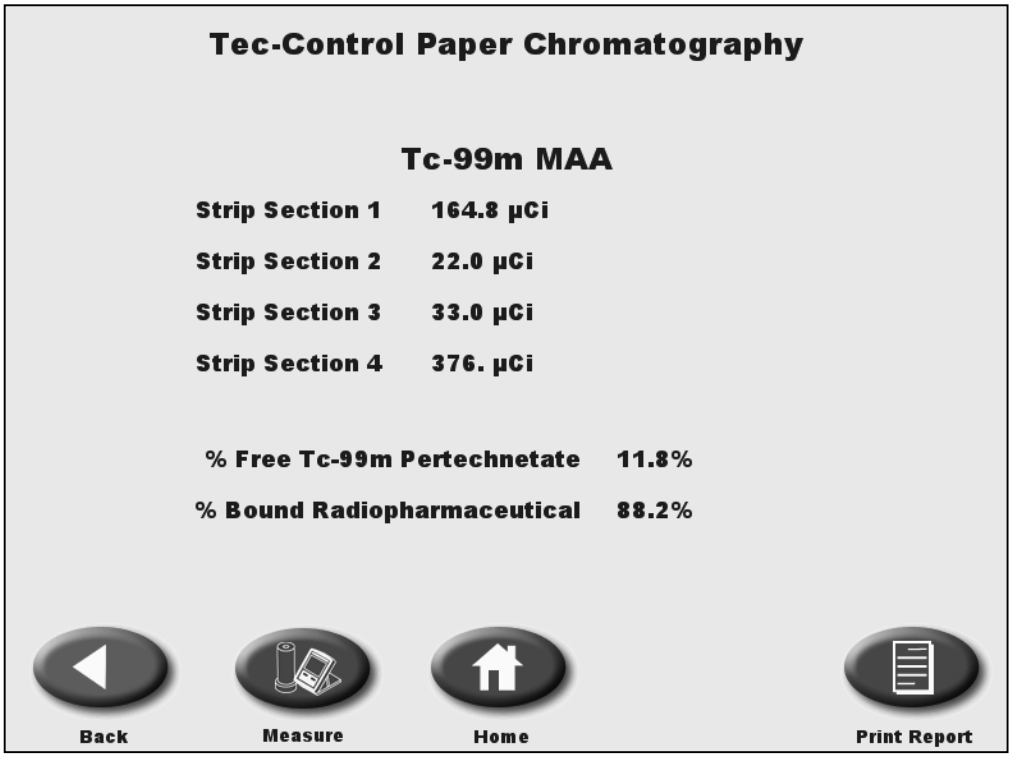


Figure 5.45*. The Tec-Control Paper Chromatography screen with completed calculations displayed.*

Tec-Control Paper Chromatography procedures are used to perform paper chromatography tests on kits to ensure the radiochemical purity of labeled radiopharmaceuticals.

1. Select the appropriate detector and Zero Background.
2. From the Nuclear Pharmacy screen, touch <Chromatography>. The Tec-Control Paper Chromatography screen is now displayed.
3. Touch <Select Kit Number>. The Inventory Kit List is now displayed. (If there is no existing kit number for the material to be tested, we suggest cancelling (touch Back) and proceed to cancel the Nuclear Pharmacy screen to create a new kit.) You can press <Select Kit>, select the isotope and kit, and then proceed with the chromatography.

NOTE: *If the kit is not in the Inventory you can select <Select Isotope> and then select the Isotope and Kit Type.*

4. Touch to highlight the sample kit on which the Tec-Control test will be performed. Touch <Enter> to advance to the Tec-Control Paper Chromatography screen.
5. Prepare and cut the strips as per manufacturer's instructions. Place each strip section into a test tube.
6. Touch to highlight strip #1, or appropriate strip section, and a live reading is displayed in red.
7. Allow the reading to settle, then touch <Record Reading> to keep the reading for strip #1. strip #2 is now automatically highlighted.
8. Measure each additional strip and record the readings. Strips do not have to be measured in order. If the test is for a single strip, skip to step 9.

   NOTE: *It is important to input the correct formula selection for the type of kit and strips to be used. Certain kits use one strip, others use two strips. Each strip is cut and the two sections are counted separately. Different formulas are used depending on the kit selected.*

   NOTE: *A minimum activity of 30 µCi on the strip is required to count a strip section in the dose calibrator.*

   NOTE: *See Appendix K for formulas used in the calculation.*

   NOTE: *When using a dose calibrator for Tec-Control, the high activity section of a strip should have an activity of at least 100 µCi for counting. When the count rate is less, use a Sodium Iodide detector.*
9. Touch <Perform Calculations>. Depending on the kit used, the activity for the strip sections counted are displayed along with the appropriate calculated percentages for:
   - % free Tc-99m Pertechnetate
   - % Hydrolyzed Reduced Tc-99m
   - % Bound Radiopharmaceutical

10. If the kit uses Single Step Procedure 1A or 1C, two calculations are performed: % Free Radiopharmaceutical and % Bound Radiopharmaceutical. If the kit used Single Step Procedure 1B, only % Bound Radiopharmaceutical is performed. If only strip sections 3 and 4 were recorded, only %Hydrolyzed Reduced is performed and displayed.
    - Touch <Print Report> to print the results shown on the screen.
    - Touch <Measure> to return to the Measure screen.
    - Touch <Back> to return to the Tec-Control Paper Chromatography screen and perform more tests.
    - Touch <Home> to return to the Home screen.

NOTE: *In order to perform Tec-Control, you must select a pharmaceutica kit, not a single isotope. The system will not calculate for anything other than a kit.*

Future Dose Calculation

(See Figures 5.46 - 5.47.)

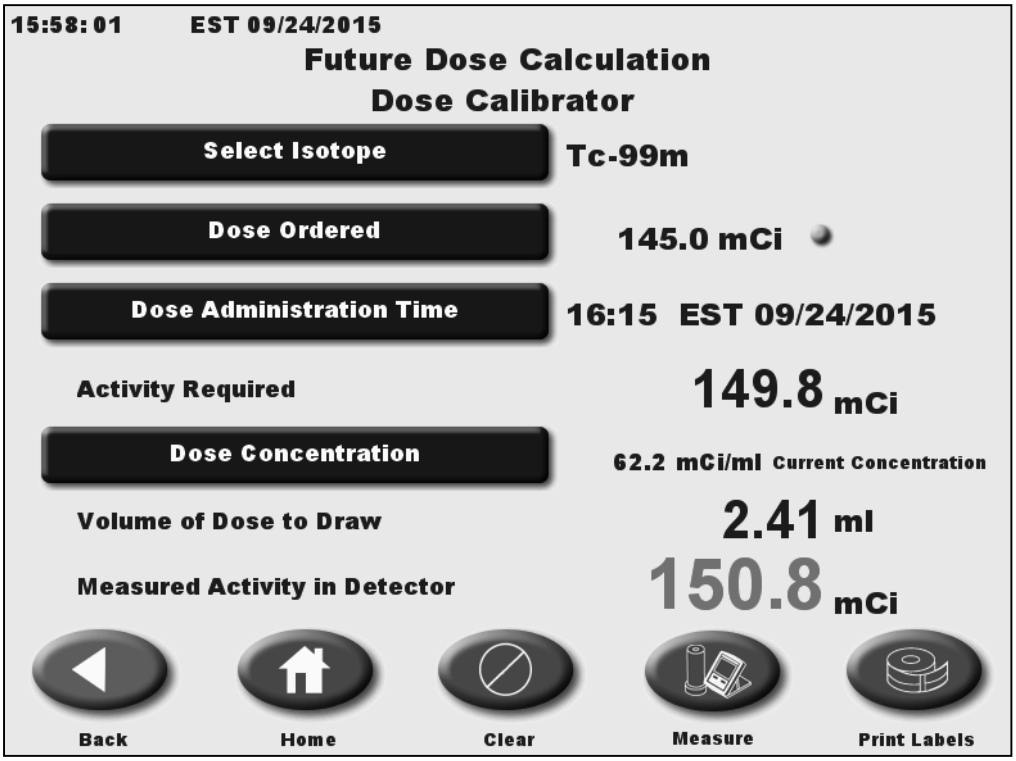


Figure 5.46. *The Future Dose Calculation screen.*

The Atomlab 500 allows quick and easy calculation of future doses by entering the dose ordered and the administration time. If they have a dose concentration of the vial they will be drawing from, the program also calculates the volume to draw. When they place the drawn dose into the dose calibrator, it shows the measured activity in the detector. Labels can then be printed if a label printer is connected.

NOTE: *The <Clear> button at the bottom of the Future Dose Calculation screen clears all data on this screen.*

The Future Dose function automatically displays the isotope selected and the Measurement screen.

Future Dose (Calculated Method):

1. At the Nuclear Pharmacy screen, touch <Future Dose Calculation>. The Future Dose Calculation screen is displayed.
2. Touch <Select Isotope> to access the select current isotope screen and select the desired isotope if it is not already displayed. Touch <Enter> to return to the Future Dose Calculation screen.
3. Touch <Dose Ordered> to display a keypad to enter the Dose Ordered activity screen. Enter the desired activity of the dose at the time it is to be administered. Touch <Enter> to return to the Future Dose Calculation with both the isotope and administered dose activity displayed.
4. If necessary, touch the unit of measure to toggle between mCi and µCi measurement units.
5. Touch <Dose Administration Time> to access the Dose Administration Time Enter screen. touch to highlight any value and use the <s> and <t> keys to scroll until the desired time/date are displayed. (If desired, time can be entered using the touch pad numbers. hours much be entered as a two-digit number). Touch <Enter> on the keypad to record the changes.
6. Touch <OK> to return to the Future Dose Calculation screen.

   NOTE: *The "Activity Required" shows the dose required now to administer the Dose Ordered at the entered future time.*

7. If there is a printer attached, you can touch <Print Labels> to print the Future Dose labels showing Dose Ordered, activity required and measured activity.

   NOTE: *If drawing additional doses, enter the administration time and Dose Ordered for another dose and the system calculates the requirements for that dose.*

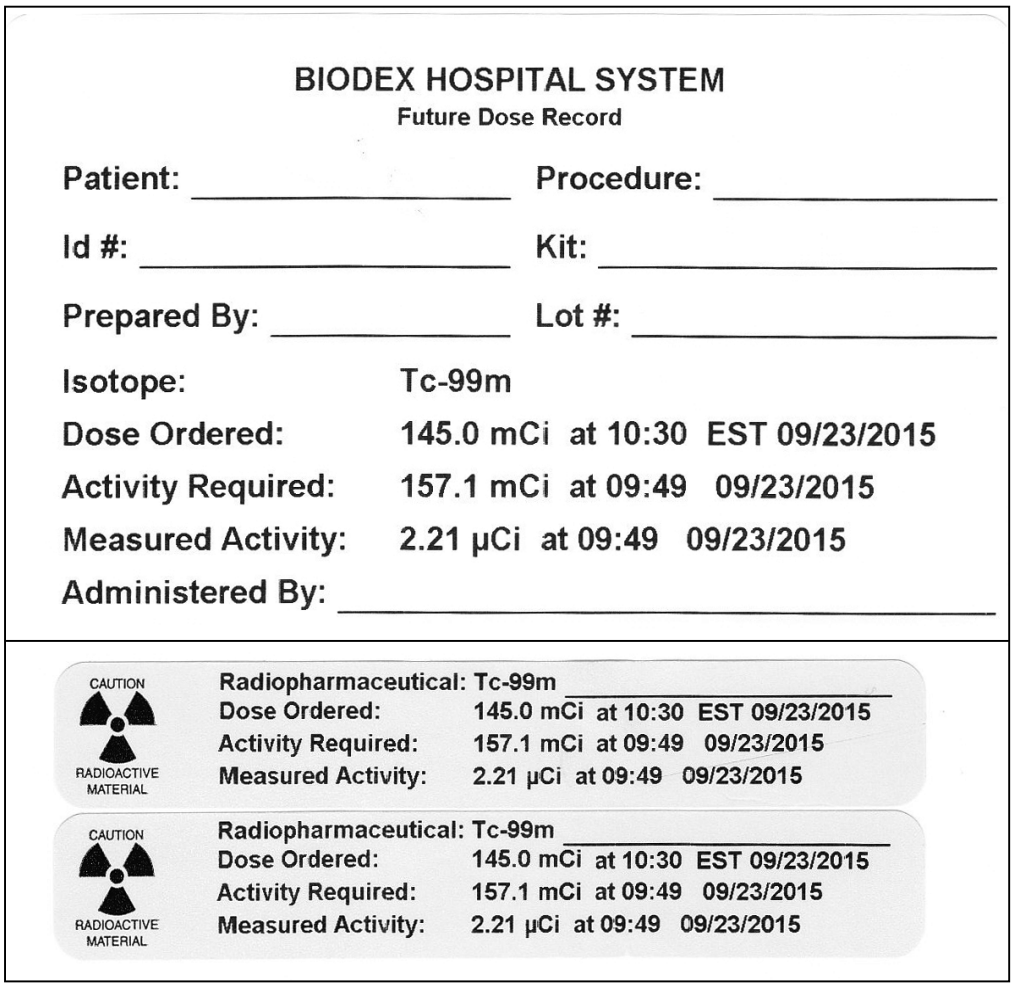


Figure 5.47. *A Future Dose Calculated Current Activity label.*

Volume Dose Calculations

(See Figure 5.48 - 5.50.)

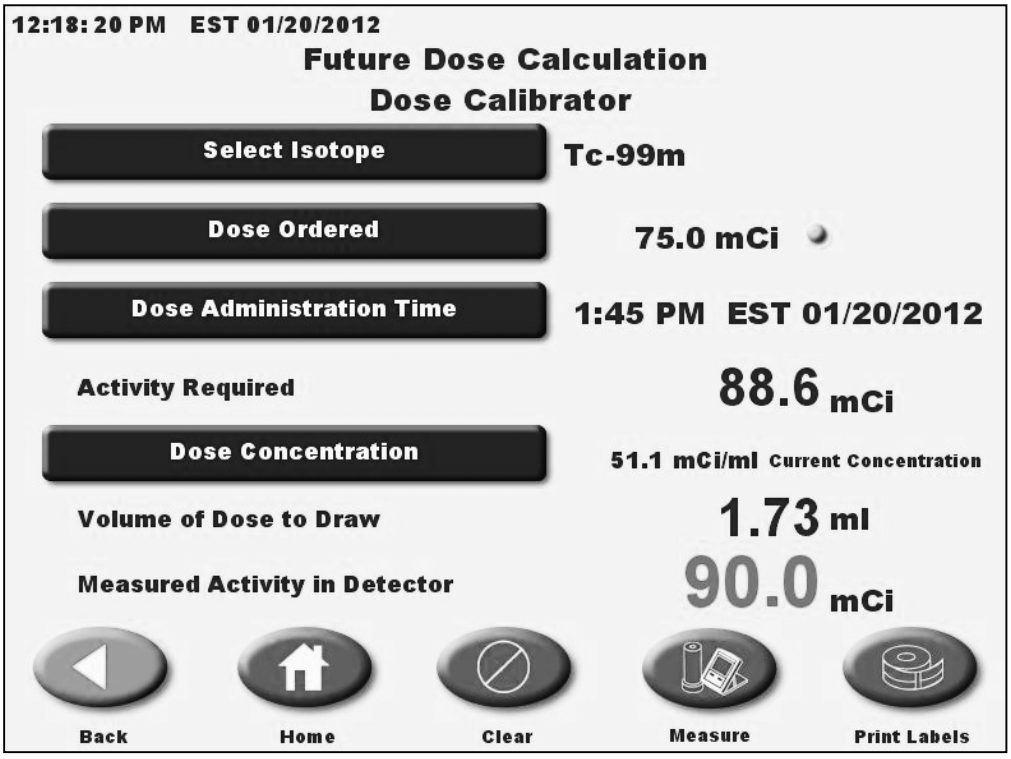


Figure 5.48. *The Volume Dose Calculation screen.*

Volume Dose Calculation is a form of Future Dose Calculation and functions in a similar fashion except this option is used to calculate the volume of a current dose to draw for a future administration time.

To Perform A Volume Dose Calculation:

1. At the Nuclear Pharmacy screen, touch <Future Dose Calculation>. The Future Dose Calculation screen is displayed.
2. Touch <Dose Ordered> to display a keypad to enter the Dose Ordered activity screen.
3. Touch <Select Isotope> to access the select current isotope screen and select the desired isotope if it is not already displayed. Touch <Enter> to return to the Volume Dose Calculation screen.
4. Touch <Administered Dose Activity> to display the Administered Dose Activity screen. Enter the desired activity of the dose at the time it is to be administered. Touch <Enter> to return to the Volume Dose Calculation screen.
5. Touch <Dose Administration Time> to access the Dose Administration Time Enter screen. Touch <Enter> on the keypad to record the changes. Touch to highlight any value and use the <▲> or <▼> keys to scroll until the desired time/date are displayed. (If desired, time can be entered using the touch pad numbers.) You must enter both hours and minutes. Touch <OK> to return to the Volume Dose Calculation screen.

   NOTE: *The current dose "Activity Required" now to administer at a future time is displayed.*

6. Touch <Dose Concentration> to access the dose concentration information screen.
7. Touch <Dose Concentration> and enter the activity/ml in the vial. Touch <Enter> to record the value and return to the dose concentration screen. Ensure the units of measure are correct for mCi/ml or µCi/ml, (MBq or GBq).
8. Touch to highlight any of the time/date values and use the <▲> or <▼> keys to scroll until the desired time/date are displayed.
9. Touch <Enter> to record the information. The system returns to the Future Dose Calculation screen.
10. At the dose calculation screen, touch <Dose Ordered> and use the numeric keypad to enter the desired activity of the dose at the time it is to be administered.
11. Enter the dose administration time by touching to highlight any of the time/date values. Use the <▲> or <▼> keys to scroll until the desired time/date are displayed. (If desired, time can be entered using the touch pad numbers.) Touch <Enter> on the keypad to record the changes. Both hours and minutes must be entered.
12. If necessary, touch the unit of measure to toggle between mCi and µCi measurement units.
13. Once both the time and Dose Ordered have been entered, the system calculates the activity and volume required now for the Dose Ordered at the future dose administration time.
14. Place the drawn dose into the detector to confirm the activity drawn in the syringe.
15. Touch <Print Labels> to generate a label if a label printer is connected.

NOTE: *If drawing additional doses, enter the administration time and dose ordered for another dose and the system calculates the requirements for that dose.*

Figure 5.49. *The Dose Concentration Information screen.*

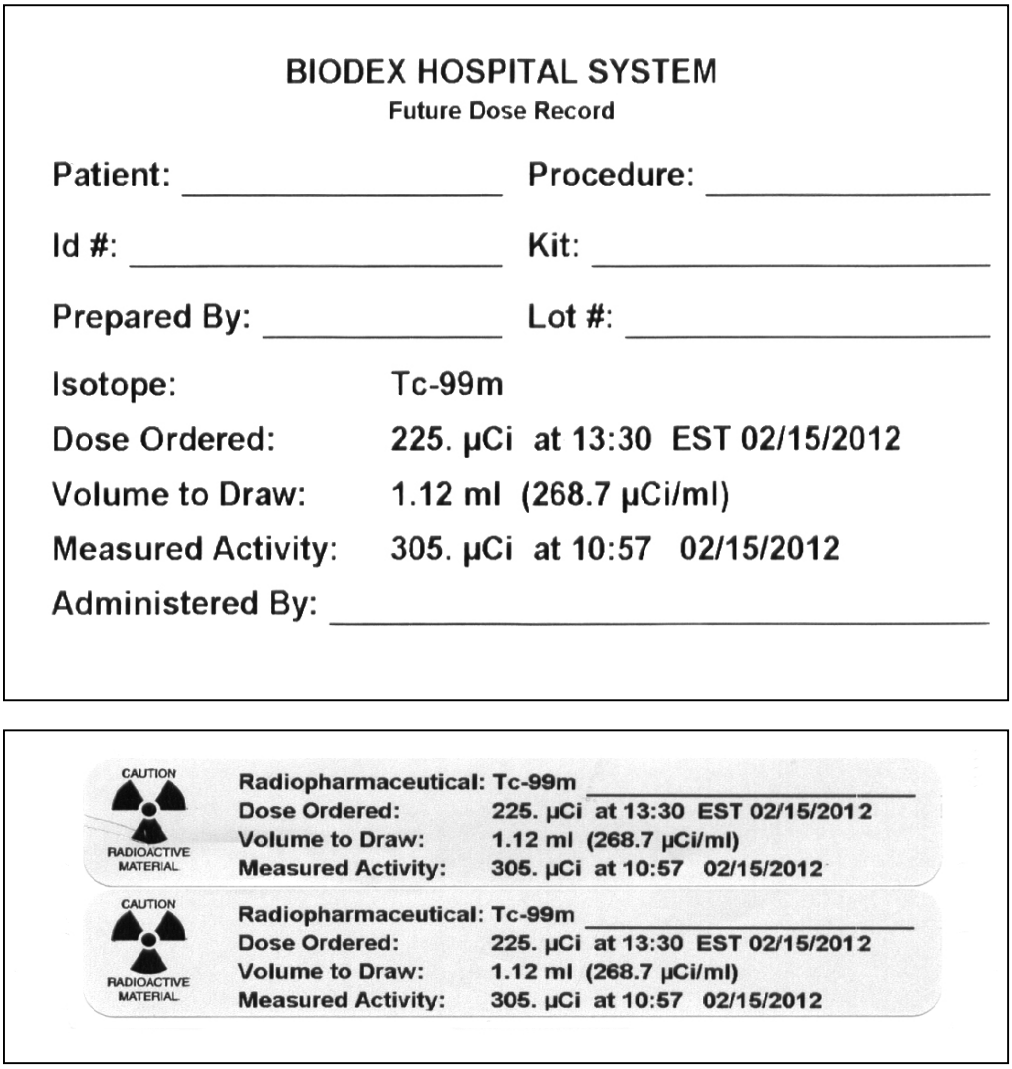


Figure 5.50. *Future dose labels showing Dose Ordered, volume to draw and measured activity.*

6. Dose Calibrator Quality Assurance

The Dose Calibrator Quality Assurance programs allow the user to perform and record a variety of system tests to assure the integrity of the readings and calculations.

To access the Dose Calibrator Quality Assurance functions, at the Home screen touch <Dose Calibrator Quality Assurance>. The QA Dose Calibrator screen should now be displayed.

QA Dose Calibrator

(See Figure 6.1.)

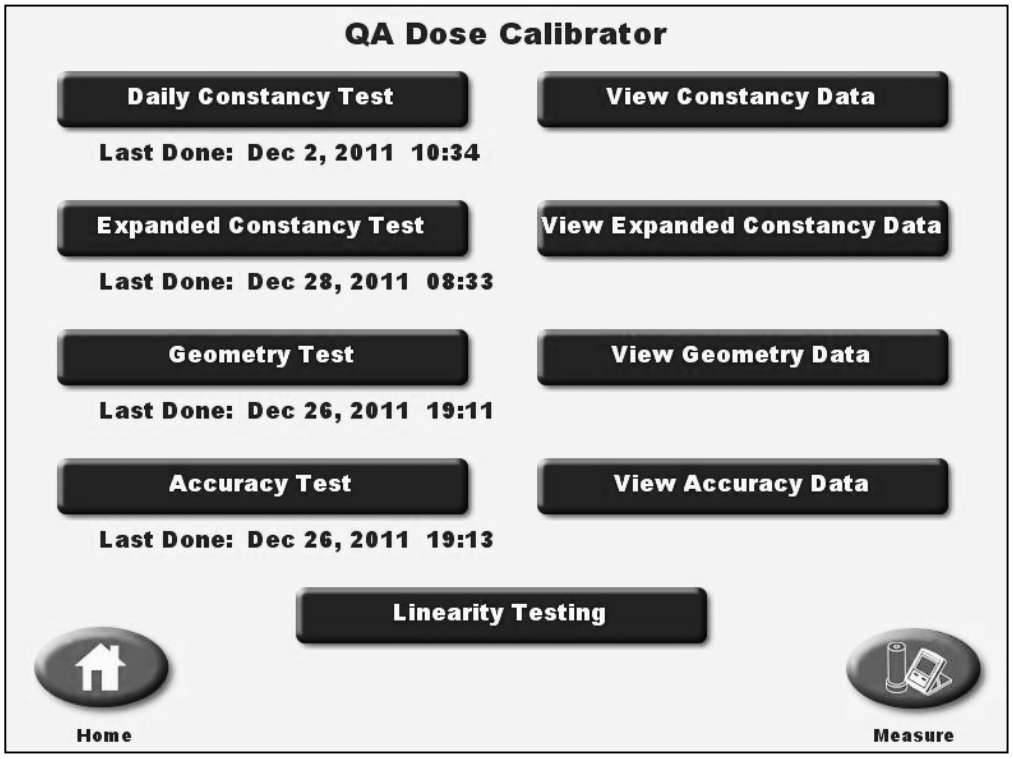


Figure 6.1. *The QA Dose Calibrator screen serves as the main menu of QA functions.*

The QA Dose Calibrator screen serves as the main menu for the QA section of the system. From this screen, you can access any of the nine QA procedures provided:

- Daily Constancy Test
- Expanded Constancy Test
- Geometry Test
- Accuracy Test
- View Constancy Data
- View Expanded Constancy Data
- View Geometry Data
- View Accuracy Data
- Linearity Testing

Daily Constancy Test

(See Figure 6.2.)

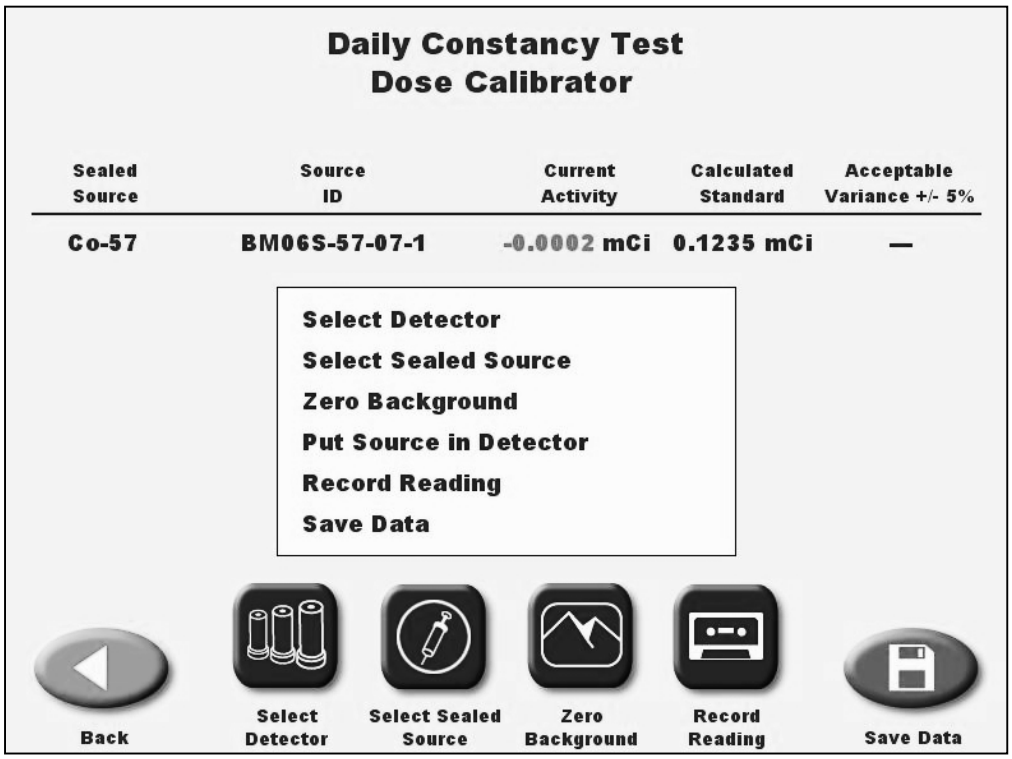


Figure 6.2. *The Daily Constancy Test screen.*

This test allows the user to put a calibrated sealed isotope into the detector and check to make sure the system is correctly reading the activity. each detector must be checked individually. The Atomlab 500 allows entry of the sealed sources into inventory and decay-corrects these sources for time. These sources are used for the testing of the dose calibrator chambers.

Constancy means reproducibility in measuring the same source, over a period of time, with decay correction. Assay a relatively long-lived source (such as Cs-137) each day before using the calibrator.

Cs-137, 200 µCi, is strongly recommended because the 30-year half-life will assure use of the same source throughout the life of the calibrator, and the Cs-137 source is readily available. The Cs-137 source should be replaced at 100 µCi.

NOTE: *You can only perform one Daily Constancy Test or Expanded Constancy Test for a specific sealed source per day.*

To Perform A Daily Constancy Test:

1. From the QA Dose Calibrator screen touch <Daily Constancy Test>. The Daily Constancy Test screen is now displayed. The source information is shown.
2. If only one detector is connected, skip to step 3. If more than one detector is connected, touch <Select Detector> and select the detector you want to test.

3. If you wish to change sources touch <Select Sealed Source>. If you have one to three sources, touching <Select Sealed Source> toggles between the sources. If more than three sources are listed, touching <Select Sealed Source> brings up the Sealed Source List.

   NOTE: *You can select your default sealed source, which will be the first source displayed when you enter the Constancy screen. Set the default in Sealed Source Set Up. Otherwise, the first source displayed will be the first source on your Sealed Source List.*

4. If the current background activity reading is higher than desired, touch <Zero Background> and zero the background.
5. Place the selected sealed source into a dipper and then into the detector. Allow the reading to settle. it is shown in the current activity section of the screen.
6. Touch <Record Reading> to enter the reading. The variance from the decayed calculated standard is shown.
7. If you touch <Back>, a message that recorded data will be lost is displayed. Touch <Yes> to return to the Daily Constancy Test screen without saving the data. Touch <No> to return to the Daily Constancy Test screen with the data recorded.
8. Touch <Save> to save the Daily Constancy Data. The Daily Constancy Data screen is now displayed.
9. Touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed staff member. (If you have previously selected a staff member, the system will default to that person on the Daily Constancy Test data screen.) If necessary, touch <Add Staff Member> or <Delete Staff Member> to update the Staff Member List. Touch <Enter> to select the staff member and return to the Save Daily Constancy Data screen.

NOTE: *A staff member name must be selected to save the constancy test.*

10. Touch <Save Data> to save the test results.
    - Touch <Measure> to go to the Measure screen
    - Touch <View Data> to advance to the Daily Constancy Test data screen and view the previous tests (see view constancy data section for details).
    - Touch <Back> to return to the Daily Constancy screen just counted. Touch <Back> again to return to the QA Dose Calibrator screen.
    - <Save Data> is inactive at this point because the data has already been saved.

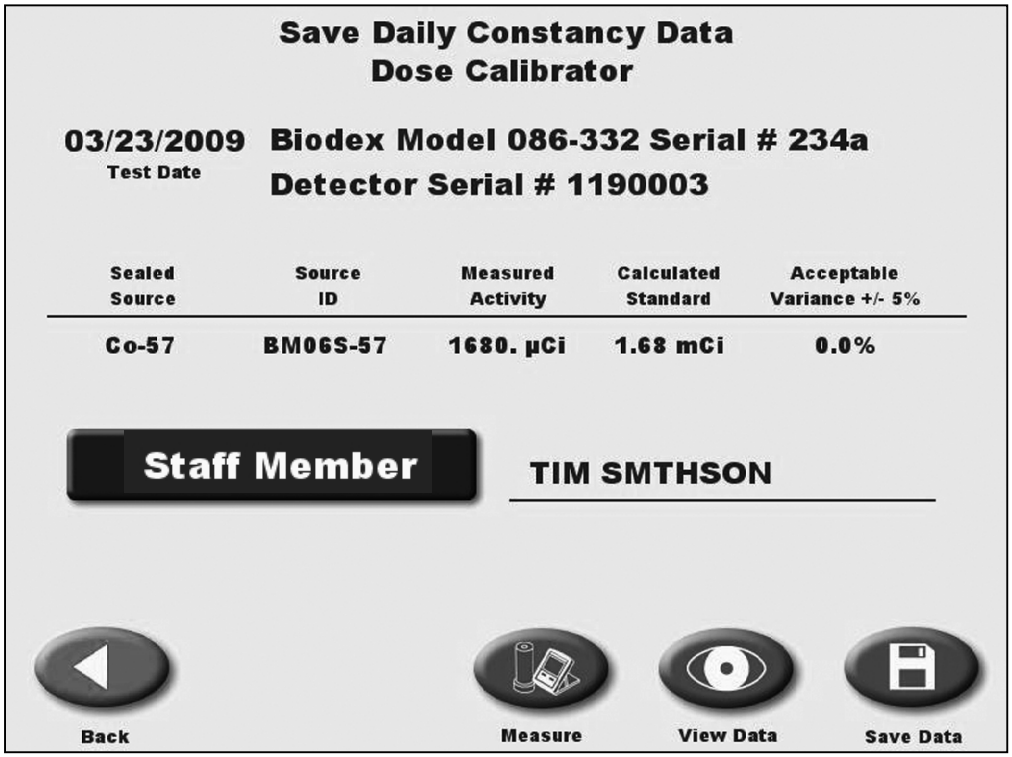


Figure 6.3. *The Save Daily Constancy screen.*

Expanded Constancy Test

(See Figure 6.4 and 6.5.

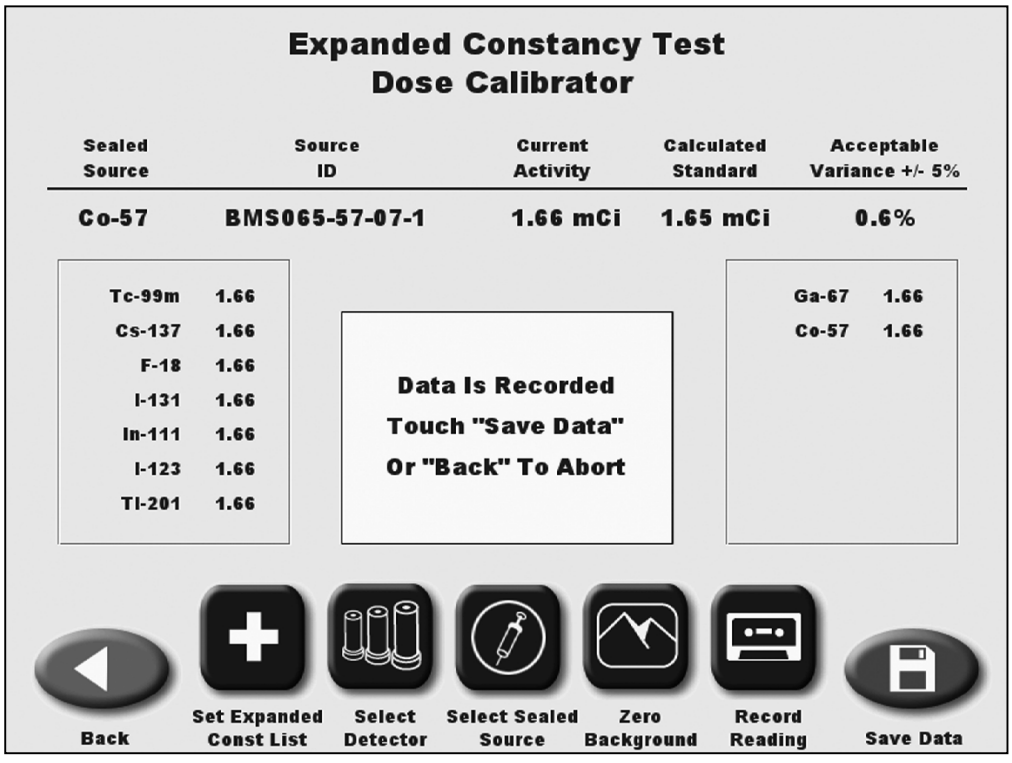


Figure 6.4. *The Expanded Constancy Test screen, also known as "channel check."*

This test allows the user to put a calibrated sealed isotope into the detector and check to make sure the system is correctly reading the activity. Expanded constancy takes and records readings for each of the isotopes listed on your Expanded Constancy Test List. Expanded constancy is sometimes called “channel check.” The Expanded Constancy Test List defaults to Tc-99m and Cs-137. You should add the appropriate isotopes that you want as part of your Expanded Constancy List before performing an Expanded Constancy Test. A maximum of 14 isotopes can be saved to the Expanded Constancy List. This includes the sealed source being used for the test.

The Expanded Constancy Test measures and records an activity reading using the selected sealed source for each of the isotopes selected for the Expanded Constancy Test. The system takes a reading and records it for each isotope. Expanded constancy then compares the readings for each isotope from one test to the next test performed, and shows the variance when the test is performed.

Each detector must be checked individually. The Atomlab 500 allows entry of the sealed sources into inventory and decay-corrects these sources for time. These sources are used for the testing of the dose calibrator detectors.

Constancy means reproducibility in measuring the same source, over a period of time, with decay correction. Assay a relatively long-lived source (such as Cs-137) each day before using the calibrator.

NOTE: *When you perform an Expanded Constancy Test, the isotope used for the isotope constancy value is put into the Daily Constancy Test screen and shows the variance from the calculated value.*

Cs-137, 200 µCi, is strongly recommended because the 30-year half-life will assure use of the same source throughout the life of the calibrator, and it is readily available. The Cs-137 source should be replaced at 100 µCi,

NOTE: *You can only perform one Daily Constancy Test or Expanded Constancy Test for a specific sealed source per day. Select the desired isotope before performing the test.*

To Perform An Expanded Daily Constancy Test:

1. From the QA Dose Calibrator screen touch <Expanded Daily Constancy Test>. The expanded Daily Constancy Test screen is now displayed. The source information is shown.
2. Touch <Set Expanded Const List>. The Set Expanded Constancy List is displayed.
3. To add an isotope, touch <Add Isotope>. The isotopes list is now displayed. Touch to highlight the isotope you wish to add to the Expanded Constancy Isotope List. Touch <Enter> to record and return to the Set Expanded Constancy List. Repeat the add isotope procedure for each isotope you wish to add to the list.
4. To remove an isotope from the Set Expanded Constancy List, touch to highlight the isotope to be removed. Touch <Delete Isotope> to remove the isotope from the Expanded Constancy List. Touch <Cancel> to discard any changes made, or <Enter> to record the changes.
5. If more than one detector is connected, touch <Select Detector> and select the detector to test.

6. If you wish to change sources touch <Select Sealed Source>. If you have one to three sources, touching <Select Sealed Source> toggles between the sources. If more than three sources are listed, touching <Select Sealed Source> brings up the Sealed Source List.

   NOTE: *You can select your default sealed source, which will be the first source displayed when you enter the Constancy screen. Set the default in Sealed Source Set Up. Otherwise, the first source displayed will be the first source on your Sealed Source List.*

7. If the current activity is higher than desired, touch <Zero Background> and zero the background.
8. Place the selected sealed source into a dipper and then into the detector. Allow the reading to settle. it is shown in the current activity section of the screen.
9. Touch <Record Reading> to enter the reading. The system takes readings for each isotope on the Expanded Constancy List. The variance from the decayed calculated standard is shown and a reading for each Isotope Listed.
10. If you touch <Back>, the message: recorded data will be lost? is displayed. Touch <Yes> to return to the expanded Daily Constancy Test screen without saving the data. Touch <No> to return to the expanded Daily Constancy Test screen with the data recorded.
11. Touch <Save Data> to save the Expanded Constancy Data. The Save Expanded Constancy Data screen is now displayed.
12. If the appropriate staff member is not displayed, touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed person. (If you have previously selected a staff member, the system will default to that person on the Expanded Constancy Test data screen.). If necessary, touch <Add Staff Member> or <Delete Staff Member> to update the Staff Member List. Touch <Enter> to select the staff member and return to the save Expanded Constancy Data screen.

NOTE: *If you have more than eight selected isotopes, the results are shown on two screens. Touch the arrow on the right side of the screen to see the second page. When you go to page 2, an arrow that allows you to go back one page appears on the left side of the screen.*

NOTE: *You must have selected a staff member name before saving the test.*

13. Touch <Measure> to go to the Measure screen without saving, <View Data> to advance to the Expanded Constancy Test data screen and view previous tests (see View Constancy Data section for details). Touch <Save Data> to save the Expanded Constancy Test just performed. The system returns to the Save Expanded Constancy Data screen.
    - Touch <Measure>. If you proceed, a message that recorded data will be lost is displayed. Touch <Yes> to abort and return to the Dose Calibrator screen without saving data, or <No> to return to the Expanded Constancy Data screen.
    - Touch <View Data> to view the data on the Expanded Constancy Test data screen.
    - <Save Data> is inactive because the data has already been saved.
    - Touch <Back> to return to the Daily Constancy screen just counted. Touch <Back> again to return to the QA Dose Calibrator screen.

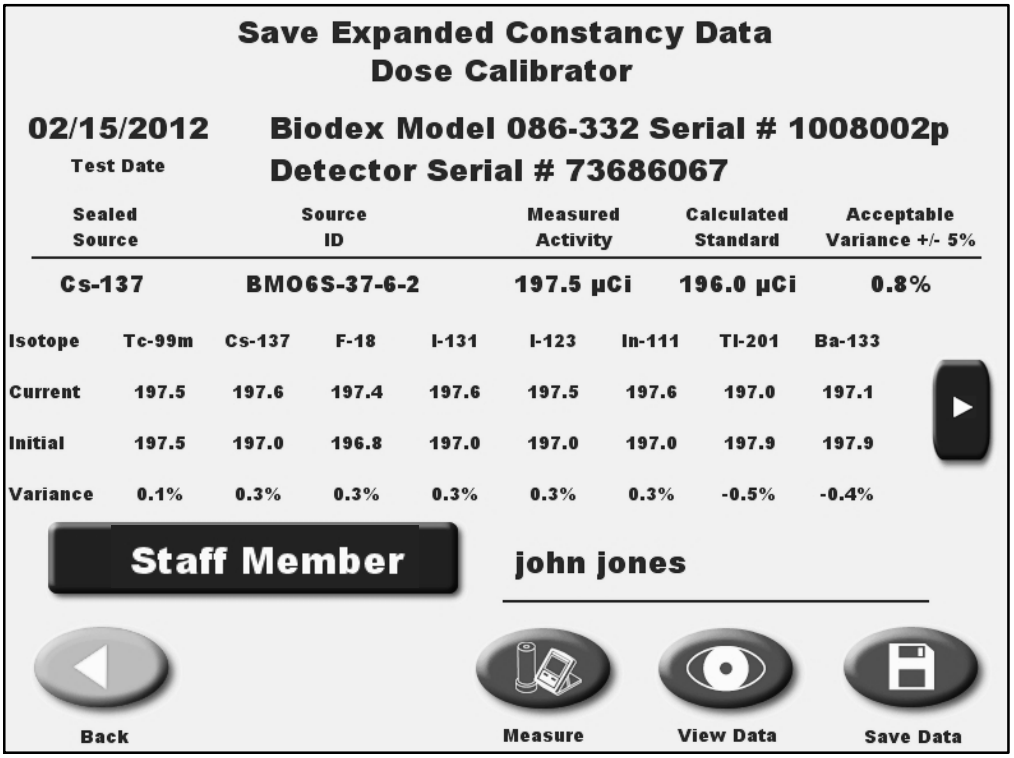


Figure 6.5. *The Save Expanded Constancy Data Results screen.*

Geometry Test

(See Figures 6.6 - 6.9.)

The Geometry Test is used to check if the system is correctly measuring the activity of a dose at different volumes as the dose is diluted. This test is usually performed using Tc-99m but other isotopes can be used if desired. Generally, a dose of a small volume is chosen to begin and saline is added to change the volume without changing the activity.

"Geometry independence" means that the indicated activity does not change with volume or configuration of the source material. This test should be done using a syringe that is normally used for injections. The following test assumes injections are done with 3 ml plastic syringes, and the radiopharmaceutical kits are made in 30 ml glass vials. If you do not use these, change the procedure so that your syringes and vials are tested throughout the range of volumes commonly used.

If a significant volume correction results from these procedures, the tests should be repeated to verify. Atomlab Dose Calibrators have been tested for volume dependence in Beta measurements which are expected to be worst case and the results were 0.13%/ml. (Reference: Accurate Dose Calibrator Activity Measurement of Y-90 Ibritumomab Tiuxetan," J. A. Siegel Et Al, J Nucl Med, 2004, 45:450-454.)

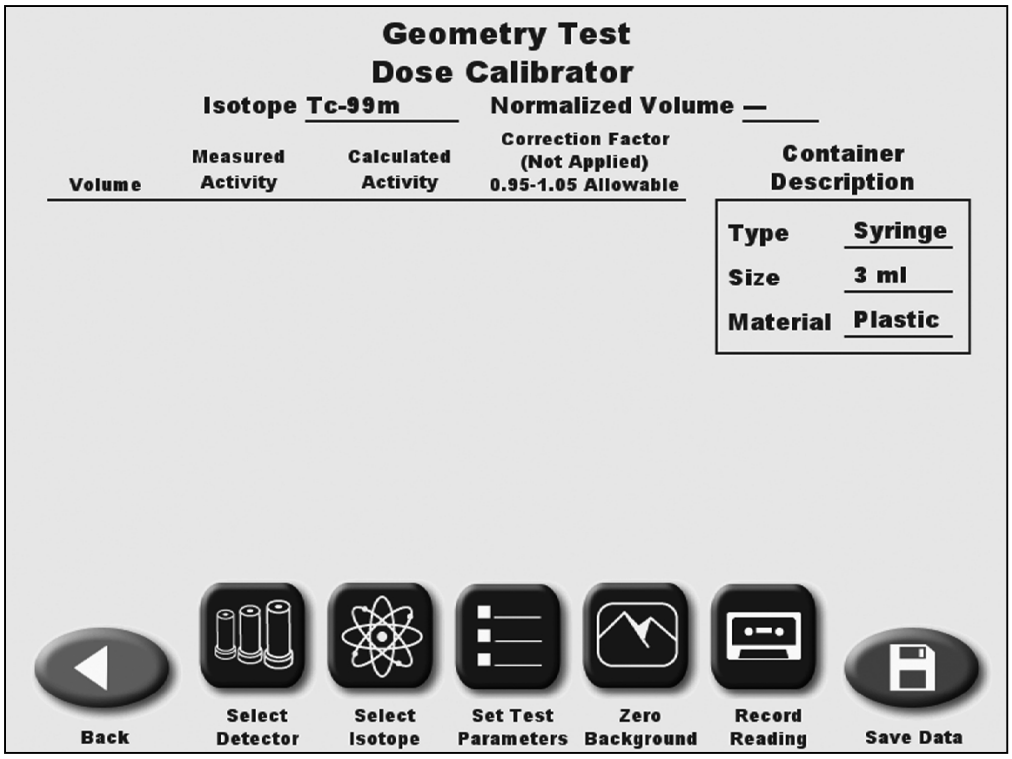


Figure 6.6. *The Geometry Test screen.*

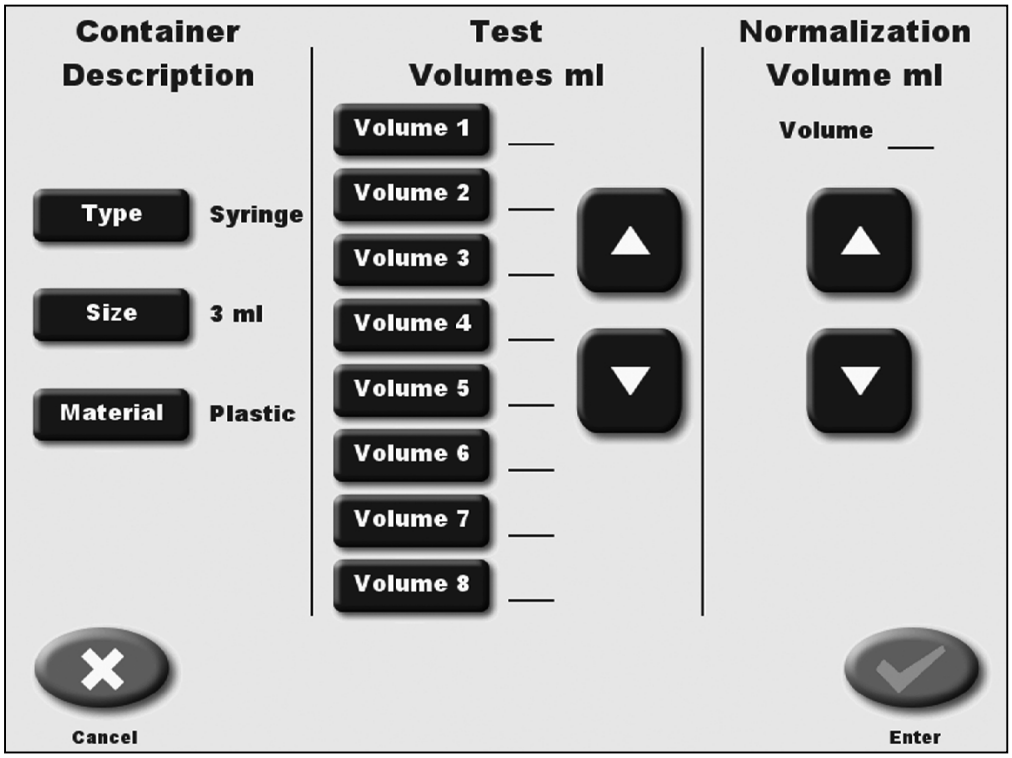


Figure 6.7. *The Geometry Set Test Parameters screen.*

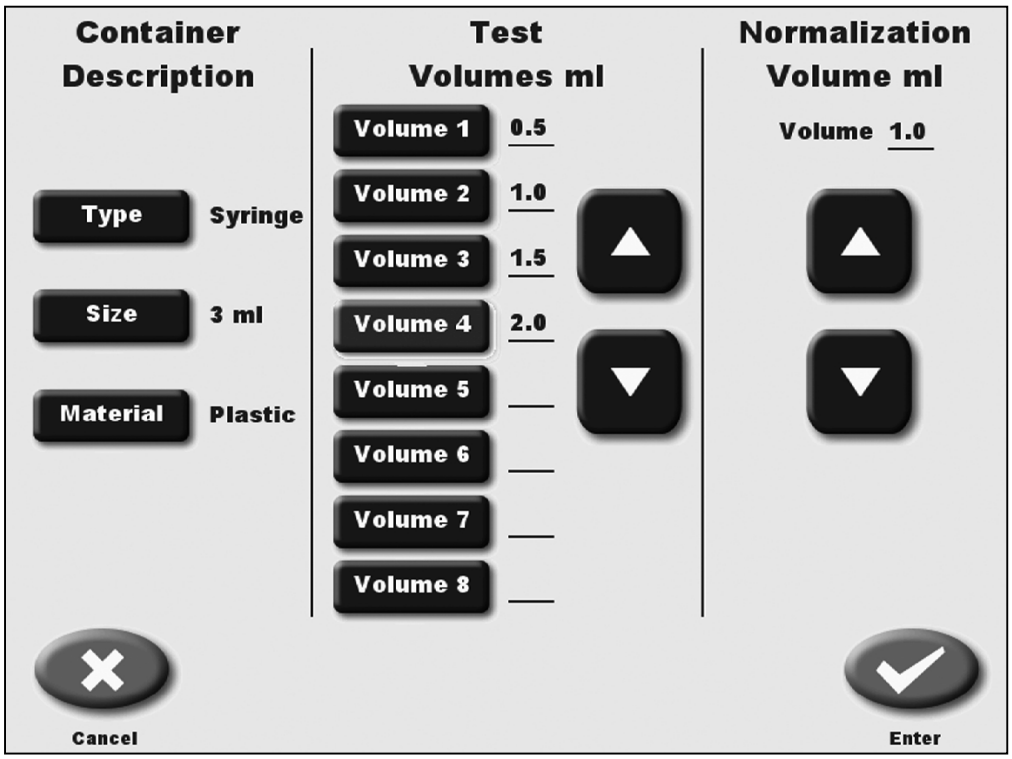


Figure 6.8. *A Geometry Test with data.*

To Perform A Geometry Test:

1. From the QA Dose Calibrator screen touch <Geometry Test>. The Geometry Test screen is now displayed.
2. If only one detector is connected, skip to step 3. If more than one detector is connected, touch <Select Detector> and select the detector to test. Zero Background if necessary.
3. The isotope for the Geometry Test always defaults to the first isotope on the button list, usually Tc-99m. If a different isotope is to be used, touch <Select Isotope> and then select the desired isotope as previously described.
4. Touch <Set Test Parameters>. The parameters screen is now displayed.
5. Set the Container Description by touching the <Type>, <Size> and <Material> icons to scroll though the choices. <Type> adjusts syringe or vial, <Size> adjusts from 1 to 30 ml, <Material> is glass or plastic.
6. Touch to highlight volume 1 and then use the <▲> and <▼> arrows to adjust the value. then touch volume 2 and the system automatically increases by the appropriate volume. If you want a different increase, use the <▲> and <▼> arrows to adjust the volume. Touch volume 3 and the system automatically increases by the appropriate volume. Use the <▲> and <▼> arrows to adjust the value. Continue entering the volumes until you reach the maximum volume for which you will test.
7. Use the <▲> and <▼> arrows to set the normalization volume.
8. Touch <Enter> when all parameters are set to return to the Geometry Test screen.
9. Touch <Zero Background> to zero the background reading, if necessary. The Background live reading is displayed next to the first volume.

10. Place the first volume in the detector. The first measured activity reading is displayed in red. When the measured activity settles, touch <Record Reading> to record the measured activity reading. The system advances to the second volume.
11. Remove the sample and adjust the volume for the second measured volume. Replace the source in the detector. When the reading settles, touch <Record Reading>. continue removing the source from the detector and adjusting the volume until all volume measurements are completed.
12. Once the normalized volume is counted, the system calculates the activity and correction factor or variance. As each new volume is recorded, the calculation for that volume is performed.

    NOTE: *To stop the test before all volumes are measured, touch <Save> to keep the test with the volumes already recorded.*

    NOTE: *If any of the correction factors are out of the acceptable range they will be highlighted in red.*

    NOTE: *The normalized volume reading is the volume used as the starting point for the calculations. The calculated activity matches the measured activity for the normalized volume and is displayed. The correction factor is 1. All future calculated activity uses this as a start point.*

13. After the last reading is completed, touch <Save Data>. The Save Geometry Test Data screen is displayed.
14. Touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed person. (If only one staff member is on the list, the system will default to that person on the Save Geometry Test Data screen.) Touch <Enter> to select the staff member and return to the Save Geometry Test Data screen. If necessary, touch <Add Staff Member> or <Delete Staff Member> to update the Staff Member List.
15. Touch <Save Data>. The system responds with a “data saved” message and returns to the save Geometry Test data screen.
16. Touch <View Data> to advance to the Geometry Test data screen. From here you can <Delete Data>, or select to view data from an <Earlier Date> or <Later Date>. <Select Isotope> toggles the screen through the data for each isotope used to complete a test.
17. Touch <Back> to return to save Geometry Test screen, <Measure> to advance to the count screen, or <View Data> to go to the Geometry Test data screen.
18. If you select <View Data> you can see the Geometry Test just performed, or any Geometry test previously completed. If a printout is desired, touch <Print> to print the Geometry Test Data screen.

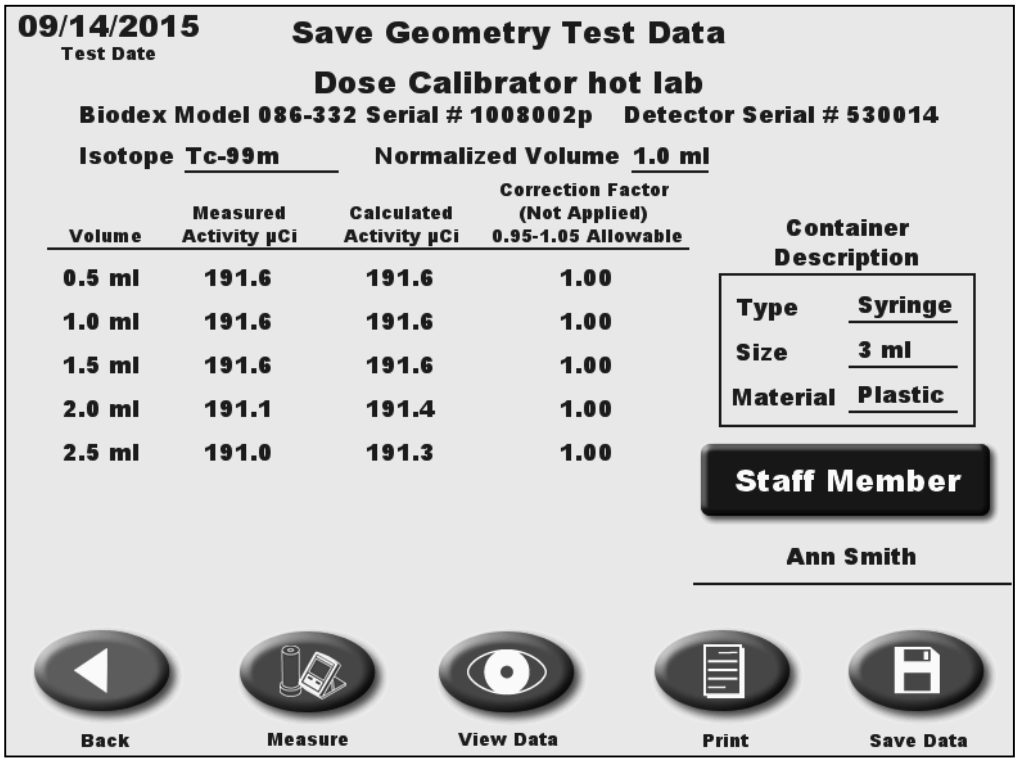


Figure 6.9. *A complete Save Geometry Test data screen.*

Accuracy Test

(See Figure 6.10 - 6.12.)

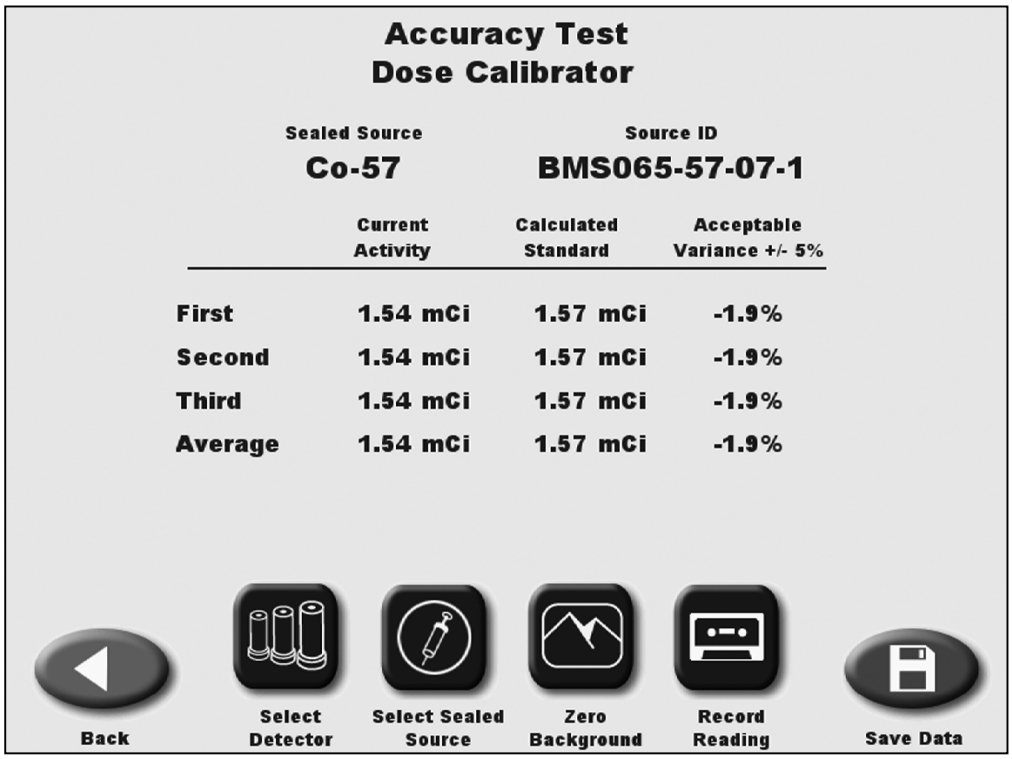


Figure 6.10. *The Accuracy Test screen.*

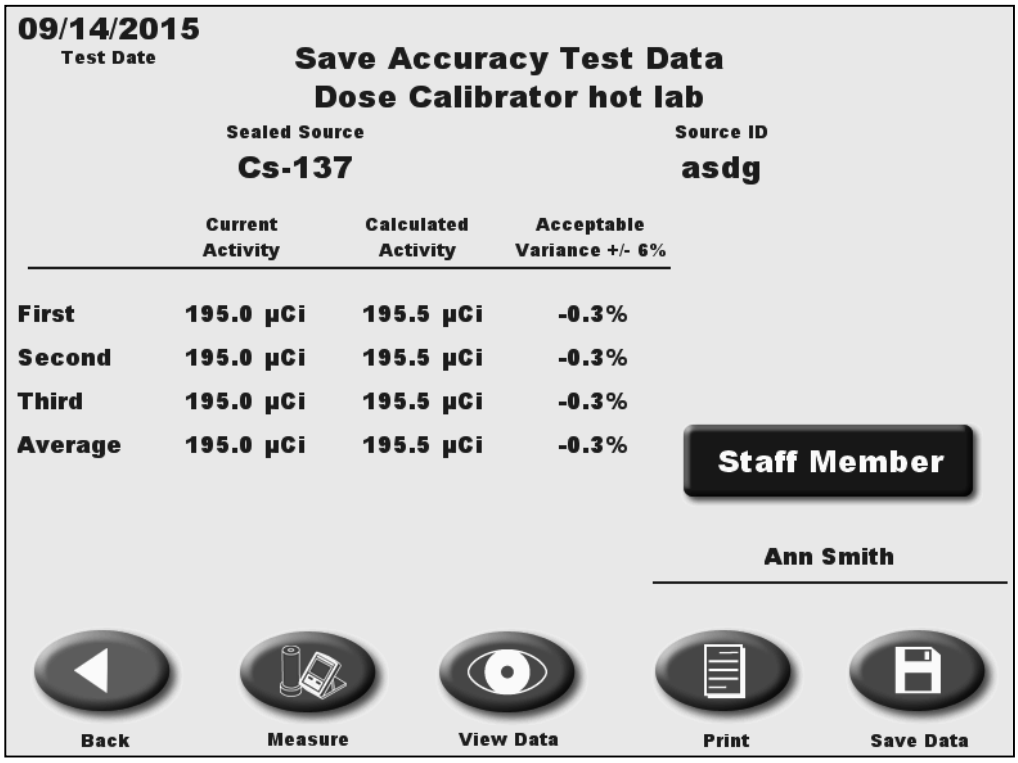


Figure 6.11. *The Save Accuracy Test data screen.*

The Accuracy Test is similar to the Geometry Test, except three readings are completed, then averaged. Accuracy means a determination of the dose calibrator's absolute error resulting from a measurement of a suitable NIST - traceable radionuclide activity. Traceable sources are available from NIST and from many radioisotope suppliers. At least two sources with different principal photon energies (such as Co-57, Cs-137 or Co-60) should be used. One should have a principal photon energy between 100 keV and 500 keV.

To Perform An Accuracy Test:

1. From the QA Dose Calibrator screen touch <Accuracy Test>. The Accuracy Test screen is now displayed.
2. If only one detector is connected, skip to step 3. If more than one detector is connected, touch <Select Detector> and select the detector to test. Zero Background if necessary.
3. Touch <Select Sealed Source> and then select the desired source as previously described.

   NOTE: *You must have previously entered the sealed source into memory.*

   NOTE: *You can select your default sealed source, which will be the first source displayed when you enter the Constancy screen. Set the default in Sealed Source Set Up. Otherwise, the first source displayed will be the first source on your Sealed Source List.*

4. Place the sealed source in the dipper and position it in the dose calibrator detector. When the reading stabilizes, press <Record Reading>.
5. Remove the source from the dose calibrator. Insert the source into the detector again. Press <Record Reading> after the reading has stabilized.

6. Repeat step five to record a total of three readings. The system calculates the average reading and compares it to the calculated standard, then determines the average variance.

   NOTE: *If any of the readings are out of the acceptable range they will be highlighted in red.*

7. Touch <Save Data>. The save Accuracy Test data screen is displayed.
8. Touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed staff member. (If only one person is on the list, the system will default to that person on the Save Geometry Test Data screen.) Touch <Enter> to select the staff member and return to the Save Geometry Test Data screen. If necessary, touch <Add Staff Member> or <Delete Staff Member> to update the Staff Member List.
9. Touch <Measure> to go to the Measure screen. A message is displayed: "if you proceed, recorded data will be lost, is it OK to exit and abort?". Touch <Yes> to delete the test and go to the Measure screen, or <No> to return to the study.
10. Touch <Back> to return to the Accuracy Test screen without saving.
11. Touch <Save Data> to save the test just performed and advance to the save Accuracy Test data screen.
12. Touch <View Data> to view this test and previously performed Accuracy Tests.
13. Touch <Back> twice to return to the QA Dose Calibrator screen.
14. If you select <View Data> you can see the Accuracy Test just performed, or any Accuracy Test previously completed. If a printout is desired, touch <Print> to print the Accuracy Test data screen.

Biodex Medical Center
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Staff

Accuracy Test Data
Dose Calibrator - Not Connected, Stored Data
Biodex Model 086-332 Serial # 1004002P Detector Serial # 4633905

Date	Sealed Source	Reading 1	2	3	AVG	Calculated Standard	Acceptable Variance +/- 4%	
04/10/10	Cs-137	209.	209.	209.	209.	204. µCi	2.1%	css
04/10/10	Ba-133	239.	239.	239.	239.	239. µCi	0.0%	css
04/09/10	Cs-137	208.	208.	208.	208.	205. µCi	1.5%	css
04/09/10	Ba-133	239.	239.	239.	239.	239. µCi	0.0%	css
04/07/10	Ba-133	239.	239.	239.	239.	239. µCi	0.0%	css
04/07/10	Cs-137	207.	207.	207.	207.	205. µCi	1.0%	css
04/06/10	Cs-137	208.	208.	208.	208.	205. µCi	1.5%	css
04/05/10	Cs-137	208.	208.	208.	208.	205. µCi	1.5%	css

Approved By: _____ Date: _____

Figure 6.12. *A printed Accuracy Test data Report.*

View Constancy Data

(See Figures 6.13 - 6.15.)

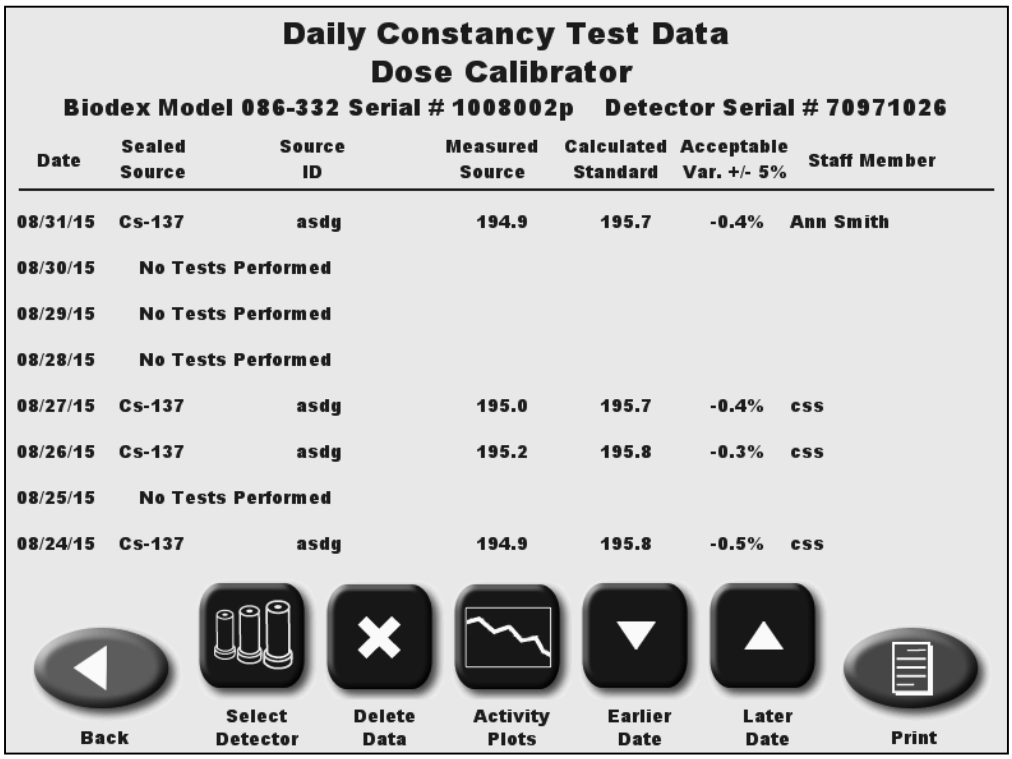


Figure 6.13. *The Daily Constancy Test data screen.*

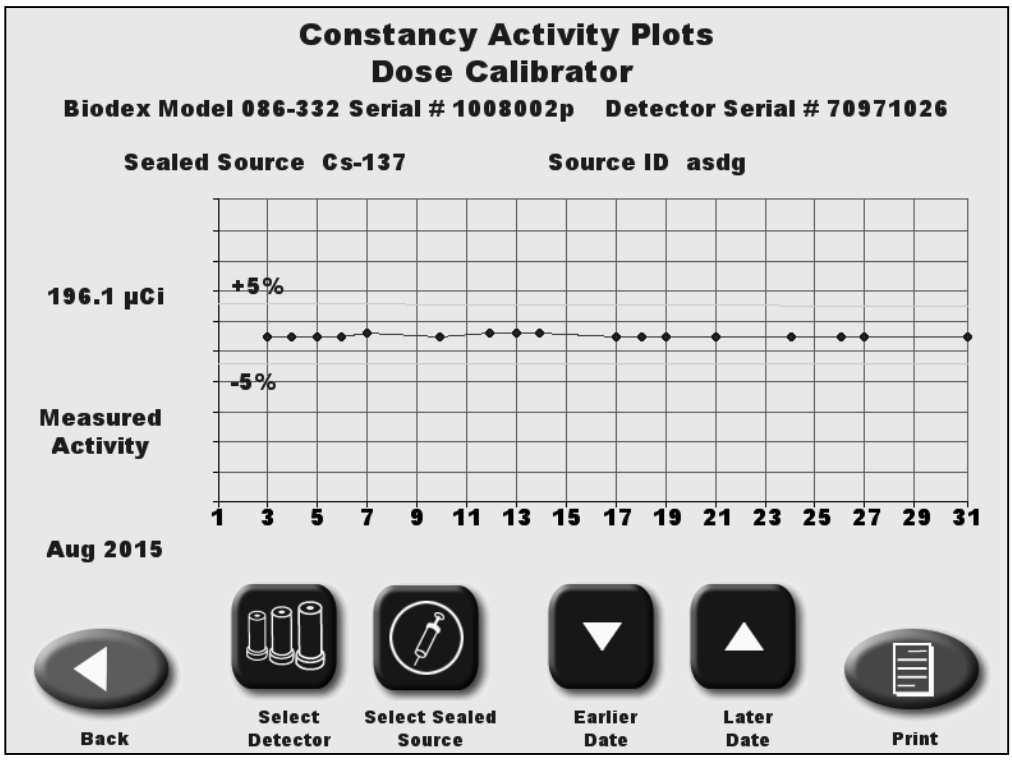


Figure 6.14. *The Constancy Activity Plots screen.*

The View Constancy Data screen displays the constancy tests performed on the dose calibrator. The data is stored for each detector connected to the system. The display shows all the isotopes for which constancy tests have been completed by the date performed. Any constancy test outside the acceptable variance is shown in red. Daily constancy activity results can be displayed by month in a plotted graph format.

- Touch <Back> to return to the QA Dose Calibrator screen.
- Touch <Select Detector>to select a different detector, if multiple detectors are connected.

To Delete Data:

1. Touch <Delete Data> and use the keypad to enter your password. Touch <Enter> to advance to the Daily Constancy Test data screen.
2. Touch to highlight the data to delete. Touch <Delete Data>. The Delete Data Confirmation screen is displayed. Touch <OK> to delete and return to the Daily Constancy Test data screen. Touch <Cancel> to return to the QA Dose Calibrator screen.

To View Earlier Or Later Dates:

1. Touch <Earlier Date> or <Later Date> to toggle to the appropriate date to view.

To Print Constancy Data Without The Plot:

1. Touch <Print>. The Test data will be printed without the plot. You can select the starting and ending date for the report.

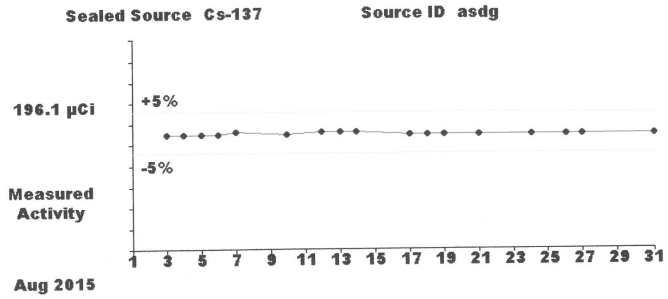
to view activity plots

1. Touch <View Activity Plots> to advance to the Constancy Activity Plots screen. P plot of the daily constancy readings, by month, is displayed.
2. Use <Earlier Date> and <Later Date> to toggle between dates.
3. Touch <Print> to print the constancy plot displayed. The printout has the plot and the data.
4. If desired, touch <Select Detector> to select and view the constancy tests if multiple detectors are connected.
5. If desired, touch <Select Sealed Source> if a different sealed source is desired.
6. Touch <Back> to return to the Daily Constancy Test data screen.

Daily Constancy Test Data

Dose Calibrator

Biodex Model 086-332 Serial # 1008002p Detector Serial # 70971026 (Printed: 08/31/2015 15:38)



Date	Sealed Source	Source ID	Measured Source	Calculated Standard	Acceptable Variance +/- 5%	Staff Member
08/01/15	No Tests Performed					
08/02/15	No Tests Performed					
08/03/15	Cs-137	asdg	195.3 µCi	196.0 µCi	-0.4%	Ann Smith
08/04/15	Cs-137	asdg	195.4 µCi	196.0 µCi	-0.3%	Ann Smith
08/05/15	Cs-137	asdg	195.3 µCi	196.0 µCi	-0.4%	AMA
08/06/15	Cs-137	asdg	195.0 µCi	196.0 µCi	-0.5%	AMA
08/07/15	Cs-137	asdg	195.7 µCi	196.0 µCi	-0.2%	AMA
08/08/15	No Tests Performed					
08/09/15	No Tests Performed					
08/10/15	Cs-137	asdg	195.0 µCi	195.9 µCi	-0.5%	AMA
08/11/15	No Tests Performed					
08/12/15	Cs-137	asdg	195.8 µCi	195.9 µCi	-0.1%	Ann Smith
08/13/15	Cs-137	asdg	195.5 µCi	195.9 µCi	-0.2%	Ann Smith
08/14/15	Cs-137	asdg	195.5 µCi	195.9 µCi	-0.2%	Ann Smith
08/15/15	No Tests Performed					
08/16/15	No Tests Performed					
08/17/15	Cs-137	asdg	194.8 µCi	195.9 µCi	-0.6%	Ann Smith
08/18/15	Cs-137	asdg	195.4 µCi	195.9 µCi	-0.3%	Ann Smith
08/19/15	Cs-137	asdg	195.2 µCi	195.8 µCi	-0.3%	Ann Smith
08/20/15	No Tests Performed					
08/21/15	Cs-137	asdg	195.3 µCi	195.8 µCi	-0.3%	Ann Smith
08/22/15	No Tests Performed					
08/23/15	No Tests Performed					
08/24/15	Cs-137	asdg	194.9 µCi	195.8 µCi	-0.5%	css
08/25/15	No Tests Performed					
08/26/15	Cs-137	asdg	195.2 µCi	195.8 µCi	-0.3%	css
08/27/15	Cs-137	asdg	195.0 µCi	195.7 µCi	-0.4%	css
08/28/15	No Tests Performed					
08/29/15	No Tests Performed					
08/30/15	No Tests Performed					
08/31/15	Cs-137	asdg	194.9 µCi	195.7 µCi	-0.4%	Ann Smith

Approved By: _____ Date: _____

Figure 6.15. *A Daily Constancy Test report showing an activity.*

View Expanded Constancy Data

(See Figure 6.16.And 16.17)

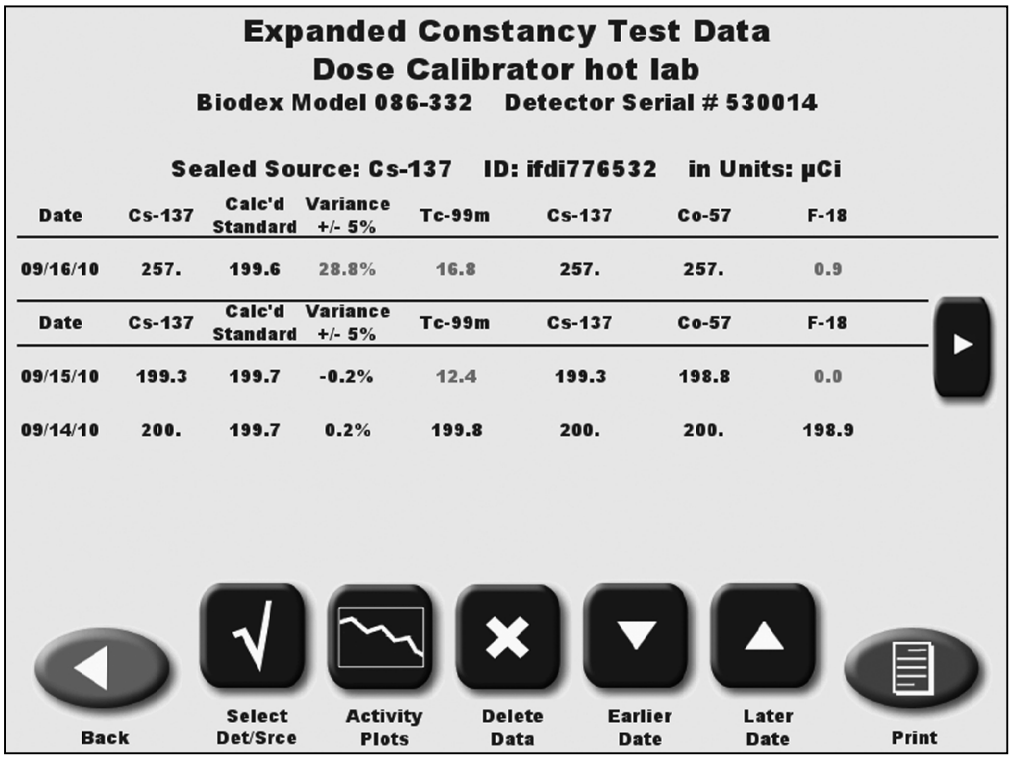


Figure 6.16. *The Expanded Constancy Test data screen.*

The View Expanded Constancy Data screen displays the expanded constancy tests performed on the dose calibrator. The data is stored for each detector connected to the system. The display shows the isotope used for the expanded constancy test, and the test results for all the isotopes listed for the expanded constancy tests, by the date performed. Any expanded constancy test outside the acceptable variance is shown in red.

- Touch <Back> to return to the QA Dose Calibrator screen.
- Touch <select DET/SRCE> to bring up the screen to select a different detector or source.
- Touch <Select Detector>to select a different detector, if multiple detectors are connected.
- Touch <Select Sealed Source> if a different sealed source is desired.
- Touch <Delete Data> to delete data.
- Use <Earlier Data> or <Later Date> to change the date range displayed.

To Delete Data:

1. Touch <Delete Data> and use the keypad to enter your password. Touch <Enter> to advance to the Expanded Constancy Test data screen.
2. Touch to highlight the data to delete. Touch <Delete Data>. The Delete Data Confirmation screen is displayed. Touch <OK> to delete and return to the Expanded Constancy Test data screen. Touch <Cancel> to return to the Expanded Constancy Test data screen.

To Change Dates Viewed:

1. Use <Earlier Date> and <Later Date> to toggle between dates.

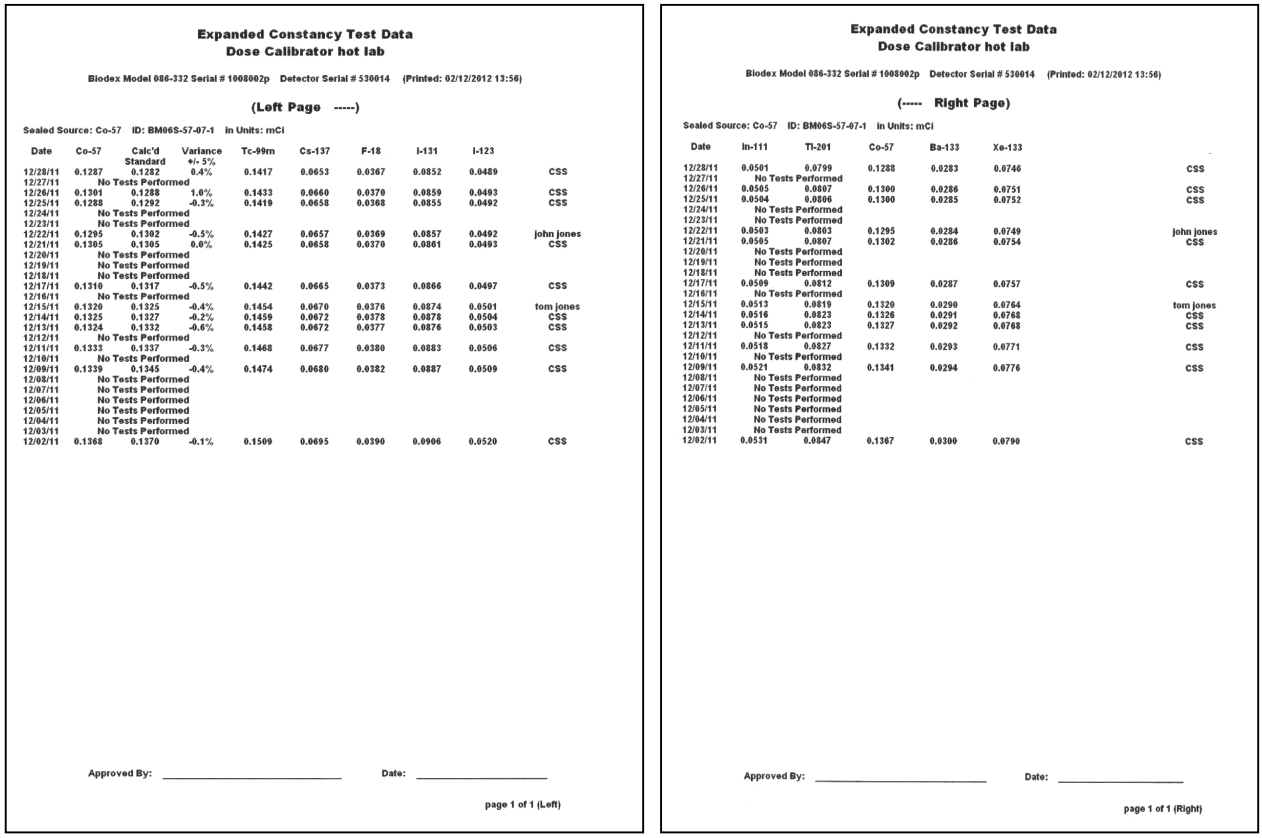
To Print The Expanded Constancy Data:

1. Touch <Print> and then enter or select the date range required. the report may be up to three pages wide, depending on the number of isotopes listed for expanded constancy. The pages are labeled “left” and “right” as necessary.

   NOTE: *The arrow at the right of the screen advances to page two or page three data.*

To Print The Expanded Constancy Plot:

1. Touch <Print> to print the expanded constancy plot displayed.
2. To view activity plots, touch <Activity Plots>. The Constancy Activity Plots screen, with the sealed source activity, prints the activity plots for the time frame displayed. It only prints the plot for the constancy source and the data for that source.



Expanded Constancy Test Data
Dose Calibrator hot lab

Biodex Model 086-332 Serial # 1008002p Detector Serial # 530014 (Printed: 02/12/2012 13:56)

(Left Page -----)

Sealed Source: Co-57 ID: BM06S-57-07-1 In Units: mCi

Date	Co-57	Calc'd Standard	Variance +/- 5%	Tc-99m	Cs-137	F-18	I-131	I-123	
12/28/11	0.1287	0.1282	0.4%	0.1417	0.0653	0.0367	0.0852	0.0489	CSS
12/27/11	No Tests Performed								
12/26/11	0.1301	0.1288	1.0%	0.1433	0.0660	0.0370	0.0859	0.0493	CSS
12/25/11	0.1288	0.1292	-0.3%	0.1419	0.0658	0.0368	0.0855	0.0492	CSS
12/24/11	No Tests Performed								
12/23/11	No Tests Performed								
12/22/11	0.1295	0.1302	-0.5%	0.1427	0.0657	0.0369	0.0857	0.0492	john jones
12/21/11	0.1305	0.1305	0.0%	0.1425	0.0658	0.0370	0.0861	0.0493	CSS
12/20/11	No Tests Performed								
12/19/11	No Tests Performed								
12/18/11	No Tests Performed								
12/17/11	0.1310	0.1317	-0.5%	0.1442	0.0665	0.0373	0.0866	0.0497	CSS
12/16/11	No Tests Performed								
12/15/11	0.1320	0.1325	-0.4%	0.1454	0.0670	0.0376	0.0874	0.0501	tom jones
12/14/11	0.1325	0.1327	-0.2%	0.1459	0.0672	0.0378	0.0878	0.0504	CSS
12/13/11	0.1324	0.1332	-0.6%	0.1458	0.0672	0.0377	0.0876	0.0503	CSS
12/12/11	No Tests Performed								
12/11/11	0.1333	0.1337	-0.3%	0.1468	0.0677	0.0380	0.0883	0.0506	CSS
12/10/11	No Tests Performed								
12/09/11	0.1339	0.1345	-0.4%	0.1474	0.0680	0.0382	0.0887	0.0509	CSS
12/08/11	No Tests Performed								
12/07/11	No Tests Performed								
12/06/11	No Tests Performed								
12/05/11	No Tests Performed								
12/04/11	No Tests Performed								
12/03/11	No Tests Performed								
12/02/11	0.1368	0.1370	-0.1%	0.1509	0.0695	0.0390	0.0906	0.0520	CSS

Approved By: _____ Date: _____

page 1 of 1 (Left)

Expanded Constancy Test Data
Dose Calibrator hot lab

Biodex Model 086-332 Serial # 1008002p Detector Serial # 530014 (Printed: 02/12/2012 13:56)

(----- Right Page)

Sealed Source: Co-57 ID: BM06S-57-07-1 In Units: mCi

Date	In-111	Tl-201	Co-57	Ba-133	Xe-133	
12/28/11	0.0501	0.0799	0.1288	0.0283	0.0746	CSS
12/27/11	No Tests Performed					
12/26/11	0.0505	0.0807	0.1300	0.0286	0.0751	CSS
12/25/11	0.0504	0.0806	0.1300	0.0285	0.0752	CSS
12/24/11	No Tests Performed					
12/23/11	No Tests Performed					
12/22/11	0.0503	0.0803	0.1295	0.0284	0.0749	john jones
12/21/11	0.0505	0.0807	0.1302	0.0286	0.0754	CSS
12/20/11	No Tests Performed					
12/19/11	No Tests Performed					
12/18/11	No Tests Performed					
12/17/11	0.0509	0.0812	0.1309	0.0287	0.0757	CSS
12/16/11	No Tests Performed					
12/15/11	0.0513	0.0819	0.1320	0.0290	0.0764	tom jones
12/14/11	0.0516	0.0823	0.1326	0.0291	0.0768	CSS
12/13/11	0.0515	0.0823	0.1327	0.0292	0.0768	CSS
12/12/11	No Tests Performed					
12/11/11	0.0518	0.0827	0.1332	0.0293	0.0771	CSS
12/10/11	No Tests Performed					
12/09/11	0.0521	0.0832	0.1341	0.0294	0.0776	CSS
12/08/11	No Tests Performed					
12/07/11	No Tests Performed					
12/06/11	No Tests Performed					
12/05/11	No Tests Performed					
12/04/11	No Tests Performed					
12/03/11	No Tests Performed					
12/02/11	0.0531	0.0847	0.1367	0.0300	0.0790	CSS

Approved By: _____ Date: _____

page 1 of 1 (Right)

Figures 6.17. *The Expanded Constancy Test data printout.*

View Geometry Data

(See Figure 6.18. And 6.19.)

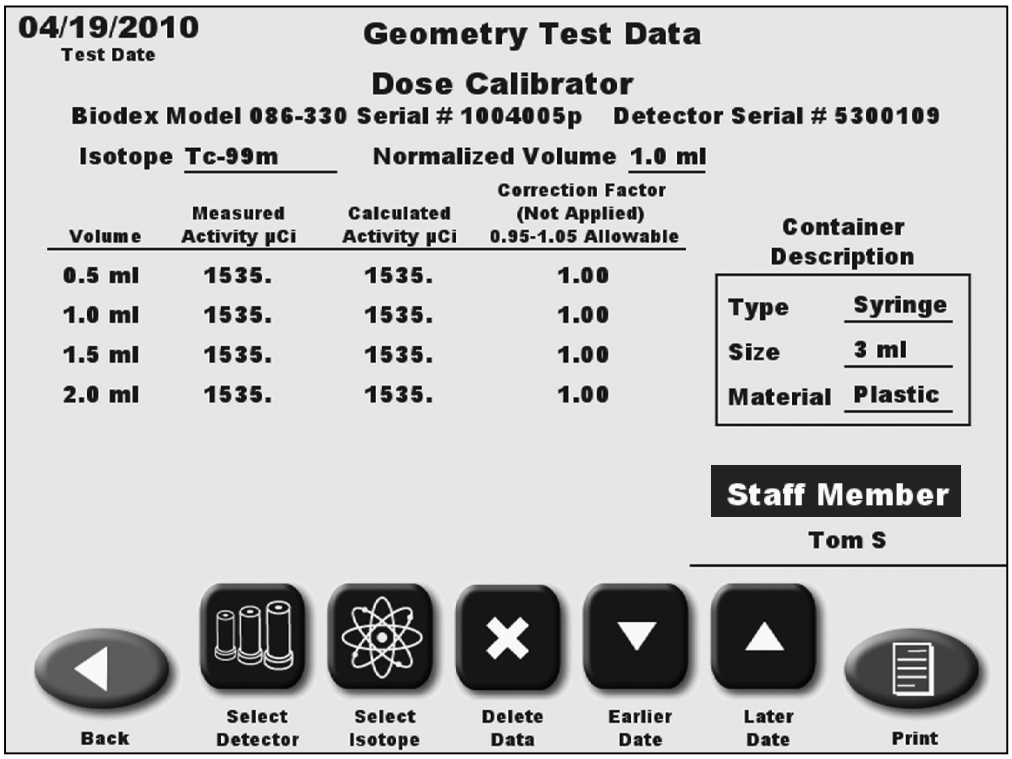


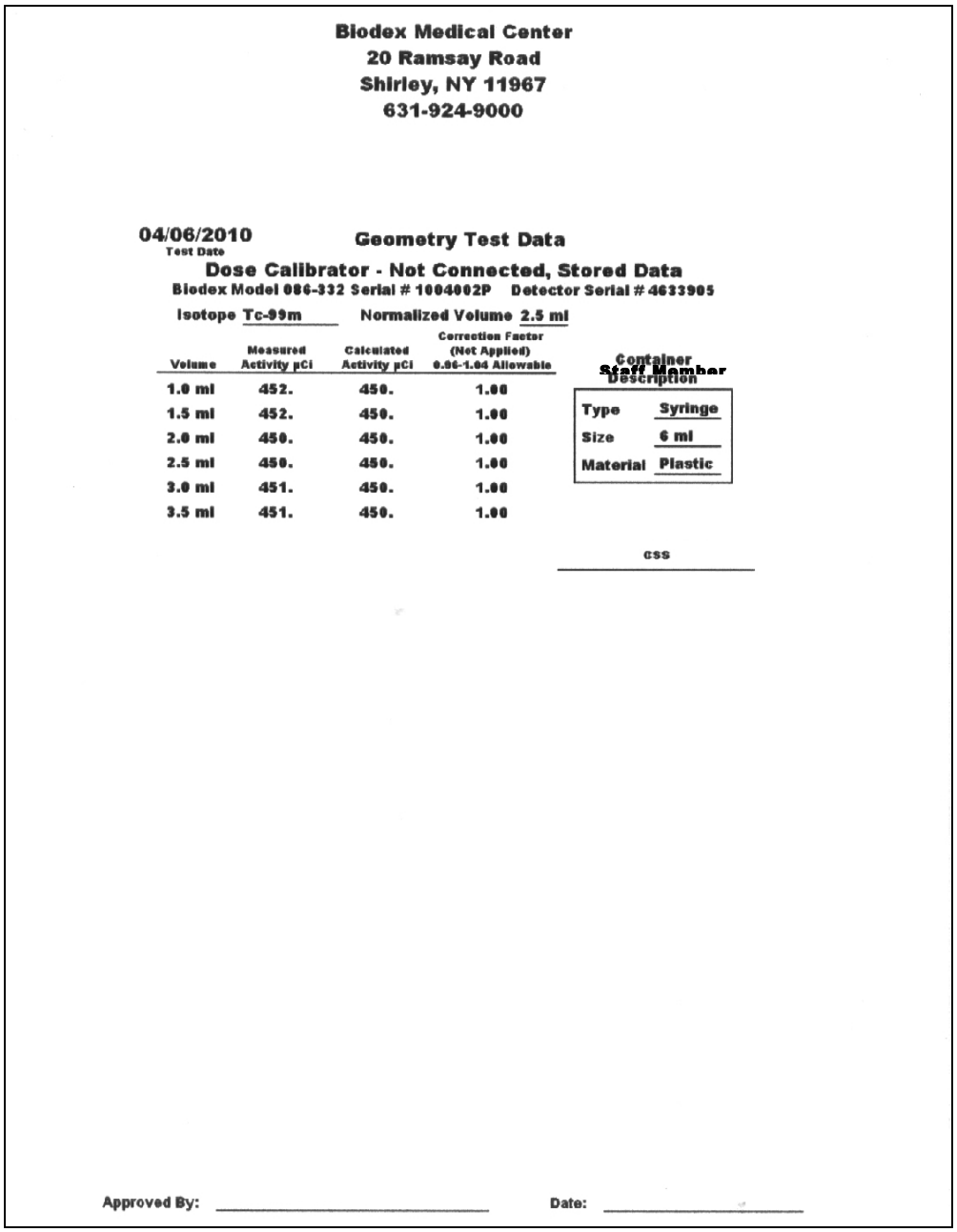
Figure 6.18. *The Geometry Test data screen.*

The View Geometry Data screen displays the Geometry Tests performed on the dose calibrator. The data is stored for each detector connected to the system. The display shows the individual isotope used for a Geometry Test. If multiple isotopes are used, you can view each isotope by using the <Select Isotope> button. Any Geometry Test outside the acceptable variance is shown in red. You can view previous Geometry Tests using <Earlier Date> or <Later Date> buttons.

- Touch <Back> to return to the QA Dose Calibrator screen.
- Touch <Select Detector>to select a different detector, if multiple detectors are connected.
- Touch <Select Isotope> to view the Isotope Lists and select the isotope to view for which a Geometry Test has been previously performed.
- Touch <Print> to print the Geometry Test data displayed.

To Delete Data:

1. Touch <Delete Data> and use the keypad to enter your password. Touch <Enter> to advance to the Geometry Test data screen.
2. Use <Earlier Date> or <Later Date> to scroll to the test to delete.
3. Touch <Delete Data>. The delete data confirmation screen is displayed. Touch <OK> to delete and return to the Geometry Test data screen.



Biodex Medical Center
20 Ramsay Road
Shirley, NY 11967
631-924-9000

04/06/2010
Test Date

Geometry Test Data

Dose Calibrator - Not Connected, Stored Data

Biodex Model 086-332 Serial # 1004002P Detector Serial # 4633905

Isotope Tc-99m Normalized Volume 2.5 ml

Volume	Measured Activity pCi	Calculated Activity pCi	Correction Factor (Net Applied) 0.96-1.04 Allowable
1.0 ml	452.	450.	1.00
1.5 ml	452.	450.	1.00
2.0 ml	450.	450.	1.00
2.5 ml	450.	450.	1.00
3.0 ml	451.	450.	1.00
3.5 ml	451.	450.	1.00

Container Description

Type Syringe
Size 6 ml
Material Plastic

Staff Member

CSS

Approved By: _____ Date: _____

Figure 6.19. *A Geometry Test data report.*

View Accuracy Data

(See Figures 6.20 and 6.21.)

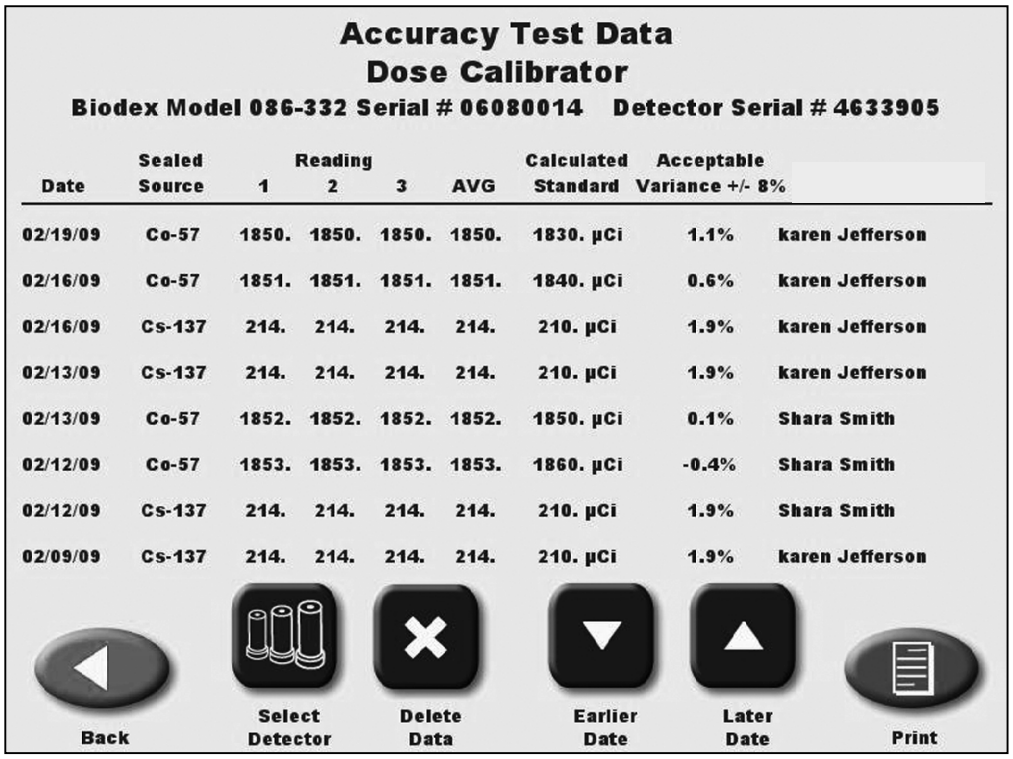


Figure 6.20. *The Accuracy Test data screen.*

The Accuracy Data screen displays the Accuracy Tests performed on the dose calibrator. The data is stored for each detector connected to the system. The display shows all the isotopes for which Accuracy Tests have been completed by the date performed. Any Accuracy Test outside the acceptable variance is shown in red.

- Touch <Back> to return to the QA Dose Calibrator screen.
- Touch <Select Detector>to select a different detector, if multiple detectors are connected.
- Touch <Print> to print the Accuracy Test data.
- Use the <Earlier Date> and <Later Date> keys to scroll through the Accuracy Test data list to test date desired.

To Delete Data:

1. Touch <Delete Data> and use the keypad to enter your password. Touch <Enter> to advance to the Accuracy Test data screen.
2. Use <Earlier Date> or <Later Date> to scroll to the test to delete.
3. Touch <Delete Data>. The Delete Data Confirmation screen is displayed. Touch <OK> to delete and return to the Accuracy Test data screen, or touch <Cancel> to return to the Accuracy Test data screen.

Shirley Medical Center
Main Road
Shirley, NY

Accuracy Test Data
Dose Calibrator

Biodex Model 086-330 Serial # 1004005p Detector Serial # 5300109

Date	Sealed Source	Reading 1	2	3	AVG	Calculated Standard	Acceptable Variance +/- 5%	
04/20/10	Co-57	1.54	1.54	1.54	1.54	1.57 mCi	-1.9%	Tom S
04/20/10	Co-57	1.53	1.53	1.53	1.53	1.57 mCi	-2.5%	Tom S
04/19/10	Co-57	1.52	1.52	1.52	1.52	1.58 mCi	-3.8%	Tom S
04/16/10	Co-57	1.56	1.56	1.56	1.56	1.59 mCi	-1.9%	Tom S
04/14/10	Co-57	1.56	1.56	1.56	1.56	1.60 mCi	-2.5%	Tom S
04/12/10	Co-57	1.61	1.61	1.61	1.61	1.60 mCi	0.6%	Tom S
04/11/10	Co-57	1.61	1.61	1.61	1.61	1.61 mCi	0.0%	Tom S
04/09/10	Co-57	1.61	1.61	1.61	1.61	1.62 mCi	-0.6%	Tom S

Approved By: _____ Date: _____

Figure 6.21. *An Accuracy Test data report.*

Linearity Testing

(See Figure 6.22)

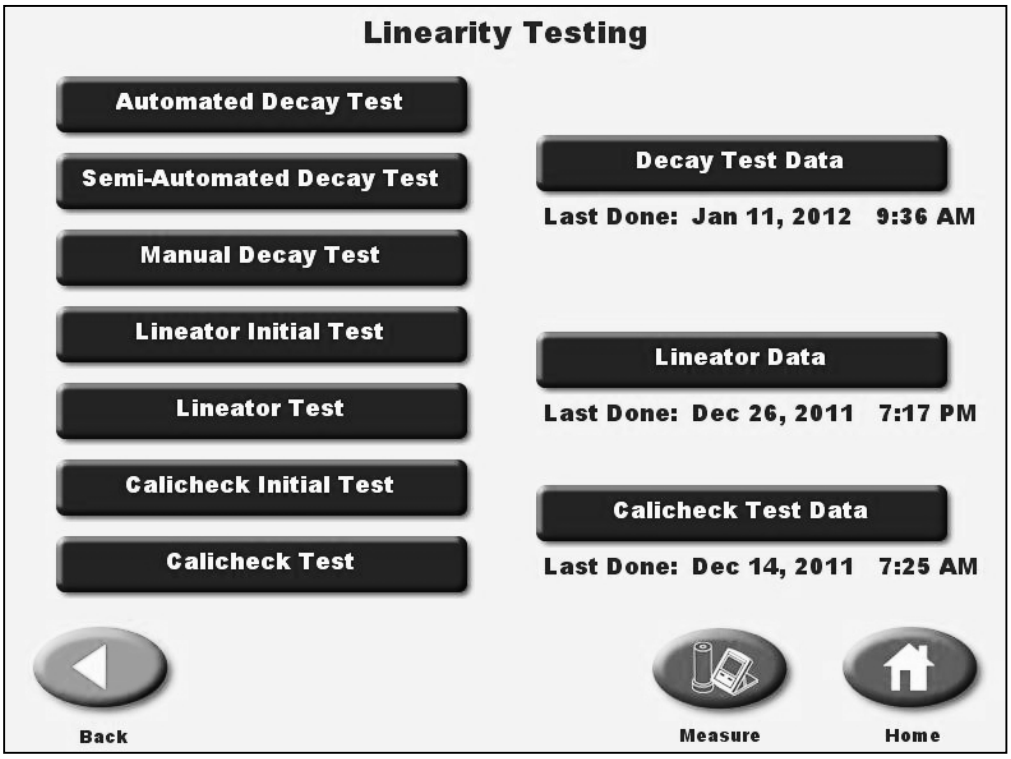


Figure 6.22. *The Linearity Testing screen.*

The linearity test is used on a dose calibrator to determine the variation in the displayed activity values from the true values, over a linear range of proportional source activities.

This test is usually performed using a vial or syringe of Tc-99m whose activity is at least as large as the maximum activity normally assayed in a prepared radiopharmaceutical kit, in a unit dosage syringe, or in a nuclearpharmaceutical therapy, whichever is largest.

Linearity means the proportionality of the measurement results to the activity measured, as determined over the intended range of use for the dose calibrator.

NOTE: *Other Isotopes such as F-18 can be used to perform linearity testing.*

There are several acceptable methods for performing linearity testing. The differences in these methods are all acceptable for determining the normalized value.

1. Decay correct the test sample from the first reading and compare each reading to the decay corrected reading.
2. For Tc-99m select 30 hours as the normalized reading, and decay correct this reading to calculate the expected activities at the times you took your readings. Compare the readings to the calculated activities. You can change from 30 hours to another time point and perform your normalized calculation from that time point. The Atomlab 500 automated linearity test uses 30 hours as the default method.

3. The average decay method described decay corrects each reading, then averages these calculated activities, and then divides the average by the time corrected reading to determine a correction factor. If the correction factor is between certain values, the calibrator is linear.

   See Appendix J for additional information.

Linearity Testing Options Include:

- Automated Decay Test
- Semi-Automated Decay Test
- Manual Decay Test
- Lineator Initial Test
- Lineator Test
- Calicheck Initial Test
- Calicheck Test
- Decay Test data
- Lineator Data
- Calicheck Test data

To Access The Linearity Testing menu:

1. From the QA Dose Calibrator screen touch <Linearity Testing>. The Linearity Testing screen is now displayed.
2. Touch to select the desired function.

Automated Decay Test

(See Figures 6.23 - 6.31)

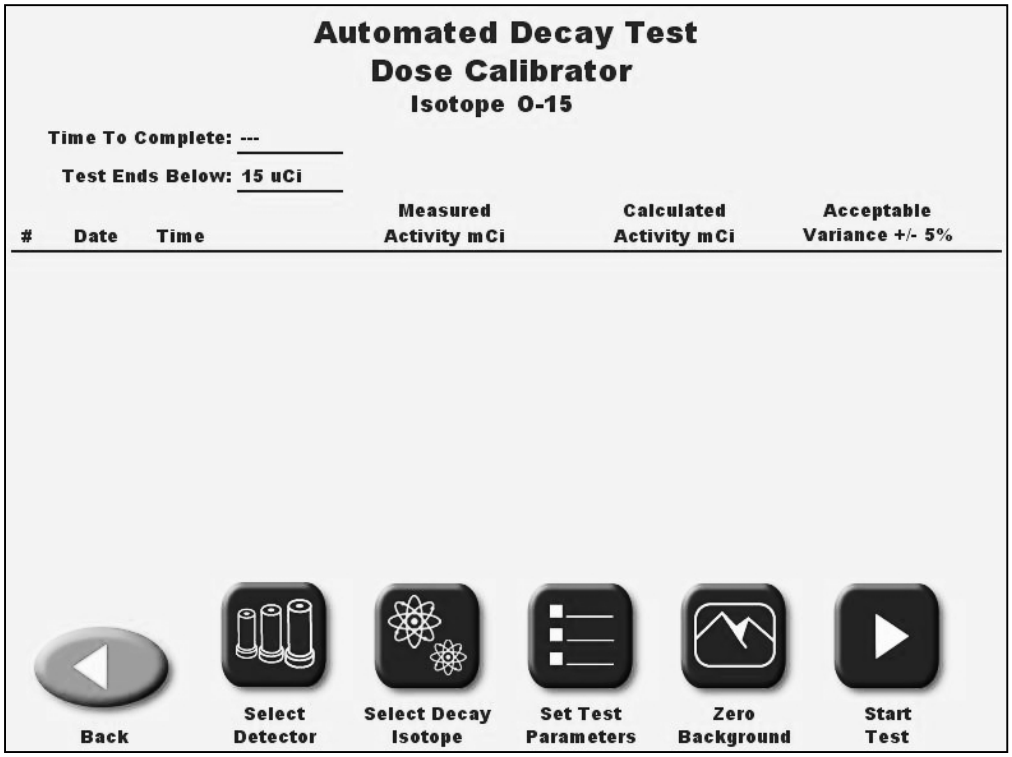


Figure 6.23. *The Automated Decay Test screen.*

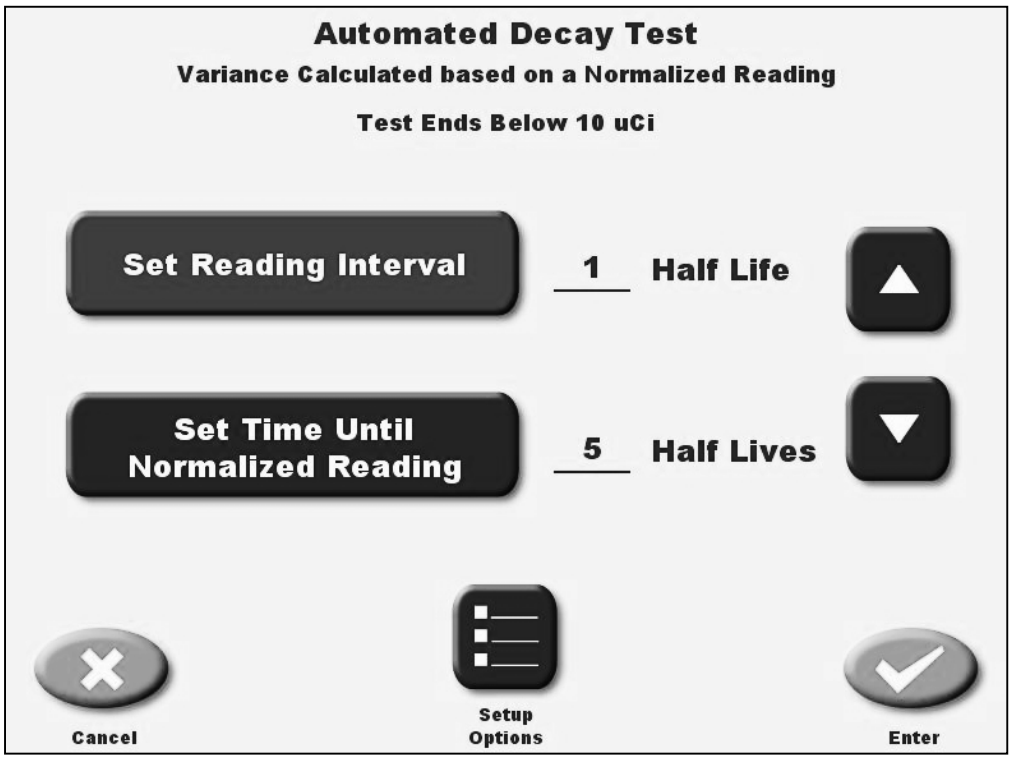


Figure 6.24. *The Automated Decay Test Set Parameters screen.*

The Automated Decay Test allows the user to set the number of counting points and the interval for each count that will be automatically taken. Once started, the Automated Decay Test will take readings without intervention. The Automated Decay Test can be paused to use the dose calibrator for measuring functions and still return to the Automated Decay Testing operation.

You can perform the automated decay linearity test taking readings by hours or half-life for the isotopes to be used. You also have a choice for the calculation method using a normalized reading or an averaging method for the calculation. These choices are made as part of setting the test parameters prior to starting the linearity test. There is a <Setup Options> button that is part of the setting test parameters. You can set the activity that you want the test to end below. The system defaults to 10 µCi.

To Perform An Automated Decay Test:

1. From the Linearity Testing menu, select <Automated Decay Test>. The Automated Decay Test screen is now displayed.
2. Select <Set Test Parameters>. The Automated Decay Test screen is displayed.
3. Select <Setup Options>. The Automated Decay Setup Options screen is displayed. From this screen, you can decide to perform the test using any of several methods including:
   - Normalized reading by hours: allows the user to set the reading interval at a set number of hours and set the time to be used for the normalized reading.
   - Normalized reading by half-life of the isotope selected: allows the user to set the reading interval by half-life and select which half-life reading will be used as the normalized reading.
   - Averaging calculation method with readings at a set number of hours: allows the user to set the number of hours between readings before the system calculates the results using the averaging method described in Appendix J, Linearity.
   - Averaging calculation method by half-life: allows the user to set the number of half-lives between readings before the system calculates the results using the averaging method described in Appendix J, Linearity.
4. Touch to highlight the linearity calculation method desired, normalized reading or averaging method.
5. Touch to highlight the reading interval units desired, by hours or by half-lives
6. Test Ends Below defaults to 10 µCi this can be changed by touching <Test Ends Below>, which brings up a keypad to enter the activity at which the test should end. You can set this number between 10 and 50 µCi.
7. Touch <Enter> to return to the Automated Decay Test set reading interval screen.

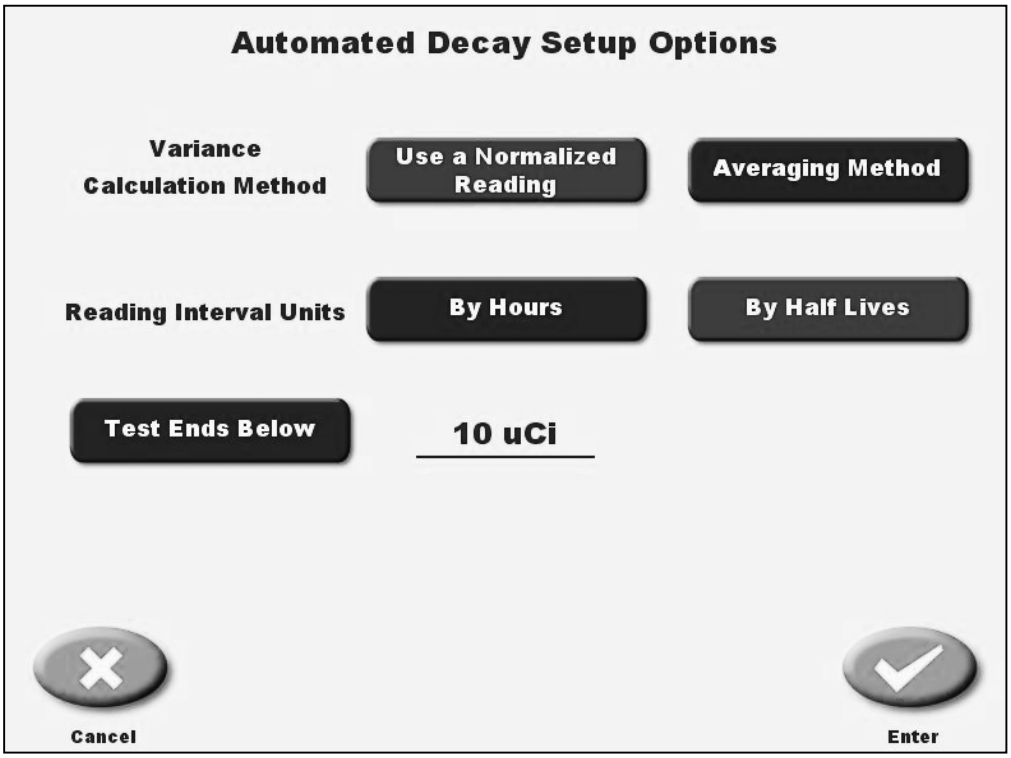


***Figure 6.25**. The Automated Decay Setup Options screen.*

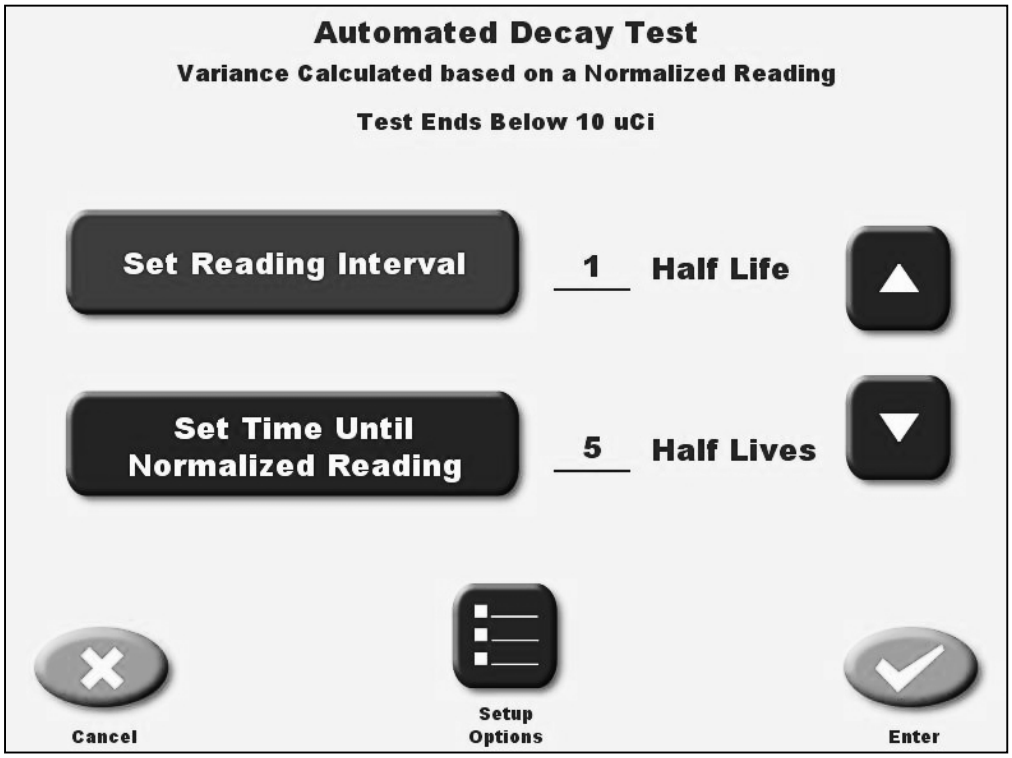


***Figure 6.26.** Automated Decay Test Set Intervals screen.*

8. Set the reading interval in either half-lives or hours depending on your selections above. Use the <▲> and <▼> to increase or decrease the reading interval.
9. Touch to highlight the <set time until normalized reading> button if you are using a normalized calculation method. Use the <▲> and <▼> to increase and decrease what will be the normalized reading for the calculation.

   NOTE: *The averaging method does not have a normalized reading.*

10. Touch <Enter> to return to the Automated Decay Test screen. The live detector reading is displayed in red on the screen. <Zero Background> if required.
11. Place your source into the detector. You can use Tc-99m, or another short half-life isotope to perform the linearity test.
12. Touch <Start Test> to record the first test reading. The system will automatically show the isotope activity as it is decaying and the clock time increasing from when the test began. The system will automatically take the next reading, and the ones after that, at the proper elapsed time.

    NOTE: *Touch <Pause> Test to pause the test and allow use of the dose calibrator for counting or other functions, such as choosing <Measure> to return to standard DOSE CALIBRATOR OPERATION.*

    NOTE: *You can pause the test, remove the source from the chamber, and perform a <Zero Background> if desired. It is important to Zero Background at low activity if the room background level changes.*

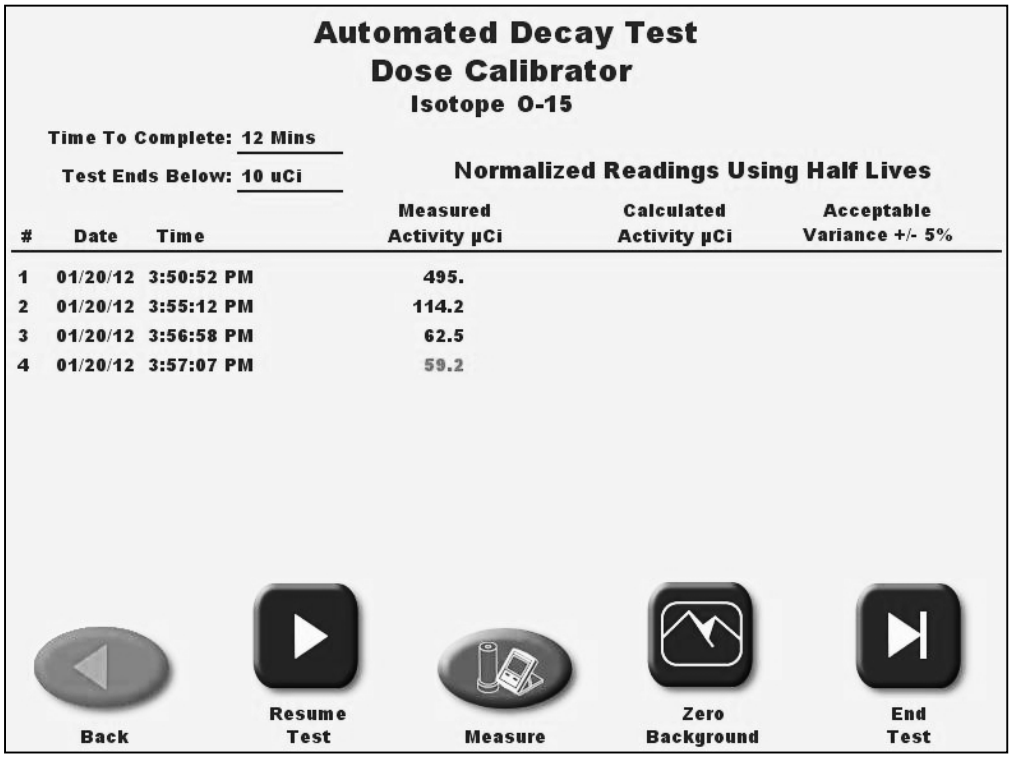


Figure 6.27. *Automated Decay Test screen.*

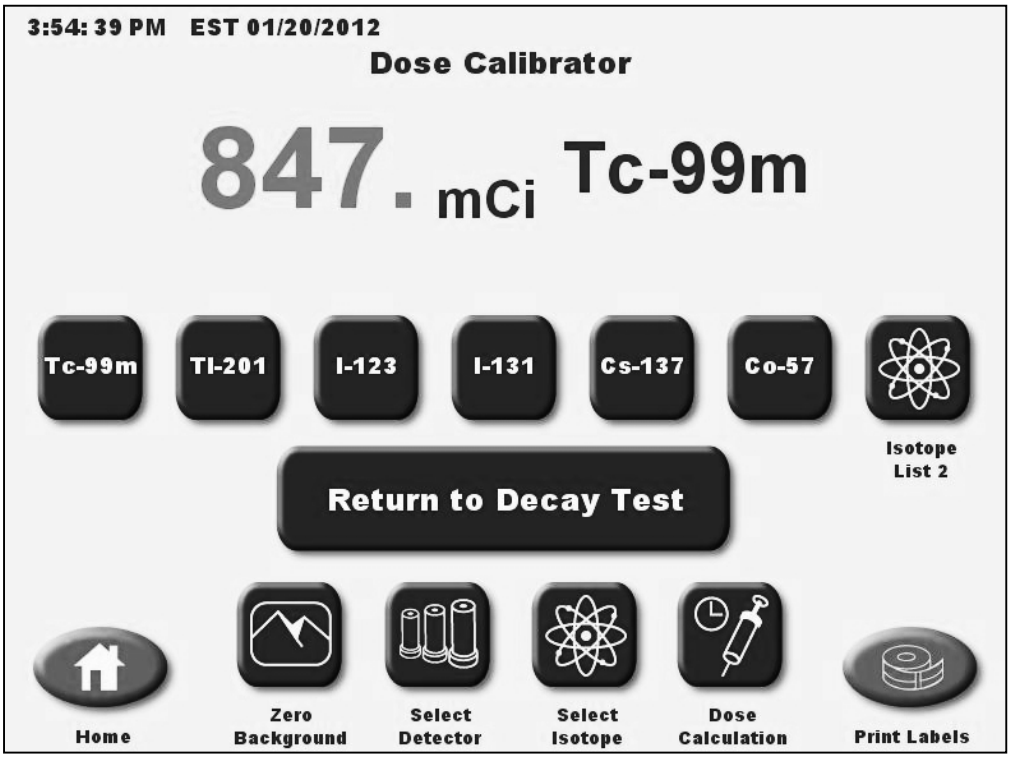


Figure 6.28. *The Measuring screen during <Pause Test>.*

13. Touch <Measure> to advance to the Measure screen and use the system as a standard dose calibrator. Touch <Return to Decay Test> on the Measure screen to return to the automated decay test. Then touch <Resume Test> to resume the Automated Decay Test.

NOTE: *Remember to place the source back into the detector before you select <Resume Test>.*

NOTE: *If the time for the reading has passed, the system will take a reading and record the time once you have resumed the test. It does not skip a reading that was not taken at the correct time.*

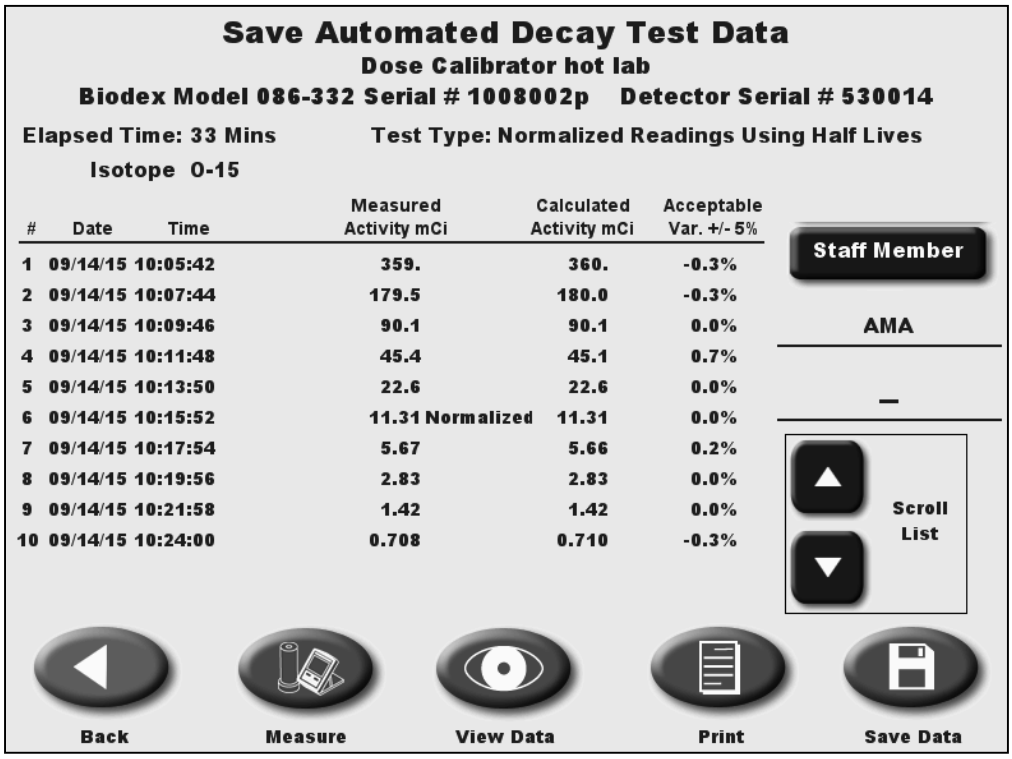


Figure 6.29. *The Save Automated Decay Test screen.*

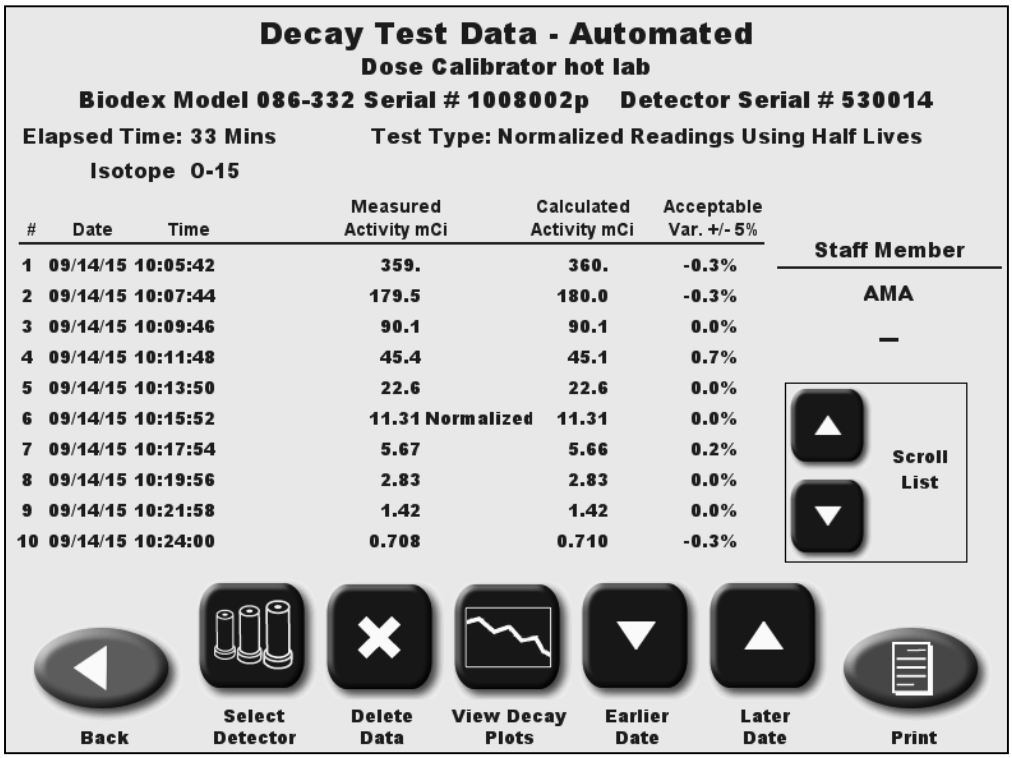


Figure 6.30. *The Automated Decay Test Data screen.*

14. Touch <End Test> once enough decay points have been recorded to end the test. The system automatically takes a final reading and ends the test when the activity is below 10 µCi. Once the test has ended, the system allows you to <Select Normalized Reading> and change which reading is selected as the normalized value. The Count time measured closest to the normalized reading time will be highlighted to be used as the normalized reading. You can highlight to change what will be used for the normalized reading by touching to highlight a different reading.
15. Touch <OK> to accept the reading and return to the Automated Decay Test screen. The screen now shows that the test has ended. If you touch <Back>, a prompt is displayed noting that recorded data will be lost. Touch <Yes> to discard the data. Touch <No> to return to the test ended screen.
16. Touch <Save Data> to save the data.
17. If the appropriate technologist is not displayed, touch <Technologist>. The Technologist List is displayed. Touch to highlight any listed technologist. (If you have previously selected a technologist, the system will default to that technologist on the Automated Decay Test screen.) Then touch <Save Data> again to save the data in memory.
18. Touch <Print> to print the data from your linearity test.
19. Touch <View Data>, then touch <view decay plots> to plot your linearity results. Now touch <Print> to print the decay plot with the data.
20. Touch <Back> four times to return to the Linearity Testing screen.

Linearity Automated Decay Test

⚠ ***WARNING:*** *There are several important items to know when using the Automated Decay Test.*

1. There are a maximum of 24 readings for the Automated Decay Test. The test will stop after the 24th reading, regardless of the activity reading. It will also stop when the reading drops below 10 µCi's.

⚠ ***WARNING:*** *NORMALIZED READING is traditionally set to the middle linearity measurement. This is the measurement that pre-calibration and post-calibration factors are applied to for determining the calculated activity. Some users set the 1st reading as the normalized reading.*

2. The Automated Linearity Test will end automatically when the activity reading falls below 10 µCi's.
3. If you choose a normalized reading that occurs after the 10 µCi reading, the system will automatically select the middle reading as the normalized value.

4. The Automated Decay Test displays the time to complete the test in the upper left of the screen. This calculation is based on the half-life of the isotope being used to perform the test and the activity reading from the first measurement.

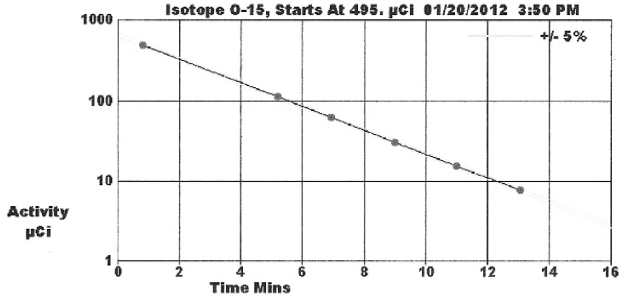
   Example: If you are using Tc-99m for linearity:
   Starting Activity: 250 mCi
   Half Life:6 hours
   Time required for activity to decay below 10 µCi's is 96 hours

NOTES:

- *Taking measurements every 6 hours will require 16 readings to decay below 10 µCi.*
- *Taking measurements every 2 hours would require 48 readings to decay below 10 µCi, which will exceed the maximum number of 24 readings for the Atomlab 500.*
- *To record readings every 2 hours using Tc-99m, you could begin a test, take 24 readings and then start a second linearity test and record a second set of readings. (Each set of 24 readings has its own normalized value).*
  The two linearity tests would then cover the required time and activity for the linearity test.
- *A linearity test with Tc-99m is normally measured at 6 hour intervals.*
- *Make sure your parameters are set up with enough readings to complete the linearity test.*

Decay Test Data - Automated

Biodex Model 086-332 Serial # 1008002p Detector Serial # 73686067



Initial Activity: 495. µCi Isotope: O-15
Elapsed Time: 12 Mins Number of Readings: 6
Reading Interval: 1 Half-Life (2.037 mins) Technologist: CSS
Calculation Method: Normalized

#	Date	Time	Measured Activity µCi		Calculated Activity µCi	Acceptable Variance +/- 5%
1	01/20/12	3:50:52 PM	495.		497.	-0.4%
2	01/20/12	3:55:12 PM	114.2		113.8	0.4%
3	01/20/12	3:56:58 PM	62.5		62.4	0.2%
4	01/20/12	3:59:00 PM	31.2	Normalized	31.2	0.0%
5	01/20/12	4:01:02 PM	15.6		15.6	0.0%
6	01/20/12	4:03:04 PM	7.8		7.8	0.0%

Approved By: _____ Date: _____

Figure 6.31. *An Automated Decay Test Data Report.*

Semi-Automated Manual Decay Test

(See Figures 6.32 - 6.39.)

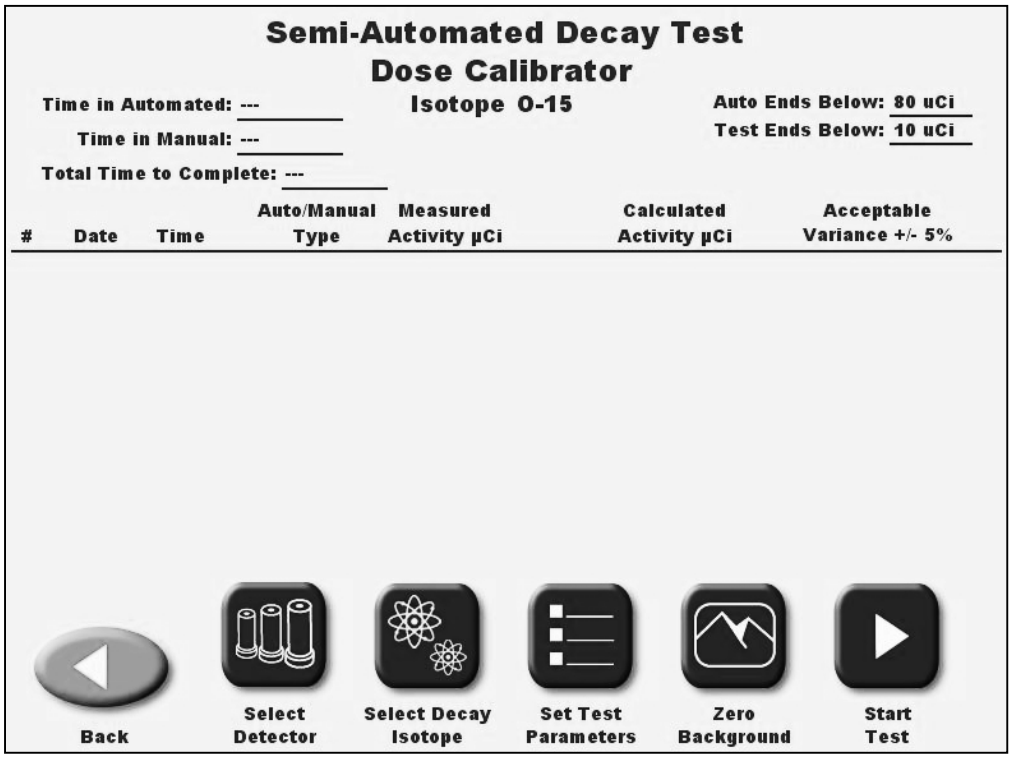


Figure 6.32. *The Semi-Automated Decay Test screen.*

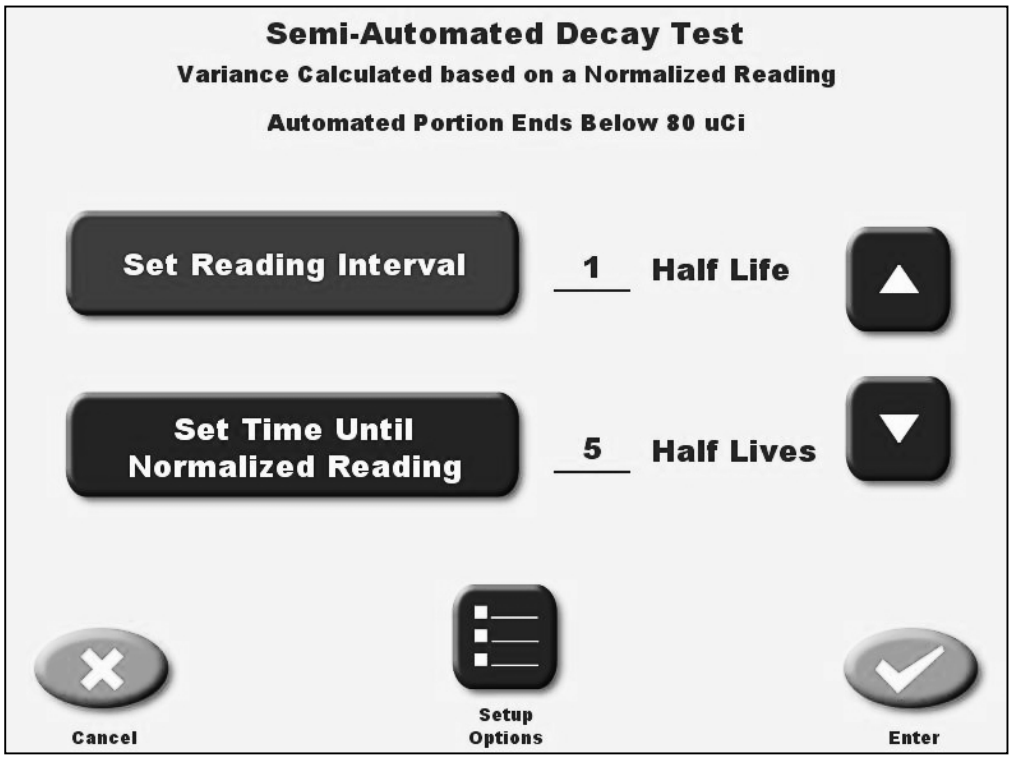


Figure 6.33. *The Semi-Automated Decay Test Parameters screen.*

The Semi-Automated Decay Test allows the user to begin a linearity test using the automated test method while the activity level is high and then switch to the manual test method to complete the test. This method prevents changing background levels from greatly affecting the reading at low activity values. The switchover to manual mode defaults to 100 µCi. The switch from auto to manual can be set from 50 µCi to 500 µCi.

To Perform A Semi-Automated Decay Test:

1. From the Linearity Testing menu, select <Semi-Automated Decay Test>. The Semi-Automated Decay Test screen is now displayed.
2. Select <Set Test Parameters>. The Semi-Automated Decay Test Set Test Parameters screen is displayed. From this screen the user can set the reading interval and set the time until normalized reading. Touch to highlight the desired setting and use the <▲> and <▼> keys to adjust the value.
3. Select <Setup Options>. The semi-automated decay setup options screen is displayed. From this screen the user can decide to perform the test using any of several methods including:
   - Normalized reading by hours: allows the user to set the reading interval at a set number of hours and set the time to be used for the normalized reading.
   - Normalized reading by half-life of the isotope selected: allows the user to set the reading interval by half-life and select which half-life reading will be used as the normalized reading.
   - Averaging calculation method with readings at a set number of hours: allows the user to set the number of hours between readings before the system calculates before the system calculates the results using the averaging method described in Appendix J, Linearity.
   - Averaging calculation method by half-life: allows the user to set the number of half-lives between readings before the system calculates the results.
4. Touch to highlight the desired variance calculation method.
5. Touch to highlight the desired reading interval units.
6. Touch to highlight <Test Ends Below> and enter the activity level at which the test should be ended. Touch <Enter> to record this value and return to the Semi-Automated Decay Setup Options screen.
7. Automated Ends Below displays the default activity to end the automated portion of the test. If the value displayed is not appropriate, touch <Automated Ends Below> and use the keypad to enter an activity between 50 and 500 µCi at which the automated portion of the test should end.
8. When all setup options have been addressed on the semi-automated decay setup options screen, touch <Enter> twice to record all settings and return to the Semi-Automated Decay Test screen. The live detector reading is displayed in red on the screen. If necessary, touch <Zero Background> to perform a Zero Background reading at this point.
9. Place the Tc-99m, or another short half-life isotope, into the dipper and then place the dipper with the source into the detector to perform the linearity test.

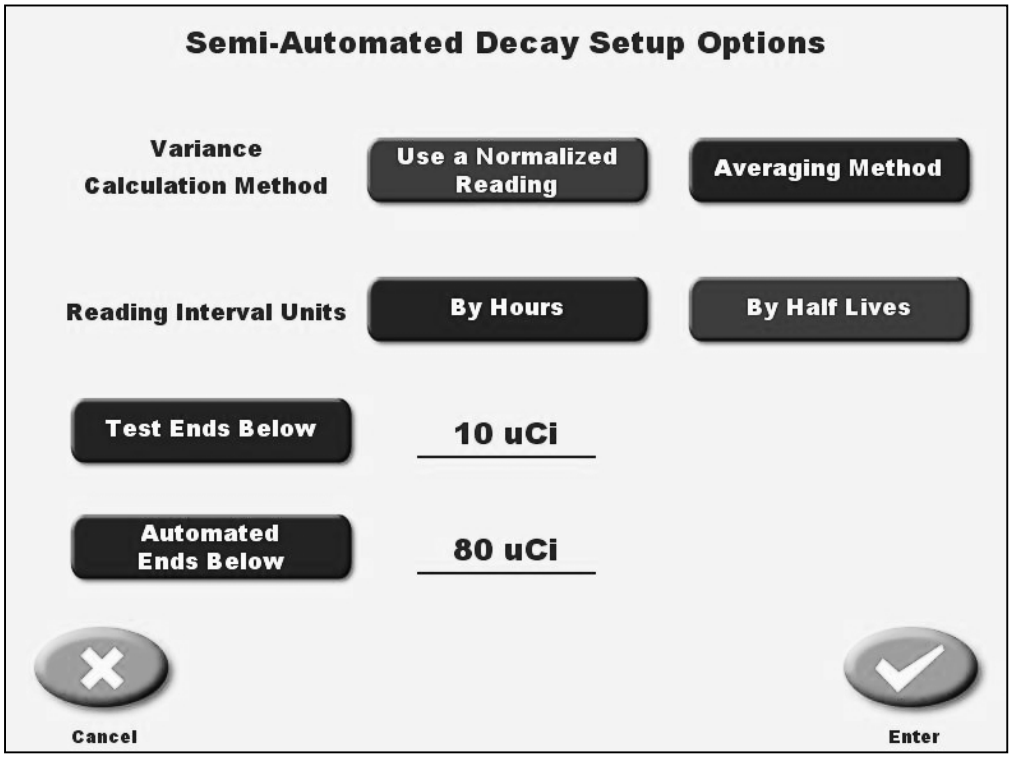


Figure 6.34. *The Semi-Automated Decay Setup Options screen.*

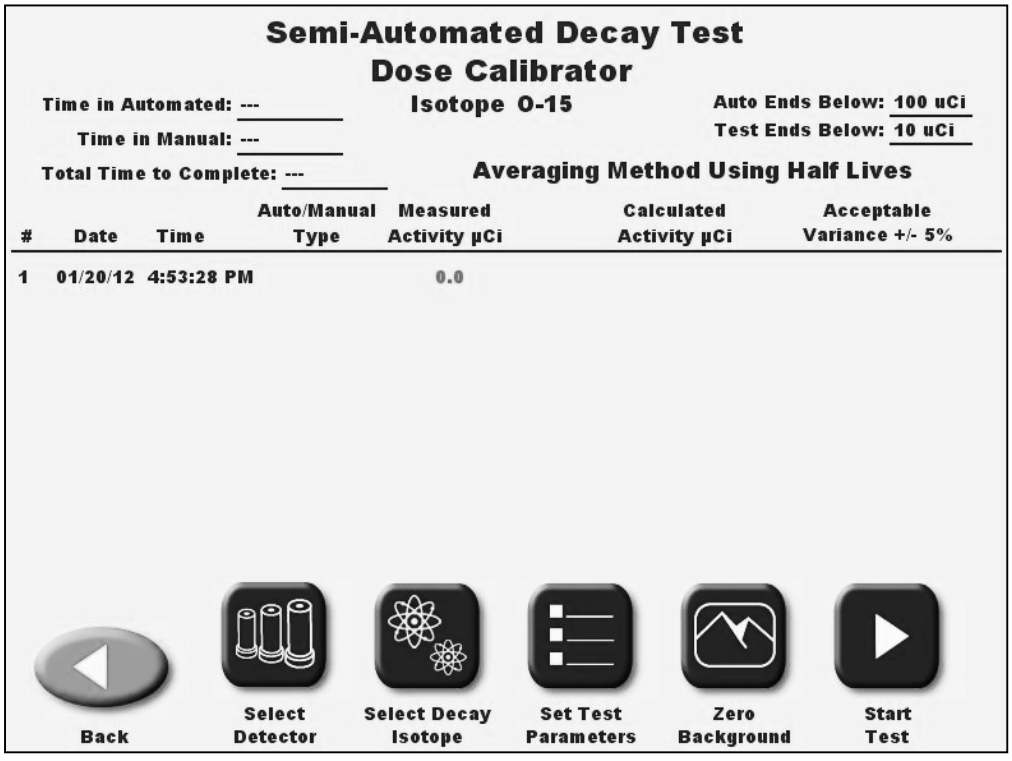


Figure 6.35. *The Semi-Automated Decay Test screen using averaging method.*

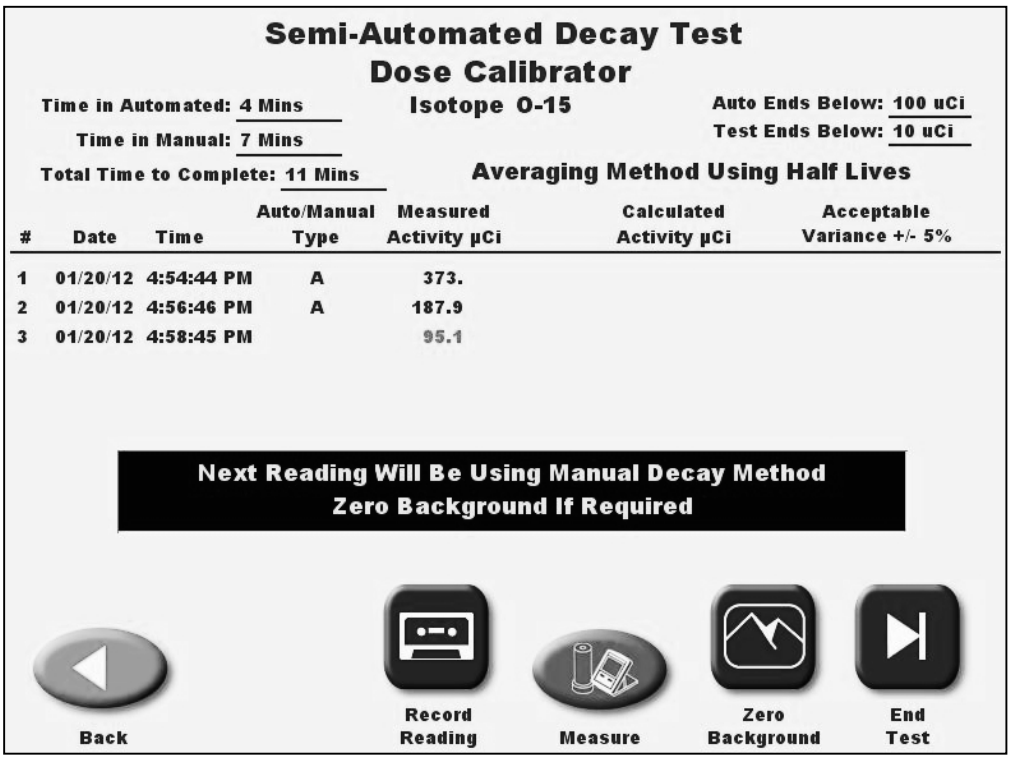


Figure 6.36. *The Semi-Automated Switchover to Manual Mode screen.*

10. Touch <Start Test> to record the first reading. The system will automatically show the isotope activity as it is decaying and the clock time increasing from when the test began. The system will automatically take the next reading, and the ones after that at the proper elapsed time, until the activity set for automated Ends Below is reached.
11. When the activity level set for automated Ends Below is reached, the system will display a message that it is changing to manual readings. From that point, any readings require the user to touch <Record Reading> to take the reading.

NOTE: Once the system switches to manual mode, remove the source and dipper from the detector and perform a Zero Background before putting the source and dipper back into the detector and recording a reading.

12. Once the reading has stabilized after the source has been returned to the detector, touch <Record Reading>. The reading is recorded and the next line for the manual Semi-Automated Decay Test is displayed. The system will continue to display a live reading until <Record Reading> is selected.
13. Continue taking readings at the appropriate time intervals by touching <Record Reading>.

NOTE: *Touch <Pause> at any time during the automated portion to pause the test and allow use of the dose calibrator for counting and other functions, such as choosing <Measure> to return to standard DOSE CALIBRATOR OPERATION.*

NOTE: *When in the manual portion of the test you can press <Measure> to go to the Measure screen to use the system as a Dose Calibrator.*

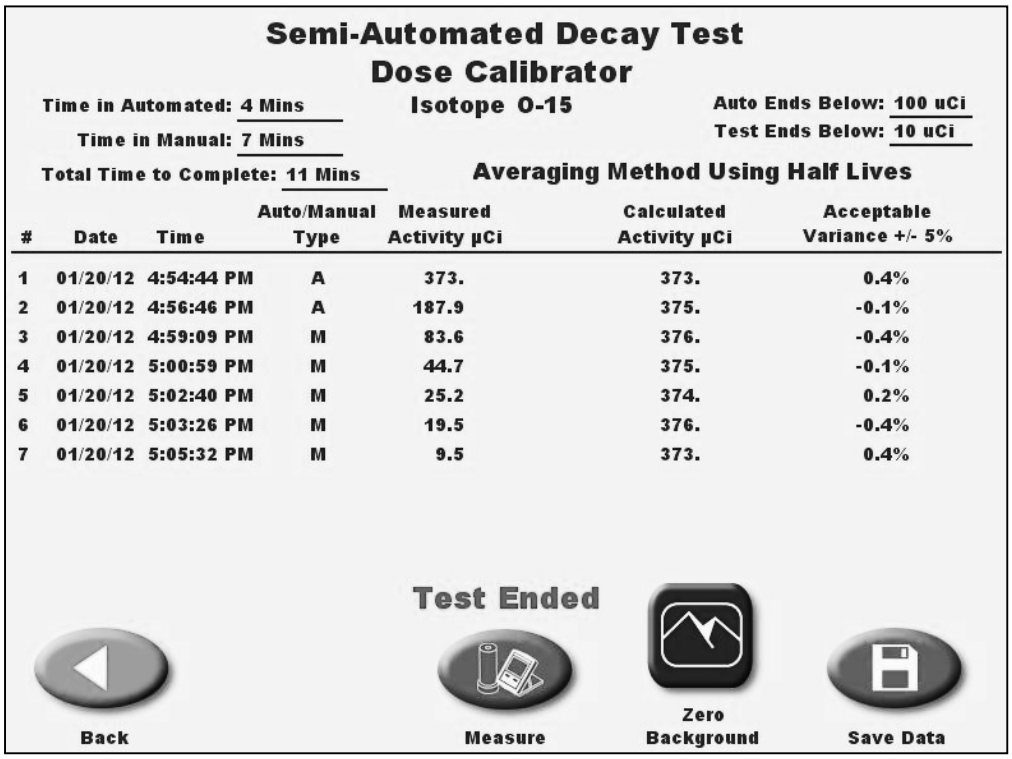


Figure 6.37. *The Semi-Automated Decay Test Ended screen.*

NOTE: *When in the manual portion the system works like the Manual Decay Test.*

14. Touch <End Test> to end the test and advance to the normalized reading screen.
15. Touch <Select Normalized Reading>. The Select Normalized Reading screen is displayed. the last reading taken is highlighted as the normalized reading. To select a different normalized reading, touch to highlight the reading and then touch <OK>. The new reading is selected and will serve as the normalized reading. The system returns to the Manual Decay Test screen.

    NOTE: *You can also select the normalized reading while the Semi-Automated Decay Test is underway. If you have not selected a normalized reading before selecting <End Test>, the system automatically displays the Select Normalized Reading screen from which you can select which reading to use as normalized.*

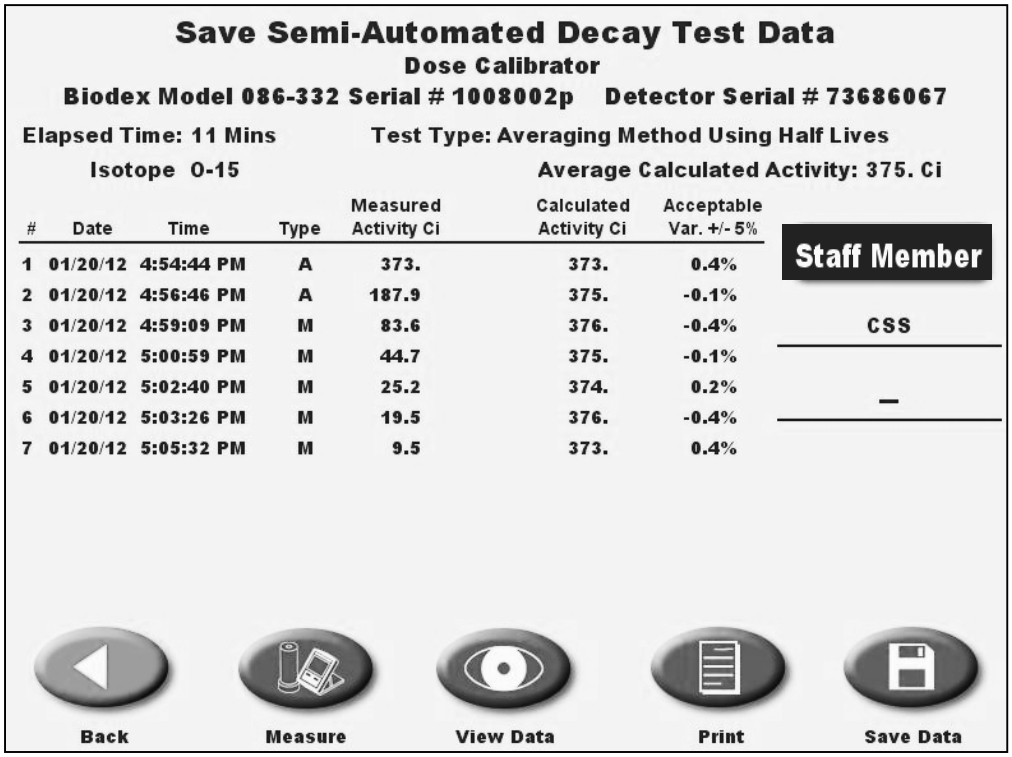
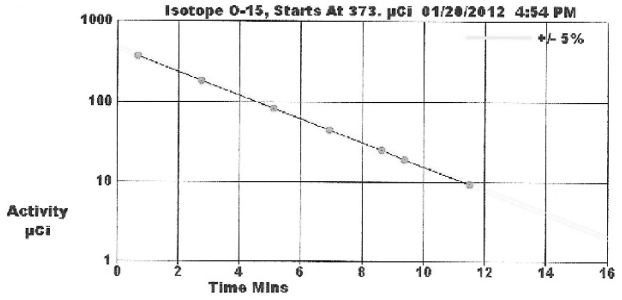


Figure 6.38. *The Semi-Automated Decay Test data screen.*

Decay Test Data - Semi-Automated

Biodex Model 086-332 Serial # 1008002p Detector Serial # 73688067



Initial Activity: 373. µCi
Elapsed Time: 11 Mins
Isotope: O-15
Number of Readings: 7
Technologist: CSS
Calculation Method: Averaged

#	Date	Time	Type	Measured Activity µCi	Calculated Activity µCi	Avg Calc Activity µCi	Acceptable Variance +/- 5%
1	01/20/12	4:54:44 PM	A	373.	373.	375.	0.4%
2	01/20/12	4:56:46 PM	A	187.9	375.	375.	-0.1%
3	01/20/12	4:59:09 PM	M	83.6	376.	375.	-0.4%
4	01/20/12	5:00:59 PM	M	44.7	375.	375.	-0.1%
5	01/20/12	5:02:40 PM	M	25.2	374.	375.	0.2%
6	01/20/12	5:03:26 PM	M	19.5	376.	375.	-0.4%
7	01/20/12	5:05:32 PM	M	9.5	373.	375.	0.4%

Approved By: _____ Date: _____

Figure 6.39. *The Semi-Automated Decay Test Averaging Method Data printout.*

Manual Decay Test

(See Figures 6.40 - 6.44.)

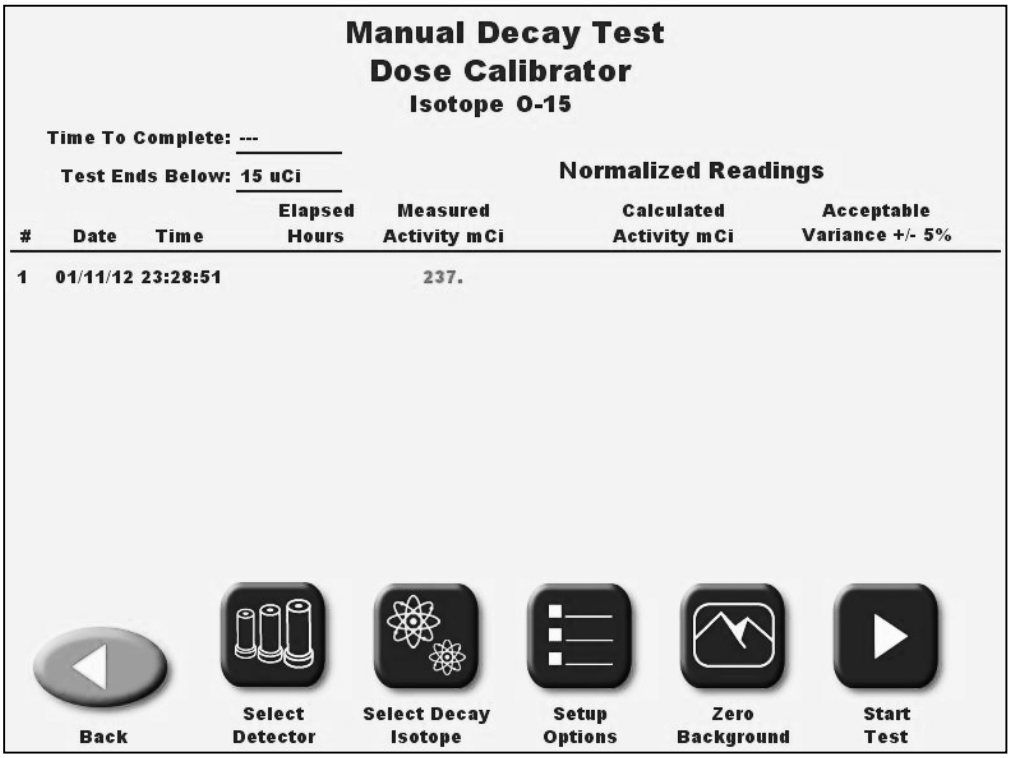


Figure 6.40. *The Manual Decay Test screen.*

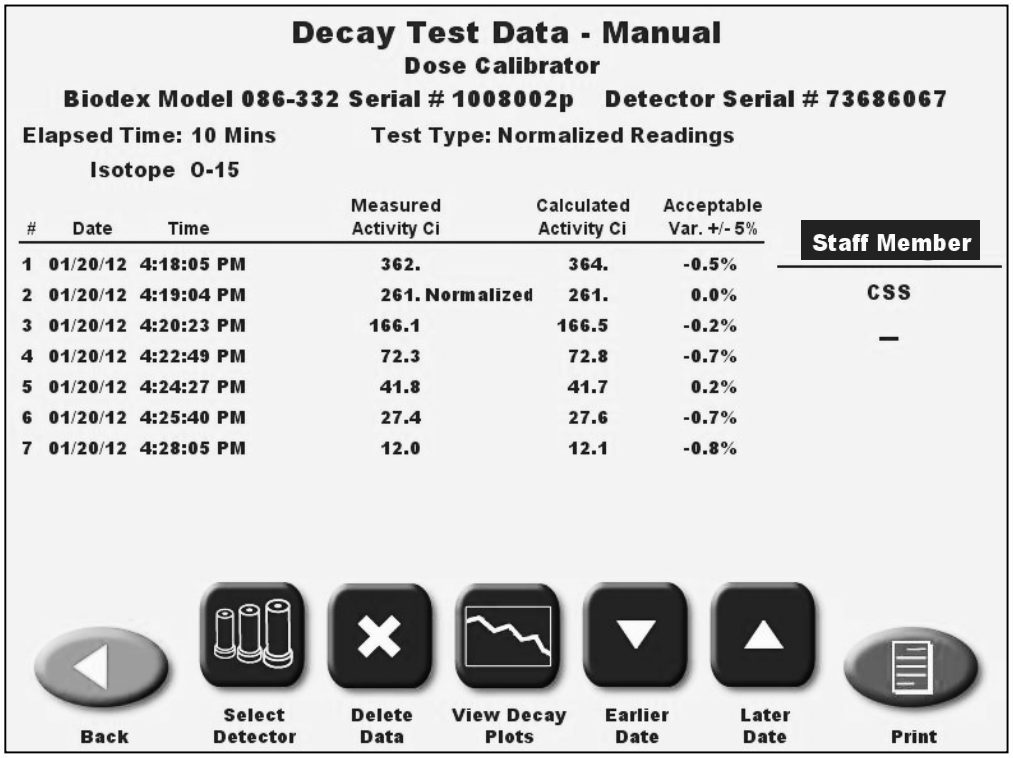


Figure 6.41. *The Manual Decay Test View Data screen.*

This test allows the user to record the linearity readings each time that <Record Reading> is touched. You have a choice for the calculation method using a normalized reading or an averaging method for the calculation. This choice is made as part of setting the test parameters prior to starting the linearity test. The manual decay test can be paused to use the dose calibrator for measuring functions and still return to the manual decay testing operation.

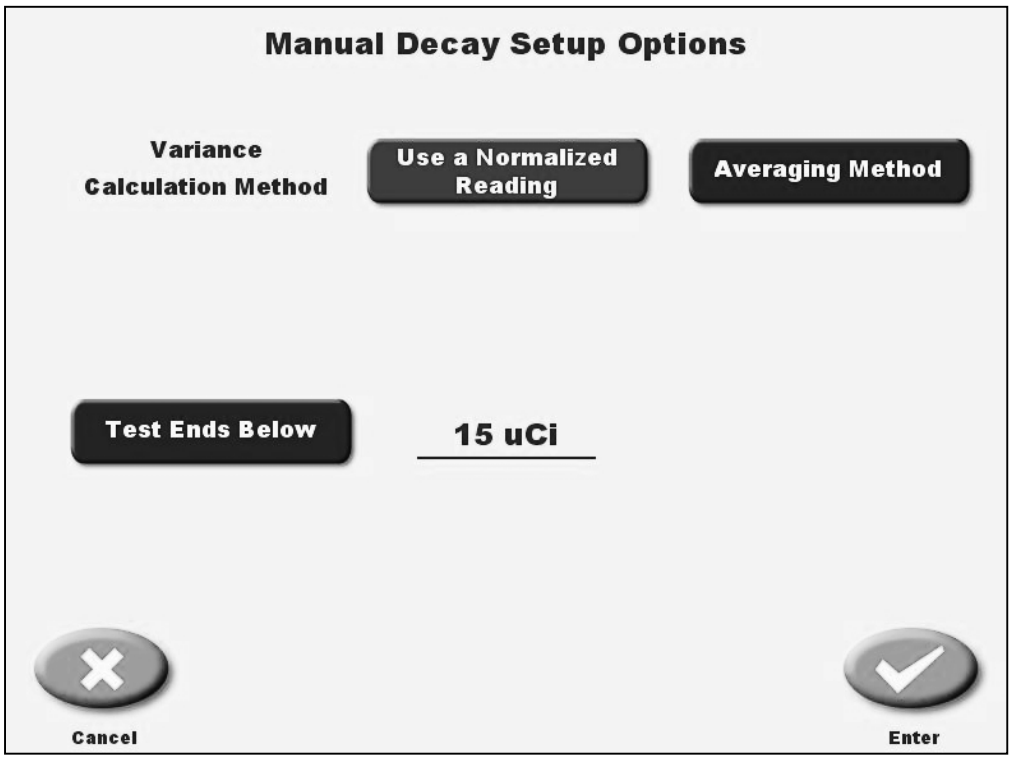


Figure 6.42. *The Manual Decay Select Setup Options screen.*

To Select Setup Options:

1. From the Manual Decay Test screen, touch <Setup Options>. The Manual Setup Options screen is displayed.
2. Choose the variance calculation method, either <Use a Normalized Reading> or <Averaging Method>.
3. If you select <Use a Normalized Reading>, touch <Enter> to go to the Manual Decay Test screen. (The normalized reading is selected at the end of the test.) If you select <Averaging Method>, the system performs the averaging calculation once the test is ended.
4. Test Ends Below defaults to 10 µCi. This can be changed by touching <Test Ends Below>, which brings up a keypad to enter the activity at which the test should end. You can set this number between 10 and 50 µCi.
5. Touch <Enter> to return to the Manual Decay Test screen with the new variance calculation method selected, or <Cancel> to return to the Manual Decay Test screen without selecting a new calculation method.

To Perform A Manual Decay Test:

1. From the Linearity Testing Menu, touch <Manual Decay Test>. The Manual Decay Test screen is now displayed.
   - Touch <Back> to return to the Linearity Testing screen.
   - Touch <Select Detector> to select a different detector if multiple detectors are selected.
   - Touch <Select Decay Isotope> to select the isotope to be used in the decay test.
   - Touch <Select Setup Options> to select setup options.
   - Touch <Zero Background> to zero the background reading if necessary.
2. Touch <Start Test> to begin the manual decay test. The Manual Decay Test screen is displayed.
3. Place the source to be used into a dipper and then place the dipper with the source into the chamber.
4. Once the reading has stabilized, touch <Record Reading>. The reading is recorded and the next line for the manual decay test is displayed. The system will continue to display a live reading until <Record Reading> is selected.
5. Continue taking readings at the appropriate time intervals by touching <Record Reading>.

   NOTE: *If you need to use the calibrator for counting doses, touch <Measure> to advance to the Measure screen. Touch <Return to Manual Decay Test> to go back to the manual decay test.*

6. Touch <End Test> to end the test and advance to the Normalized Reading screen.

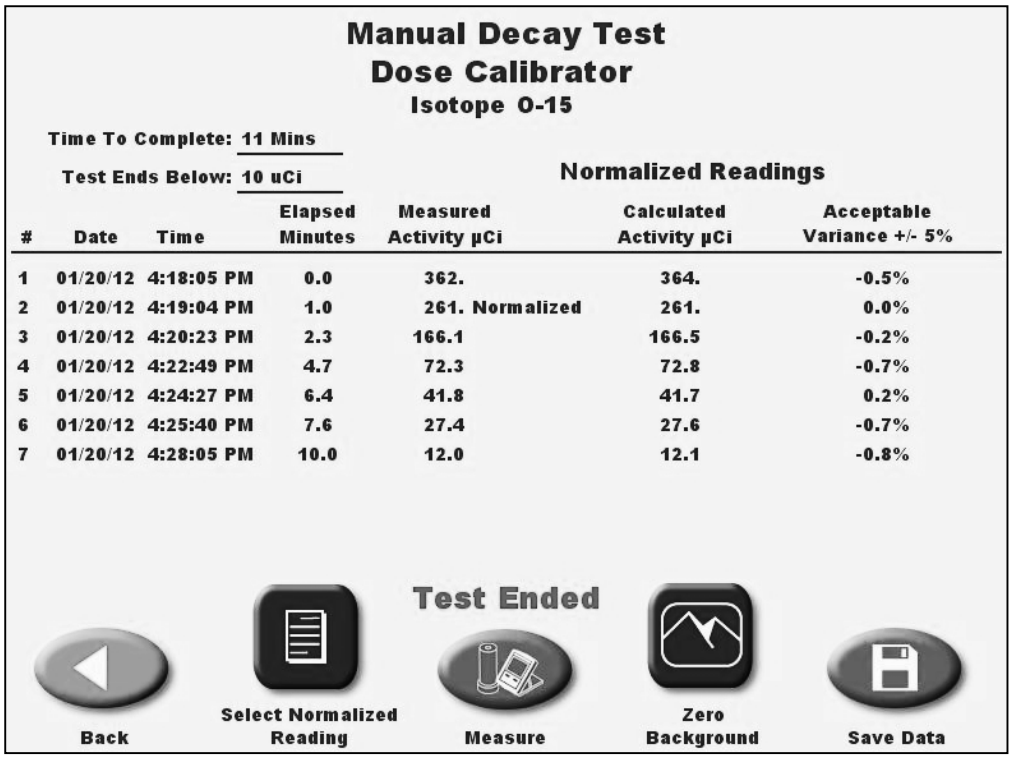
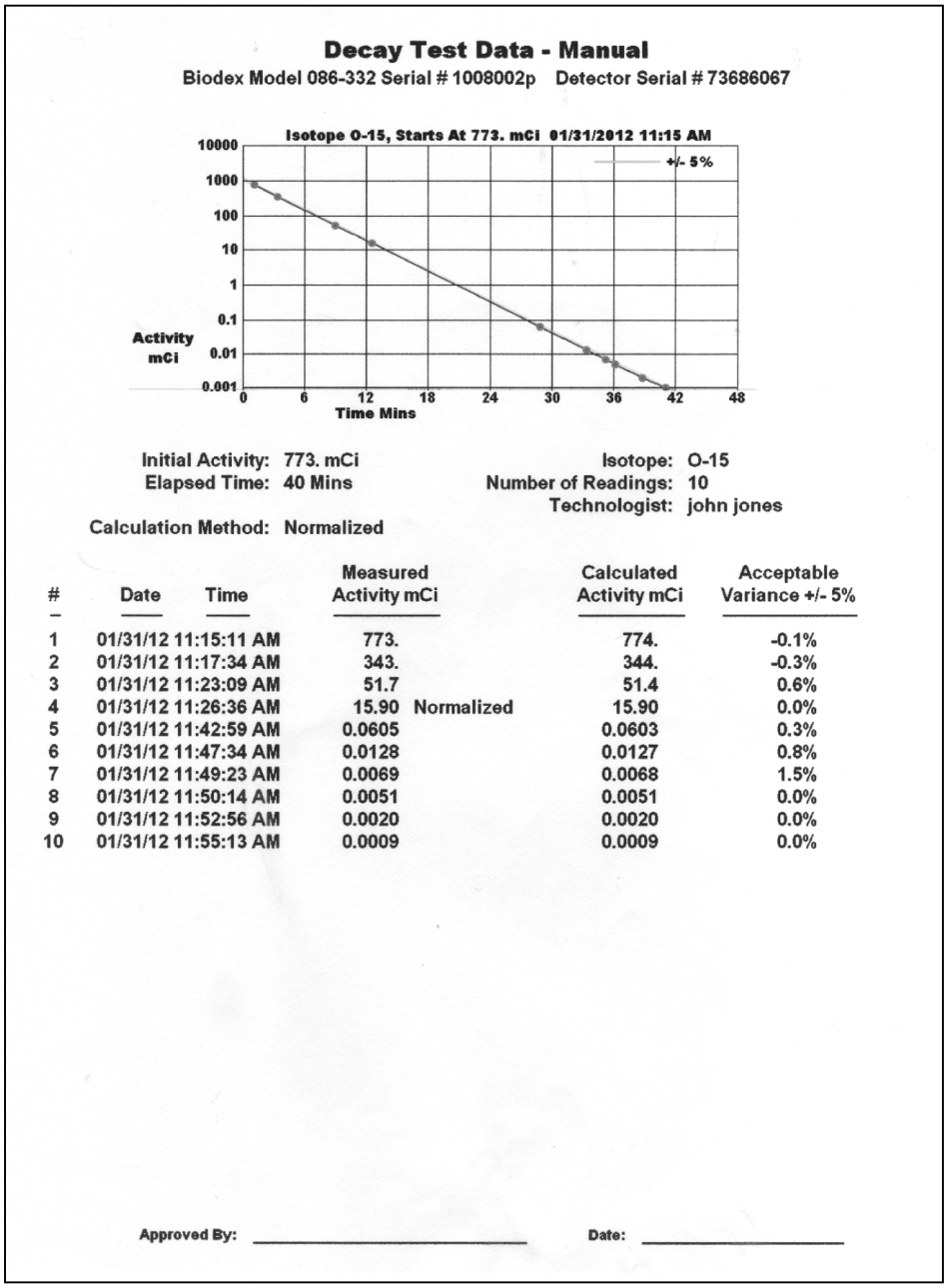


Figure 6.43. *The Manual Decay Test screen with Test Ended message and data displayed*

7. Touch <Select Normalized Reading>. The Select Normalized Reading screen is displayed. The last reading taken is highlighted as the normalized reading. To select a different normalized reading, touch to highlight the reading and then touch <OK>. The new reading is selected and will serve as the normalized reading and the system returns to the manual decay test screen.

   NOTE: *You can also select the normalized reading while the decay test is underway. If you have not selected a normalized reading before selecting <End Test>, the system automatically displays the Select Normalized Reading screen from which you can select which reading to use as normalized.*



Decay Test Data - Manual

Biodex Model 086-332 Serial # 1008002p Detector Serial # 73686067

Initial Activity: 773. mCi Isotope: O-15
Elapsed Time: 40 Mins Number of Readings: 10
Technologist: john jones
Calculation Method: Normalized

#	Date	Time	Measured Activity mCi		Calculated Activity mCi	Acceptable Variance +/- 5%
1	01/31/12	11:15:11 AM	773.		774.	-0.1%
2	01/31/12	11:17:34 AM	343.		344.	-0.3%
3	01/31/12	11:23:09 AM	51.7		51.4	0.6%
4	01/31/12	11:26:36 AM	15.90	Normalized	15.90	0.0%
5	01/31/12	11:42:59 AM	0.0605		0.0603	0.3%
6	01/31/12	11:47:34 AM	0.0128		0.0127	0.8%
7	01/31/12	11:49:23 AM	0.0069		0.0068	1.5%
8	01/31/12	11:50:14 AM	0.0051		0.0051	0.0%
9	01/31/12	11:52:56 AM	0.0020		0.0020	0.0%
10	01/31/12	11:55:13 AM	0.0009		0.0009	0.0%

Approved By: _____ Date: _____

Figure 6.44. *The Decay Test data - Manual printout.*

Decay Test Data

(See Figures 6.45 - 6.46.)

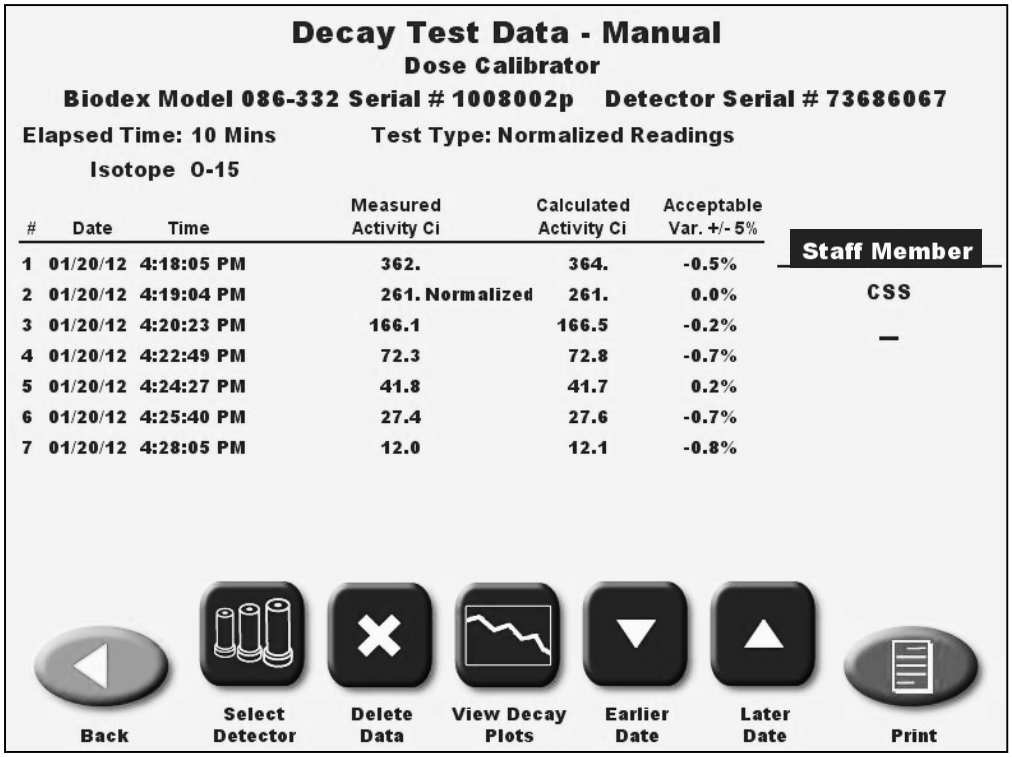


Figure 6.45. *The Decay Test data screen.*

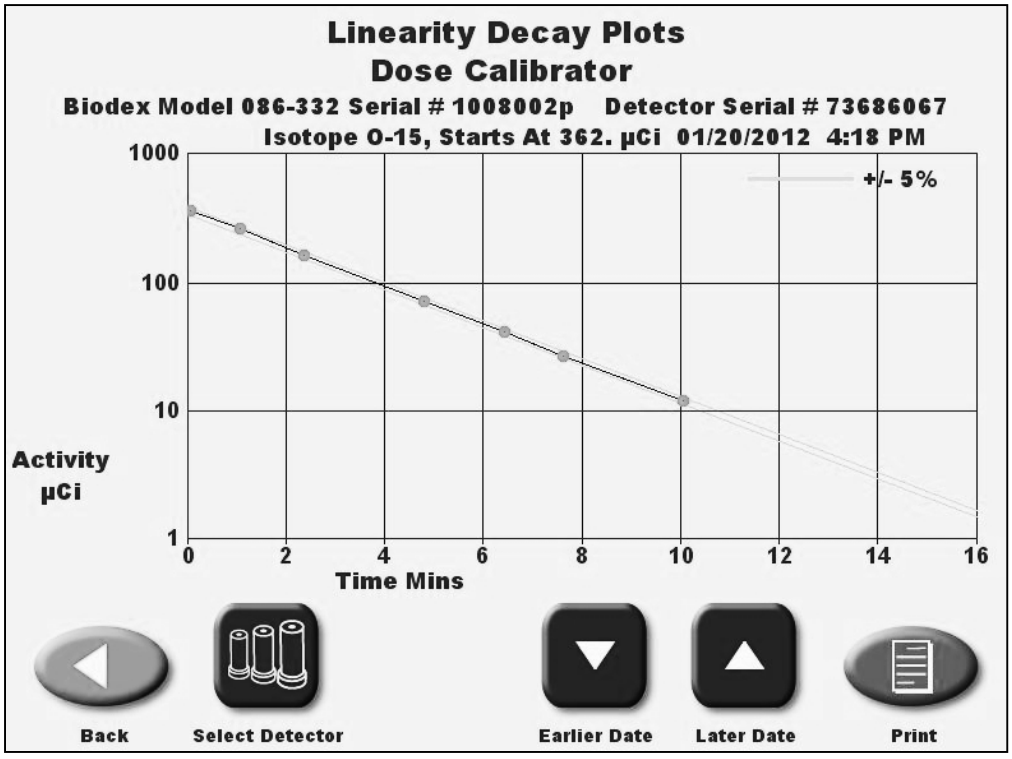


Figure 6.46. *The Manual Decay Test screen with Linearity Decay Plot.*

The View Decay Test data screen displays the decay tests performed on the dose calibrator. The data is stored for each detector connected to the system.

The display shows individual decay tests with the most recent test as the default. Use <Earlier Date> and <Later Date> to scroll to view the test results desired. Any test or reading outside the acceptable variance is shown in red. You can view the decay plot for the test being shown on the display.

- Touch <Back> to return to the Linearity Testing screen.
- Touch <Select Detector>to select a different detector, if multiple detectors are connected.
- Touch <Print> to print the linearity decay test currently displayed on the screen.
- Touch <Earlier Date> and <Later Date> to scroll to view the tests desired.

To Delete Data:

1. Touch <Delete Data> and use the keypad to enter your password. Touch <Enter> to advance to the decay Test data screen.
2. Touch <Delete Data> to delete the test currently on the screen. The delete data Confirmation screen is displayed. Touch <OK> to delete and return to the Decay Test data screen. Touch <Cancel> to return to the Linearity Testing screen.

To View Activity Plots:

1. Touch <View Activity Plots> to advance to the Linearity Decay Plots screen. A plot of the displayed linearity test will be shown.
2. Use <Earlier Date> and <Later Date> to toggle between dates.
3. Touch <Print> to print the linearity plot displayed.
4. If desired, touch <Select Detector> to select and view the decay tests if multiple detectors are connected.
5. Touch <Back> to return to the decay Test data screen.
6. Touch <Earlier Date> and <Later Date> to plot the other linearity tests stored in memory.
7. Touch <Print> to print the linearity plot display.

Lineator Initial Test

(See Figure 6.47.)

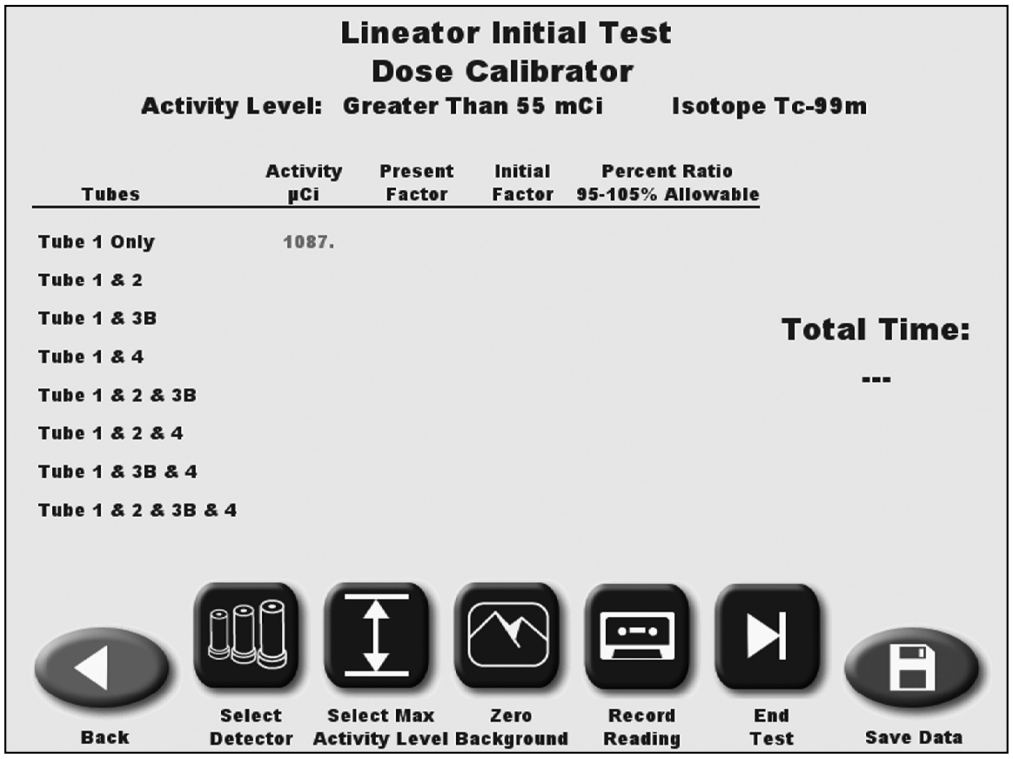


Figure 6.47. *The Lineator Initial Test screen.*

The first time the Lineator is used with this dose calibrator, initial factors for the Lineator function must be set and the Atomlab 500 must be calibrated for the specific Lineator package using the initial procedure described below. The Atomlab 500 will store the initial factors and print them in the initial factor column of the results table.

The initial Lineator Test needs to be performed only once unless the Lineator is replaced or damaged, in which case the initial factors will need to be redone. The Atomlab 500 procedure allows recording of two initial linearity tests - one less than 55 *m*Ci and one greater than 55 *m*Ci. The Lineator does not have a wide enough range using the tube combinations to obtain a minimum reading of less than 10 µCi when starting with an activity greater than 55 *m*Ci. Using two linearity ranges allows the user to obtain a maximum reading in excess of 500 *m*Ci to less than 10 µCi.

NOTE: *Your initial test and future tests should all start with similar starting activities. Variation in starting activities can cause variance in results.*

NOTE: *Some state regulations allow linearity tests to end at activities greater than 10 µCi. You may discontinue the linearity test at the activity which your state regulations or license permit.*

NOTE: *You must perform a traditional linearity test at the time you are doing your initial Lineator Test to prove the calibration is linear. If you perform the Lineator Test first and then the traditional test, you can perform both tests with one source.*

To Perform An Initial Lineator Test:

1. From the QA Dose Calibrator menu, touch <Linearity Testing>. The Linearity Testing screen
   is displayed.
2. Touch <Lineator Initial Test>. The Lineator Initial Test screen is now displayed.
   - Touch <Back> to return to the Linearity Testing screen.
   - Touch <Select Detector> to select a different detector, if multiple detectors are connected.
   - Touch <Select Max Activity Level> to toggle between maximum activities of less than 55 *m*Ci and greater than 55 *m*Ci.

NOTE: *The system defaults to less than 55 mCi. If your test starts with an activity greater than 55 mCi you must select this range. Some states allow linearity to stop at values*
greater than 10 µCi.

   - Touch <Zero Background> to zero the background reading if necessary.

3. Place the Tc-99m vial into the Lineator Tube 1. Place Tube 1 into the detector. The activity for Tube 1 is now displayed as a live reading.
4. Once the reading has stabilized, touch <Record Reading>. The reading for Tube 1 is recorded and the line for Tube 1 & 2 is now displayed as a live reading.
5. Touch <Record Reading> to record the reading for Tube 1 & 2.
6. Continue taking readings by touching <Record Reading> after each new tube or set of tubes is placed in the detector.
7. Touch <End Test> to end the test.
8. Touch <Save Data> to save the test just performed. The Save Lineator Initial Test data screen is now displayed.
9 If the appropriate staff member is not displayed, touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed person. (If you have previously selected a staff member, the system will default to that person on the save Lineator Initial Test screen.) Then touch <Save Data> again to save the data in memory.
10. Touch <Enter> to select and return to the save Lineator Initial Test data screen.
11. Touch <Save Data> to save the data.
    - Touch <Back> twice to return to the Linearity Testing screen.
    - Touch <Measure> to advance to the Measure screen.
    - Touch <View Data> to view the linearity tests stored in the system.

Lineator Test

(See Figure 6.48 - 6.49.)

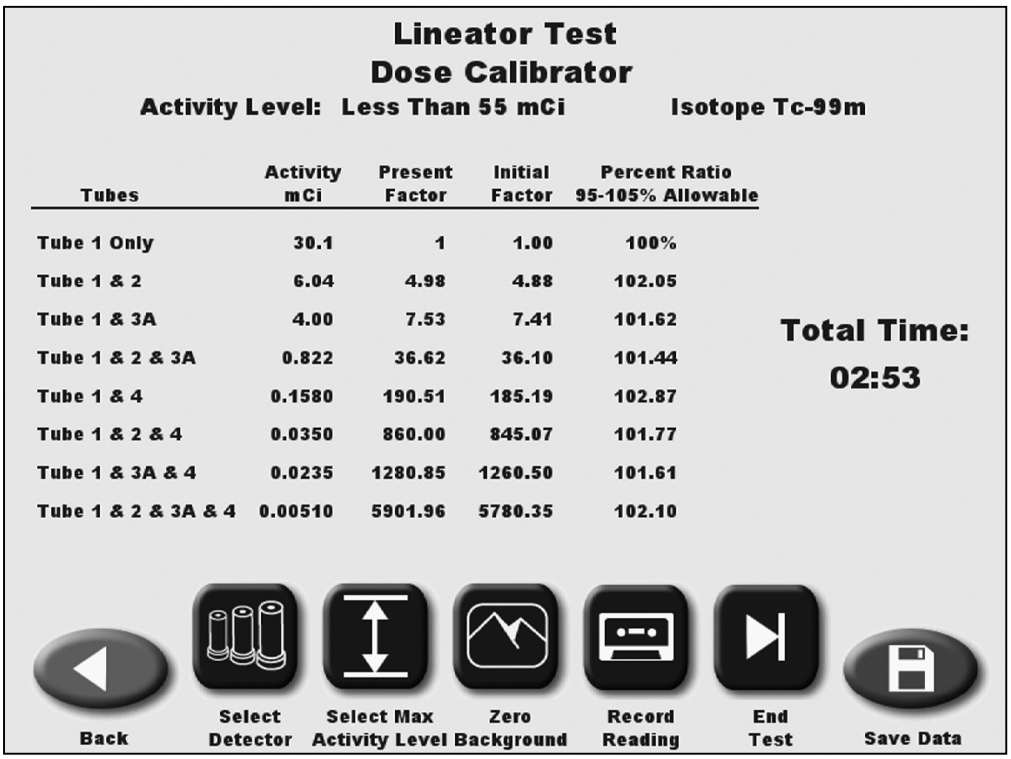


Figure 6.48. *The Lineator Test screen.*

The Lineator Test is performed with this dose calibrator after the initial factors for the Lineator function have been taken and saved. The Lineator Test is a comparison of the initial factors with the current factors.

The Linearity Test should be performed at installation and at least quarterly thereafter. The Atomlab 500 system allows recording of two linearity tests, one less than 55 *m*Ci and one greater than 55 *m*Ci. linearity should be within + or - 5%.

To Perform A Linearity Test:

1. From the QA Dose Calibrator menu, touch <Linearity Testing>. The Linearity Testing screen is displayed.
2. Touch <Lineator Test>. The Lineator Test screen is now displayed.
   - Touch <Back> to return to the Linearity Testing screen.
   - Touch <Select Detector> to select a different detector, if multiple detectors are connected.
   - Touch <Select Max Activity Level> to toggle between maximum activities of less than 55 *m*Ci and greater than 55 *m*Ci.

NOTE: *The system defaults to less than 55 mCi. If your test starts with an activity greater than 55 mCi you must select this range.*

   - Touch <Zero Background> to zero the background reading if necessary.

NOTE: *The starting activity used for the Linearity Test should be a similar activity to the Initial Linearity Test.*

3. Place the Tc-99m vial into the Lineator Tube 1. Place Tube 1 into the detector. The activity for Tube 1 is now displayed as a live reading.
4. Once the reading has stabilized, touch <Record Reading>. The reading for Tube 1 is recorded and the line for Tube 1 & 2 is now displayed as a live reading.
5. Touch <Record Reading> to record the reading for Tube 1 & 2.
6. Continue taking readings by touching <Record Reading> after each new tube or set of tubes is placed in the detector.
7. Touch <End Test> to end the test.
8. Touch <Save Data> to save the test just performed. The Save Lineator Test data screen is now displayed.
9. If the appropriate staff member is not displayed, touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed person. (If you have previously selected a staff member, the system will default to that person on the save Lineator Test data screen.) Then touch <Save Data> again to save the data in memory.
10. Touch <Enter> to select and return to the save Lineator Test data screen.
11. Touch <Save Data> to save the data.
    - Touch <Back> twice to return to the Linearity Testing screen.
    - Touch <count>to advance to the <Measure>.
    - Touch <View Data> to view the linearity tests stored in the system.

NOTE: *The Lineator Test must be performed in less than six minutes or the test must be redone because of decay. See the Lineator instructions.*

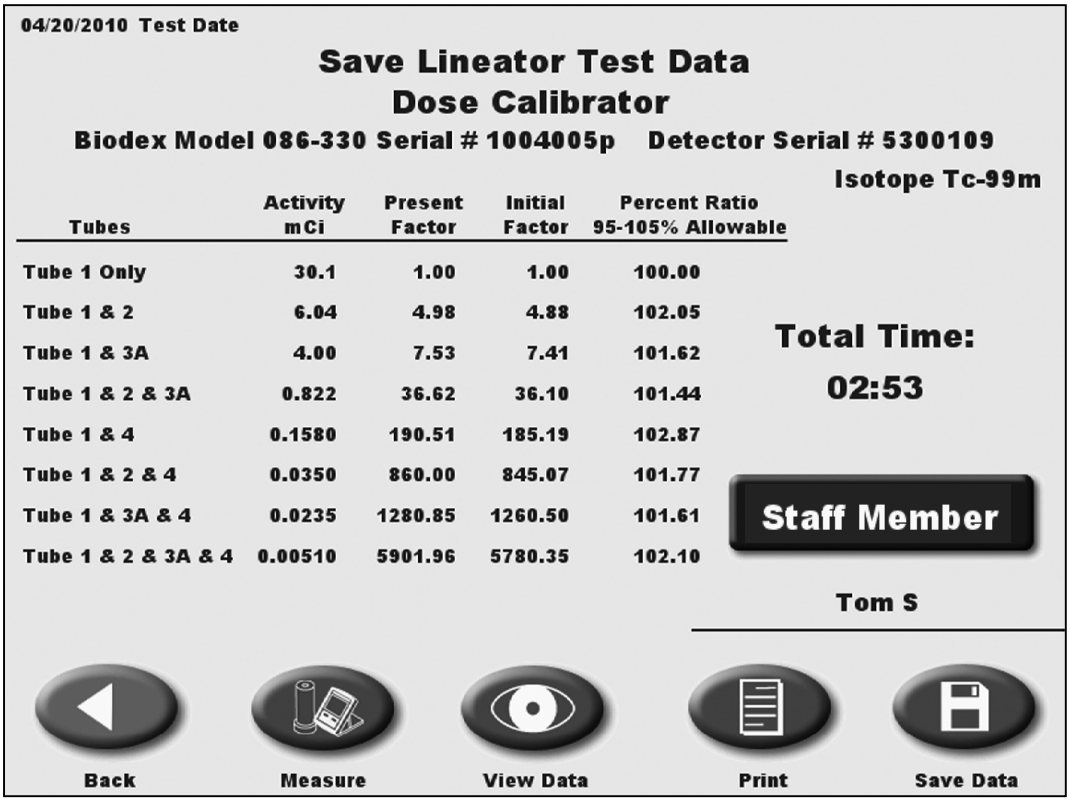


Figure 6.49. *The Save Lineator Test data screen.*

View Lineator Data

(See Figures 6.50 - 6.51.)

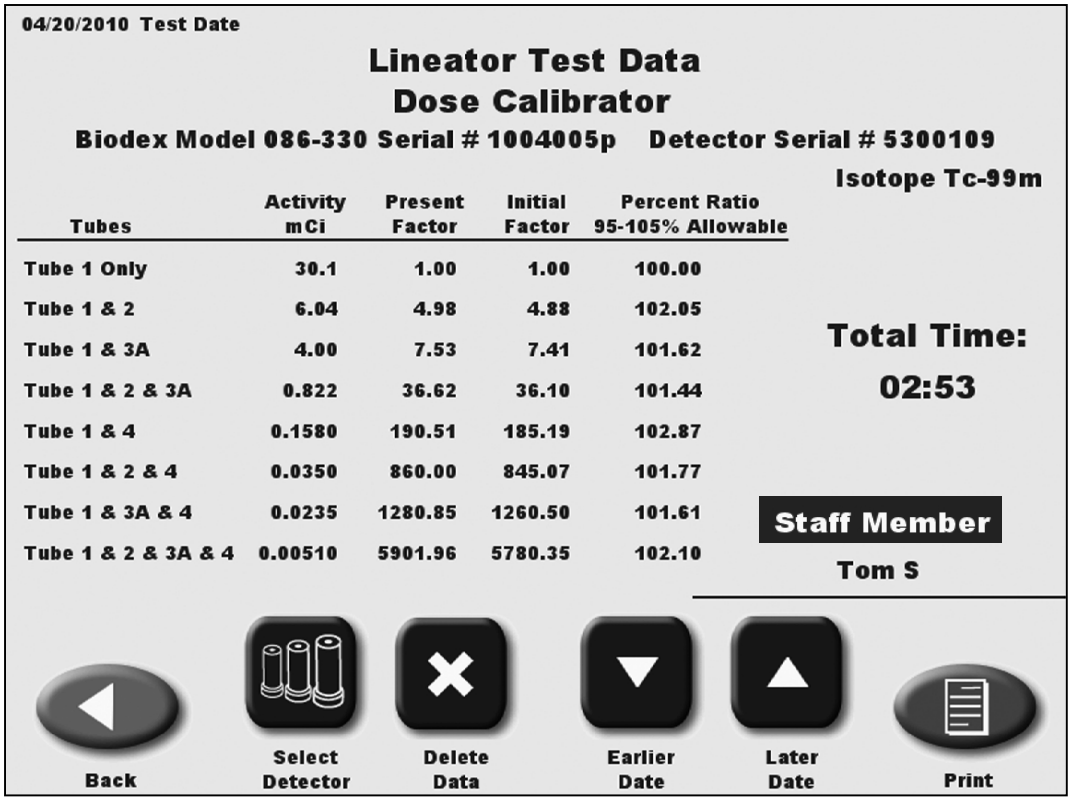


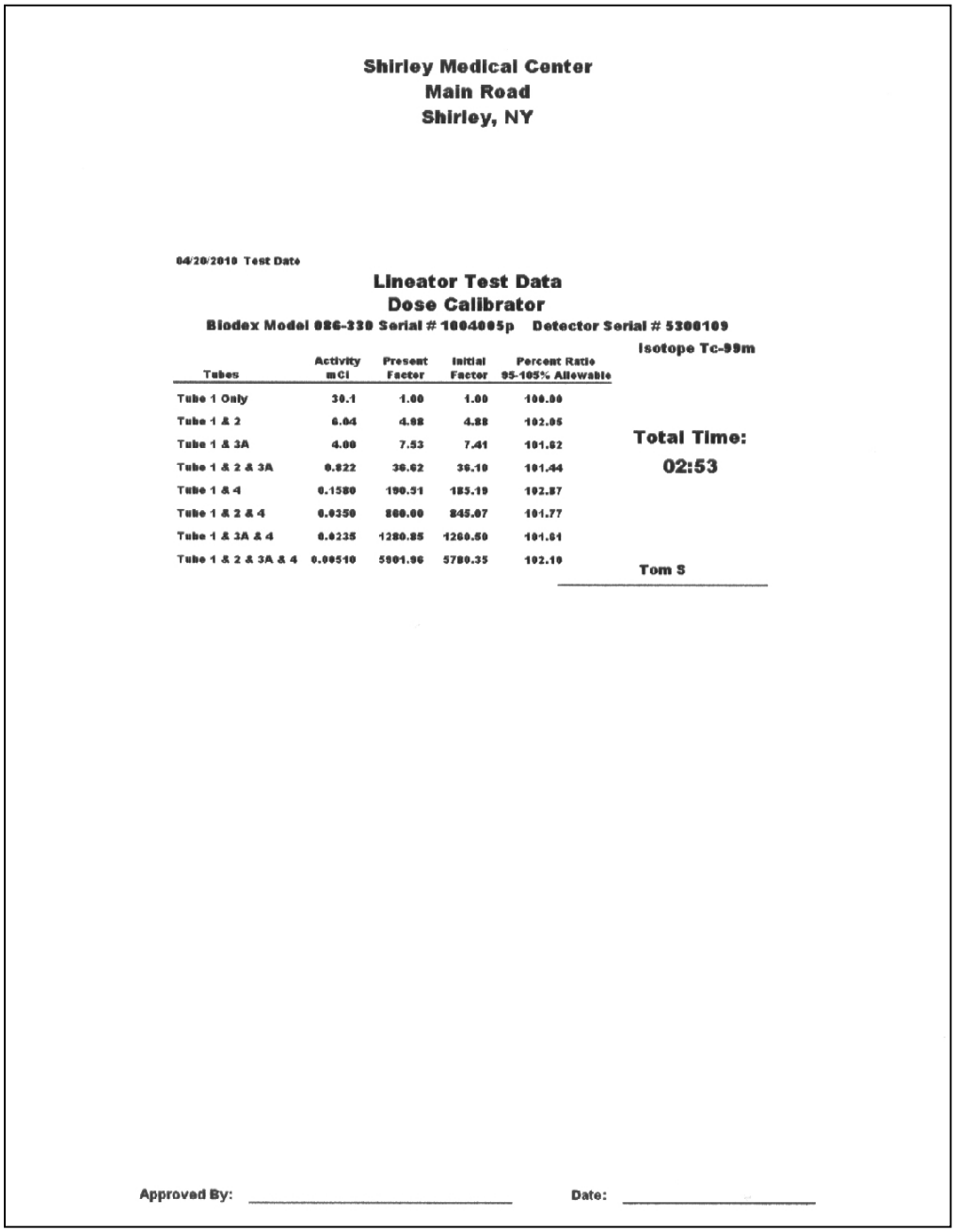
Figure 6.50. *The Lineator Test data screen.*

The Lineator Test data screen displays the Linearity Tests performed on the dose calibrator. The data is stored for each detector connected to the system.

- Touch <Back> to return to the QA Dose Calibrator screen.
- Touch <Select Detector>to select a different detector, if multiple detectors are connected.
- Touch <Earlier Date> and <Later Date> to scroll to view the tests desired.
- Touch <Print> to print the linearity test report shown on the screen.

To Delete Data:

1. Touch <Delete Data> and use the keypad to enter your password. Touch <Enter> to advance to the Lineator Test data screen.
2. Use <Earlier Date> and <Later Date> to scroll to the test you wish to delete.
3. Touch <Delete Data> to delete the test shown on the screen. The Delete Data Confirmation screen is displayed. Touch <OK> to delete and return to the Lineator Test data screen.
4. Touch <Cancel> to return to the Lineator Test data screen.



Shirley Medical Center
Main Road
Shirley, NY

04/20/2010 Test Date

Lineator Test Data
Dose Calibrator

Biodex Model 086-330 Serial # 1004005p Detector Serial # 5308109

Isotope Tc-99m

Tubes	Activity mCi	Present Factor	Initial Factor	Percent Ratio 95-105% Allowable
Tube 1 Only	30.1	1.00	1.00	100.00
Tube 1 & 2	6.04	4.88	4.88	102.05
Tube 1 & 3A	4.00	7.53	7.41	101.62
Tube 1 & 2 & 3A	0.822	36.62	36.10	101.44
Tube 1 & 4	0.1580	190.51	185.19	102.87
Tube 1 & 2 & 4	0.0350	860.00	845.07	101.77
Tube 1 & 3A & 4	0.0235	1280.85	1260.50	101.61
Tube 1 & 2 & 3A & 4	0.00510	5901.96	5780.35	102.10

Total Time:
02:53

Tom S

Approved By: _____ Date: _____

Figure 6.51. *The Lineator Test data report.*

Calicheck Initial Test

(See Figures 6.52 - 6.53.) (Also Known As Calicheck Calibration Factor)

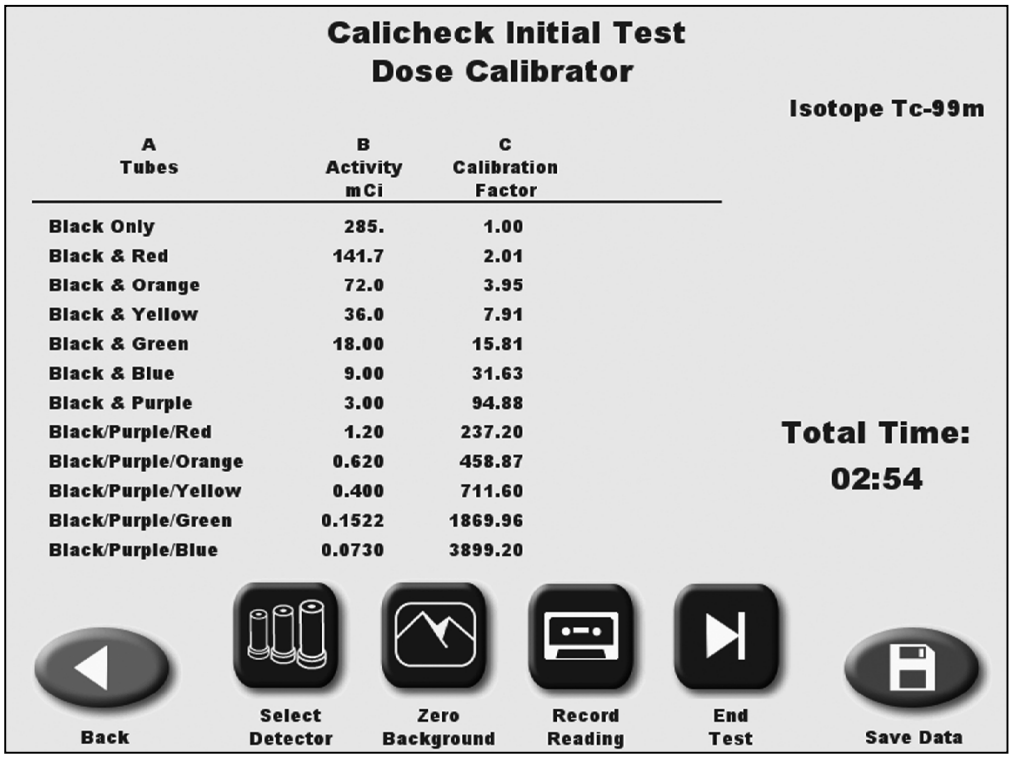


Figure 6.52. *The Calicheck Initial Test screen.*

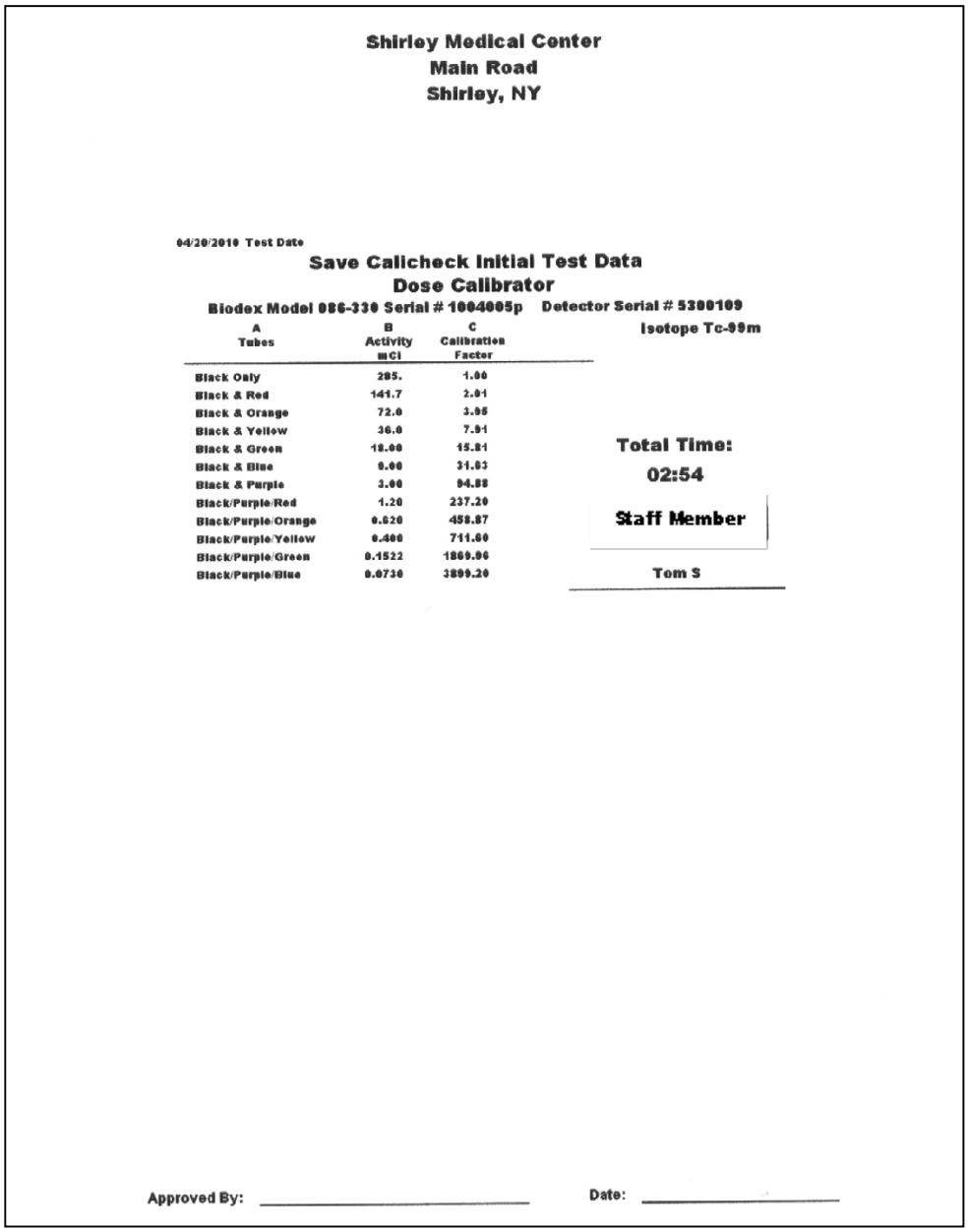
The first time the Calicheck is used with Atomlab 500, calibrator factors for the Calicheck function must be set and the Atomlab 500 must be calibrated for the specific Calicheck package using the initial procedure described below. The Atomlab 500 will store the initial factors and print them in the factor column of the results table.

The initial Calicheck Test needs to be performed only once unless the Calicheck is replaced or damaged, in which case the initial factors will need to be redone.

To Perform An Initial Calicheck Test:

1. From the QA Dose Calibrator menu, touch <Calicheck Initial Test>. The Calicheck Initial Test screen is displayed.
   - Touch <Back> to return to the Linearity Testing screen.
   - Touch <Select Detector> to select a different detector, if multiple detectors are connected.
   - Touch <Zero Background> to zero the background reading if necessary.
3. Place the Tc-99m vial into the Calicheck Black Tube. Place the Black Tube into the detector. The activity for the Black Tube is now displayed as a live reading.
4. Once the reading has stabilized, touch <Record Reading>. The reading for the Black Tube is recorded and the line for the Black & Red Tube is now displayed as a live reading.
5. Touch <Record Reading> to record the reading for the Black & Red Tube.

6. Continue taking readings by touching <Record Reading> after each new tube is placed over the Black Tube in the detector (be sure to remove the previous colored Tube before adding each new tube to the Black Tube).
7. Touch <End Test> to end the test.
8. Touch <Save Data> to save the test just performed. The save Calicheck Initial Test data screen is now displayed.
9. If the appropriate staff member is not displayed, touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed person. (If you have previously selected a staff member, the system will default to that person on the save Calicheck Initial Test data screen.) Then touch <Save Data> again to save the data in memory.
10. Touch <Enter> to select and return to the save Calicheck Initial Test data screen.
11. Touch <Save Data> to save the data.
    - Touch <Back> twice to return to the Linearity Testing screen.
    - Touch <Measure> to advance to the Measure screen.
    - Touch <View Data> to view the Calicheck linearity tests stored in the system.
    - Touch <Print> to print the initial Calicheck Test data.



Shirley Medical Center
Main Road
Shirley, NY

04/20/2010 Test Date

Save Calicheck Initial Test Data
Dose Calibrator

Biodex Model 086-330 Serial # 1004005p Detector Serial # 5380109
Isotope Tc-99m

A Tubes	B Activity mCi	C Calibration Factor
Black Only	285.	1.00
Black & Red	141.7	2.01
Black & Orange	72.0	3.95
Black & Yellow	36.0	7.91
Black & Green	18.00	15.81
Black & Blue	9.00	31.63
Black & Purple	3.00	94.88
Black/Purple/Red	1.20	237.20
Black/Purple/Orange	0.620	458.87
Black/Purple/Yellow	0.400	711.80
Black/Purple/Green	0.1522	1869.96
Black/Purple/Blue	0.0736	3899.20

Total Time:
02:54

Staff Member

Tom S

Approved By: _____ Date: _____

Figure 6.53. *A Save Calicheck Initial Data printout.*

Calicheck Test

(See Figures 6.54 - 6.55.)

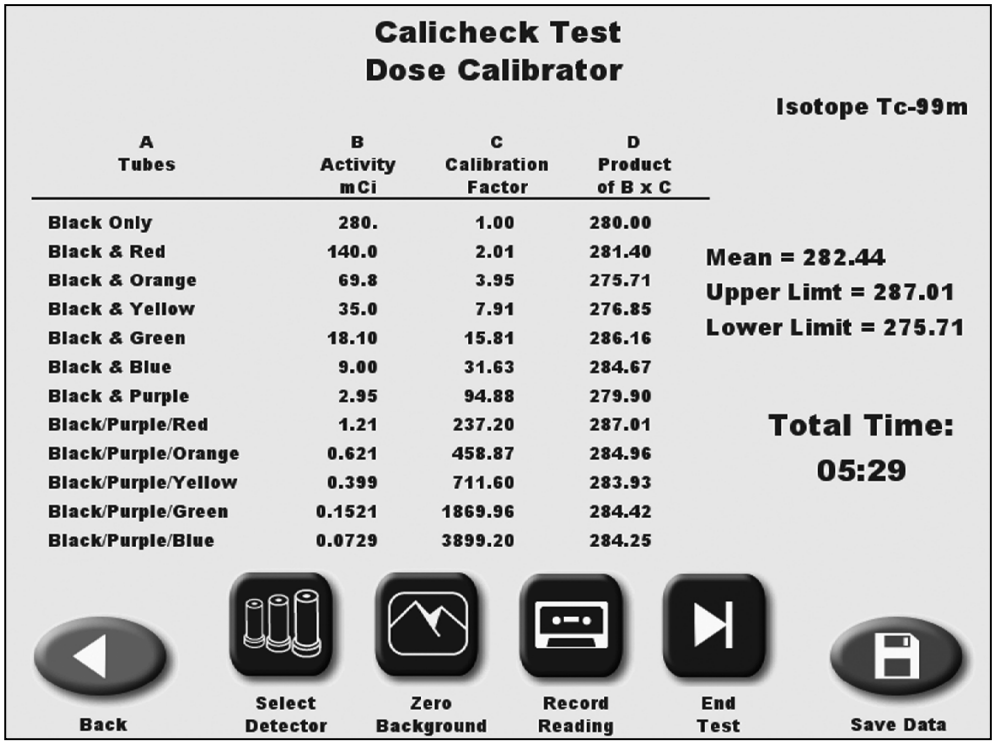


Figure 6.54. *The Calicheck Test screen.*

The Calicheck Test is performed with this dose calibrator after the initial calibration factors for the Calicheck function have been taken and saved. The current Calicheck calibration test is a calculation of the Calicheck calibration factors with the current activity readings.

The Calicheck Linearity test should be performed at installation and at least quarterly thereafter.

To Perform A Calicheck Linearity Test:

1. From the QA Dose Calibrator menu, touch <Linearity Testing>. The Linearity Testing screen is displayed.
2. Touch <Calicheck Test>. The Calicheck Test screen is now displayed.
   - Touch <Back> to return to the Linearity Testing screen.
   - Touch <Select Detector> to select a different detector, if multiple detectors are connected.
   - Touch <Zero Background> to zero the background reading if necessary.

   NOTE: *The starting activity used for the Calicheck Test should be a similar activity to the initial Calicheck Test.*

3. Place the Tc-99m vial into the Calicheck Black Tube. Place the Black Tube into the detector. The activity for the Black Tube is now displayed as a live reading.
4. Once the reading has stabilized, touch <Record Reading>. The reading for the Black Tube only is recorded and the line for the Black and Red Tube is now displayed as a live reading.

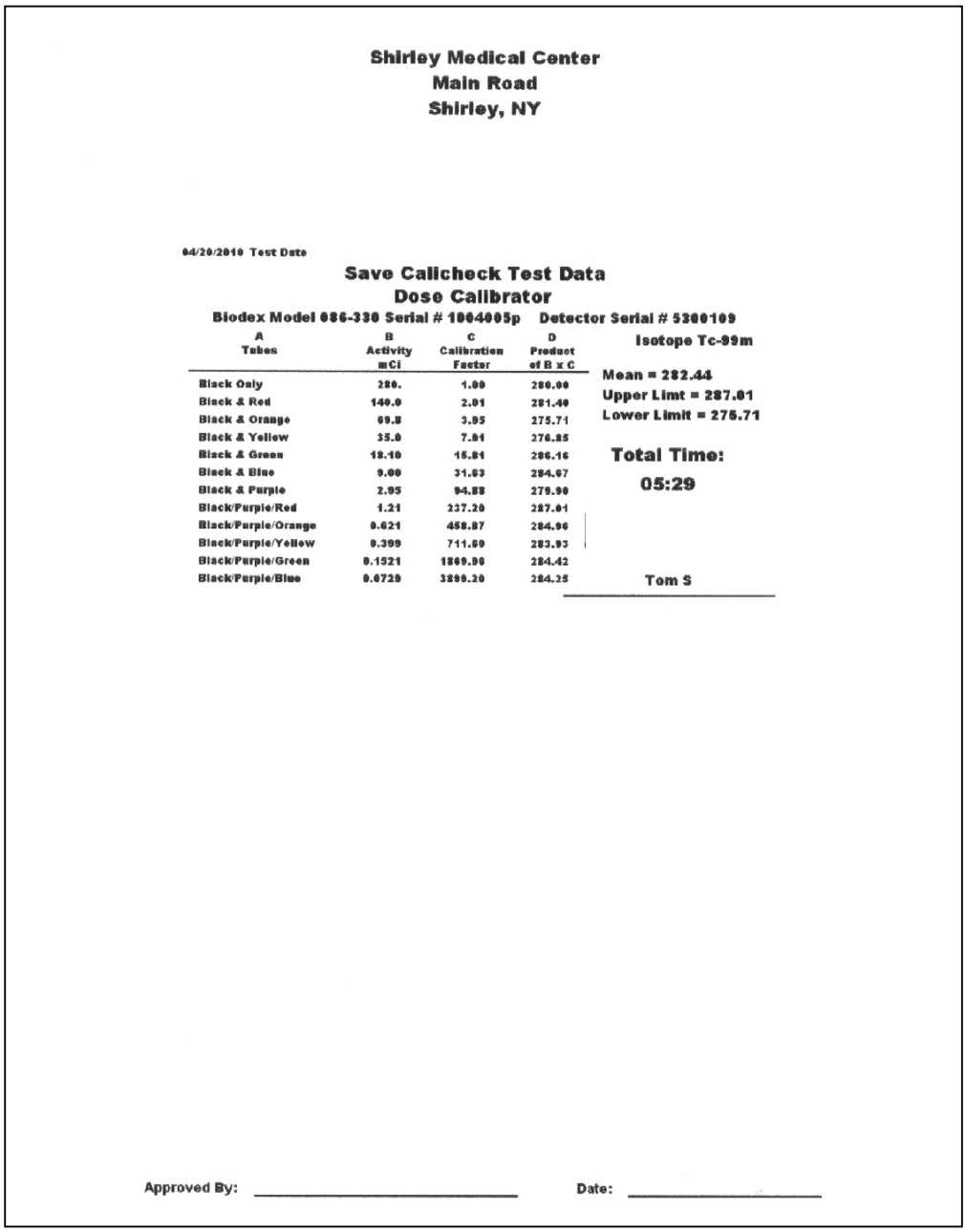
5. Touch <Record Reading> to record the reading for the Black and Red Tube.
6. Continue taking readings by touching <Record Reading> after each new tube is placed in the detector (be sure to remove the previous colored Tube before adding each new tube to the Black Tube).

   NOTE: *Make sure you have the correct tube combination, as highlighted on the display.*

7. Touch <End Test> to end the test.

   NOTE: You can only record the same tube combinations as recorded for the Calicheck Initial Test.

8. Touch <Save Data> to save the test just performed. The Save Calicheck Test data screen is now displayed.
9. If the appropriate staff member is not displayed, touch <Staff Member>. The Staff Member List is displayed. Touch to highlight any listed person. (If you have previously selected a staff member, the system will default to that person on the save Calicheck Initial Test data screen.) Then touch <Save Data> again to save the data in memory.
10. Touch <Enter> to select and return to the save Calicheck Test data screen.
11. Touch <Save Data> to save the data.
    - Touch <Back> twice to return to the Linearity Testing screen.
    - Touch <Measure> to advance to the Measure screen.
    - Touch <View Data> to view the linearity tests stored in the system.
    - Touch <Print> to print the Calicheck linearity test report shown on the screen.



Shirley Medical Center
Main Road
Shirley, NY

04/20/2010 Test Date

Save Calicheck Test Data
Dose Calibrator

Biodex Model 086-330 Serial # 1004005p Detector Serial # 5300109

Isotope Tc-99m

A Tubes	B Activity mCi	C Calibration Factor	D Product of B x C
Black Only	280.	1.00	280.00
Black & Red	140.0	2.01	281.40
Black & Orange	69.8	3.95	275.71
Black & Yellow	35.0	7.91	276.85
Black & Green	18.10	15.81	286.16
Black & Blue	9.00	31.53	284.07
Black & Purple	2.95	94.88	279.90
Black/Purple/Red	1.21	237.20	287.01
Black/Purple/Orange	0.621	458.87	284.96
Black/Purple/Yellow	0.399	711.80	283.93
Black/Purple/Green	0.1521	1869.90	284.42
Black/Purple/Blue	0.0729	3899.20	284.25

Mean = 282.44
Upper Limit = 287.01
Lower Limit = 275.71

Total Time:
05:29

Tom S

Approved By: _____ Date: _____

Figure 6.55*. A Calculated Linearity Test Report.*

Calicheck Test Data

(See Figure 6.56.)

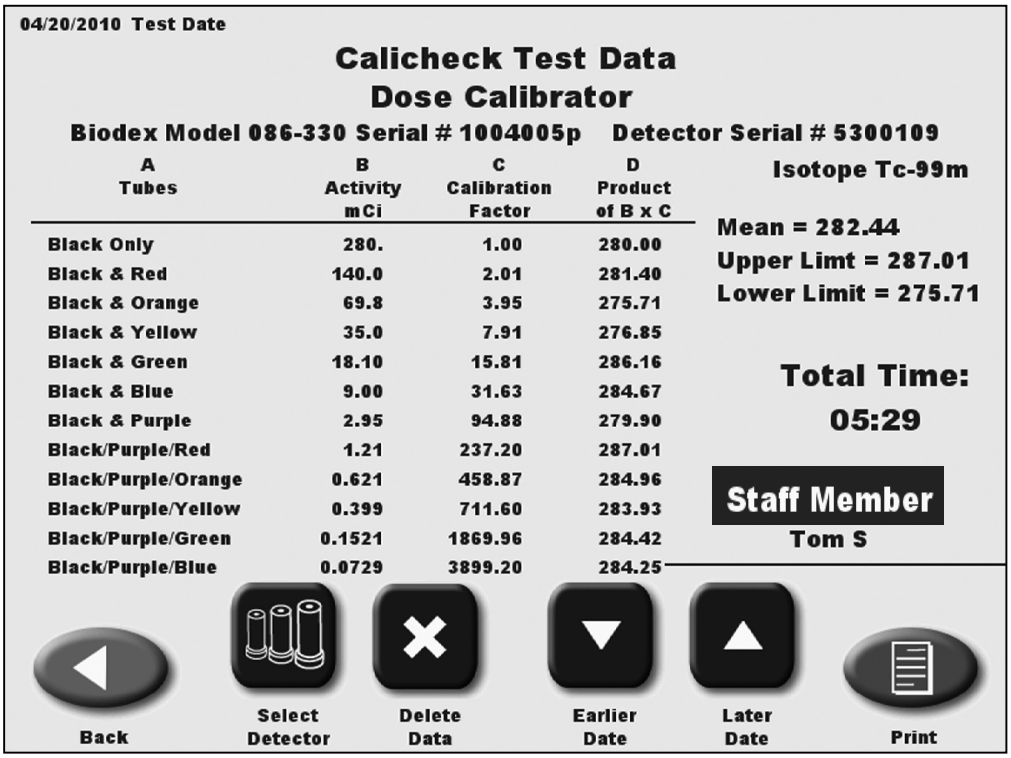


Figure 6.56. *The Calicheck Test data screen.*

The Calicheck Test data screen displays the Calicheck Linearity Tests performed on the dose calibrator. The data is stored for each detector connected to the system.

- Touch <Back> to return to the QA Dose Calibrator screen.
- Touch <Select Detector>to select a different detector, if multiple detectors are connected.
- Touch <Earlier Date> and <Later Date> to scroll to view the tests desired.
- Touch <Print> to print the Calicheck linearity test report shown on the screen.

To Delete Data:

1. Touch <Delete Data> and use the keypad to enter your password. Touch <Enter> to advance to the Calicheck Test data screen.
2. Use <Earlier Date> and <Later Date> to scroll to the test you wish to delete.
3. Touch <Delete Data> to delete the test shown on the screen. The Delete Data Confirmation screen is displayed. Touch <OK> to delete and return to the Calicheck Test data screen.
4. Touch <Cancel> to return to the Calicheck Test Data screen.

7. Glossary

This glossary provides definitions for the most common terms relevant to the Atomlab Dose Calibrators.

Accuracy Tests
The test of a dose calibrator to see how close the displayed activity values are to the true values.

Averaging Period
The time the Atomlab takes to display a stable activity reading.

Background Correction
The function of the Atomlab, initiated by pressing the <BKGND> key, which stores a value for the ambient activity. This value is automatically subtracted from all subsequent activity measurements to compensate for the background activity level.

Becquerel (Bq)
The international unit of activity, corresponding to one dps (disintegration per second, or one nucleus decaying per second). The Atomlab displays activity values in units of MBq (million Bq) or GBq (billion Bq).

Calibration
The use of calibrated activity sources traceable to the National Institute Of Standards & Technology to calibrate each Atomlab unit and verify the accuracy of the activity values it displays.

Calibration Value
The value set on the dial value display to adjust the Atomlab to correctly respond to a particular radioisotope. See Response, Ionization Chamber.

Calicheck
A sleeve shield package to perform linearity tests on dose calibrators.

Chamber Bias
The high voltage applied to the chamber which causes ions in the argon gas to move to the collector electrode.

Constancy Check
Performing daily checks using a radioisotope with a long half-life to ensure that the activity values a dose calibrator displays is stable over a long period of time.

Decay Chart
A chart projecting how the activity of a source will decay over a period of time at specified time intervals.

Detector Unit
An Atomlab component housing the ionization chamber detector and the electrometer.

Dial Values
The dial value is used to convert the current to the activity being measured in the chamber. The system allows the operator to enter any dial value possible on the display into the Atomlab program for an isotope.

Display Fluctuations
displayed value changes without the removal or insertion of a source in the chamber well.

Display Unit
The Atomlab component incorporating the electronics, control keys and displays which perform and show activity measurements.

Dose Calibration
The verification of the activity of a radiopharmaceutical to be administered to a patient, corresponding to the radiation to be delivered to the body.

Electrometer
Measures the current in the ionization chamber, which is proportional to the activity of a source within the chamber.

Geometry Tests
The test of a dose calibrator to determine the variation in the displayed activity values due to the geometric configuration of the source's container (vial, syringe, etc.) and its location within the ionization chamber detector.

Ionization Chamber
A device which responds to the activity of a source by forming ion pairs which can be collected as a measure of the radioactivity.

Kit
A calibrated solution containing a compound which can be labeled with a radionuclide such as Tc-99m (radiopharmaceuticals.) From such kits, doses are prepared to administer to patients to facilitate nuclear imaging.

L-Block Shield
A partially transparent radiation shield behind which doses can be prepared.

Linearity Tests
The test of a dose calibrator to determine the variation in the displayed activity values from the true ones over the measurement range of the instrument.

Lineator
A sleeve shield package to perform linearity tests on dose calibrators.

Moly Breakthrough Shield
Used in the Moly Breakthrough Test to shield the radiation of the Tc-99m in an eluent so that the activity of the Mo-99 can be measured.

Moly Break-Through Test
Used to determine the percentage of parent Mo-99 remaining in the eluent containing the daughter Tc-99m radionuclide.

Molybdenum-99 (Mo-99)
The parent radionuclide which decays into the daughter Tc-99m, used to generate radiopharmaceuticals.

NIST
National Institute of Standards & Technology, whose activities include maintaining radioactive material standards.

NRC
Nuclear Regulatory Commission, which is the agency of the Federal Government which regulates radioactive materials.

Range Selection
The Atomlab unit automatically selects which range of display units (µCi, *m*Ci or Ci or MBq or GBq) to be used for the activity display to show activity values with the most significant number of digits.

Response, Ionization Chamber
The variation of the ion current collected by an ionization chamber because of individual decay processes associated with different radioisotopes. Calibration values (Dial Value) are required to adjust the output of the electrometer for each radioisotope to compensate for this variation in response, thereby ensuring accuracy over the entire range of commonly used radioisotopes.

Sleeve Shield
A method of performing linearity tests on a dose calibrator by encircling a single source with leaded sleeves of varying thickness, thereby reducing the activity the dose calibrator measures by a known amount. Comparison of the expected and actual activity values constitutes the test of linearity.

Source Decay
A method of performing linearity tests on a dose calibrator by measuring the initial activity of a source, accurately calculating its decayed activity at prescribed time intervals, and making activity measurements at those time intervals. Comparison of the calculated and actual activity values constitutes the test of linearity.

Traceability
Refers to using sources for calibrating a dose calibrator whose activities can be traced to the National Institute of Standards & Technology.

APPENDIX A:
Troubleshooting Procedures

Should it appear that your Atomlab Dose Calibrator is not functioning properly, the procedures explained in this appendix, should allow you to determine whether a problem does indeed exist and what steps can be taken to correct the difficulty.

Should you encounter any of the problems discussed in the following sections, immediately perform the accompanying steps to ascertain whether your dose calibrator requires servicing. If you conclude that it does, contact the Biodex Customer Service Department at 1-800-224-6339 for further instructions.

Problem Descriptions

The Following Problems Are Described In This Appendix:

- System Will Not Power Up
- Fluctuations In Activity Measurement
- Unexpected Readings
- Important Notes About System Errors

System Will Not Power Up

if your Atomlab Dose Calibrator fails to power up, perform the following steps, proceeding to the next step only if the current one fails to remedy the problem:

Procedure:

1. Make sure the ON/OFF switch on the display is ON (I).
2. Check that the power cord is plugged into the display.
3. Remove the power cord from the electrical outlet. Remove the other end of the power cord from the receptacle on the power pack.
4. Re-insert the power cord into the receptacle and then plug the power cord back into the power pack. The dose calibrator should restart and the display will boot up after several seconds.
5. Remove the power cord from the outlet and verify that the voltage of the outlet is correct. If not, Repair the outlet or find another outlet that provides the required voltage. Re-insert the power cord and turn the power back on. The power pack converts wall power from 100V to 230V to the correct voltage for the dose calibrator.

If your system still will not power up, call the Biodex Customer Service Department.

Fluctuations In Activity Measurements

When the system is displaying activity for the more common isotopes, the electrometer continually averages the data it receives from the detector. This ensures, for most readings, a stable activity display.

After you insert an isotope into the detector and select the properly calibrated key, the display may vary at low activity values as the system acquires the new data. After a short time the activity display will stabilize, with expected fluctuations described below. If the display continues to fluctuate, and you have verified it is not because of a high calibration value, consult Biodex customer service department.

Display Fluctuations For High Calibration Values

For some isotopes which require a high calibration value, you may observe fluctuations of ±0.5 µCi or more. Keep in mind that the calibration value for an isotope is related to gain of the electrometer, or by what factor the electrometer has to amplify the signal from the detector. the calibration for Tc-99m is 37.1, and a reading of 10 µCi for Tc-99m is equivalent to 160 to 180 femtoamps of current measured by the electrometer. High calibration values impact gains so that the electrometer amplifies inherent noise to a greater degree. Thus, greater fluctuations are observed in the activity display.

For instance, the calibration value for Co-60 is 5.0. The fluctuation due to noise probably would not be noticeable (±0.01 µCi). The fluctuation due to noise for Tc-99m (37.1) is approximately ±0.05 µCi. For an isotope requiring a calibration value of 500 (for P-32 it is 530) the fluctuation will be ±0.5 µCi or more.

Mo-99 Fluctuations

The Atomlab Dose Calibrator begins averaging display data the moment you press the Mo-99 key (calibration value =175). This means that at first the fluctuations will seem relatively high before gradually decreasing. This is why the Atomlab Dose Calibrator provides the 30-second countdown. In addition, the relatively high calibration value means the fluctuation due to inherent noise will be slightly higher than for the other common isotopes. Again, these fluctuations are to be expected and do not require any action on your part.

Unexpected Readings

If for some reason you suspect that the reading on the activity display is inaccurate, ensure that the calibration value for the proper isotope selection key is correct.

Detector Service

⚠ ***CAUTION:*** *Only qualified service personnel should remove the detector cover. There is an electrical shock hazard. Components under cover operate at 350 volts. The detector bias supply capacitors require at least two weeks, with power disconnected, to discharge to less than 50 volts.*

⚠ ***ATTENTION:*** *On ne doit confier qu'à un personnel d'entretien qualifié le soin de déposer le couvercle de la chambre d'ionisation. Il y risque de danger électronique. Les composants sous le couvercle fonctionnent sous une tension d'environ 350V. La chambre d'ionisation est dotée de condensateurs qui nécessitent au moins deux semaines d'alimentation débranchée pour se décharger à moins de 50V.*

APPENDIX B:
Atomlab Display Diagnostics For 400/500 Series

Overview

The nine button black & white Atomlab 400 and color touch screen Atomlab 500 for the new generation of Atomlab products have built-in boot-up self-diagnostics, along with real-time monitoring of the detector statuses. The detectors themselves have real-time self tests, the results of which are reported back to the display approximately once per second. Dose calibrator detectors and Well counters are the two types of detectors supported.

The results of the display module's self-test are displayed during the display's power-up, as well as on-demand, shown on the system test screen under utilities, in the upper section of the display results. in addition, during normal operation detector status changes are handled by the display, reported on screen with a popup screen and audio tone alert, and actions taken based on the severity of the reported status.

The System Test Screen Displayed Results Are Divided Into Two Sections:

- Upper half is the display module's details (static result from boot-up)
- Lower half lists diagnostic and status results for each identified detector, up to 7 on an Atomlab 500. Dynamically updated in real-time, about once/second

Real-Time Operating Detector Status Changes

During the course of normal operation, detectors report their status constantly to the display unit, including any detectable error conditions. The status reports come in as long the power to the display remains on, the detectors stay connected, and not in a severe fault state (communication error). so this means even if the detectors are not being used, or the display is blanked from the screen saver, the detectors are still communicating and being monitored.

For all newly reported error statuses, a detector or detector status error reporting screen will appear with an audio tone to alert the user. an error code will be displayed with its brief description. If WARNING is displayed next to the code, it indicates the detector is still usable. If Fail is displayed next to the code, the detector will automatically be dropped from being selectable by the user. For an Atomlab 500 with multiple detectors, the next available detector will automatically be selected. If there are no available detectors, the activity readings displayed will be dashed out and activity screen will indicate no available detector, or detector error.

For "Detector Leaking Gas" or "Detector Gas Low" warnings, there is a 24 hour reminder warning implemented. If either of these warnings is in effect for a connected detector, every 24 hours the detector or Detector Status screen will display with this warning code and description. All the 24 hour reminders are scheduled to appear 8am, and only if 4 hours elapsed since the warning was first detected and displayed.

Bios Post Results - PASS/FAIL results of power on self tests

Detector Diagnostics Display

There are several properties of a dose calibrator detector monitored and measured. The results are reported as a coded value, with an associated description. Space on the display is tight to accommodate up to 7 detectors, so if there's only 1 error in effect, we display the associated description. If there are multiple errors, we display only the codes. Here is the list of error codes, their class, and their description for dose calibrators:

Error Code	Class	500 Description	400 Description
Code 2	FAIL	Firmware Checksum	Firmware Checksum
Code 3	FAIL	Electrometer Needs Recalibration	Electrometer Recalibration
Code 4	FAIL	Eeprom Data Corrupt	EEPROM Data Corrupt
Code 5	WARNING	Detector Gas Low, Correctable	Detector Gas Low - OK
Code 6	FAIL	Detector Gas Too Low To Use	Detector Gas Too Low
Code 7	FAIL	Communications Error	Communications Error
Code 8	FAIL	Detector Bias Voltage Anomaly	Detector Voltage
Code 9	FAIL	Electrometer Monitor Voltage Anomaly	Electrometer Voltage
Code 10	WARNING	Overrange Detector Reading (Too High)	Overrange Reading

Following Is The Display Status Displays For The Dose Calibrators:

Warming Up	{Detector Is In A Power Warm-Up State}
Initializing	(Count down) {initial background reading/calc is in effect}
Background PASS -	no reported problems {no errors in effect, ready for measuring activity}
WARNING n -	<description> {1 error code}
WARNING n-n-n	{2 or more error codes may be present}
FAIL: n -	<description>
FAIL: n-n-n	{2 or more error codes may be present}

Warnings are errors flagged by the self tests, but not considered permanent or serious enough to not use the reported activity measurements.

Failures (FAIL) are considered serious enough to not use the detector for any activity measurements. The detector will automatically be taken offline by the system, no longer selectable.

Detector Error Code Descriptions

Code 2, Firmware Checksum

FAIL - The detector's firmware has a checksum pre-calculated and stored, and it's verified during detector power up. This error indicates the checksum calculated failed to match the checksum stored. Continuing to operate the detector would be at risk. The detector should be serviced.

Code 3, Electrometer Needs Recalibration

FAIL - On start-up, this error code is set if any of the following numbers don't exist or fail a sanity check:
- Activity calibration factor
- ump, ubp (factors for linearity corrections for higher gains)
- monitor channel scaling factor
- any of the four linearity correction constants

The detector should be serviced.

Code 4, Eeprom Data Corrupt

Fail - The detector's stored data has a checksum pre-calculated and stored, and it's verified during detector power up. This error indicates the checksum calculated failed to match the checksum stored for the appropriate stored data. Continuing to operate the detector would be at risk. The detector should be serviced.

Code 5, Detector Gas Low, Correctable

WARNING - If grams of argon drops more than 5% of the initial factory measured value, this error code is set. There is no correction done when this error code is active.

Code 6, Detector Gas Too Low To Use

Fail - If the grams of argon drops more than 10% of the initial factory measured value, this error code is set. there is no correction done when this error code is active. The detector should be serviced.

Code 7, Communications Error

Fail - This error code is set when repeated attempts of the display unit to communicate with a detector failed. Once this error code is set, the display unit will no longer attempt to communicate with the detector. This could be caused from a bad detector or a bad or disconnected cable between the detector and the display unit.

Code 8, Detector Bias Voltage Anomaly

Fail - Detector voltage bias must be out of the range of 325V – 375V for this error code to be set. The detector should be serviced.

Code 9, Electrometer Monitor Voltage Anomaly

Fail - Electrometer voltage must be out of the range of 2.375V - 2.55V for this error code to be set. The detector should be serviced.

Code 10, Overrange Detector Reading (Too High)

WARNING - The detected detector activity reading has exceeded the capability of what the detector can accurately measure. This error code should be only temporary, for the time a very high reading is being measured. If this occurs without an explainable cause, the detector may be faulty and should be serviced.

APPENDIX C:
Atomlab 500 Dose Calibrator Specifications

Overview

This Appendix provides the physical and operating specifications of your Atomlab 500 Dose Calibrator.

Measurement Range

For Tc-99m, 0.01 µCi to 100 curies, auto-ranging or 25 curies of F-18.

Display Ranges

Units are user selectable:

ci		bq	
00.00-1999	µCi	00.00-19.99	MBq
2.00-19.99	*m*Ci	20.0-199.9	MBq
20.0-199.9	*m*Ci	200-1999.	MBq
200-9999	*m*Ci	2.00-399.9	GBq
10.00-100.00	Ci	400.0-3700.0	GBq

Response Time

Auto Selection: Display updates once per second.

1-2 seconds	>200 microcuries Tc
3 seconds	>20 microcuries Tc
50-100 seconds	<20 microcuries Tc

NOTE: *Response time for activity of less than 20 microcuries can be decreased by reducing the measurement threshold. Reducing the measurement threshold decreases response time at the cost of higher fluctuation.*

NOTE: *All activities listed in specifications are for Tc-99m; for the specifications concerning other isotopes, please convert to Tc-99m equivalent. The Tc-99m equivalent of an isotope can be found by multiplying the source activity by the Tc-99m dial value, then dividing by the isotope dial value. The Tc-99m equivalent is the activity of a Tc-99m source which would produce the same current as the isotope source when placed in the well detector.*

Accuracy

Overall accuracy of activity determination for isotopes Co-57, Co-60, Ga-67, Tc-99m, In-111, i-131, Ba-133, Cs-137, and Tl-201, using the factory set calibration values are within 3% or 0.3 microcuries, whichever is greater.

NOTE*: Intercomparison of calibrated sources and the Atomlab 500 requires combining the uncertainties of both the Atomlab 500 and the calibrated source to determine expected agreement.*

Detector Linearity
Within 1% or 0.2 µCi, whichever is greater.

Electrometer Linearity
Within 1% or 0.2 µCi, whichever is greater up to 40 curies of Tc-99m, ±1.5% up to 100 curies of Tc-99m.

Electrometer Accuracy
Within 1% or 0.2 µCi, whichever is greater.

Stability
Short term (24 hours): within 0.3% above one mCi, exclusive of background.
Long term (one year): within 1%.

Noise Fluctuations

Display Fluctuations	Activity range
<1 digit after 1-2 seconds	>199.9 microcuries
<+/- 4 after 3 seconds, +/-2 after 10 seconds	>19.99 microcuries
<+/-4 after 50-100 seconds	0.01 to 19.9 microcuries

Energy Range
25 keV to 3 MeV

Isotope Selection
12 Routine buttons: Tc-99m, Tl-201, I-123, I-131, Cs-137, Co-57, Xe-133, Ga-67, In-111, F-18, Y-90s and Ba-133

The unit displays readings in µCi, *m*Ci, Ci, MBq or GBq.
dials can be reset for new calibration values.
The Mo-99 key is calibrated for Mo-99 assay in a shielded vial of Tc-99m.
The Atomlab 500 provides a 30-second countdown.
Alphabetical List
24 Routine isotopes
20 User set isotopes

Calibration Value Display
Up and down arrow control with dial values from 0.0 to 999.9.

Detector Type
Well-type pressurized ionization detector, with argon filled gas. Replaceable plastic liner included. Dimensions are:

Well opening: 2.75 in. (7 cm)
Well depth: 10.5 in. (26.7 cm)
Well opening with liner: 2.5 in. (6.35 cm)
Well depth with liner: 10.25 in. (26 cm)

Detector Shield
.25 in. (6 mm) lead surrounding ionization detector, with top well opening.

Detector Bias
355 +/-5 volts

Environmental Operating Conditions
Temperature: 10 to 30˚C
Humidity: 0 to 90% rh, non-condensing

For optimum performance, the Atomlab 500 should be operated in a normal laboratory environment where the temperature and humidity are maintained for normal human comfort and the ambient radiation level is low and constant.

Environmental Shipping And Stowage Conditions
Temperature: 0 to 40˚C
Humidity: 0 to 90% rh, non-condensing

For optimum performance, the Atomlab 500 should be operated in a normal laboratory environment where the temperature and humidity are maintained for normal human comfort and the ambient radiation level is low and constant.

Physical Data

	Display Unit	Detector Unit
Size:	9.5" w x 12" h x 12" d	6" dia x 15.5" h
	(24.13 x 30.48 x 30.48 cm)	(15.24 x 39.37 cm)
Weight:	4.2 lb (1.9 kg)	38 lb (17.3 kg)

Power
This system uses an XP power supply for medical use, model #pdm60us15, or the alternate ICC Nexergy (Pei Genesis) model MWA065015A-11A (modified).

Line Voltage
100 to 240 VAC, auto selectable by the power supply.
1.5 - 0.75 AMPS

Line Frequency
50/60 Hz
Detachable line cord. Built-in EMI filter and transient suppression.

WARNING: *Before inserting or removing connectors turn system power OFF.*

AVERTISSEMENT: Avant le fait d'insérer ou le fait d'enlever des connecteurs éteignent le pouvoir de système.

Detector Cable
Length

Standard: 8 ft (2.438 m); custom cable lengths available up to 20 meters

Conductors
Six total: two for power, two for chassis ground, two for serial data.

Connectors
RJ-12

Auxiliary Port
RS-232 connector
USB ports (2)
VGA Video Output
RS-232 Serial Port
Ethernet Port

Calibration Constancy Isotopes
Co-57 and Cs-137 are normally used for accuracy and constancy testing. The facility enters the isotopes to be used for constancy testing.

⚠ ***CAUTION:*** *Medical electrical equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in the accompanying documents; Appendix H (EMC chart). Portable and mobile RF communications equipment can affect medical electrical equipment.*

⚠ ***ATTENTiON:*** *l'équipement électrique médical a besoin des précautions spéciales quant à EMC et doit être installé et mis dans le service selon l'EMC information fourni dans le papiers d'accompagnement; Appendeix H (le graphique d'EMC). RF portatif et mobile l'équipement de communications peut affecter l'équipement électrique médical.*

⚠ ***CAUTION:*** *The use of accessories, and cables other than those specified, with the exception of cables sold by manufacturer, may result in increased or decreased immunity of the equipment or system.*

⚠ ***ATTENTION: l'****utilisation d'accessoires et de câbles autre que ceux a spécifié, à l'exception des câbles vendus par le fabricant, peut s'ensuivre dans l'immunité augmentée ou diminuée de l'équipement ou du système.*

Electromechanical Compatibility
As per CISPR 11 complies with Group 1 Class B requirements

ETL Listed
Electrical Equipment, Laboratory Use;
Part 1, General Requirements for Safety conforms to UL 60601-1, CAN/CSA C22.2 No: 601-1-M90, IEC 60601-1, IEC 60601-1-4 and IEC 60601-1-2.

Authorized European Community Representative:

EC	REP

Emergo Europe
Molenstraat 15
2513 BH, The Hague
The Netherlands

Appendix D:
Decay Calculations

This appendix provides methods of performing radioisotope decay calculations.

The first section provides two methods of performing Decay Calculations, the second section provides the DECAY FACTOR CHART, and the third section provides an explanation of how the procedures used in the first section, and the DECAY FACTOR CHART in the second section, are generated.

Decay Calculation Methods - Calculator Method

If You Are Using A Calculator With The Y^x Function, Perform The Following:

1. Measure the current activity of the radioisotope (A_0), which can be compared to the decayed calculated activity.
2. Look up the half life $T_{1/2}$ of the radioisotope in Appendix E. Note the time units.
3. $T_{1/2}$ = Half life of the isotope

   t = Elapsed Time

   A = Current Activity

   A_0 = Activity at the time of calibration

4. Calculate $A = A_0 \times 2^{(-t/T_{1/2})}$
5. Calculate the elapsed time (t) in the same units as the ($T_{1/2}$) that will elapse between when the calibrated activity measurement was made and when you wish to know what the decayed activity of your radioisotope will be.

Sample Calculation

The following is a calculation of the decayed activity of Tc-99m, with an initial activity of 43 *m*Ci, after 53 minutes:

6. A_0 = 43 *m*Ci.
7. For Tc-99m, $T_{1/2}$ = 6.007 h.
8. Elapsed t = 53 min x $\frac{1\ hr}{60\ min}$ = 0.8833 hr
9. $A = A_0 \times 2^{(-t/T_{1/2})}$

   $A = 43\ mCi \times 2^{(-0.8833/6.007)}$

   $A = 43\ mCi \times 2^{(-0.147045)}$

   $A = 43\ mCi \times 0.903$

   $A = 38.83\ mCi$

Alternate Decay Calculation Method

If You Are Using A Calculator With The Y^x Function, Perform The Following:

1. Measure the current activity of the radioisotope (A_0), which can be compared to the decayed calculated activity.

2. Look up half life ($T_{1/2}$) of the radioisotope in APPENDIX E. Note the time units.

3. $T_{1/2}$ = half life of the isotope
   t = Elapsed Time
   a = Current Activity
   a_0 = Activity at the time of calibration
   n = elapsed time / half life

4. Calculate $A = A_0 / 2^n$

5. Calculate the elapsed time (t) in the same units as the ($T_{1/2}$) that will elapse between when the calculated activity measurement was made and when you wish to know what the decayed activity of your radioisotope will be.

Sample Calculation

6. A_0 = 43 *m*Ci.

7. For Tc-99m, $T_{1/2}$ = 6.007 h.

8. Elapsed t = 53 min x $\frac{1 \text{ hr}}{60 \text{ min}}$ = 0.8833 hr

9. Replace equation with following:
   $A = A_0 / 2^n$
   A = 43 *m*Ci / $2^{(0.8833/6.007)}$
   A = 43 *m*Ci / $2^{(0.1470451)}$
   A = 43 *m*Ci / 1.1072992
   A = 38.83 *m*Ci

Decay Factor Method

The following method is used to perform radioisotope decay calculations using a calculator without the e^x function:

1. Measure the current activity A_i of the radioisotope.

2. Look up half life ($T_{1/2}$) of the radioisotope. Note the time units.

3. Calculate the time t, in the same units as $T_{1/2}$, That will elapse between when the activity Measurement was made and when you wish to know what the decayed activity of your radioisotope will be.

4. Calculate $t / T_{1/2}$ in terms of N + R, where N is an integer (0, 1, 2, etc.) and R is less than 1.

5. Look up X_n (N) in Table 1.

6. Look up X_r (R) in the DECAY FACTOR CHART.

7. Calculate $A_f = A_i \times X_n (N) \times X_r (R)$.

Sample Calculation

The following is a calculation of the decayed activity of Tc-99m, with an initial activity of 43 *m*Ci, after 32.5 hours:

1. A_i = 43 *m*Ci.

2. For Tc-99m, $T_{1/2}$ = 6.007 h.

3. t = 32.5 h.

4. $t / T_{1/2}$ = 32.5 h / 6.007 = 5.410. N = 5, R = 0.410.

5. From Table 1, X_n (5) = 0.03125.

6. From the Decay Factor Chart, the **.41** row and the **.000** column, X_r (.410) = .75262.

7. $A_f = A_i \times X_n (N) \times X_r (R)$ = 43 *m*Ci x (0.03125) x (.75262) = 1.01 *m*Ci.

n	$X_n (n) = 2^{-n}$
0	1
1	0.5
2	0.25
3	0.125
4	0.0625
5	0.03125
6	0.01563
7	0.007813
8	0.003906
9	0.001953
10	0.000977

Table 1

DECAY FACTOR CHART

X_r (R), where $R = t / T_{1/2}$ (0.000 to 0.499)

R	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
.00	1.00000	.99931	.99861	.99792	.99723	.99654	.99585	.99516	.99447	.99378
.01	.99309	.99240	.99172	.99103	.99034	.98966	.98897	.98829	.98760	.98692
.02	.98623	.98555	.98487	.98418	.98350	.98282	.98214	.98146	.98078	.98010
.03	.97942	.97874	.97806	.97739	.97671	.97603	.97536	.97468	.97400	.97333
.04	.97265	.97198	.97131	.97063	.96996	.96929	.96862	.96795	.96728	.96661
.05	.96594	.96527	.96460	.96393	.96326	.96259	.96193	.96126	.96059	.95993
.06	.95926	.95860	.95794	.95727	.95661	.95595	.95528	.95462	.95396	.95330
.07	.95264	.95198	.95132	.95066	.95000	.94934	.94868	.94803	.94737	.94671
.08	.94606	.94540	.94475	.94409	.94344	.94278	.94213	.94148	.94083	.94017
.09	.93952	.93887	.93822	.93757	.93692	.93627	.93562	.93498	.93433	.93368
.10	.93303	.93239	.93174	.93109	.93045	.92980	.92916	.92852	.92787	.92723
.11	.92659	.92595	.92530	.92477	.92402	.92338	.92274	.92210	.92146	.92083
.12	.92019	.91955	.91891	.91828	.91764	.91700	.91637	.91573	.91510	.91447
.13	.91383	.91320	.91257	.91193	.91130	.91067	.91004	.90941	.90878	.90815
.14	.90752	.90689	.90626	.90563	.90501	.90438	.90375	.90313	.90250	.90188
.15	.90125	.90063	.90000	.89938	.89876	.89813	.89751	.89689	.89627	.89565
.16	.89503	.89440	.89379	.89317	.89255	.89193	.89131	.89069	.89008	.88946
.17	.88884	.88823	.88761	.88700	.88638	.88577	.88515	.88454	.88393	.88332
.18	.88270	.88209	.88148	.88087	.88026	.87965	.87904	.87843	.87782	.87721
.19	.87661	.87600	.87539	.87478	.87418	.87357	.87297	.87236	.87176	.87115
.20	.87055	.86995	.86934	.86874	.86814	.86754	.86694	.86634	.86574	.86514
.21	.86454	.86394	.86334	.86274	.86214	.86155	.86095	.86035	.85976	.85916
.22	.85857	.85797	.85738	.85678	.85619	.85559	.85500	.85441	.85382	.85323
.23	.85263	.85204	.85145	.85086	.85027	.84968	.84910	.84851	.84792	.84733
.24	.84675	.84616	.84557	.84499	.84440	.84382	.84323	.84265	.84206	.84148
.25	.84090	.84031	.83973	.83915	.83857	.83799	.83741	.83683	.83625	.83567
.26	.83509	.83451	.83393	.83335	.83278	.83220	.83162	.83105	.83047	.82989
.27	.82932	.82874	.82817	.82760	.82702	.82645	.82588	.82531	.82473	.82416
.28	.82359	.82302	.82245	.82188	.82131	.82074	.82017	.81960	.81904	.81847
.29	.81790	.81734	.81677	.81620	.81564	.81507	.81451	.81394	.81338	.81282
.30	.81225	.81169	.81113	.81057	.81000	.80944	.80888	.80832	.80776	.80720
.31	.80664	.80608	.80552	.80497	.80441	.80385	.80329	.80274	.80218	.80163
.32	.80107	.80051	.79996	.79941	.79885	.79830	.79775	.79719	.79664	.79609
.33	.79554	.79499	.79443	.79388	.79333	.79278	.79223	.79169	.79114	.79059
.34	.79004	.78949	.78895	.78840	.78785	.78731	.78676	.78622	.78567	.78513
.35	.78458	.78404	.78350	.78295	.78241	.78187	.78133	.78079	.78025	.77970
.36	.77916	.77862	.77809	.77755	.77701	.77647	.77593	.77539	.77486	.77432
.37	.77378	.77325	.77271	.77218	.77164	.77111	.77057	.77004	.76950	.76897
.38	.76844	.76791	.76737	.76684	.76631	.76578	.76525	.76472	.76419	.76366
.39	.76313	.76260	.76207	.76154	.76102	.76049	.75996	.75944	.75891	.75838
.40	.75786	.75733	.75681	.75628	.75576	.75524	.75471	.75419	.75367	.75315
.41	.75262	.75210	.75158	.75106	.75054	.75002	.74950	.74898	.74846	.74794
.42	.74742	.74691	.74639	.74587	.74536	.74484	.74432	.74381	.74329	.74278
.43	.74226	.74175	.74123	.74072	.74021	.73969	.73918	.73867	.73816	.73765
.44	.73713	.73662	.73611	.73560	.73509	.73458	.73408	.73357	.73306	.73255
.45	.73204	.73154	.73103	.73052	.73002	.72951	.72900	.72850	.72799	.72749
.46	.72699	.72648	.72598	.72548	.72497	.72447	.72397	.72347	.72297	.72247
.47	.72196	.72146	.72096	.72047	.71997	.71947	.71897	.71847	.71797	.71747
.48	.71698	.71648	.71598	.71549	.71499	.71450	.71400	.71351	.71301	.71252
.49	.71203	.71153	.71104	.71055	.71005	.70956	.70907	.70858	.70809	.70760

DECAY FACTOR CHART

X_r (R), where $R = t / T_{1/2}$ (0.500 to 1.0)

R	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
.50	.70711	.70662	.70613	.70564	.70515	.70466	.70417	.70368	.70320	.70271
.51	.70222	.70174	.70125	.70076	.70028	.69979	.69931	.69882	.69834	.69786
.52	.69737	.69689	.69641	.69592	.69544	.69496	.69448	.69400	.69352	.69304
.53	.69255	.69208	.69160	.69112	.69064	.69016	.68968	.68920	.68873	.68825
.54	.68777	.68729	.68682	.68634	.68587	.68539	.68492	.68444	.68397	.68349
.55	.68302	.68255	.68207	.68160	.68113	.68066	.68019	.67971	.67924	.67877
.56	.67830	.67783	.67736	.67689	.67642	.67596	.67549	.67502	.67455	.67408
.57	.67362	.67315	.67268	.67222	.67175	.67129	.67082	.67036	.66989	.66943
.58	.66896	.66850	.66804	.66757	.66711	.66665	.66619	.66573	.66526	.66480
.59	.66434	.66388	.66342	.66296	.66250	.66204	.66159	.66113	.66067	.66021
.60	.65975	.65930	.65884	.65838	.65793	.65747	.65702	.65656	.65611	.65565
.61	.65520	.65474	.65429	.65384	.65338	.65293	.65248	.65203	.65157	.65112
.62	.65067	.65022	.64977	.64932	.64887	.64842	.64797	.64752	.64707	.64662
.63	.64618	.64573	.64528	.64483	.64439	.64394	.64349	.64305	.64260	.64216
.64	.64171	.64127	.64082	.64038	.63994	.63949	.63905	.63861	.63816	.63772
.65	.63728	.63684	.63640	.63596	.63552	.63508	.63464	.63420	.63376	.63332
.66	.63288	.63244	.63200	.63156	.63113	.63069	.63025	.62982	.62938	.62894
.67	.62851	.62807	.62764	.62720	.62677	.62633	.62590	.62546	.62503	.62460
.68	.62417	.62373	.62330	.62287	.62244	.62201	.62157	.62114	.62071	.62028
.69	.61985	.61942	.61900	.61857	.61814	.61771	.61728	.61685	.61643	.61600
.70	.61557	.61515	.61472	.61429	.61387	.61344	.61302	.61259	.61217	.61174
.71	.61132	.61090	.61047	.61005	.60963	.60921	.60878	.60836	.60794	.60752
.72	.60710	.60668	.60626	.60584	.60542	.60500	.60458	.60416	.60374	.60332
.73	.60290	.60249	.60207	.60165	.60123	.60082	.60040	.59999	.59957	.59915
.74	.59874	.59832	.59791	.59750	.59708	.59667	.59625	.59584	.59543	.59502
.75	.59460	.59419	.59378	.59337	.59296	.59255	.59214	.59173	.59132	.59091
.76	.59050	.59009	.58968	.58927	.58886	.58845	.58805	.58764	.58723	.58682
.77	.58642	.58601	.58561	.58520	.58479	.58439	.58398	.58358	.58317	.58277
.78	.58237	.58196	.58156	.58116	.58075	.58035	.57995	.57955	.57915	.57875
.79	.57834	.57794	.57754	.57714	.57674	.57634	.57594	.57554	.57515	.57475
.80	.57435	.57395	.57355	.57316	.57276	.57236	.57197	.57157	.57117	.57078
.81	.57038	.56999	.56959	.56920	.56880	.56841	.56801	.56762	.56723	.56683
.82	.56644	.56605	.56566	.56527	.56487	.56448	.56409	.56370	.56331	.56292
.83	.56253	.56214	.56175	.56136	.56097	.56058	.56019	.55981	.55942	.55903
.84	.55864	.55826	.55787	.55748	.55710	.55671	.55632	.55594	.55555	.55517
.85	.55478	.55440	.55402	.55363	.55325	.55287	.55248	.55210	.55172	.55133
.86	.55095	.55057	.55019	.54981	.54943	.54905	.54867	.54829	.54791	.54753
.87	.54715	.54677	.54639	.54601	.54563	.54525	.54488	.54450	.54412	.54374
.88	.54337	.54299	.54261	.54224	.54186	.54149	.54111	.54074	.53036	.53999
.89	.53961	.53924	.53887	.53849	.53812	.53775	.53737	.53700	.53663	.53626
.90	.53589	.53552	.53514	.53477	.53440	.53403	.53366	.53329	.53292	.53255
.91	.53218	.53182	.53145	.53108	.53071	.53034	.52998	.52961	.52924	.52888
.92	.52851	.52814	.52778	.52741	.52705	.52668	.52632	.52595	.52559	.52522
.93	.52486	.52449	.52413	.52377	.52340	.52304	.52268	.52232	.52196	.52159
.94	.52123	.52087	.52051	.52015	.51979	.51943	.51907	.51871	.51835	.51799
.95	.51763	.51727	.51692	.51656	.51620	.51584	.51548	.51513	.51477	.51441
.96	.51406	.51370	.51334	.51299	.51263	.51228	.51192	.51157	.51121	.51086
.97	.51051	.51015	.50980	.50945	.50909	.50874	.50839	.50803	.50768	.50733
.98	.50698	.50663	.50628	.50593	.50558	.50523	.50488	.50453	.50418	.50383
.99	.50348	.50313	.50278	.50243	.50208	.50174	.50139	.50104	.50069	.50035
1.0	.50000									

$A_f = A_i e^{-\lambda t}$

Explanation Of Decay Calculation Methods

Where:

Calculator Method

The radioactivity of an isotope can be calculated as it decays using the following expression:

A_f = final activity at the end of the decay time;

A_i = initial activity measured at some starting time;

t = net decay time in units inverse to λ; and

λ = (lamda) decay constant specific to the radioisotope.

$\lambda = \ln(2) / T_{1/2} = 0.693 / T_{1/2}$

where

$T_{1/2}$ = half life specific to the radioisotope.

So, using a calculator with the $\mathbf{e}^x$ function, decay calculations can easily be performed, as shown in the first section of this appendix.

Decay Factor Method

If you do not have a calculator with the $\mathbf{e}^x$ function, the above expression can be rewritten as follows:

$A_f = X A_i$

where

$X = (X_n)(X_R)$

N = integer number of half lives in time **t**; and

R = decimal remainder after dividing **t** by $T_{1/2}$. To verify this, remember three important relations regarding exponentials:

$e^{A+B} = e^A \times e^B$;

$e^{\ln(A)} = A$; and

$e^{AB} = (e^A)^B$.

Now $\mathbf{t} / T_{1/2} = N + R$

where N is an integer, and R is the remainder less than 1.

For $\mathbf{t}$ = 32.5 hours and $T_{1/2}$ = 6.007 hours,

$\mathbf{t} / T_{1/2} = 32.5 / 6.007 = 5.410$

so that N = 5 and R = 0.410.

Now, to simplify calculations, we can write the above rela- tion as:

$A_f = A_i\, e^{-\lambda \mathbf{t}} = A_i\, e^{-\ln (2) \mathbf{t} / T_{1/2}}$

$A_f = A_i\, e^{-\ln (2)(N + R)} = A_i\, e^{-\ln (2)N} \times e^{-\ln (2)R}$

$= A_i \times X_n (N) \times X_r (R)$

$X_n (N) = e^{-\ln (2)N} = (e^{\ln (2)})^{-N} = 2^{-N}$

This expression is used to generate the values in Table 1. $X_r (R) = e^{-\ln (2)R}$

This expression is used to generate the Decay Factor Chart
for values of R from 0.001 to 0.999. For the above example

$X_n (5) = 0.03125$

$X_r (0.410) = 0.75262$
$A_f = X\, A_i = [X_n (N) \times X_r (R)]\, A_i = [0.03125 \times 0.75262]\, 43$ mCi

$A_f = 1.01$ mCi

DIAL VALUE LIST FOR 400 & 500 CHAMBERS
1/26/2016

Nuclide		Dial Value	Decay Scheme	Avg Beta Energy (keV)	Half-life	Expected Uncertainty		Container	Notes
Ac-225	Actinium	36.2	A		10.0d	C	+/-10%	NIST	
As-76	Arsensic	24.4	B-	1068	1.1d	C	+/-10%	NIST	
At-211	Astatine	61.6	A,E		7.21h	C	+/-10%	NIST	
Au-198	Gold	24.1	B-	406	2.69d	C	+/-10%	NIST	
Au-199	Gold	46.7	B-	87	3.139d	C	+/-10%	NIST	
Ba-133	Barium	7.4	E		10.54y	M	+/- 3%	NIST	
Bi-212/Tl-208	Bismuth/Thallium	3.8	A,B-	492 & 560	1.01h	C	+/-10%	NIST	In equilibrium
Bi-213	Bismuth	53.5	B-	12.3	45.6 m	C	+/-10%	NIST	
Br-75	Bromine	8.3	E,B+	499	1.62h	C	+/-10%	NIST	H(r)=.00056, did not include Se-75
Br-76	Bromine	4.4	E,B+	642	16.2h	C	+/-10%	NIST	
Br-77	Bromine	20.6	E,B+	1.12	2.376 d	C	+/-10%	NIST	
C-11	Carbon	10.1	E,B+	385	20.39m	C	+/-10%	NIST	
Cd-109	Cadmium	32.0	E		1.267y	C	+/-10%	NIST	
Ce-144/Pr-144	Cerium/Praseodymium	57.4	B-/B-	82 & 1209	285d/17m	C	+/-10%	NIST	
Co-55	Cobalt	5.6	E,B+	430	17.53h	C	+/-10%	NIST	Fe-55 ignored. Contribution is insignificant.
Co-57	Cobalt	33.7	E		271.77d	M	+/- 3%	NIST	
Co-58	Cobalt	11.5	E		70.9d	C	+/-10%	NIST	
Co-60	Cobalt	5.0	B-	96	5.271y	M	+/- 1%	NIST	Cal values defined relative to Co-60
Cr-51	Chromium	295.0	E		27.7d	C	+/-10%	NIST	
Cs-134	Cesium	7.1	B-	157	2.06y	C	+/-10%	NIST	
Cs-137	Cesium	17.1	B-	188	30.0y	M	+/- 3%	NIST	
Cu-61	Copper	12.3	E,B+	306	3.408 h	C	+/-10%	NIST	
Cu-62	Copper	9.7	E,B+	1280	9.74m	C	+/-10%	NIST	
Cu-64	Copper	55.0	B+,B-	49.8 & 71	12.701h	C	+/-10%	NIST	
Cu-67	Copper	43.6	B-	142	2.58d	C	+/-10%	NIST	
Dy-165	Dysprosium	92.8	B-	442	2.334h	C	+/-10%	NIST	Includes **Bremsstralung contributions

Scheme: EC = Electron Capture IT = Isomeric Transition

NOTES:
1. Isotope: A/B implies that B is in equilibrium with A
2. Half life: s=seconds, m=minutes, d=days, y=years
3. Scheme: E=electron capture, B=beta decay, IT = isomeric transition, A= alpha decay
4. Cal Value = Atomlab dose calibrator dial setting to calibrate for corresponding isotope
5. Notes:
   *H(r) = Half life ratio of daughter over parent, implies daughter is ignored
   **Bremsstrahlung included implies low energy photons from electron interaction in saline

Isotope should be measured in plastic syringe or vial or thin wall glass ampule, unless otherwise stated above.

Calculated or Measured:
C: Calculated with corrected Monte Carlo
B: Beta MC, response strongly dependent upon measurement geometry: best if Cal Value used is determined using actual measurement with clinical geometry
M: Confidence value of a measurement made using the listed dial value

DIAL VALUE LIST FOR 400 & 500 CHAMBERS 1/26/2016									
Nuclide		Dial Value	Decay Scheme	Avg Beta Energy (keV)	Half-life	Expected Uncertainty		Container	Notes
Eu-152	Europium	6.2	E,B-	496	13.33yr	C	+/-10%	NIST	
F-18	Flourine	10.1	E,B+	242	1.83h	M	+/- 3%	NIST	
Fe-52	Iron	11.9	E,B+	189	8.275h	C	+/-10%	NIST	
Fe-52/Mn-52	Iron/Manganese	3.3	E,B+/E,B+	189 & 1133	8.275h/21.1m	C	+/-10%	NIST	
Fe-59	Iron	10.5	B-	118	44.5d	C	+/-10%	NIST	
Ga-67	Gallium	32.5	E		3.261d	M	+/- 3%	NIST	
Gd-153	Gadolinium	8.7	E		241.6d	C	+/-10%	NIST	
Ge-68/Ga-68	Germanium/Gallium	10.2	E/E,B+	740	270.8 d/1.14 h	M	+/- 3%	special	
Hg-197	Mercury	24.0	E		2.67d	C	+/-10%	NIST	
Hg-203	Mercury	32.1	B-	58	46.6d	C	+/-10%	NIST	
Ho-166	Holmium	77.0	B-	16.5	1.117d	C	+/-10%	NIST	Includes **Bremsstralung contributions
I-122	Iodine	9.5	E,B+	1087	3.62m	C	+/-10%	NIST	
I-123	Iodine	12.8	E		13.2h	M	+/- 3%	NIST	
I-124	Iodine	7.7	E,B+	188	4.18d	C	+/-10%	NIST	
I-125	Iodine	10.8	E		60.14d	M	+/- 3%	NIST	
I-131	Iodine	22.3	B-	182	8.04d	M	+/- 3%	NIST	
In-111	Indium	13.1	E		2.807d	M	+/- 3%	NIST	
In-113m	Indium	31.1	IT		1.6h	C	+/-10%	NIST	
Ir-192	Iridium	11.1	B-&E	171	73.83d	C	+/-10%	NIST	
Ir-196	Iridium	45.2	B-	1170	52s	C	+/-10%	NIST	Includes **Bremsstralung contributions
Ir-196	Iridium	4.0	B-	337	1.40h	C	+/-10%	NIST	
K-38	Potassium	3.9	E,B+	1204	7.636 m	C	+/-10%	NIST	
K-43	Potassium	10.7	B-	314	22.3h	C	+/-10%	NIST	
La-140	Lanthanum	5.4	B-	525	1.678d	C	+/-10%	NIST	
Lu-177	Lutetium	114.0	B-	133	6.71d	M	+/-10%	NIST	

Scheme: EC = Electron Capture IT = Isomeric Transition

NOTES:

1. Isotope: A/B implies that B is in equilibrium with A
2. Half life: s=seconds, m=minutes, d=days, y=years
3. Scheme: E=electron capture, B=beta decay, IT = isomeric transition, A= alpha decay
4. Cal Value = Atomlab dose calibrator dial setting to calibrate for corresponding isotope
5. Notes:
   *H(r) = Half life ratio of daughter over parent, implies daughter is ignored
   **Bremsstrahlung included implies low energy photons from electron interaction in saline

Isotope should be measured in plastic syringe or vial or thin wall glass ampule, unless otherwise stated above.

Calculated or Measured:

C: Calculated with corrected Monte Carlo
B: Beta MC, response strongly dependent upon measurement geometry: best if Cal Value used is determined using actual measurement with clinical geometry
M: Confidence value of a measurement made using the listed dial value

DIAL VALUE LIST FOR 400 & 500 CHAMBERS
1/26/2016

Nuclide		Dial Value	Decay Scheme	Avg Beta Energy (keV)	Half-life	Expected Uncertainty		Container	Notes
Mo-99	Molybdenum	175.0	B-	390	2.748d	M	+/- 3%	NIST	In 1/4 inch lead wall breakthru shield.
N-13	Nitrogen	10.1	E,B+	491	9.965m	C	+/-10%	NIST	
Na-22	Sodium	5.3	E,B+	195	2.6y	C	+/-10%	NIST	
Nb-95	Niobium	14.7	B-	9.8	34.97d	C	+/-10%	NIST	
O-15	Oxygen	10.0	E,B+	735	2.037m	C	+/-10%	NIST	
Os-191	Osmium	27.2	B-	37.5	15.4d	C	+/-10%	NIST	
P-32	Phosphorous	509.0	B- (Pure)	695	14.28d	M	+/-20%	vial	vial
P-32	Phosphorous	712.0	B- (Pure)	695	14.28d	M	+/-20%	syringe	syringe
Pb-203	Lead	15.0	E		2.169d	C	+/-10%	NIST	
Pb-212	Lead	34.0	B-	74 & 101	10.64h	C	+/-10%	NIST	
Pm-149	Promethium	485	B-	366	2.212d	B	+/-20%	NIST	Includes **Bremsstralung, ~40%
Pt-195m	Platinum	22.6	IT		4.02d	C	+/-10%	NIST	
Pt-197	Platinum	103.0	B-	195	18.3h	C	+/-10%	NIST	
Ra-223	Radium	17.8	A		11.43d	M	+/-10%	syringe	Includes X-ray contributions
Rb-81/Kr-81	Rubidium/Krypton	14.5	E,B+/IT	132	4.6h/13s	C	+/-10%	NIST	
Rb-82	Rubidium	8.7	E,B+	1409	1.273m	C	+/-10%	NIST	
Re-186	Rhenium	110.3	B-,E	323	3.777d	C	+/-10%	NIST	Includes **Bremsstralung contributions
Re-188	Rhenium	82.5	B-	765	16.98h	C	+/-10%	NIST	Includes **Bremsstralung contributions
Sb-124	Antimony	6.6	B-	105	60.2d	C	+/-10%	NIST	
Sc-46	Scandium	6.0	B-	52	83.83d	C	+/-10%	NIST	
Se-73	Selenium	7.2	E,B+	368	7.15h	C	+/-10%	NIST	H(r)=.0037, did not include As-73
Se-75	Selenium	17.6	E		119.8d	C	+/-10%	NIST	
Sm-153	Samarium	20.4	B-	225	1.946d	M	+/-10%	vial	vial
Sm-153	Samarium	15.4	B-	225	1.946d	M	+/-10%	syringe	syringe
Sm-153	Samarium	19.0	B-	225	1.946d	C	+/-10%	NIST	
Sm-156	Samarium	8.1	B-		9.4h	C	+/-10%	NIST	H(r)= 0.0258, ignored Eu-156 daughter
Sn-117m	Tin	17.1	IT		13.6d	C	+/-10%	NIST	

Scheme: EC = Electron Capture IT = Isomeric Transition

NOTES:
1. Isotope: A/B implies that B is in equilibrium with A
2. Half life: s=seconds, m=minutes, d=days, y=years
3. Scheme: E=electron capture, B=beta decay, IT = isomeric transition, A= alpha decay
4. Cal Value = Atomlab dose calibrator dial setting to calibrate for corresponding isotope
5. Notes:
   *H(r) = Half life ratio of daughter over parent, implies daughter is ignored
   **Bremsstrahlung included implies low energy photons from electron interaction in saline

Isotope should be measured in plastic syringe or vial or thin wall glass ampule, unless otherwise stated above.

Calculated or Measured:
C: Calculated with corrected Monte Carlo
B: Beta MC, response strongly dependent upon measurement geometry: best if Cal Value used is determined using actual measurement with clinical geometry
M: Confidence value of a measurement made using the listed dial value

DIAL VALUE LIST FOR 400 & 500 CHAMBERS 1/26/2016									
Nuclide		Dial Value	Decay Scheme	Avg Beta Energy (keV)	Half-life	Expected Uncertainty		Container	Notes
Sr-85	Strontium	20.6	E		64.84d	C	+/-10%	NIST	
Sr-87m	Strontium	30.9	IT		2.795h	C	+/-10%	NIST	
Sr-89	Strontium	686.0	B-	583	50.55d	B	+/-20%	NIST	Pure Sr-89, NIST Grade, **Brems...
Ta-178	Tantalum	16.6	E		9.31 m	C	+/-10%	NIST	Pure
Tc-99m	Technetium	37.1	IT		6.007h	M	+/- 3%	NIST	
Tl-201	Thallium	20.9	E		3.046d	M	+/- 3%	NIST	
W-178	Tungsten	68.7	E		21.5 d	C	+/-10%	NIST	Pure
W-178/Ta-178	Tungsten/Tantalum	13.4	E/E		21.5d/9.31m	C	+/-10%	NIST	Ta-178 in equilibrium with W-178 (use for W contamination activity)
W-188/Re-188	Tungsten/Rhenium	82.1	B-	99 & 765	69.4 d	C	+/-10%	NIST	Includes **Bremsstralung contributions from Re-188
Xe-127	Xenon	11.0	E		36.4d	C	+/-10%	NIST	
Xe-133	Xenon	19.5	B-	100	5.245d	M	+/- 3%	NIST	
Y-86	Yttrium	3.4	B+	2.88	14.74h	C	+/-10%	NIST	B+ contribution is ~12%
Y-88	Yttrium	4.9	E		106.6d	C	+/-10%	NIST	
Y-90	Yttrium	350.0	B-	934	2.671d	M	+/ 5%	NIST	**Bremsstralung only, 10 cc plastic syringe (From 2002 vol study)
Y-90	Yttrium	375.0	B-	934	2.671d	M	+/ 3%	NIST	**Bremsstrahlung only, NIST vial measurement
Yb-169	Ytterbium	5.5	E		32d	C	+/-10%	NIST	
Zn-65	Zinc	21.2	E,B+	2	244.1d	C	+/-10%	NIST	B+ contribution is ~3%
Zr-89/Y-89m	Zirconium/Yttrium	10.0	E,B+/IT	7.1	3.268d/16.1s	C	+/-10%	NIST	

Scheme: EC = Electron Capture IT = Isomeric Transition

NOTES:

1. Isotope: A/B implies that B is in equilibrium with A
2. Half life: s=seconds, m=minutes, d=days, y=years
3. Scheme: E=electron capture, B=beta decay, IT = isomeric transition, A= alpha decay
4. Cal Value = Atomlab dose calibrator dial setting to calibrate for corresponding isotope
5. Notes:
   *H(r) = Half life ratio of daughter over parent, implies daughter is ignored
   **Bremsstrahlung included implies low energy photons from electron interaction in saline

Isotope should be measured in plastic syringe or vial or thin wall glass ampule, unless otherwise stated above.

Calculated or Measured:

C: Calculated with corrected Monte Carlo
B: Beta MC, response strongly dependent upon measurement geometry: best if Cal Value used is determined using actual measurement with clinical geometry
M: Confidence value of a measurement made using the listed dial value

Dial Value Settings and Source Containers (Glass Vial, Glass Syringe, etc.)
The Atomlab Dial Value (DV) settings enable the software to convert ion chamber current into a displayed activity value for the isotope corresponding to the DV selected. The displayed activity value is directly proportional to the DV.

The isotope's "*source container*" is either a vial or syringe; the composition of the vial or syringe MAY influence the accuracy of the activity measurement. The DV supplied in the Atomlab User Guide (Instruction Manual), or pre-programmed into the isotope dial value, *are calibrated for use with the source material in an un-shielded plastic syringe (nominal 1mm wall)*, while hanging in the supplied "source dipper" syringe support. For isotopes contained in sealed long lived QA sources (Cs-137, etc.), the DV supplied are calibrated for use with type Vial E epoxy sources or equivalent. Yttrium-90 is listed in both a plastic syringe and a vial.

Accurate measurement of unsealed sources in any other configuration must be with a new Container Dial Value *"CDV", determined by the USER* with the following procedure. During following steps, set DV to the Atomlab published value.

Container with NO source material

1 Assay a quantity of isotope source material in a plastic syringe, nominal wall thickness of 1mm, record as *(Plastic Syringe Activity)1*.
2 Transfer part or all of the source material from the plastic syringe into the empty Container.
3 Assay the Container with the isotope source material, record as *(Container Activity)*.
4 Assay the partial or "empty" plastic syringe for residual activity, record as *(Plastic Syringe Activity)2*.
5 Calculate the Container Dial Value for use with isotope assayed in that type of container,
*CDV = DV * (PSA1 - PSA2) / (Container Activity)*
where *PSA = Plastic Syringe Activity*

Container with source material

1 Assay Container with the isotope source material, record as *(Container Activity) 1*.
2 Transfer part or all of the source material from the Container into a plastic syringe, nominal wall thickness of 1mm.
3 Assay the plastic syringe with the isotope source material, record as *(Plastic Syringe Activity)*.
4 Assay the partial or "empty" Container for residual activity, record as *(Container Activity)* 2.
5 Calculate the Container Dial Value for use with isotope assayed,
*CDV = DV * PSA / (CA1-CA2)*
where *PSA* = Plastic Syringe Activity and *CA* = Container Activity.
Typically, for glass wall source Containers, CDV will be higher than DV when the isotope has a significant portion of low energy photons in its emission spectrum.

- Scheme: EC = Electron Capture IT = Isomeric Transition

NOTES

1. **Isotope: A/B implies that B is in equilibrium with A**
2. **Half Life: s = seconds, m = minutes, d = days, y = years**
3. **Scheme: EC = Electron Capture, B = Beta decay, IT = Isomeric transition, A = Alpha Decay**
4. **Cal Value = Atomlab Dose Calibrator dial setting to calibrate for corresponding isotope**
5. **Notes:**
   ***H(r) = Half-life ratio of daughter over parent, implies daughter is ignored**
   ****Bremsstrahlung includes implies low energy photons from electron interaction in saline**
   Isotope should be measured in plastic syringe or vial or thin wall glass ampule.

Isotope should be measured in plastic syringe or vial or thin wall glass ampule, unless otherwise stated above.

CONFIDENCE VALUES

C	Calculated with corrected Monte Carlo
B	Beta MC, response strongly dependent upon measurement geometry: best if Cal Value used is determined using actual measurement with clinical geometry confidence value of a measurement made using the listed dial value
M	Measured directly
S	Special Case
+/-3%	As stated

Dial Settings For Y-90

The typical Atomlab 500 Dose Calibrator dial setting for Y-90 activity in a 10 cc plastic syringe is 350. This value can be used as a starting point for initial measurements. However, it is recommended that the dial setting used for clinical measurements be determined from the first dose of Zevalin received from the radiopharmacy, as outlined below. Following doses should then be compared to the radiopharmacy doses for constancy.

The Y-90 recipient, using an Atomlab Dose Calibrator, should determine the correct dial value from the first Y-90 dose that they receive from a commercial radiopharmacy. This is determined by selecting the Y-90 button and adjusting the dial setting until the displayed activity agrees with the decay corrected Y-90 syringe activity as stated by the commercial radiopharmacy. If the adjusted dial setting falls within the range of 333 to 368, then use that dial setting.

If It Falls Outside The Range, Verify That:

- there is a well liner in place
- a hook style dipper is used
- the annual accuracy and Daily Constancy Test results are acceptable

If these criteria are met, then determine the percent difference of the new dial value with respect to the nearest range limit value (333 or 368), i.e. dial value error (DVE). Add this percent to the change in constancy percent error (CCPE). If the sum of the errors is in the range of -2% to +2%, then the new dial value should be used. If not, contact Biodex Technical Support. The user may also want to contact the radiopharmacy to determine if a calibration error may have occurred.

NOTE: *The CCPE is the percent change from calibrator installation of the constancy measurement, where CCPE = "Today's" Constancy Percent Error - "Installation's" Constancy Percent Error. The Constancy Percent Error is the measurement error with respect to the decay corrected source activity. A change down in the Atomlab Calibrator constancy will cause a change up in the dial value required to compensate the change in constancy, and visa-a versa. Thus, the CCPE will have the opposite sign as the DVE, so adding them should cancel to within 2%.*

For example, a new dial value for Y-90 is found to be 374. This falls outside the range and is +1.5% higher than 368. The constancy measurement shows a -2.5% change since the dose calibrator was installed. Their sum is (+1.5%) + (-2.5%) = -1.0%, which within -2% and +2%. The dial value of 374 should be used.

NOTE: *For all Atomlab Dose Calibrator models, the well liner must be installed before making measurements. The well liner provides attenuation for the Y-90 betas that would otherwise enter the detector and cause high readings.*

NOTE: *The dial value range provided above is for use with plastic syringes; due to the wide variation in styles between vials it is recommended that the user determine the dial value for vials themselves. This can be done using a vial containing a known activity of Y-90, by changing the dial value until the activity read using the Y-90 button matches the known activity within the vial.*

Appendix F:
Atomlab Dose Calibrator
Calibration And Traceability

This appendix describes the calibration procedures performed on your Atomlab Dose Calibrator and their traceability to the National Institute of Standards & Technology.

Calibration & Traceability

The calibration of the Atomlab Dose Calibrators is directly traceable to the national institute of standards & technology, formerly the national Bureau of Standards (NBS). This is achieved through the establishment of a set of working laboratory standards, the maintenance of these working standards, and the use of these working standards to calibrate each Atomlab Dose Calibrator.

The working standards consist of two ionization detectors identical to the detectors used in each Atomlab Dose Calibrator for radiation measurement, and several long-lived radiation sources.

the two standard ionization detectors have been calibrated using radionuclides that were calibrated by the National Institute of Standards & Technology, generating response numbers. These response numbers were then used to determine the photon response function of the ionization detectors. The shielding configuration is identical to that of the Atomlab Dose Calibrator design.

The National Institute of Standards & Technology sources are in glass ampule form and, because of the potential for breakage, are not suitable for routine calibration. Instead the working standards are in epoxy resin form in a plastic vial e package. These standards have been calibrated against the National Institute of Standards & Technology sources in the two standard ionization detectors. Together, the detectors and the sources provide a high degree of accuracy and redundancy. Periodically, the source activity is measured in the two standard detectors and the results are compared to the expected decayed activity.

The Atomlab Dose Calibrator must first pass all electronic testing and operate for three days prior to calibration. Calibration then takes place with the Co-60 working standard. The calibration value is stored in a special memory chip on the detector circuit board. Calibration is then verified by measuring the activity of all the working standards, including Co-60, Cs-137, Ba-133, and Co-57.

Appendix G:
Atomlab 500 And 500*Plus*
Serial Communications Interface

The Atomlab 500 has the ability to be controlled and monitored, with limitations, via the DB-9 RS-232 serial port.

Connection Details:

Cable: RS-232 female/female null modem, for connection to a standard PC COM Port
Port Settings: 19.2 KBAUD, no parity, 1 stop

Command Format:

All commands are in ASCII format, terminated by a carriage return (0x0D), and no longer than 7 letters. If a parameter is given, the command must be separated from the parameter by at least 1 space and/or comma. If the command or parameter has a format error, or a numeric parameter is out of range, an error message is sent out the serial port, terminated by a CR/LF. All data transmitted as a result of a command is also in ASCII and terminated by a CR/LF.

Usage Notes:

Some of these commands that actively change settings and operation of the display can cause corruption of an activity someone may be in progress of at the display console. These remote commands must be used with great care and consideration of how the unit is being used. The ISO command, for example, when used to change an isotope is fine on a detector not in use, but if a QA test is in progress for a sealed source and the ISO command changes the isotope, the displayed activity will be out of sync with the displayed isotope symbol name.

Command Descriptions:

There are commands to report status, and some control the unit. Following is a list with descriptions in alphabetic order.

^C (Hex: 0x03) sends the most current activity reading out the serial port. A carriage return (0x0D) is not required. This is implemented for backwards compatibility with the Atomlab 100/200 models. Please refer to the DS command for details of the activity report format.

1 (Hex: 0x31) same as ^C above. A carriage return (0x0D) is not required.

BAUD
Sets the baud rate of this serial port, where 1 = 19.2k baud, 2 = 38k baud, 3= 56k baud, and 4 = 115 baud.

BEEP
Issues a beep tone on the display for "###" milliseconds. If not specified, it defaults to 100. longest beep sounded can be for 10 seconds.

BKGND {#}
Where # = 1..7 (Detector #) (For a Dose Calibrator Only) this command will do a Zero Background on the specified detector number. If no parameter is given, it will use detector #1. If the command cannot be performed, one of the following errors will be returned:

ERROR: Cannot Display Zero Background {a "modal" screen is being viewed, blocking the view of Zero Background}

ERROR: Invalid Detector Number {the detector # specified cannot be found, or is not available}

If the command succeeds, it may be done instantly, taking effect on the very next activity reading, or may take up to 100 readings. If the Zero Background does not happen instantly, each reading from that detector will be preceded by:

~ Calculating background… {Followed by CR/LF}

When this command is received, the Zero Background screen will be displayed for that detector. However if there is a "modal" style screen displayed, our GUI package will not allow another screen to pop up over it, so in this case, we will return an error. There are not many modal screens, but examples are the QWERTY keyboard screen, the numeric keypad screen, Select Sealed Source, Select Detector, Set Date/Time, etc.

CAPSCR {0/1}
Captures the screen to the local hard disk (=0), or to a USB Flash drive (=1). This operation takes a snap shot of the current display screen and captures it to a BMP file. It may take a few seconds to complete. If no parameter is given, it defaults to 0 (local hard disk).

CHROMA ((For a Dose Calibrator Only)
Request the readings of the last performed Tec-Control Chromatography test (the last valid complete set of readings). There must be at least 2 readings performed, with only 2 readings (sections 1 and 2, or 3 and 4) or 4 readings (sections 1 to 4) being reported. Following is an example of what is returned:

Chromatography
Total Records: 1
Chamber: 4633919
Date 12/16/2015 9:50 AM
Isotope: Tc-99m
Kit Number:
Kit Name: Exametazime
Section Count: 2
Section1: 320. uCi
Section2: 323. uCi

COUNTRY
sets or displays the current country setting, used for formatting dates and times, and configuring the keyboard screen. currently, translations of the screens is not available. The choices are: US, Can, Fra, Ger, Ita, Jpn, Spa, UK

DBGLOG {1/0}
(For a Dose Calibrator Only) Detector Debug Logging On=1, OFF=0. Default to OFF. When On, every time a reading is reported from a detector, it's raw current value is reported out the serial port (streaming mode.) This continues until it's turned OFF. If there is more than 1 detector connected, the detector number is appended on the end of each report.

DCNT
Display the number of active, connected detectors.

DMPSCR
Dumps the content of the screen in a binary format out to the serial port.

DS {1/0}
(For a Dose Calibrator Only) Turns Data Streaming Mode ON=1, OFF=0. If no parameter is given, the current data streaming mode is displayed. When on, every time a reading is reported from a detector, the isotope's symbol, dial values, and activity reading is reported continuously until turned OFF. If there is more than 1 detector connected, the detector number is appended on the end of each report. The report starts with a tilda (~) character with the fields separated by a space. The activity reading always has 3 decimal digits in the report followed by the units. Here is an example of a report: ~Tc-99m 37.1 1404.767 µCi

DSMODE {#}
(For a Dose Calibrator Only) Configures data streaming mode for all or a specific detector, where All=0, 1..n is the detector number.

DSTAT {#}
Displays detector status of all or a specific detector. If no parameter is given, it will default to all detectors, while 1..n is the detector number.

The data returned for a dose calibrator is as follows in this order: Detector ID, High Voltage, Pressure, Temperature, Argon gas (grams)

The data returned for a Wipe test detector is as follows in this order: Detector ID, Current High Vol Age, Last Saved High Voltage, Channel # Cs-137 peak was detected at

If there are multiple detectors connected, an additional field is added - the detector number.

Here is an example of the returned data for an Atomlab 500Plus:
8 359.4 260.2 21.3 7.4 1
14 1188.0 1188.0 52 2

DT {#}
Display or Set the Date/Time. If no parameter is given, the current Date/Time is displayed in US 24hr format. For setting the date/time, the display's current date/time is updated and the real-time clock updated. The date/time parameter must be in standard us 24hr format as follows: mm/dd/yyyy hh:mm:ss

ECHO {1/0}
Display or turn local character echo ON (=1) or OFF (=0). Local character echo is on by default. If using data streaming, this should be turned OFF to avoid mangling the streaming reports.

HELP
Same as the "?" command, displays all available commands with a brief description.

ISO {#}{-#}
(For a Dose Calibrator Only)
Displays or sets the isotope assigned to a detector. For a single detector system, the 2nd parameter is not required. The 1st parameter is an isotope index number, 1 to 88 for the default isotopes, 89 to 113 for custom isotopes. Refer to the separate isotope index document at the end of this chapter for details. The 2nd parameter is the detector number. If no parameter is given, the current assigned isotope for each detector is displayed. Use this command with great care - if the display is in use doing a QA test, this command can corrupt the current running test.

Example of a command:
ISO 43 {sets isotope Tc-99m for detector #2}

The Following errors may be returned:
ERROR: Invalid isotope index # {a number greater than 90 was specified}
ERROR: Measure Screen Not Active {The Measure screen must be on view for this command to work}

When this command is received, the newly selected isotope will be displayed, and the activity changed accordingly. However if any screen other than the Measure screen is on view, the isotope cannot be changed, and the displayed screen will not be affected.

NOTE: *Reference Isotope Index # Table for programming.*

PRTSCR
Prints the current displayed screen on the HP inkjet printer

PWD {1/0}
Sets the screen password override (1=Override, 0=entry required). If no parameter is given, the current state of the password override is displayed.

QADATA
Displays a summary of stored QA Data Records. For each QA data type, the allocated space and used space is shown.

REQDATA

{Qatype} {Locationtype} {Date-Range}

Where:
QA Type: Set to “ALL” or 1 of 11 data types: CON, GEO, ACC, DEC, LIN, CAL, HVA, CLB, BCK, WIP, or CHI

Location Type: If the QA type is “Wip”, then location type can be “ALL” or AREA (Restricted or Unrestricted), SRC (Sealed Source), or PKG (Package)

Date-Range: “From-To” for a date range or a date for a single day. A date is in the format of “mm/dd/yy” or can be “mm/dd” assuming the current year

Examples:
REQDATA W IP AREA 05/01-05/31
{get all the Restricted/Unrestricted wipe results for the month of May}

REQDATA BCK 05/22
{get all the wipe background results from May 22nd}

REQDATA ALL
{all recorded data}

REQDATA ALL 03/21/2009
{all data recorded on one day: 03/21/2009}

The QA Type’s are defined as:
CON - Daily and Expanded Constancy, **Geo** - Geometry, **ACC** - Accuracy,

DEC - Decay, **Lin** - Lineator,
CAL - Calicheck, **HVA** - wipe High Voltage Adjustment,
CLB - wipe Daily Calibration, **BCK** - wipe Background,
WIP - Wipe Tests, **CHI** - Chi-Square

The first item returned will be a CR/LF terminated line:

n Records {count of records being sent}

Followed by the actual records in the current export format. If there are no records meeting the criteria, all that is returned would be: 0 Records

For the Wipe Test Data, a line will be added immediately after the location line for the Location Type:

Type,”Location Type” where ”Location Type” can be Restricted, Unrestricted, Sealed Source, or
Package

Also, the Wide Window Background CPM value is currently being exported (I didn't realized this before). It's in the Wide Window record. Here is an example of the Wide Window record with a brief description of the fields:

WideWindow, Cs-137, 40 DPM,14.0,1039 DPM,20000 DPM,Ok,35.24,25-800 keV

Where:
Cs-137: isotope name assigned for the wide window
40 DPM: wide window net count in DPM
14.0: wide window net count in CPM
1039 DPM: Background CPM for the wide window
20000 DPM: trigger level for the wide window
Ok: status of the wide window (Ok or Over)
35.24: total efficiency of the wide window
25-800 keV: ROI of the wide window

RESET
immediately re-starts the Atomlab firmware program.

SETID #-#
Changes a detector ID specified as "from-to". Valid ID's are: 2, 4, 6, 8, 10, 12, and 14.

SMP {#}
Displays details on an inventory sample number. If no parameter is given, the number of stored samples is displayed.

SSAV
Sets the screen saver time in seconds. It's in effect only until the next reboot, then the configured screen saver takes effect. If no parameter is given, it displays the current screen saver time in effect.

SSRC {#}
Deletes the specified sealed source number. If no parameter is given, a summary of the current defined sealed sources is displayed.

STAT {1/0}
This is for more advanced detector status viewing. This command will turn on an on-screen display of detector status on the <Measure> (1=Set On, 0=Turn OFF). If no parameter is given, a detailed state of the current connected detectors is displayed.

VER
Displays the Atomlab Display Unit's firmware versions as follows: UDM Vers: 1.22 10/12/2010 Windows CE 6.0 Based System

Atomlab 500 Isotope Index

Index	Symbol	Index	Symbol
1	C-11	49	I-124
2	N-13	50	Sb-124
3	O-15	51	I-125
4	F-18	52	Xe-127
5	Na-22	53	I-131
6	P-32	54	Ba-133
7	K-38	55	Xe-133
8	K-43	56	Cs-134
9	Sc-46	57	Cs-137
10	Cr-51	58	La-140
11	Fe-52	59	Ce/Pr-144
12	Fe/Mn-52	60	Pm-149
13	Co-55	61	Eu-152
14	Co-57	62	Gd-153
15	Co-58	63	Sm-153
16	Fe-59	64	Sm-156
17	Co-60	65	Dy-165
18	Cu-61	66	Ho-166
19	Cu-62	67	Yb-169
20	Cu-64	68	Lu-177
21	Zn-65	69	Ta-178
22	Cu-67	70	W-178
23	Ga-67	71	W/Ta-178
24	Ge/Ga-68	72	Re-186
25	Se-73	73	Re-188
26	Br-75	74	W/Re-188
27	Se-75	75	Os-191
28	As-76	76	Ir-192
29	Br-76	77	Pt-195m
30	Br-77	78	Ir-196
31	Rb/Kr-81	79	Ir-196p
32	Rb-82	80	Hg-197
33	Sr-85	81	Pt-197
34	Y-86	82	Au-198
35	Sr-87m	83	Au-199
36	Y-88	84	TI-201
37	----------	85	Hg-203
38	Sr-89	86	Pb-203
39	Zr/Y-89m	87	Bi-213
40	Y-90s	88	Y-90v
41	Nb-95	89	Ra-223
42	Mo-99	90	Ac-225
43	Tc-99m	91	Rt-211
44	Cd-109	92	Bi-212/TI-208
45	In-111	93	PB-212
46	In-113m	94	Sn-117m
47	I-122	95	P-32s (syringe)
48	I-123	96	Sm-153v (vial)
		97	Sm-153s (syringe)

03/18/16

APPENDIX H:
Conformance To Standards

This equipment conforms to the following safety standards:

Standard Edition and/or date	
IEC60601-1-2	First edition, 2007

Table 1.1. Safety Standards.

Accompanying EMC Documents

This medical electrical equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.

- Portable and mobile RF communications equipment can affect medical electrical equipment.
- Use of accessories, transducers and cables other than those specified, with the exception of accessories, transducers and cables sold by the manufacturer of this equipment, as replacement parts for internal and external components, may result in increased emissions or decreased immunity of the equipment.
- The AL 500 should not be used adjacent to or stacked with other equipment. If the AL 500 is used while positioned adjacent to other equipment, it should be observed to verify normal operation in the configuration in which it will be used.

List Of Cable Accessories

The list in Table 1.2 includes all accessory cables supplied with the AL 500 for which the manufacturer of this equipment claims compliance to EN 60601-1-2 when used with the AL 500.

Cable description	*Part no.*	*Cable length*
Power Input Wall Pack	Biodex # C13116	6ft
NEMA Cord Set	Biodex # C11789	10ft

Table 1.2. AL 500 cables.

Declaration Of Conformity

Emissions

Manufacturer's declaration electromagnetic emissions		
The AL 500 is intended for use in the electromagnetic environment specified below. The customer or the user of the AL 500 should assure that it is used in such an environment		
Emissions Test	***Compliance***	***Electromagnetic Environment***
RF emissions CISPR 11	Group 1	The AL 500 generates RF energy only for its internal functions. Therefore, its RF emission is very low and is not likely to cause any interference in nearby electronic equipment
RF emissions CISPR 11	Class A	The AL 500 is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network supplying buildings used for domestic purposes.
Harmonic distortion EN 61000-3-2	Class A	
Voltage fluctuations and flicker EN 61000-3-3	Complies	
NOTE: *It is essential that the actual shielding effectiveness and filter attenuation of the shielded location be verified to assure that they meet the minimum qualifications.*		

Immunity

Manufacturer's declaration electromagnetic immunity			
The AL 500 is intended for use in the electromagneticenvironment specified below. The customer or the user of the AL 500 should assure that it is used in such an environment.			
Immunity test	***IEC 60601-1-2 Test level***	***IEC 60601-1-2 Compliance Level***	***Electromagnetic environment – guidance***
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	Contact±6kV Air ± 8 kV	Floor should be wood, concrete or ceramic tiles. If floor is covered with synthetic material, the relative humidity should be at least 30%
Electrical fast transients/burst IEC 61000-4-4	± 2 kV for power lines ± 1 kV for input/output	Contact±6kV Air ± 8 kV	
	± 2 kV for power lines ± 1 kV for input/output	Power ±2 kV Signal ±1kV	Mains power qualityshould bethatof a typical commercial or hospital environment

Immunity test	*IEC 60601-1-2 Test level*	*IEC 60601-1-2 Compliance level*	*Electromagnetic environment – guidance*
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5% UT (> 95% of dip in UT) for 1/2 cycle 40% UT (60% of dip in UT) for 5 cycle 70% UT (30% of dip in UT) for 25 cycle < 5% UT (> 95% of dip in UT) for 5 sec	< 5% UT (> 95% of dip in UT) for 1/2 cycle 40% UT (60% of dip in UT) for 5 cycle 70% UT (30% of dip in UT) for 25 cycle < 5% UT (> 95% of dip in UT) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If a better mains power quality is required, it is recommended that the AL 500 is powered from an uninterruptible power supply
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	If image distortion occurs, it may be necessary to position the AL 500 display further from sources of power frequency magnetic fields or to install magnetic shielding. The power frequency magnetic field should be measured in the intended installation location to assure that it is sufficiently low
Conducted RF IEC 61000-4-6	3 Vrms, 150 KHz to 80 MHz	3 Vrms, 150KHz to 80 MHz	Portable and mobile RF communications equipment should be used no closer to any part of the AL 500, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance: $d = 1.2\sqrt{P}$ 150 KHz to 80 MHz $d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watt (W) according to the transmitter manufacturer, and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be less than the compliance level in each frequency range. [b] Interference may occur in the vicinity of equipment marked with the following symbol: 
Radiated RF IEC 61000-4-3	3 V/m, 80 MHz to2.5 GHz	3 V/m, 80 MHz to2.5 GHz	

Note 1. UT is the a.c. mains voltage prior to application of the test level.

Note 2. At 80 MHz and 800 MHz, the higher frequency range applies.

Note 3. These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflections from structures, objects and people

[a] Field strength from mixed transmitters, such as base stations for radio telephones and land mobile radios, amateur radio, AM or FM broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the AL 500 is used exceeds the applicable RF compliance levels above, the AL 500 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the AL 500. [b] Over the frequency range 150 KHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended Separation Distances

Recommended separation distances between portable and mobile RF communications equipment and the AL 500.
Table 6

The AL 500 is intended for use in the electromagnetic environment in which radiated RF disturbance are controlled. The customer or the user of the AL 500 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communication equipment (transmitters) and the AL 500 as recommended below, according to the maximum output power of the communication equipment.

Rated maximum output power of transmitter [W]	***Separation distance according to frequency of transmitter [m]***		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.
Note 1. At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
Note 2. These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

APPENDIX I:
Determining Dial Values

Because the dose calibrator is not inherently capable of detecting which radioisotope has been inserted in the re-entrant detector, the user must select which isotope is currently being measured. Each radioisotope selection has a corresponding calibration value (also referred to as a "dial value" for historical reasons). The dial value for a given isotope is a unitless number which is a means of expressing the detector's sensitivity to the radiation produced by that isotope. Dial values are defined relative to Co-60, an isotope chosen for its high energy gamma radiation and long term stability. The detector response R for a given isotope is defined as the amount of detector current produced by a given amount of isotope activity:

$$R_{isotope} = \frac{chamber\ current}{isotope\ activity} \qquad (1)$$

The dial value for Co-60 is defined to be 5.0. The dial value for any other isotope is defined as 5.0 times the response of the detector to Co-60 divided by the response of the detector to the isotope:

$$Dial\ value_{isotope} = 5.0 \times \frac{R_{Co\text{-}60}}{R_{isotope}} \qquad (2)$$

The response of the detector can be calculated as the sum of the detector sensitivity to photons of energy e, times the intensity of the photon radiation of energy e from the radioisotope:

$$R_{isotope} = \sum_{e} S_e\, I_e \qquad (3)$$

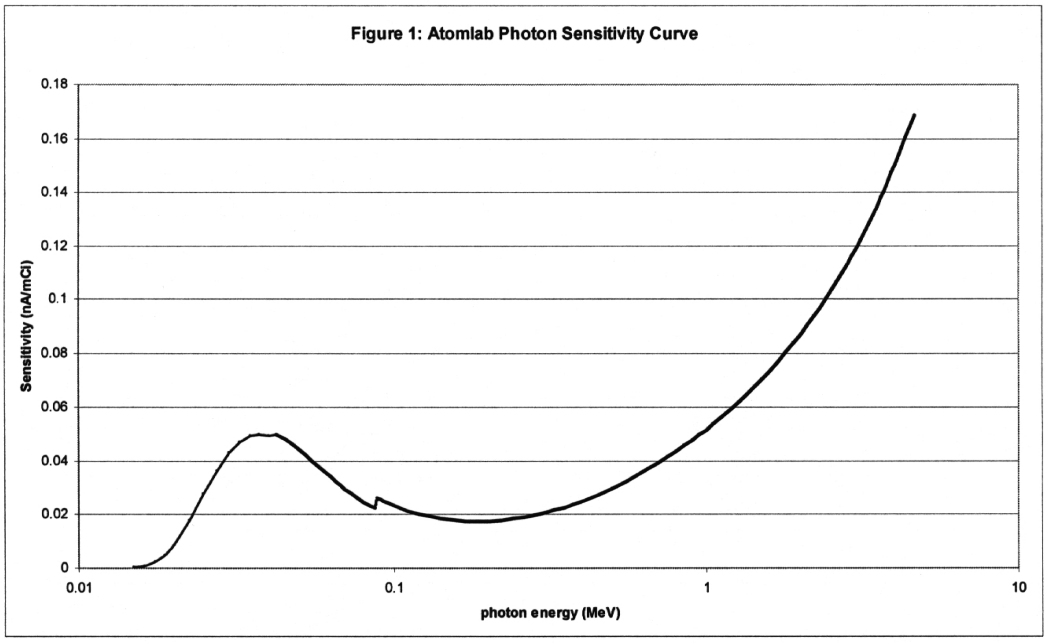
where the sensitivity of the detector detector to photons of energy e, in nA/*m*Ci is:

$$S_e = \frac{chamber\ current\ (nA)}{3.7 \times 10^7\ photons\ of\ energy\ e} \qquad (4)$$

A sensitivity curve can be made by plotting the sensitivity of a detector with respect to photon energy. Given the photon sensitivity curve and the intensity of photon emission from radioisotopes (which are tabulated in sources such as reference 1 and 2), the detector response and dial value can be calculated using equations (1), (2) and (3). The calculated dial values for many common isotopes are listed in the appendix to this manual.

The sensitivity curve of the Atomlab detector with respect to photon energy has been determined by means of measuring NIST calibrated isotopes at a multitude of photon energies. The isotopes Ga-67, Tc-99m, Mo-99, In-111, I-125, I-131, Xe-133, and TI-201 were provided from the NIST standard reference materials program. in addition, NIST traceable sources of the isotopes F-18, Co-57, Co-60, Ba-133, and Cs-137 were measured. all of the NIST SRM isotopes with the exception of Xe-133 were contained liquid solutions of 5 ml volume, in sealed borosilicate glass ampoules of wall thickness 0.6 mm. The Xe-133 samples were sealed, mixed with non-radioactive xenon gas, in borosilicate glass ampoules of wall thickness 1.3 mm. The F-18 source was measured in a 10 ml B-D plastic syringe. The Co-57, Co-60, Ba-133, and Cs-137 sources were contained within epoxy sealed Type E-vials.

In addition to the isotopes measured, a Monte Carlo simulation of the Atomlab detector has been created. The Monte Carlo simulation allows better determination of the shape of the sensitivity curve in the regions between measured data points. The photon sensitivity curve generated by the Monte Carlo simulation was found to be consistent with the sensitivity curve generated by the isotope measurements. The Atomlab detector sensitivity curve is plotted below, with a logarithmic scale for photon energy:



The accuracy for dial value calculation depends upon not only the accuracy of the sensitivity curve and the photon emission intensity data, but also upon the sample configuration, due to low energy photon absorption (see Radioisotope container below). The photon sensitivity curve displayed is for sources with configurations similar to the NIST ampoule configuration noted above. All Atomlab Dose Calibrators are calibrated with NIST traceable Co-60, Ba-133, Co-57, and Cs-137 sources. Each dose calibrator is certified to measure the correct activity of the calibration sources to within the specified accuracy.

The following factors can affect measurement accuracy and should be taken into consideration when using the Atomlab Dose Calibrator:

Lead Shield: A lead shield is necessary to protect personnel from exposure to the radiation produced by radioactive isotopes. This lead shield is integrally installed as part of the Atomlab dose calibrator. However, photon backscatter occurs from the lead shield, resulting in increased detector sensitivity in the 88-200 keV photon energy range. This increase in sensitivity is already included in the sensitivity curve above, and it can be easily seen in the peak at 88 keV. However, if for any reason the dose calibrator is operated without the integral shield installed, the sensitivity curve will be incorrect in this energy range, resulting in incorrect measurements for isotopes which emit photons in this range. It is recommended that the dose calibrator always be operated with the lead shield in place.

Radioisotope container: the style and type of container a radioisotope is in can effect the measurement. Users should have a standard procedure, container, and solution volume for measuring radioisotopes. Plastic syringes are often used as a standard container as they are usually the means of delivery to the patient in a clinical environment. The dial values generated using the photon sensitivity curve above should be appropriate for most plastic and thin glass syringes. Glass vials may require a correction factor for some isotopes.

The wall thickness of the container is especially important when measuring isotopes which emit low energy photon and/or high energy Beta radiation. I-125, I-123, and Xe-133 are especially susceptible to errors caused by low energy photon absorption. In cases where a container has a wall thickness or material significantly different from the NIST standards used above, it is recommended that a correction factor or corrected dial value be used to correct for the difference in absorption between the NIST configuration and the configuration used in clinical practice. Whichever container and configuration is used in clinical practice, it is strongly recommended that such configuration be standardized and used every single time.

Determining Your Own Dial Values

Dial values can be determined by the user for isotopes for which no published dial value exists. In order to do this, you will need a sample for which the activity value is known. The activity value may be provided by the isotope producer or pharmacy, or it may be measured by a method independent of the dose calibrator. The accuracy of the dial value will depend upon the accuracy of the known activity value of the sample used; because of this, it is best if an estimate of the accuracy of the isotope calibration is available.

To determine the dial value for the isotope, select the Co-60 isotope key and measure the isotope sample in the same container and geometry which will be used to measure the isotope in clinical practice. The dial value can then be calculated by the following formula:

$$\text{New Dial value} = 5.0 \times \frac{\text{activity}}{\text{measurement}}$$

where the activity is the known activity of the source and the measurement is the displayed activity when measured on the Co-60 isotope key. Remember to decay correct the source's activity for time elapsed since source activity calibration.

Once the new dial value has been calculated, a new isotope name should be created on the display for the isotope, with the dial value as calculated above. Then, the source should be measured again and compared with its known time-decayed activity, in order to verify that the calculation is correct. It may be necessary to adjust the dial value very slightly in order to match the known activity - if necessary, do so at this time.

Once the dial value has been determined by means of comparison to a source of known activity, it should not be changed unless access to a source with an activity known to higher accuracy allows determination of a more accurate dial value. Dial values should never be adjusted daily to make a source match daily isotope measurements. The dial value should only be determined with a calibrated isotope source of known accuracy.

Biodex supplies dial values for many isotopes. Many of these dial values are calculated using a Monte Carlo simulation corrected by actual measurements. If a source is available which has calibrated accuracy better than the uncertainty listed in the table in Appendix E, then this source can be used to modify the dial value for an existing isotope.

Biodex is interested in users' measurements which have better accuracy than the uncertainty listed in the dial value table. If you have a more accurate dial value for an isotope listed in the table, please contact us and supply documentation including the measurements, isotope calibration (and independent measurement method), measurement geometry and source container, and calculation, so that we may share this information with other users.

References

1. National Nuclear Data Center, *Nudat 2.2 Database,* Upton, NY: Brookhaven National Laboratory, 2007
2. Browne, Edgardo, and Richard B. Firestone, *Table of Radioactive Isotopes,* New York: John Wiley and Sons, Inc., 1986
3. David C. Rayburn, *Determination of The Response Characteristics of The Atomlab Re-Entrant Ionization Detector*, Melbourne, FL: Florida Institute of Technology, 2007

Appendix J: Quality Assurance Testing Of Atomlab Calibrators (Manufacturer's* Instructions)

Introduction

The following procedures are the manufacturer's instructions for qualifying Atomlab® 100, 100+, 200, 300, 400, and 500 dose calibrators in accordance with NRC regulation 10 CFR 35.60 of 1 January 2003 (or applicable agreement State Regulation). Use of these instructions outside the USA may require modification in order to satisfy local regulations.

Qualification is the determination of errors associated with the following tests at the indicated frequency. Acceptable errors for each test are indicated in parentheses.

- **Constancy:** Starting at installation and at least once each day before measuring patient dosages (±5 percent).
- **Dial Value Setting:** at first receipt of isotope activity in container other than a plastic syringe (±10% from decay corrected calibration activity).
- **Linearity:** at installation and at least quarterly thereafter (±5 percent).
- **Geometry:** at installation (±5 percent).
- **Accuracy:** at installation and at least annually thereafter (±5 percent).

After repair of the dose calibrator, repeat the above tests as a new installation.

NOTE: A plastic well liner and source dipper must be used in all measurements.

NOTE: If possible, leave the dose calibrator powered-on 24 hours a day, 7 days a week. If not, allow 1 hour warm-up after power-on before performing these procedures.

NOTE: We have an acceptance variance percentage listed for each test. These are the default settings. You can use ±10% for acceptability and ±5% for investigation. Call Biodex Service Dept. If readings are outside the acceptable range. The default acceptable range is based on 10CFR35.60 of January 1, 2003 and IEC-61145. You must consider what your state or government regulations require.

NOTE: Assay means to place the source container into the dose calibrator so that the dipper is resting in the well liner.

NOTE: The Atomlab® 500 control module has built-in Constancy, Linearity, Geometry, and Accuracy software functions which provide ease-of-use to the user in performing the functions below.

Constancy

Constancy means reproducibility in measuring the same source, over a period of time, with decay correction. Assay a relatively long-lived source (such as Cs-137) each day before using the calibrator.

Cs-137, 100 µCi minimum activity, is strongly recommended because the 30-year half life will assure use of the same source throughout the life of the calibrator, and it is readily available. Consider using the following procedure or equivalent:

1 Press the Zero Background (Bkgnd) button. When the display zeroes, the unit has automatically adjusted for Background.

2 Assay each reference source using the appropriate dose calibrator setting (i.e., use the Cs-137 setting to assay Cs-137.)

3 Record the activity reading of the constancy source in a permanent log.

4 Compare the measurement observed to the calculated activity of the source and if the measurement exceeds 5% of predicted, investigate potential sources of error (patients in the area, exposed sources, use of the wrong isotope or setting, etc.)

5 If the constancy result is determined to be greater than 10% of predicted, suspend the use of the instrument and repair or replace the dose calibrator.

***NOTE**: It is recommended that the Cs-137 and Ba-133 sources be replaced when the activity is below 100* µCi. *It is recommended to replace a Co-57 source when the activity is less than 200 µCi.*

**Manufactured by Sun Nuclear Corporation, Melbourne, FL; distributed by Biodex Medical Systems.*

Dial Value Settings and Source Containers (Glass Vial, Glass Syringe, etc.)

The Atomlab Dial Value (DV) settings enable the software to convert ion chamber current into a displayed activity value for the isotope corresponding to the DV selected. The displayed activity value is directly proportional to the DV.

The isotope's "*source container*" is either a vial or syringe; the composition of the vial or syringe MAY influence the accuracy of the activity measurement. The DV supplied in the Atomlab User Guide (Instruction Manual), or pre-programmed into the isotope buttons, *are calibrated for use with the source material in an un-shielded plastic syringe (nominal 1mm wall)*, while hanging in the supplied "source dipper" syringe support. For isotopes contained in sealed long lived QA sources (Cs-137, etc.), the DV supplied are calibrated for use with type Vial E epoxy sources or equivalent.

Accurate measurement of unsealed sources in any other configuration must be with a new Container Dial Value *"CDV", determined by the USER* with the following procedure.

NOTE: This is important to determine the appropriate Dial Value for Beta and low energy gammas when the container (syringe or vial) changes.

During following steps, set DV to the Atomlab published value.

Container with no source material

1. Assay a quantity of isotope source material in a plastic syringe, nominal wall thickness of 1mm, record as *(Plastic Syringe Activity)*$_1$.
2. Transfer part or all of the source material from the plastic syringe into the empty Container.
3. Assay the Container with the isotope source material, record as *(Container Activity)*.
4. Assay the partial or "empty" plastic syringe for residual activity, record as *(Plastic Syringe Activity)*$_2$.
5. Calculate the Container Dial Value for type of container use with isotope assayed in that type of container,

$$CDV = DV \cdot \frac{(PSA)_1 - (PSA)_2}{(Container\ Activity)}$$

where *PSA* = *Plastic Syringe Activity*.

Container with source material

1. Assay Container with the isotope source material, record as *(Container Activity)*$_1$.
2. Transfer part or all of the source material from the Container into a plastic syringe, nominal wall thickness of 1mm.
3. Assay the plastic syringe with the isotope source material, record as *(Plastic Syringe Activity)*.
4. Assay the partial or "empty" Container for residual activity, record as *(Container Activity)*$_2$.
5. Calculate the Container Dial Value for use with isotope assayed,where *PSA* = Plastic Syringe Activity and *CA* = Container Activity.

$$CDV = DV \cdot \frac{(PSA)}{(CA)_1 - (CA)_2}$$

Typically, for glass wall source Containers, CDV will be higher than DV when the isotope has a significant portion of low energy photons in its emission spectrum.

Linearity

Linearity means the proportionality of the measurement result to the activity measured, as determined over the intended range of use for the dose calibrator.

This test is done using a vial or syringe of Tc-99m whose activity is at least as large as the maximum activity normally assayed in a prepared radio pharmaceutical kit, in a unit dosage syringe, or in a radio pharmaceutical therapy, whichever is largest.

There are several acceptable methods for preparing linearity testing. The difference in these methods is which reading is used for decay correction of the activities. The following methods are all acceptable for determining the normalized value.

a. Decay correct the test sample from the first reading and compare each reading to the decay corrected reading.

b. For Tc-99 select 30 hours as the normalized reading, and decay correct this reading to calculate the expected activities at the times you took your readings. Compare the readings to the calculated activities. You can change from 30 hours to another time point and perform your normalized calculation from that time point.

   The Atomlab 500 automated linearity test uses 30 hours as the default method.

c. The following decay method described in detail decay corrects each reading, then averages these calculated activities, and then divides the average by the time corrected reading to determine a correction factor. If the correction factor is between certain values, the calibrator is linear.

Decay Method

1 Zero the Background by pressing the Zero Background (Bkgnd) button.

2 Assay the Tc-99m syringe or vial in the dose calibrator to obtain the activity. This first assay should be done in the morning at a convenient time, for example, 8 A.M.

3 Repeat steps 1 and 2 several times per day until the displayed activity is 10 microcuries or below the lowest activity assayed in accordance with applicable State/NRC regulation or the condition of your license. One should collect 2 to 4 readings per day. Additional readings are acceptable depending on the isotope used.

   If the display indicates less than 50 µCi, (1.85 MBq), wait 30 seconds before recording the reading. To get a faster reading on the Atomlab 100, 100 Plus, 200 and 300, press the Mo-99 button and then the Tc-99m button, or adjust the transition threshold on the Atomlab 400 or 500 controllers. Record the date, time (to the nearest minute), and activity for each reading.

NOTE: Some state regulations allow linearity tests to end at activities greater than 10 µCi. You may discontinue the linearity test at the activity which your state regulations or license permit.

NOTE: Use of a spreadsheet, such as Microsoft Excel, in steps 4 and 5 will simplify calculations.

4 Convert the time and date information you recorded to hours (*t*) elapsed since the first assay. Decay-correct each displayed activity measurement (*M*) using the equation,

$$M_0 = M \times (2)^{\frac{t}{T_{1/2}}}$$

where $T_{1/2}$ = 6.007 h. Record the values. See linearity form, Figure 1. Calculate activity correction factors (*cf*) by dividing the average of all decay corrected measurements (M_0) by each M_0, i.e.,

$$cf_M = \frac{Average\ of\ all\ M_0}{M_0\ (t)}$$

Accept if $0.95 < cf_M < 1.05$. Consider correcting the displayed activity measurement (*M*) of radio pharmaceuticals if a linearity error is greater than ± 5% and less than ± 10%, i.e., $0.90 < cf_M < 0.95$ or $1.05 < cf_M < 1.10$. Corrected $M = M * cf_M$ where subscript *M* is closest in value to *M* in most recent linearity form. For low activity values, if $cf_M < 0.95$ see the following note about Mo-99 contamination.

NOTE: If there is any Mo-99 contaminant in the Tc-99m sample, then long decay times (>48h) will compromise the decay linearity test. This will be apparent with decreasing cf_M values for the lowest displayed activity measurements (M). In order to test for this, prepare another linearity test sample with an activity of about 1 mCi. Repeat the linearity test. If the cf_M values are within an acceptable range and if the 1st linearity test by decay produced acceptable cf_M values at higher M values, then the dose calibrator passes. The two linearity tests should have overlapping activity values in the acceptable range.[1] Hint: Recalculate first test (M_0) without including failing values from low (M) Mo-99 contamination.

5 If $cf_M < 0.90$ or > 1.10, contact Biodex technical support and provide full details, including all linearity decay data.

Attenuation Tube Method or Sleeve Test Method

If you decide to use a set of "sleeves" of various thicknesses or combination of sleeves to test for linearity, it will be necessary to first use the Decay Method to show the calibrator is linear. Then immediately repeat the test. Follow the directions furnished with your lead sleeves (i.e. Lineator instructions.)

If failure occurs at the low activities, check for Mo-99 contamination by repeating the test with 1 mCi. See NOTE under "Decay Method," step 4.

NOTE: You can perform the Sleeve Test procedure first and immediately perform a traditional Linearity test. This allows the user to perform both tests with one dose.

NOTE: Other isotopes can be used to perform linearity, such as F-18. The sleeves can only be used with Tc-99.

1. See "Quality Control Testing of Dose Calibrators," R.Y.L. Chu and W. E. Simon, Journal of Nuclear Medicine Technology, 24, #2, June 1996, pp 124-128.

January, 2016

Atomlab Dose Calibrator Linearity Test, Model: _____ Serial Number:_____

Date	Time	Activity Measured, *M*	Hours elapsed, *t*	$M_{0,t}$	$cf_M = Avg / M_{0,t}$
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
				Avg: _____	

Accept if $0.95 < Avg / M_{o,t} < 1.05$

Figure 1. Sample dose calibrator linearity data collection form.

Geometry

Geometry Independence means that the indicated activity does not change with volume or configuration of the source material. This test should be done using a syringe that is normally used for injections. The following test assumes injections are done with 3 ml plastic syringes and that radio pharmaceutical kits are made in 30 ml glass vials. If you do not use these, change the procedure so that your syringes and vials are tested throughout the range of volumes commonly used.

If a significant volume correction results from these procedures, the tests should be repeated to verify. Atomlab dose calibrators have been tested for volume dependence in Beta measurements which are expected to be worst case and the results were 0.13 %/ml.[2]

NOTE: There are two methods that can be used to calculate the results.

- **Method one** select a normalized volume and decay correct the activity readings for the other volumes to the same time. Divide the calculated activity for each volume by the actual reading to get the correction factor for each volume.
- **Method two** take the average of all the volume activity readings. Divide this average activity by the activity of each volume to get the correction factor for each volume. If the test takes longer than 10 minutes, decay correct the readings.

Syringe Test (example)

1. In a small vial, mix 2.0 ml of a solution of Tc-99m with an activity concentration between 1 and 10 mCi/ml.
2. Set out a second small vial containing non-radioactive saline solution.
3. Draw 0.5 ml of the Tc-99m solution into the syringe and assay it.
4. Record the volume and activity of the first assayed sample (Figure 2).
5. Remove the syringe from the calibrator, draw an additional 0.5 ml of non-radioactive saline into the same syringe (total volume 1.0 ml), and assay again. Record the volume and measured activity on the form.
6. Repeat step 5 twice more until you have assayed 1.5 ml and 2.0 ml volumes and recorded them.
7. Assay the vial used to draw saline into the syringe. If the measured activity is greater than 1% of the 0.5 ml syringe assay, Tc99m was lost during filling. Repeat the procedure.
8. Calculate results:
   - **Method one** - select a normalized volume and decay correct the activity readings for the other volumes to the same time. Divide the calculated activity for each volume by the actual reading to get the correction factor for each volume.
   - **Method two** - take the average of all the volume activity readings. Divide this average activity by the activity of each volume to get the correction factor for each volume. If the test takes longer than 10 minutes, decay correct the readings.
9. If any correction factors are greater than 1.05 or less than 0.95, it will be necessary to make a correction table that will allow you to convert from “indicated activity” to “true activity.” If this is necessary, be sure to label the table “syringe geometry dependence”, and note the date of the test as well as the model number and serial number of the dose calibrator.

Vial Test (10 ml) (example)

1. To test the geometry dependence for a 10 ml glass vial, draw 1.0 ml of Tc-99m solution (between 1 and 10 mCi/ml) into a syringe and inject it into the vial. Assay the vial. Record the volume and activity indicated.
2. Remove the vial from the calibrator and, using a clean syringe, inject 2.0 or 3.0 ml of non-radioactive saline, and assay again. Record the volume and activity indicated on the form (Figure 2). Repeat the process until you have assayed a 8.0 ml volume. The entire process must be completed within ten (10) minutes, or, if not, decay-correct the activity.
3. Calculate results:
   - **Method one** - select a normalized volume and decay correct the activity readings for the other volumes to the same time. Divide the calculated activity for each volume by the actual reading to get the correction factor for each volume.
   - **Method two** - take the average of all the volume activity readings. Divide this average activity by the activity of each volume to get the correction factor for each volume. If the test takes longer than 10 minutes, decay correct the readings.
4. If any correction factors are greater than 1.05 or less than 0.95, it will be necessary to make a correction table that will allow you to convert from “indicated activity” to “true activity.” If this is necessary, be sure to label the table “vial geometry dependence”, and note the date of the test and the model number and serial number of the calibrator.

NOTE: Perform the vial test with the vial size you commonly use.

NOTE: Other isotopes can be used for performing Geometry Testing.

2. See “Accurate Dose Calibrator Activity Measurement of Y-90 Ibritumomab Tiuxetan,” J. A. Siegel et al, J Nucl Med, 2004, 45:450-454.

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Atomlab Dose Calibrator Geometry Test, Model:_____ Serial Number:_____

Syringe: Type_____ Volume_____ Decay correct if test not completed in 10 min.

Date	*Time*	*Volume*	$(Activity)_V$	*Volume cf = Avg/* $(Activity)_V$	*Volume cf = Normalized* $(Activity)_V$
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
		Avg:	_____		

Vial: Type_____ Volume_____ Decay correct if test not completed in 10 min.

Date	*Time*	*Volume*	$(Activity)_V$	*Volume cf = Avg/* $(Activity)_V$	*Volume cf = Normalized* $(Activity)_V$
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
		Avg:	_____		

***Figure 2**. Sample Atomlab Dose Calibrator Geometry Test form.*

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Accuracy

Accuracy means a determination of the dose calibrator's absolute error resulting from a measurement of a suitable NIST-traceable radionuclide activity. Traceable sources are available from NIST and from many radioisotope suppliers. At least two sources with different principal photon energies (such as Co-57, Co-60 Cs-137 or Ba-133) should be used. One should have a principal photon energy between 100 keV and 500 keV.

1 Press the Zero Background (Bkgnd) button which zeroes the dose calibrator.

2 Assay a calibrated reference source of appropriate activity at the appropriate setting (i.e., use the Co-57 setting to assay Co-57). Record the displayed activity measurement, *M*, the date, and the reference source identification (nuclide, activity, date of calibration, serial number, model number, and manufacturer.)

3 Take 3 readings for the reference source. Remove and reinsert the reference source between readings.

4 Repeat the procedure for the other calibrated reference source.

5 For both sources, decay-correct the reference source activity value and record as "true activity."

6 Calculate the average for the 3 measurements and compare the average to the calculated activity.

7 Calculate activity measurement % error from:

$$\%\,Error = \left(\frac{M - True}{True}\right) 100$$

8 Evaluate the calculated % errors according to the approximate location of the dots in Figure 3 and take the recommended action corresponding to your error condition.

NOTE: It is recommended that the Cs-137 and Ba-133 sources be replaced when the activity is below 100 µCi. It is recommended to replace a Co-57 source when the activity is less than 1 mCi.

Error Condition	Percent Error*						Recommended Action
	-10	-5	0	+5	+10		
Between 0 and -5%			• •				None.
Between 0 and +5%				• •			
Less than ±5%			•	•			
Large difference, skewed low		•		•			Probable source calibration activity error. Examine sources with error > 5%, < 10%.
Large difference, skewed high			•		•		
Both skewed low		•	•				Probable dose calibrator error. If average error ≤ 5%, continue use. If average error ≥ 5% contact manufacturer. Continue use under advisement.
Both skewed high				•	•		
Both high within tolerance					• •		Contact manufacturer. Continue to use under advisement.
Both low within tolerance		• •					
Both high, straddling 10%					•	•	Contact manufacturer to return for repair.
Both high, outside tolerance						• •	
Both low, straddling 10%	•	•					
Both low, outside tolerance	• •						

* A dot represents a source accuracy error. Dot location represents any value between the error bars. For example, in the 3rd row, the left dot indicates a source error of any value between -5% and 0% and the right dot any value between 0% and +5%.

***Figure 3**. Recommended action for Accuracy test error conditions.*

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Records

Article 10 CFR 35.2060 requires that a NRC licensee maintain instrument qualification records for 3 years. The records must include the model and serial number of the instrument, the date of the qualification, the results of the qualification, and the name of the individual who performed the qualification.

Dipper and Well Liner

Inspect the instrument on a quarterly basis to ascertain that the well liner is in place and is not damaged. Check for contamination of the liner and dipper as follows:

1. Remove the plastic dipper and liner from the well chamber.
2. Press the Zero Background (Bkgnd) button to zero the calibrator.
3. Put the liner back in. If the display reading increases, the liner may be contaminated.
4. If the liner is OK, put the dipper back in and check for contamination.
5. If any part is contaminated, you must decontaminate or replace the item and then recheck for contamination.

Dial Value Checks—Monthly

Each isotope button is programmed with a specific dial value (DV). The user can adjust the DV for a particular need. Each isotope button should be checked periodically to verify it is set to the correct dial value for that isotope. The method of displaying the dial values varies by model; consult the operation manual for your dose calibrator to see how to display the dial values.

NOTE: The Dial Value check is to verify that no one has accidentally changed the Dial Value from the factory settings or the appropriately determined facility settings.

Repair or Replacement

Consider repair or replacement, if the dose calibrator falls outside the suggested tolerances.

If repair or replacement is required, contact Biodex Medical Systems for instructions

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Diphoshonate	use	b	(DSMA) (HMDP Glucoheptonate)
FDG	use	a	(Pyrophosphate)

APPENDIX K:
Tec-Control Formulas

a	For 2 sections use	% Free Tc-99m Pertechnetate = $\frac{\text{Net cts Section 2}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100 % Bound Radiopharmaceutical = $\frac{\text{Net cts Section 1}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100
b	For 4 sections use	% Free Tc-99m Pertechnetate = $\frac{\text{Net cts Section 2}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100 % Hydrolyzed Reduced Tc-99m = $\frac{\text{Net cts Section 3}}{\text{Net cts Section 3 + Net cts Section 4}}$ x 100 % Bound Radiopharmaceutical = 100 -(Tc-99m soluble impurities) -(Hydrolyzed Reduced Tc-99m)
c	For Sestamibi and Tetrofosmin use:	% Soluble Impurities = $\frac{\text{Net cts Section 1}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100 % Bound Radiopharmaceuticals = $\frac{\text{Net cts Section 2}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100
d	For Bicisate and Exametazime use:	% Bound Radiopharmaceuticals = $\frac{\text{Net cts Section 2}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100
e	For Monocolonals, Iodide, Indium and Octreotide use:	% Free Radionuclide = $\frac{\text{Net cts Section 2}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100 % Bound Radiopharmaceutical = $\frac{\text{Net cts Section 1}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100
f	For Hippuran use:	% Free Radionuclide = $\frac{\text{Net cts Section 1}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100 % Bound Radiopharmaceutical = $\frac{\text{Net cts Section 2}}{\text{Net cts Section 1 + Net cts Section 2}}$ x 100

PHARMACEUTICAL KIT LIST

Each Phanmaceutial Kit shows the letter (a-f) corresponding to the formula shown above that is used for the appropriate calculations in the Atomlab 500 program.

I-125 RISA	use	e
In-111 OctreoScan ®	use	e
Bexxar®	use	e
Disofenin	use	b
Exametazime	use	d
Monoclonal Antibodies (Zevalin)	use	e
ProstaScint®	use	e
Sulfur Colloid	use	a
Tc-99 Albumin Colloid	use	a
Tc-99 Bicisate	use	d
Tc-99 DTPA	use	b

Tc-99 Gluceptate	use	b
Tc-99 HDP	use	b
Tc-99 HSA	use	b
Tc-99 MAA	use	a
Tc-99 MAG 3	use	b
Tc-99 MDP	use	b
Tc-99 Mebrofenin	use	b
Tc-99 Pertechnetate	use	a
Tc-99 PYP	use	b
Tc-99 Sestamibi	use	c
Tc-99 Succimer	use	a
Tc-99 Tetrofosmin (Myoview)	use	c

Calculations:

% Tc-99m Petechnetate

$$= \left[\frac{\text{(NET CTS SECTION 2)}}{\text{(NET CTS SECTION 1) + (NET CTS SECTION 2)}} \right] \text{X } 100$$

% HYROLYZED REDUCED TC-99M

$$= \left[\frac{\text{(NET CTS SECTION 5)}}{\text{(NET CTS SECTION 5) + (NET CTS SECTION 6)}} \right] \text{X } 100$$

% LIPOPHILIC EXAMETAZINE COMPLEX

$$= \left[\left[\frac{\text{(NET CTS SECTION 1)}}{\text{(NET CTS SECTION 1)+ (NET CTS SECTION 2)}} \right] - \left[\frac{\text{(NET CTS SECTION 1)}}{\text{(NET CTS SECTION 3) + (NET CTS SECTION 4)}} \right] \right] \text{X } 100$$

APPENDIX L:
Atomlab 500 Dose Calibrator Replacement Parts

Atomlab 500 Dose Calibrator Replacement Parts

C13116	POWER SUPPLY
C11789	CORD SET
C10547	THREE LOBE KNOB
083-330-E102	UNIVERSAL MEMBRANE SWITCH
C13020	ON/OFF SWITCH
950-400-E803	SINGLE BOARD COMPUTER
950-385-E850	PCB, PC-104 DISPLAY
C12696	LCD INVERTER
086-241	WELL INSERT
086-242	WELL VIAL/SYRINGE DIPPER
086-330-E705	CHAMBER CABLE
C8187	BUMPONS, SELF ADHESIVE, GREY

APPENDIX M:
Schematics

BIODEX
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