

CRC[®]-25R

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OWNER'S MANUAL

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TABLE OF CONTENTS

PREFACE

SAFETY	1-1
GENERAL.....	1-1
SYMBOL DEFINITIONS	1-1
WARNING AND CAUTION LABELS	1-2
CAUTIONS AND NOTES	1-3
GENERAL SAFETY TIPS.....	1-6
FUNCTIONAL & TECHNICAL DESCRIPTION	2-1
INTENDED USE	2-1
OPERATOR PROFILE	2-1
OPERATOR TRAINING	2-2
FUNCTIONAL DESCRIPTION	2-2
OVERALL PROGRAM FLOW	2-3
Utility Programs.....	2-3
Test Programs.....	2-3
TECHNICAL DESCRIPTION.....	2-4
On / Off Switch	2-4
Warm Up Period.....	2-4
Environment Requirements.....	2-4
Power Requirements.....	2-5
Dimensions	2-6
Performance	2-6
Regulatory Listings.....	2-7
GENERAL OPERATING INSTRUCTIONS	3-1
GENERAL.....	3-1
KEYBOARD	3-1
Layout	3-1
Key Usage	3-2
ENTERING DATA.....	3-4
Numeric Data	3-4
Alphanumeric Data	3-4
MAKING MENU SELECTIONS	3-4
RESPONDING TO QUESTIONS (YES) or (NO).....	3-4
SYSTEM SETUP	4-1
GENERAL.....	4-1
RECEIVING CONDITION EXAMINATION	4-1
UNPACKING AND INSTALLATION	4-1
ASSEMBLY	4-3
Liner, Dipper, and Optional Holders.....	4-5
ENVIRONMENT REQUIREMENTS	4-6

POWER REQUIREMENTS	4-6
Readout	4-6
Printers (optional)	4-6
TURN ON PROCEDURES.....	4-7
GENERAL OPERATIONAL SETUP.....	4-7
ACCEPTANCE TESTING	4-9
Chamber Tests	4-9
OPERATIONAL SUMMARY	4-9
 SYSTEM INITIALIZATION	 5-1
GENERAL	5-1
SETTING DATE AND TIME	5-1
CHOOSING Ci or Bq.....	5-3
PRINTING	5-4
Printer Power Requirements.....	5-5
Printer Selection	5-5
SCREEN SETUP	5-17
Screen Saver	5-18
Screen Contrast.....	5-19
 CHAMBER INITIALIZATION.....	 6-1
GENERAL	6-2
USER KEY ASSIGNMENT	6-2
Selecting User Key	6-2
Current Assignment Display	6-3
Nuclide Name Assignment	6-3
Assignment Confirmation.....	6-4
TEST SOURCES	6-4
Source Verification.....	6-5
Entering Serial Number	6-6
Entering Calibration Date.....	6-6
Entering Calibration Activity.....	6-7
Indicating Daily Usage	6-8
Confirming Calibration Data.....	6-8
CONSTANCY TEST SOURCE	6-9
No Daily Source Chosen	6-9
One Daily Source Chosen	6-9
More than One Daily Source Chosen	6-10
MOLY ASSAY SETUP	6-11
Selecting Moly Assay Method.....	6-12
Moly Assay Limit.....	6-13
ADDING A NUCLIDE	6-14
Entering Nuclide Name	6-15
Entering Half-Life	6-15
Entering Calibration Numbers.....	6-16
DELETING A NUCLIDE	6-18
CALIBRATION NUMBERS	6-19
Entering New Calibration Numbers	6-20
Changing Calibration Numbers.....	6-21

Restoring Original Calibration Numbers.....	6-23
LINEARITY TEST DEFINITION.....	6-23
Setting Up Standard Linearity Test	6-25
Setting Up Lineator Test	6-26
Setting Up Calicheck Test.....	6-27
REMOTE NUCLIDE ASSIGNMENT (LEGACY SYSTEMS ONLY).....	6-29
Remove Nuclides	6-30
Adding Nuclides	6-31
USB PORT SETTINGS	6-31
 ACCEPTANCE & QUALITY ASSURANCE TESTS.....	 7-1
GENERAL.....	7-1
ACCEPTANCE TESTS.....	7-1
Diagnostic Test	7-2
Daily Test	7-2
Accuracy Test	7-2
Linearity Test	7-2
DAILY QUALITY ASSURANCE TESTS.....	7-3
Daily Tests	7-3
Accuracy Test	7-3
Contamination Test.....	7-3
QUARTERLY TESTS	7-4
Diagnostic Test	7-4
YEARLY TESTS	7-4
Linearity Test	7-4
 BACKGROUND AND TESTS.....	 8-1
GENERAL.....	8-1
BACKGROUND	8-1
DAILY TEST	8-3
Auto Zero	8-4
Background.....	8-5
Chamber Voltage	8-6
Data Check	8-7
Accuracy and Constancy Test in Daily Test.....	8-8
CHAMBER VOLTS	8-10
ACCURACY TEST	8-11
 DIAGNOSTICS	 9-1
GENERAL.....	9-1
 MEASUREMENT PROCEDURES.....	 10-1
GENERAL.....	10-1
MEASUREMENT PROCEDURES	10-2
General Activity Measurement Procedure	10-2
Optimizing Low Activity Measurements	10-2
Specifying Nuclide.....	10-3
Entering Calibration Number.....	10-4

SOURCES Key.....	10-5
Selecting Resolution	10-6
ACTIVITY AT A DIFFERENT TIME	10-6
USER ID	10-8
PRINTING A RECORD OF THE MEASUREMENT	10-9
OKIDATA Printer	10-9
Epson LX-300+II Printer	10-9
Roll Printer	10-10
Slip Printer	10-10
MOLY ASSAY	10-10
Mo99 Background.....	10-11
Mo99 Assay	10-13
Tc99m Assay	10-14
Moly Assay Results	10-14
 ENHANCED TESTS	 11-1
GENERAL	11-1
ENHANCED TESTS MENU	11-1
GEOMETRY TEST	11-2
Measuring with Syringe	11-2
Measuring with Vial.....	11-4
Measurement Results.....	11-6
PERFORMING LINEARITY TEST	11-7
Standard Test	11-7
Lineator Test.....	11-12
Calicheck Test	11-13
QUALITY CONTROL (QC).....	11-15
Single Strip Test	11-16
Two Strips Test.....	11-18
HMPAO Test.....	11-21
MAG3 Test.....	11-25
 INVENTORY	 12-1
GENERAL	12-1
INVENTORY MENU	12-1
ADDING TO THE INVENTORY	12-2
Input Activity	12-4
Measuring Activity.....	12-6
Mo/Tc Ratio	12-6
MAKING A KIT	12-7
WITHDRAWING FROM INVENTORY	12-11
PRINTING THE INVENTORY	12-13
DELETING FROM INVENTORY	12-13
Deleting Individual Items from the Inventory.....	12-14
Deleting All Items in the Inventory	12-14
 DOSE TABLE	 13-1

CALCULATION UTILITIES	14-1
GENERAL.....	14-1
CONVERSION BETWEEN Ci and Bq (Ci ↔ Bq)	14-2
DECAY CALCULATION	14-3
 CLEANING AND MAINTENANCE	 15-1
GENERAL.....	15-1
CLEANING and DISINFECTING	15-2
Cleaning Instructions.....	15-2
Disinfecting Instructions	15-3
PREVENTATIVE MAINTENANCE	15-4
SERVICING	15-4
DISPOSAL.....	15-5
FUSE SERVICING	15-6
Readout Fuses.....	15-6
Printer Fuse.....	15-6
BATTERY REPLACEMENT	15-7
TROUBLESHOOTING.....	15-13
Nothing appears on the display.....	15-13
Nothing happens when any key is pressed.....	15-13
Buzzer buzzes continuously.....	15-13
High background indication.....	15-13
Zero activity is indicated with a source in the Chamber.....	15-14
Readings appear overly noisy for low activities.....	15-14
Indication of significant negative activity	15-14
The time is reset to 00:00.....	15-14
Printer prints junk or prints with incorrect spacing.....	15-14
Print head hangs up when printing tickets.	15-14
Printer will not respond.....	15-14
RELATED PRODUCTS.....	15-15
SHIPPING.....	15-16

APPENDIX I – Principle of the Calibrator**APPENDIX II – Calibration Numbers****APPENDIX III – Multiplication Factors for Non-Equilibrium Radioisotopes****APPENDIX IV – Operational Summary****INDEX****WARRANTY****DECLARATION OF CONFORMITY**

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PREFACE

GENERAL	1
SYSTEM DESCRIPTION.....	1
YEAR 2000 COMPLIANCE	2
MEDICAL EQUIPMENT SAFETY CLASSIFICATION.....	2
ELECTROMAGNETIC INTERFERENCE POTENTIAL	3
IMPORTANT SAFETY INFORMATION.....	3

GENERAL

Thank you for purchasing the Capintec, Inc. CRC®-25R Radioisotope Dose Calibrator. Every effort has been made to insure that the information in this document is complete, accurate, and up-to-date. Capintec, Inc. assumes no responsibility for the results of errors beyond its control. Mention of products manufactured by other companies does not necessarily constitute endorsement by Capintec, Inc.

Please address any comments pertaining to this manual to:

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CRC®-25R and CII are registered trademarks of Capintec, Inc.

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

SYSTEM DESCRIPTION

The CRC®-25R Radioisotope Dose Calibrator consists of the following:

- Display Unit (Readout)
- Chamber
- Power Cord
- Printer (optional)

The Enhanced functions provide the following enhancements:

- Inventory Functions
- Geometry Test
- Linearity Tests
 - Standard Test
 - Lineator
 - Calicheck
- QC Tests
 - Single Strip
 - Two Strips
 - Tc99m HMPAO
 - Tc99m MAG3

YEAR 2000 COMPLIANCE

The CRC®-25R measurement system contains information technology that accurately processes date and time data between the years 1999 and 2000. These products, when used in combination with products purchased from other manufacturers, whose products properly exchange date and time information, will accurately process the date and time. All future products are committed to meeting the same Year 2000 compliance.

MEDICAL EQUIPMENT SAFETY CLASSIFICATION

- CLASS I EQUIPMENT energized from an external power source.
- TYPE B EQUIPMENT with no applied parts to the patient.
- Ordinary EQUIPMENT without protection against the ingress of water or particulates (IP00).
- Suitable for CONTINUOUS OPERATION.
- NOT suitable for use in an OXYGEN or a FLAMMABLE ENVIRONMENT.

ELECTROMAGNETIC INTERFERENCE POTENTIAL

This equipment complies fully with interference immunity requirements of the standard IEC 61326 "Electrical equipment for measurement control and laboratory use – EMC requirements".

This equipment generates radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to nearby devices. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference, the user is encouraged to try to correct the interference by one of the following measures:

- Increase the separation between the equipment and the affected device.
- Plug the unit into an outlet on a circuit different from that which the affected device is connected.

If this fails to correct the problem, please contact Capintec's only Authorized Service Center.

IMPORTANT SAFETY INFORMATION

The CRC®-25R measurement system has been carefully designed to provide years of safe and reliable performance. As with all electrical equipment, however, there are basic precautions that must be observed to avoid injuring yourself, the patient or damaging the equipment.

- **Follow** the unpacking and assembly instructions document, and **read** this manual carefully before using this equipment. Be sure to save all provided documents for future reference.
- **Understand all** warning and caution labels as explained in CHAPTER 1: SAFETY before operating this equipment.

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CHAPTER 1

SAFETY

GENERAL	1-1
SYMBOL DEFINITIONS.....	1-1
WARNING AND CAUTION LABELS.....	1-2
CAUTIONS AND NOTES.....	1-3
GENERAL SAFETY TIPS	1-6

GENERAL

These warnings and instructions for use form an integral part of the CRC®-25R and must therefore be kept available for consultation at all times. Precise compliance with the instructions is an essential condition for normal use, correct application and thus safety of the user.

SYMBOL DEFINITIONS

	Dangerous Voltage Present
	Functional Earth Ground
	Caution
	Operator should consult accompanying documents
	Fuse
	Low Battery: Indicates that the internal Lithium Battery has depleted.
	AC Voltage
	“ON” (power)
	“OFF” (power)
	Date of manufacture
	CE Mark

	Waste in Electrical and Electronic Equipment (WEEE) – This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately.
	Environmentally Friendly Use Period (EFUP) – 20 years from the date of manufacture – Toxic or hazardous substances or elements contained in the unit will not leak or mutate under normal operating conditions resulting in any environmental pollution, bodily injury or damage to assets.

WARNING AND CAUTION LABELS

Located on the back of the Readout Unit is a label, (Figure 1-1), providing the system power requirements and the replacement fuse values for power line voltages.



CAUTION: Please reference CHAPTER 15: CLEANING AND MAINTENANCE, SECTION: FUSE SERVICING for instructions on how to change the fuses of the CRC®-25R.



CAUTION: A fire hazard may exist if the wrong size of fuse is installed.

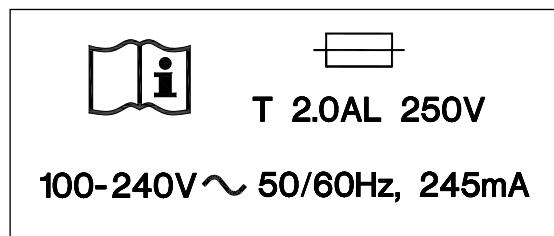


Figure 1-1

The bottom of the Chamber contains the following labels:

- Figure 1-2 contains statements denoting not to remove the cover because there are no adjustments that the user can perform in the Chamber.

**CAUTION: DO NOT REMOVE COVER.
NO USER-SERVICEABLE PARTS INSIDE.
REFER SERVICING TO AUTHORIZED
SERVICE PERSONNEL.** PN 7120-1205

MISE EN GARDE : NE RETIREZ
PAS LE COUVERCLE. AUCUNE PIÈCE À
ENTREtenIR PAR L'UTILISATEUR À
L'INTÉRIEUR. FAITES EFFECTUER L'ENTRETIEN
PAR DU PERSONNEL AUTORISÉ. RÉF 7120-1469

Figure 1-2

- Figure 1-3 pertains to the electrical safety of the Chamber. It is necessary because of the high voltage present (approximately 180 Volts DC) on the PC board installed in the chamber. A screwdriver is necessary to remove the cover.

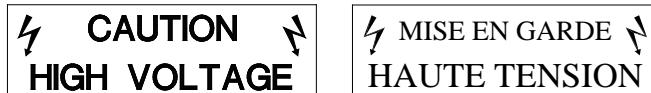


Figure 1-3

CAUTIONS AND NOTES

- ⚠ CAUTION:** Only qualified/trained personnel should operate or service this unit.
- ⚠ CAUTION:** If the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.
- ⚠ CAUTION:** Do not store high activity radioactive samples in the CRC®-25R Chamber(s). The Chamber is carefully designed for accurate and precise measurements of high activity radioactive materials. It was not designed to function as a long term storage vessel. Prolonged storage of high activity radioactive samples in the Chamber may cause premature failure of the unit.
- ⚠ CAUTION:** In order to obtain a correct reading for a Test Source (Standard Source) Vial, the supplied liner and dipper must be used to achieve the correct geometry. The CRC®-25R is not designed to use syringe Test Sources in any application.
- ⚠ CAUTION:** Capintec, Inc. does not provide the calibration number for any type of Brachytherapy source. The user should have the source calibrated by a regional Accredited Dosimetry Calibration Laboratory (ADCL) site or obtain a calibrated source from the manufacturer and perform your own in-house calibration (All Brachytherapy sources used in IVBT applications must be calibrated in an ADCL facility).
- ⚠ CAUTION:** In order to obtain a correct reading for any Brachytherapy sources including HDR & LDR, use the appropriate source holder for the source type being measured to achieve the correct geometry. (e.g. I125 Seed Holder, Ir192 Ribbon Holder, etc). When making a measurement, use the same source holder that was used in determining the calibration number. Verify that the liner has been removed from the chamber before making the measurement. If additional information is needed, contact Capintec, Inc. for further assistance.

- ⚠ CAUTION:** In order to obtain a correct reading for any Brachytherapy sources used in IVBT, use the appropriate source holder (Note that IVBT source holders are individually serialized) for the source type being measured to achieve the correct geometry. (e.g. Novoste Seed Holder). When making a measurement, use the same source holder (same serial number) that was used in determining the calibration number. Verify that the liner has been removed from the chamber before making the measurement. If additional information is needed, contact Capintec, Inc. for further assistance.
- ⚠ CAUTION:** IVBT source calibration is only to verify source output and is not to be used in treatment planning.
- ⚠ CAUTION:** High voltage is present inside the Chamber (up to 180 Vdc). Due to the presence of this high voltage, opening the covers with the system plugged in may be hazardous. Refer all servicing to qualified personnel.
- ⚠ CAUTION:** No internal adjustments inside the Readout or Chamber may be performed by the user within the conditions of the warranty, except for changing the fuse. Due to the presence of high voltages, opening the cover with the system plugged in may be hazardous. Refer all servicing to qualified personnel.
- ⚠ CAUTION:** Except for Brachytherapy, never use the calibrator without the Chamber Liner in place. Liners are inexpensive and easy to replace. A contaminated Chamber is a very costly mistake. If the unit becomes contaminated, remove the liner and clean the unit as stated in CHAPTER 15: CLEANING AND MAINTENANCE, SECTION: CLEANING and DISINFECTING before operating.
- ⚠ CAUTION:** Care must be exercised when moving the instrument or when maintenance is performed. The shielded cylinder is heavy (13.6 kg or 30 lb.). In order to provide the required sensitivity, the wall of the ionization chamber is extremely thin and the chamber is filled with pressurized gas. It is therefore, essential to avoid mechanical shock or vibration of any kind.
- ⚠ CAUTION:** When working with a heavy sample (especially a CapMac or Moly Assay Canister) always lower it gently into the Chamber. Dropping any heavy object into the Chamber can cause permanent, expensive damage.
- ⚠ CAUTION:** The use of multiplication and division factors in Calibration Numbers is only to maintain a degree of consistency with other Capintec Dose Calibrators. The CRC®-25R is a direct reading instrument. If multiplication or division is required, the arithmetic will be done by the system. The actual activity is displayed. DO NOT apply these factors to the displayed activity yourself.

- ⚠ CAUTION:** It is desirable to leave the unit powered at all times in order to prevent moisture absorption and to maintain the stability of the instrument (especially if the instrument is subjected to high humidity or low temperature).
- ⚠ CAUTION:** The sensitivity of the Chamber is somewhat dependent upon the vertical position of the sample within the well. All calibrations were done with a Standard Sample placed in the supplied sample holder (dipper). It should be noted that in this configuration, the sample is not quite at the bottom of the well. If, for any reason, you make a measurement without using the dipper, be sure that the sample is in the correct vertical position. Both the CapMac and the Standard Moly Assay Canister maintain the same position as the dipper.
- ⚠ CAUTION:** This equipment generates radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful Electromagnetic Interference (EMI) to nearby devices. However, there is no guarantee that interference will not occur in a particular installation.
- ⚠ CAUTION:** If any printer other than one of the models supplied by Capintec is used, the safety of the unit may be compromised or Electromagnetic Interference (EMI) may be introduced into other devices located in the same general area as the CRC®-25R or the CRC®-25R may become susceptible to EMI.
- ⚠ CAUTION:** The unit contains lead. Appropriate caution should be taken if the interior of the unit is exposed. The unit should be disposed of in accordance with local and national regulations.
- ⚠ CAUTION:** The unit contains a Lithium Battery. This should be disposed of in accordance with local and national regulations.
- ⚠ CAUTION:** The user should always verify the validity of any measurement or test result in order to minimize measurement errors.

Note: *It is recommended that periodic (every five years) re-calibration of the unit be performed only by Capintec's only Authorized Service Center (reference CHAPTER 15: CLEANING AND MAINTENANCE) to guarantee that the instrument's high reliability is maintained.*

GENERAL SAFETY TIPS

- Unplug the equipment before cleaning it. Use only a damp cloth; do not use solvents or aerosol cleaners.
- To protect the equipment from overheating, do not use the equipment directly in front of a radiator or heat register.
- Do not use the equipment near water, or spill liquids of any kind into the equipment.
- Be sure that your power source matches the rating listed on the CRC®-25R Calibrator.
- The CRC®-25R power cord has a grounded, 3-prong plug as a safety feature, and it will only fit into a grounded outlet. Do not use an adapter to defeat the grounding.
- To avoid damaging the power cord, do not place anything on it or place it where it will be stepped on. If the cord becomes damaged, replace it immediately.
- Aside from the routine maintenance described in this manual, do not try to service this equipment yourself. Do not make any adjustments other than those outlined in this manual, as you may in-validate the calibration or cause damage requiring extensive repair work. Refer servicing to qualified service personnel.

CHAPTER 2

FUNCTIONAL & TECHNICAL DESCRIPTION

INTENDED USE	2-1
OPERATOR PROFILE	2-1
OPERATOR TRAINING	2-2
FUNCTIONAL DESCRIPTION	2-2
OVERALL PROGRAM FLOW	2-3
Utility Programs	2-3
Test Programs	2-3
TECHNICAL DESCRIPTION	2-4
On / Off Switch	2-4
Warm Up Period	2-4
Environment Requirements	2-4
Power Requirements	2-5
Dimensions	2-6
Performance	2-6
Regulatory Listings	2-7

INTENDED USE

The CRC®-25R is intended to be used by trained Nuclear Medicine Technologists and Physicians, for measuring the activity of a radioisotope samples for Nuclear Medicine and Brachytherapy.

Also using the system are Health Physicists with expertise in nuclear medicine and radiation safety – typically used for assessing reproducibility of counting instruments with various Quality Assurance procedures (Linearity, Constancy, Accuracy, etc.).

OPERATOR PROFILE

The operator profile for the Nuclear Medicine Technologists, Physicians and Health physicists is as follows:

- **Education:**
 - Minimum: at least an Associate Degree
 - No maximum
- **Knowledge:**
 - Minimum: Understands the basic concepts of nuclear medicine.
 - No maximum

- **Language Understanding:**
 - English
 - Other languages are available for instructions for use
- **Experience:**
 - Minimum: Has minimum training or is under surveillance by a trained user.
 - No maximum

OPERATOR TRAINING

This Owner's Manual contains all of the information required to operate the CRC®-25R.

FUNCTIONAL DESCRIPTION

The CRC®-25R provides a precise, accurate, fast and very convenient method of measuring the activity of a radioisotope sample for Nuclear Medicine and Brachytherapy.

The activity of the sample will be displayed with a proper unit when a sample of unknown strength (activity) of a known radioisotope is placed in the ionization chamber and the correct calibration number is selected.

The sample must be placed in the same geometry as the reference source used to determine the calibration number by using the appropriate source holder.

Note: *For a detailed description of the basic principles of the calibrator, reference APPENDIX I: PRINCIPLE OF THE CALIBRATOR.*

Most radioisotopes can be measured in the Chamber.

Eight preset nuclide keys are provided for the most often used radioisotopes.

Five user assignable nuclide keys are provided for commonly used radioisotopes that do not have a preset nuclide key.

Assays may be made reliably in the Chamber, from as low as 1 microcurie (0.037 megabequerel) for most radioisotopes to as high as 6.6 curies [244 giga (10^9) Becquerels] of Tc99m.

The 6cm diameter and 25cm deep ionization chamber well allows convenient measurements of virtually any radioisotope geometry in clinical use including whole generators, syringes and seed trains.

The external shield of the ionization chamber protects users from exposure to intensive radiation and reduces the effects from background radiation on low-level measurements.

OVERALL PROGRAM FLOW

When the power is turned on, the Sign-On Screen appears. When the **ENTER** key is pressed, the Measurement Screen is displayed and the CRC®-25R begins measuring the activity. All measurements, the Main Menu and the Test Menu are accessed from this screen. These features are illustrated in Figure 2-1 Program Flow.

Utility Programs

Utility programs are accessed by pressing the **MENU** key from the Measurement Screen.

Test Programs

Testing programs are accessed by pressing the **TEST** key from the Measurement Screen

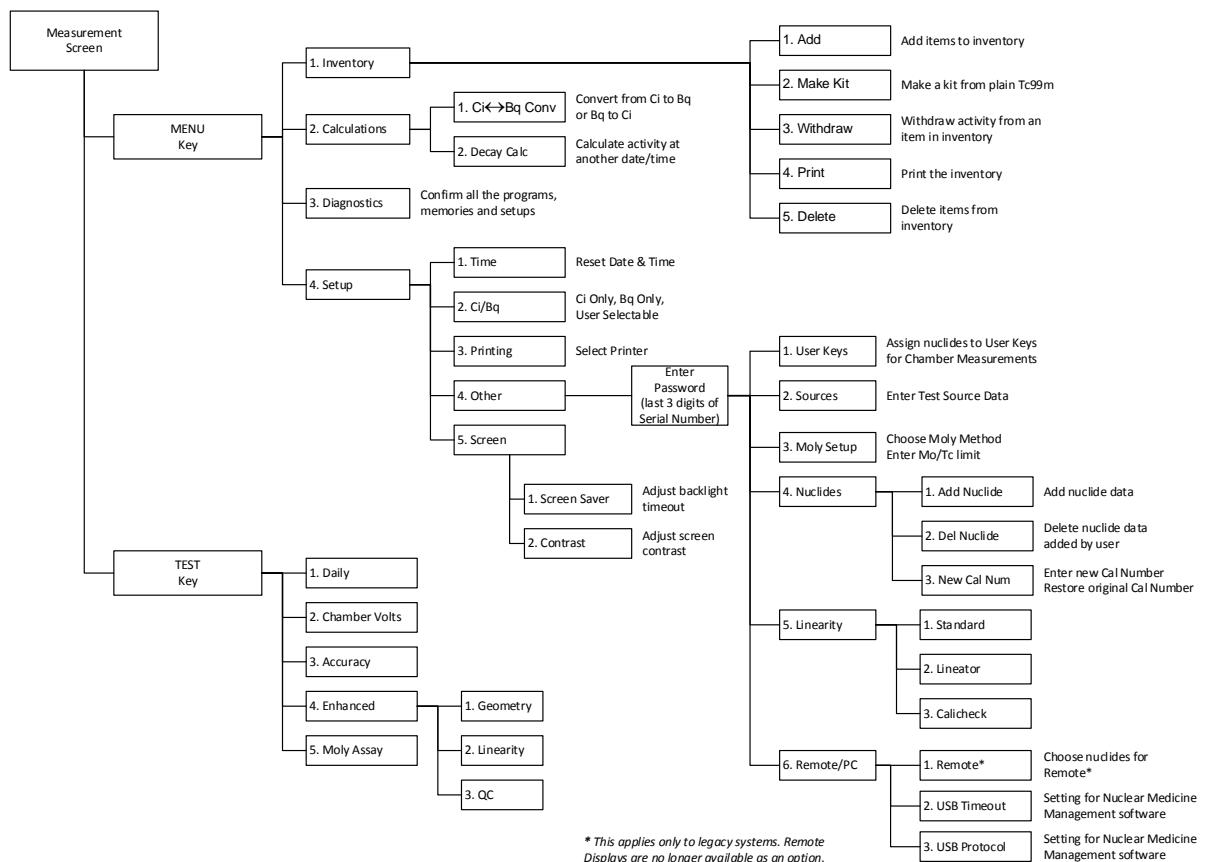


Figure 2-1 Program Flow

TECHNICAL DESCRIPTION

On / Off Switch

The on/off switch (I = on; O = off) is located on the back of the instrument.

Warm Up Period

Approximately 30 minutes should be allowed for the instrument to stabilize. While the instrument is warming up, it is strongly recommended that you become familiar with the CRC®-25R.

Environment Requirements

Indoor use only. Pollution Degree 2, Altitude, and Installation Cat. II.

Operational

The instrument should be located where the level of the background radiation is as low and as constant as possible.

The instrument should be located where the temperature is stable within a range of +50°F to +85°F (+10°C to +30°C) and the maximum relative humidity is 90% non-condensing to warrant maximum reliability and accuracy.

The instrument should be located where the barometric pressure is within a range of 27 – 31 inches of mercury (91 – 105 kilopascals).

Storage

The instrument should be stored where the temperature is stable and the range is from +39°F to +110°F (+4°C to +43°C) and the maximum relative humidity is 90% non-condensing to warrant maximum reliability.

The instrument should be stored where the barometric pressure is within a range of 15 – 33 inches of mercury (51 – 112 kilopascals).



CAUTION: If these environmental requirements are not followed, the instrument may display erroneous readings

Power Requirements



CAUTION: If the input voltage to the following items is not within the stated limits, the unit may not function correctly or may be damaged

Line Voltage

Readout

100-240Vac, 50/60Hz, 245mA

Printers

Okidata Microline 320 (optional)
120Vac, 60Hz, 0.9A or
230/240Vac, 50/60Hz, 0.5A

Epson LX-300+II printer (optional)
99-132Vac, 50/60Hz, 0.6A (maximum 1.4A depending on the character type)
198-264Vac, 50/60Hz, 0.3A (maximum 1.4A depending on the character type)

Epson TM-295II Slip Printer (optional)
Input: 100-240Vac, 50/60Hz, 1.2A; **Output:** +24Vdc, 0.8A

Epson TM-U220D Roll Printer (optional)
Input: 100-240Vac, 50/60Hz, 1.0A max; **Output:** 24Vdc, 1.5A

HP DeskJet 6000/8000 Series Inkjet (or equivalent) Printer (optional)
100-240Vac, 50/60Hz, 1.5A

Epson Stylus C86 Inkjet (or equivalent) Printer (optional)
100-240Vac, 50/60Hz, 0.4A

Line Filter

Line filter is provided internally.

Use of a filtered line is recommended if excessive line noise is anticipated.

Ground Current

Less than .5mA

Power Connector and Cable

A grounded 3-prong plug cord for the instrument that is approved for use at the user's site must be used.

Interconnection of devices must be made using the cables supplied with the instrument.

Dimensions

Console

Height.....13.7cm.....(5.38in)
Width.....26.0cm.....(10.25in)
Depth26.7cm.....(10.5in)
Weight.....1.8kg.....(3.9lb)

Chamber

Height.....43.8cm.....(17.25in)
Diameter.....17.2cm.....(6.76in)
Weight.....13.6kg.....(30lb)
Well Diameter.....6.1cm.....(2.4in)
Well Depth.....25.4cm.....(10.0in)
Cable Length¹.....3.7m(12ft)
Lead Shielding.....3.2mm.....(1/8")

Cables

Power1.8m(6ft)
Printer²1.8m(6ft)

Performance

Measurement Range:

Maximum Activity (Co60).....37.4 GBq (1.00 Ci)
Maximum Activity (Co57).....206. GBq (5.57 Ci)
Resolution.....0.001 MBq (.01 µCi)
Electrometer Accuracy³.....better than ±2%
System Precisionbetter than ± 0.1% of FSD
System Linearitywithin ±2%
Response Time
Below 20µCiwithin 25 seconds
Above 20µCi.....within 4 seconds

¹ Longer cables are available. Consult factory.

² Optional

³ Overall accuracy is determined by the calibration for the specific nuclide and the sample configuration and the accuracies of the standard sources used for calibration of the electrometer.

Regulatory Listings

The CRC®-25R has been independently tested and is manufactured in compliance with the following Standards:

EMC

- IEC 61326: Electrical equipment for measurement control and laboratory use
 - EMC requirements

Electrical

- EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: general requirements

ETL Listed

- CAN/CSA C22.2 No. 61010-1:2004, 2nd Edition: Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1: General Requirements
- CAN/CSA C22.2 No. 61010-2-101:04, 1st Edition: Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Particular requirements for in vitro diagnostic (IVD) medical equipment
- ANSI/UL 61010-1:2004, 2nd Edition: Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1: General Requirements

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CHAPTER 3

GENERAL OPERATING INSTRUCTIONS

GENERAL	3-1
KEYBOARD	3-1
Layout	3-1
Key Usage.....	3-2
ENTERING DATA	3-4
Numeric Data.....	3-4
Alphanumeric Data.....	3-4
MAKING MENU SELECTIONS	3-4
RESPONDING TO QUESTIONS (YES) or (NO)	3-4

GENERAL

This section describes general operating procedures: the keyboard, how to enter data and make menu selections.

KEYBOARD

Layout

CRC®-25R keyboard is shown below.

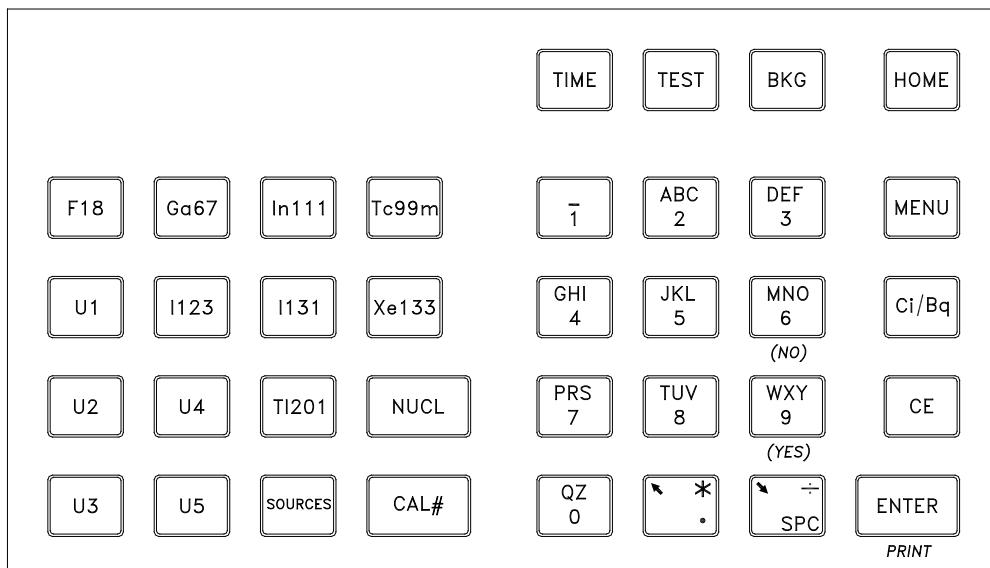


Figure 3-1 Keyboard

Key Usage

General usage of keys is briefly described. Specific key usage will be given in the appropriate sections.

NUCLIDE Keys

Pressing one of these keys selects that nuclide.

F18, Ga67, In111, Tc99m, I 123, I 131, Xe133, Tl201

USER Keys

Any nuclide in memory may be assigned to any of the **USER** Keys.

When a key is assigned, it acts just like a Nuclide Key.

U1, U2, U3, U4, U5

SOURCES Key

Pressing this key will toggle through the entered Test Sources for the chamber.

NUCL Key

Pressing this key allows the user to select any nuclide in memory (including nuclides added by the user).

The nuclide is chosen using the number/ letter keys.

CAL# Key

CAL#

Pressing this key in allows the user to input a Calibration Number to be used for the current measurement.

TIME Key

After pressing this key, a time and date is input. The activity at the input time of the source being measured is displayed under the current activity along with the input time and date.

TEST Key

Pressing this key will display the Test Menu.

BKG Key

Pressing this key steps the user through the Background Measurement. The background will be measured and stored.

HOME Key

Pressing this key will return the user to the Measurement Screen.

If this key is pressed before ending the task being performed, the task will be terminated without being finished (e.g. entered data will not be stored and previous values are maintained).

MENU Key

Pressing this key brings up the Main Menu.

This key is also used to return to the previous menu screen.

Ci / Bq Key

Pressing this key toggles the measurement between Curies and Becquerels. It is only active if *USER SELECTABLE* has been chosen for Ci/Bq.

CE Key

This is the Clear Entry key and is used to erase the last character when entering data.

ENTER (*PRINT*) Key**ENTER**

This key is used to accept entered data.

PRINT

This key is used to print a record of the measurement.

NUMBER / LETTER (Alphanumeric) Keys

The keys with Numbers and Letters on them are used to enter data. The decimal point is the **UP ARROW (▲)** key. The **DOWN ARROW (▼)** key is the **SPC** (Space).

ARROW Keys (▲ and ▼)

During a measurement, the arrows are used to change the precision of the displayed measurement for low activity.

When a multi-field entry is being made (e.g. date, time, activity, half-life) the arrows are used to move to the next field or to change the value of the unit.

ENTERING DATA

Numeric Data

Numeric data is entered via the NUMBER / LETTER keys on the right hand side of the keyboard.

The decimal point is on the same key as the **UP ARROW (↑)**.

If the entry must be an integer, the decimal point will not be allowed.

Press **CE** to erase the last digit entered.

Press **ENTER** when a correct entry has been made.

Alphanumeric Data

Alphanumeric data (numbers and letters) are entered via the NUMBER / LETTER keys.

When a NUMBER / LETTER key is pressed, the number appears. Press the key again to change the number into one of the letters on the same key (e.g. press the **2** key 3 times to get the letter B). To go to the next character, press another key. If the next character is on the same key, press the **UP ARROW (↑)** to repeat use of that key. The **DOWN ARROW (↓)** is the **SPACE (SPC)** key.

When entering a name for an additional nuclide, the entries are constrained to conform to legitimate nuclide names.

MAKING MENU SELECTIONS

All menus appear with a number in front of each selection.

To make a selection, press the NUMBER key corresponding to the desired selection.

RESPONDING TO QUESTIONS (YES) OR (NO)

There are several occasions where the user is asked a question which is to be answered Yes or No.

Press **Y** (9, WXY) for (YES). Press **N** (6, MNO) for (NO).

CHAPTER 4

SYSTEM SETUP

GENERAL	4-1
RECEIVING CONDITION EXAMINATION.....	4-1
UNPACKING AND INSTALLATION.....	4-1
ASSEMBLY.....	4-3
Liner, Dipper, and Optional Holders.....	4-5
ENVIRONMENT REQUIREMENTS	4-6
POWER REQUIREMENTS	4-6
Readout.....	4-6
Printers (optional)	4-6
TURN ON PROCEDURES	4-7
GENERAL OPERATIONAL SETUP	4-7
ACCEPTANCE TESTING	4-9
Chamber Tests	4-9
OPERATIONAL SUMMARY	4-9

GENERAL

Initial installation and checkout procedures are described in this section.

RECEIVING CONDITION EXAMINATION

Be sure to verify that the shipping carton is received in good condition, i.e., no damage should be visible and the box should be dry and clean.

Should the instrument be received in a damaged condition, save the shipping container and the packing material and request an immediate inspection by the carrier.

Capintec, Inc. is not responsible for the damage, which occurs during shipment but will make every effort to help obtain restitution from the carrier.

UNPACKING AND INSTALLATION

The instrument is packed and shipped as a complete unit. All the accessories are contained in the cartons. (If an optional printer is included, it will be in a separate carton.)

The instrument is shipped in a plastic bag in order to provide a dry and clean environment during shipment.



CAUTION: Be sure the instrument has reached room temperature prior to opening the bag. (Leave the box in the room 24 hours before opening it.)

1. Remove all outer packing material and tapes. The shipping and packing material should be saved for future use.
2. The following equipment should be found upon unpacking:
 - Readout Unit
 - Chamber and Liner/Dipper
 - Power Cord
 - Printer (optional)
 - Okidata Microline 320, or
 - Epson LX-300+II, or
 - Epson Slip printer, or
 - Epson Roll printer, or
 - HP DeskJet 6000/8000 Series Inkjet (or equivalent) printer, or
 - Epson Stylus C86 Inkjet (or equivalent) printer

The Printer should have the following accessories:

- Power Supply
- Printer Ribbon
- Communications Cable
- Roll Paper (If Roll printer ordered)
- Tickets (If Ticket printer ordered)

Note: If Test Sources are ordered, they will be shipped separately.

3. Be sure to remove all tape and protective material from the instrument prior to connecting to the power line.

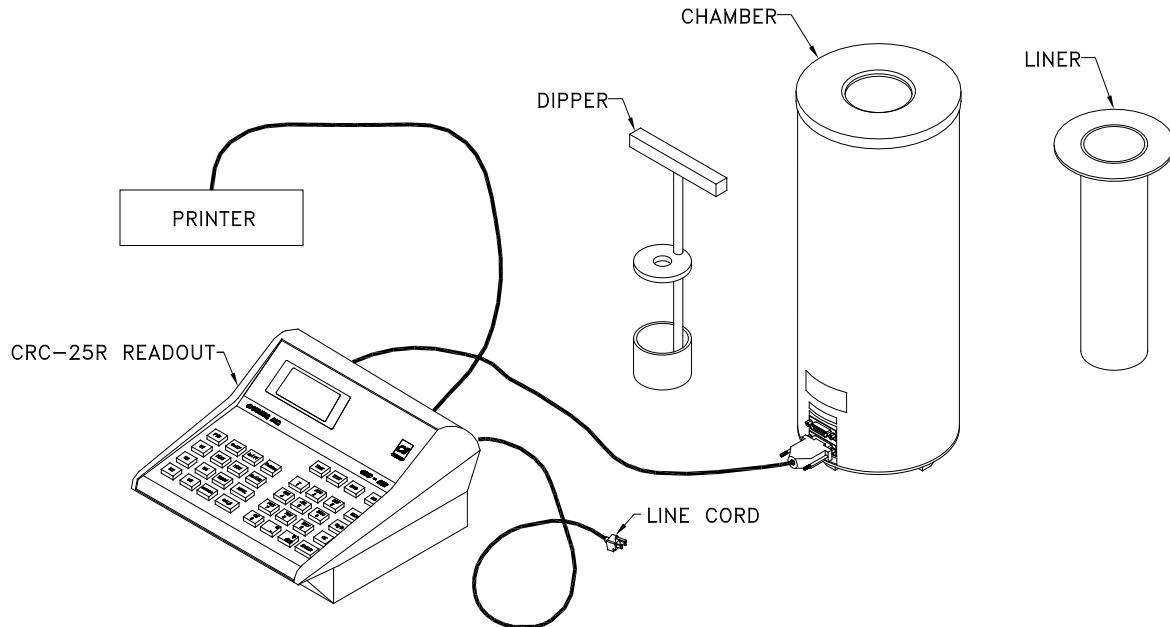
ASSEMBLY

Figure 4-1

1. Verify that all power switches (Readout and Printer) are in the "OFF" or "0" position.

Note: If using the Slip-Ticket printer, please unplug from AC Power.

2. Connect the Chamber Cable to the connector at the rear of the CRC®-25R Readout labeled "CHAMBER".

Note: To avoid damage, do not over-tighten the screws on the Cable connectors.
The screws should be finger-tightened only!

3. Attach the Power Cable to the receptacle on the Power Module located on the back of the Readout Unit.

Note: Do not place the Readout unit against a wall or other object so that the power cord can be detached from the back of the Readout unit.

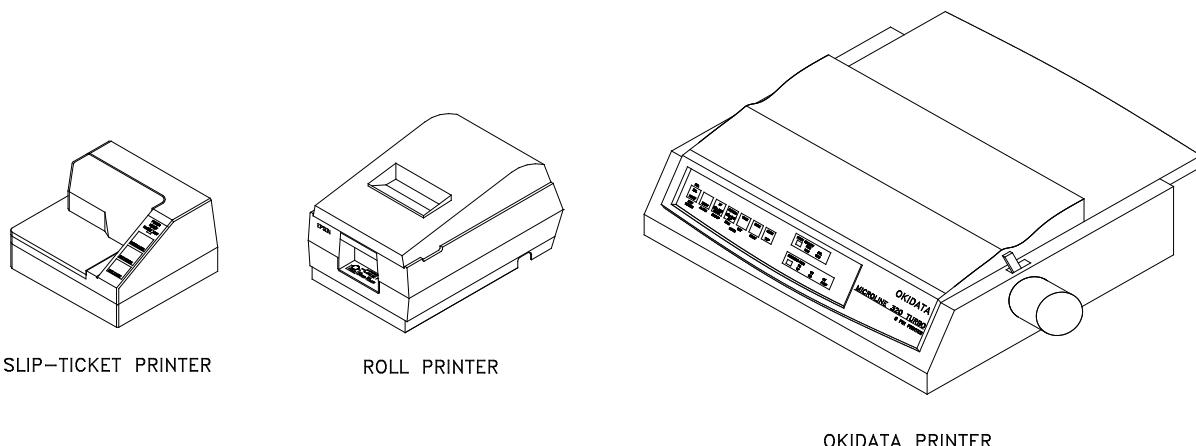


Figure 4-2 Printers

4. If the optional printer is an RS-232 (serial) version, attach the printer cable (one end has a 9 pin "D" connector, the other end has a 25 pin "D" connector) to the connector at the rear of the CRC®-25R Readout marked "PRINTER". Attach the other end to the printer.

Note: *To avoid damage, do not over-tighten the screws on the Cable connectors.
The screws should be finger-tightened only!*

Note: *Do not attach the printer cable to the "RS232" connector.*

If the optional printer is a USB version, attach the printer cable to the connector on the rear of the CRC®-25R Readout marked "PRINTER". Attach the other end to the printer.

Note: *Do not attach the printer cable to the "PC" connector.*

5. For each printer type, verify that the correct paper is installed.

Note: *The Slip-Ticket printer paper is manually inserted at the time of printing.*

Liner, Dipper, and Optional Holders

The supplied Chamber Liner and Dipper are shown below.

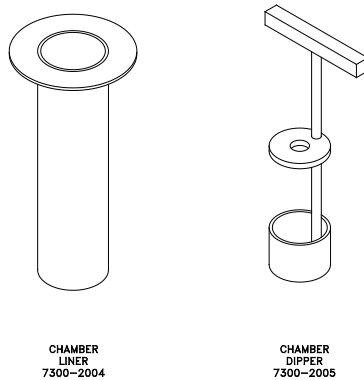


Figure 4-3 Liner and Dipper

The Chamber Liner provides protection against spills. It is made of clear, tough Plexiglass for improved durability. It is recommended that the Liner be installed inside the Chamber at all times.

⚠ CAUTION: Never use the calibrator without the Chamber Liner in place. Liners are inexpensive and easy to replace. A contaminated Chamber is a very costly mistake.

The Dipper (Vial/Syringe sample holder) is specially designed to hold syringes and vials of various sizes. It provides a safe, convenient way to hold a vial or syringe during activity measurement. Proper placement in the Chamber is assured every time. The cup portion will accommodate up to a 30ml vial. The Syringe Guide will accommodate 3, 5 and 10cc syringes. An adapter (7310-1109) is available to accommodate a tuberculin syringe (1cc).

For seed measurements, use the appropriate source holder for the source type being measured in order to obtain a correct reading. If additional information is needed, contact Capintec, Inc. for further assistance.

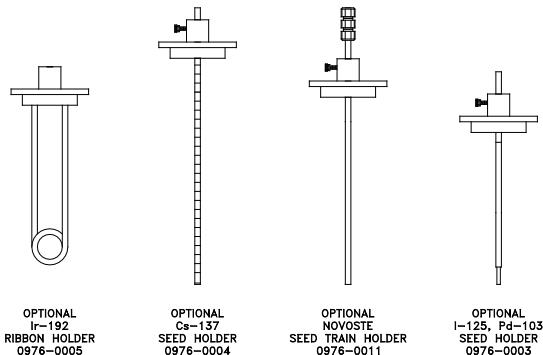


Figure 4-4 Optional Holders

ENVIRONMENT REQUIREMENTS

Indoor use only. Pollution Degree 2, Altitude, and Installation Cat. II.

The instrument should be located where the level of the background radiation is as low and as constant as possible.

The instrument should be located where the temperature is stable within a range of +50°F to +85°F (+10°C to +30°C) and the maximum relative humidity is 90% non-condensing to warrant maximum reliability and accuracy.

The instrument should be located where the barometric pressure is within a range of 27 – 31 inches of mercury (91 – 105 kilopascals).

 **CAUTION:** If these environmental requirements are not followed, the instrument may display erroneous readings.

POWER REQUIREMENTS



CAUTION: If the input voltage to the following items is not within the stated limits, the unit may not function correctly or may be damaged.

Readout

100-240Vac, 50/60Hz, 245mA

Printers (optional)

Okidata Microline 320 (optional)

120Vac, 60Hz, 0.9A or

230/240Vac, 50/60Hz, 0.5A

Epson LX-300+II printer (optional)

99-132Vac, 50/60Hz, 0.6A (maximum 1.4A depending on the character type)

198-264Vac, 50/60Hz, 0.3A (maximum 1.4A depending on the character type)

Epson TM-295II Slip Printer (optional)

Input: 100-240Vac, 50/60Hz, 1.2A; **Output:** +24Vdc, 0.8A

Epson TM-U220D Roll Printer (optional)

Input: 100-240Vac, 50/60Hz, 1.0A max; **Output:** 24Vdc, 1.5A

HP DeskJet 6000/8000 Series Inkjet (or equivalent) printer (optional)

100-240Vac, 50/60Hz, 1.5A

Epson Stylus C86 Inkjet (or equivalent) printer (optional)

100-240Vac, 50/60Hz, 0.4A

TURN ON PROCEDURES

1. Be sure the interconnecting cable from the Chamber is properly plugged into the back of the Readout unit.
2. Confirm the power requirements of the instrument.
3. Be sure the power switch is off. (Push lower part of the rocker switch next to the power receptor located on the rear of the main unit.)
4. Plug the power plug into a grounded three-wire outlet of the specified power line.
5. Turn on the Readout Unit using the power switch located at the rear of the unit.
6. The unit should now display the CRC®-25R start up screen (Figure 4-5)



CAUTION: Accidental connection of the power plug into a DC line or to an AC line which exceeds the specified voltage may result in catastrophic damage to the instrument's circuits.

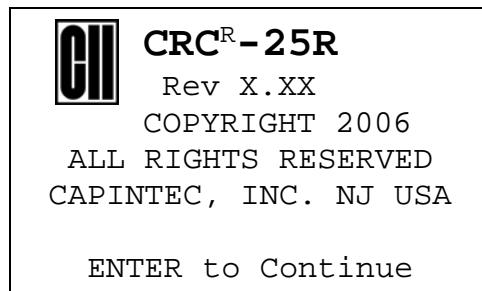


Figure 4-5

Note: The screen will display the revision level of the installed software.

GENERAL OPERATIONAL SETUP

There are several things that **must** be done before using the CRC®-25R Radioisotope Dose Calibrator for the first time. The following briefly describes these steps:

- Verify or set the date/time: Although the date and time are set in the factory, you should verify that the date and time are correct for your location. Reference CHAPTER 5: SYSTEM INITIALIZATION, SECTION: SETTING DATE AND TIME.
- Select proper units: Ci or Bq. Although the system can be changed at any time, it is recommended that the user set the proper units prior to using the unit to prevent confusion. Reference CHAPTER 5: SYSTEM INITIALIZATION, SECTION: CHOOSING Ci or Bq.

- Enter Test Source Data: Test Sources (standard sources) are used for the accuracy and constancy tests. The accuracy may be tested using Co57, Co60, Ba133, Cs137 or Ra226. There can be a Test Source for each of these nuclides. One or more of the Test Sources must be designated as the source(s) to be used in the Daily Test. Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES.
- Enter Constancy Test Source: The source for the Constancy Test is chosen from the sources designated as Daily Sources. Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: CONSTANCY TEST SOURCE.
- Verify correct printer setting: The CRC®-25R may be used with one of the following printers. Reference CHAPTER 5: SYSTEM INITIALIZATION, SECTION: PRINTING.
 - Okidata Microline 320
 - Epson LX-300+II
 - Epson TM-U295 SLIP Printer
 - Epson TM-U220D Roll Printer
 - USB HP Inkjet
 - USB Epson Inkjet

The following items should be performed before use if required:

- Assign **USER** Keys: The **USER** Keys (U1, U2, U3, U4, U5) are a quick way to select a nuclide. A nuclide may be assigned to each key. Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: USER KEY ASSIGNMENT.
- Adding a Nuclide: The CRC®-25R contains nuclide data (name, half-life, calibration number) for over 80 nuclides. The user may add up to 10 nuclides: the name, half-life and calibration number will be added for each one. Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: ADDING A NUCLIDE.
- Changing Calibration Numbers: The user is allowed to change the calibration number of up to 10 built-in nuclides. Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: CALIBRATION NUMBERS.
- Selecting Moly Assay Method: Moly Assay can be performed using the CAPMAC or CANISTER. Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: SELECTING MOLY ASSAY METHOD.
- Setting Mo/Tc Limit: The Mo/Tc limit is set at the factory to 0.15 μ Ci/mCi. The user can change this value. Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: MOLY ASSAY LIMIT.

ACCEPTANCE TESTING

The following tests should be performed prior to operational use of the unit.

Chamber Tests

Diagnostics Test

Reference CHAPTER 9: DIAGNOSTICS for instructions on how to perform this test.

Daily Test

Reference CHAPTER 8: BACKGROUND AND TESTS, SECTION: DAILY TEST for instructions on how to perform this test.

Accuracy Test

Reference CHAPTER 8: BACKGROUND AND TESTS, SECTION: ACCURACY TEST for instructions on how to perform this test.

OPERATIONAL SUMMARY

While all users the CRC®-25R are strongly encouraged to read the manual, we realize that there are some who would much rather jump right in. If you are one of those people who say, "if all else fails, read the manual", then reference Appendix IV. These very simplified instructions are intended to assist in getting you familiar with the basic operation of the CRC®-25R. They are not intended to replace the detailed operating directions in the main body of the manual.

WARNING

The General Operational Setup and Acceptance Testing sections above must be performed before referring to Appendix IV. The steps described omit several important tests which may be required by your license and which are also required in order to achieve the full accuracy of the system. Samples measured without the complete start-up procedure having been performed should not be administered to patients.

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CHAPTER 5

SYSTEM INITIALIZATION

GENERAL	5-1
SETTING DATE AND TIME	5-1
CHOOSING Ci or Bq	5-3
PRINTING	5-4
Printer Power Requirements	5-5
Printer Selection.....	5-5
SCREEN SETUP	5-17
Screen Saver	5-18
Screen Contrast	5-19

GENERAL

This section describes initialization and parameter setup.

All of these functions are accessed via the Main Menu.

Press **MENU** from the Measurement Screen. The *Main Menu* will appear.

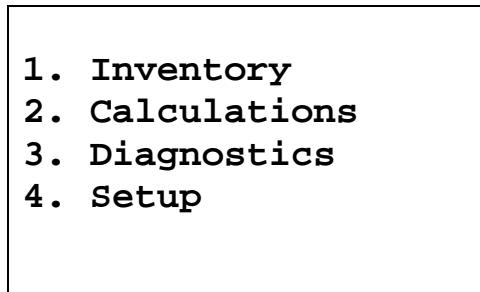


Figure 5-1 Main Menu

SETTING DATE AND TIME

To view and/or change the date and/or time, select **SETUP**. Figure 5-2 Main Setup Menu will appear.

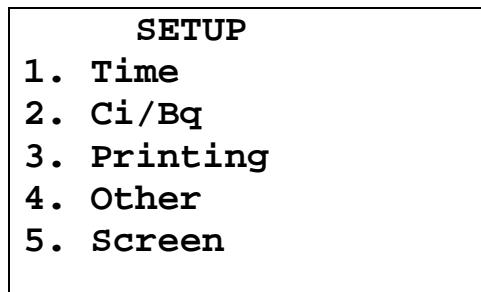


Figure 5-2 Main Setup Menu

Select **TIME** to view and/or change the date and/or time. Figure 5-3 Date / Time Verification Screen will appear showing the current date and time.

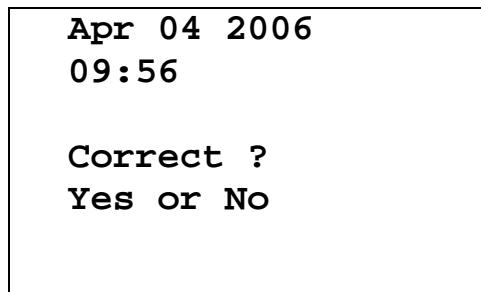


Figure 5-3 Date / Time Verification Screen

If the date and time are correct, press **YES**. Figure 5-2 Main Setup Menu will re-appear.

If the date and/or time are incorrect, press **NO** to make necessary changes. Figure 5-4 Date Entry Screen will appear.

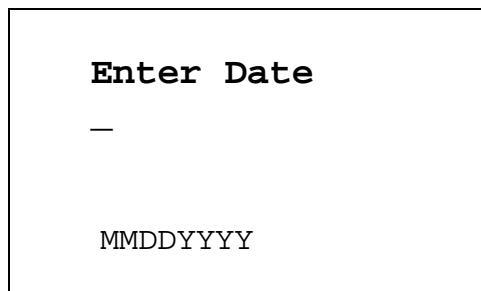


Figure 5-4 Date Entry Screen

Input the date in the form MMDDYYYY (example: July 3, 2005 would be 07032005) and press **ENTER**. The date is checked for validity. If the input date is not valid, a beep will sound and "DATE ERROR" will be displayed. The date must be re-entered.

Figure 5-5 Time Entry Screen will appear.

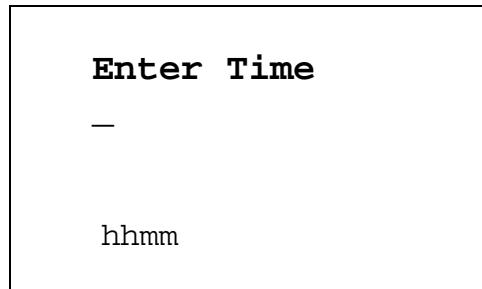


Figure 5-5 Time Entry Screen

Input the time as hhmm in 24-hour time format (example: 1:25 PM would be 1325, 9:15 AM would be 0915) and press **ENTER**. The time is checked for validity. If the entered time is not valid, a beep will sound and “TIME ERROR” will be displayed. The time must be re-entered.

Figure 5-3 Date / Time Verification Screen will be shown. Press **YES** if it is correct. Figure 5-2 Main Setup Menu will re-appear. Press **NO** to make corrections.

CHOOSING CI OR BQ

Measurement results can be displayed in Ci or Bq. The **Ci/Bq** key is used to switch the measurement result between Ci and Bq. However, in some facilities, it may be decided to disable this feature and allow measurements to be displayed only in Ci or only in Bq. When the system arrives, it is set up to display in Ci and Bq.

To enable or disable Ci/Bq switching, press **MENU** from the Measurement Screen. Figure 5-1 Main Menu will appear.

From Figure 5-1 Main Menu, select **SETUP**. Figure 5-2 Main Setup Menu will appear.

From Figure 5-2 Main Setup Menu, select **CI/BQ**. The current Ci/Bq selection will be shown. The example below is for the default of Selectable (i.e., the user may select Ci or Bq)

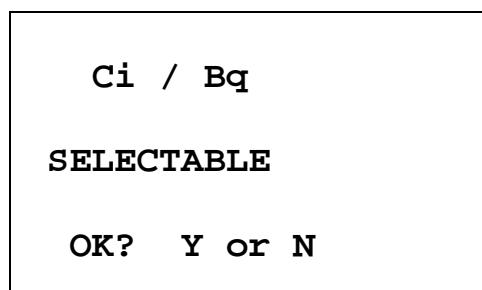


Figure 5-6 Ci / Bq Verification Screen

If the displayed setting is correct, press **YES**. Figure 5-2 Main Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-7 Ci / Bq Selection Screen will appear.

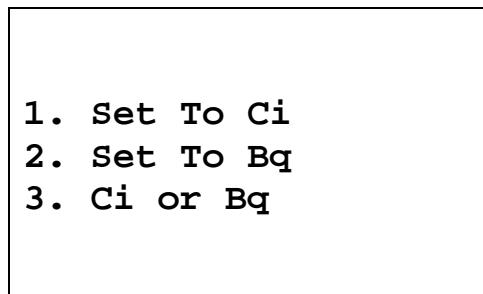


Figure 5-7 Ci / Bq Selection Screen

Press **1**, **2** or **3** to select the desired setting.

After choosing the desired setting, Figure 5-6 Ci / Bq Verification Screen will re-appear showing the new selection.

If **1** was pressed, the Verification Screen will display: FIXED TO Ci.

If **2** was pressed, the Verification Screen will display: FIXED TO Bq.

If **3** was pressed, the Verification Screen will display: Ci / Bq Selectable.

If the displayed setting is correct, press **YES**. Figure 5-2 Main Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-7 Ci / Bq Selection Screen will re-appear.

PRINTING

⚠ CAUTION: If any printer other than one of the models supplied by Capintec is used, Electromagnetic Interference (EMI) may be introduced into other devices located in the same general area as the CRC®-25R.

The CRC®-25R may be used with the following printers:

- RS-232 printers
 - Okidata Microline 320
 - Epson LX-300+II
 - Epson TM-295II Slip printer
 - Epson TM-U220D Roll printer
- USB printers
 - HP DeskJet 6000/8000 Series Inkjet (or equivalent) printer
 - Epson Stylus C86 Inkjet (or equivalent) printer

Printer Power Requirements

Okidata Microline 320 printer (optional)

120Vac, 60Hz or

230/240Vac, 50/60Hz

Epson LX-300+II printer (optional)

99-132Vac, 50/60Hz, 0.6A (maximum 1.4A depending on the character type)

198-264Vac, 50/60Hz, 0.3A (maximum 1.4A depending on the character type)

Epson TM-295II Slip Printer (optional)

Input: 100-240Vac, 50/60Hz, 1.2A; **Output:** +24Vdc, 0.8A

Epson TM-U220D Roll Printer (optional)

Input: 100-240Vac, 50/60Hz, 1.0A max; **Output:** 24Vdc, 1.5A

HP DeskJet 6000/8000 Series Inkjet (or equivalent) Printer (optional)

100-240Vac, 50/60Hz, 1.5A

Epson Stylus C86 Inkjet (or equivalent) printer (optional)

100-240Vac, 50/60Hz, 0.4A

Printer Selection

If a printer was included with the CRC®-25R, the system will already be set to use the included printer. If a printer is being added or the system did not include a printer at the time of purchase, then the CRC®-25R must be set to use the printer in order to provide printed data.

To view and/or change the selected printer, press the **MENU** key from the Measurement Screen. Figure 5-1 Main Menu will appear.

From Figure 5-1 Main Menu, select **SETUP**. Figure 5-2 Main Setup Menu will appear.

From Figure 5-2 Main Setup Menu, select **PR/INT/NG**. The currently selected printer will be displayed. In the example below, OKIDATA – ONE LINE is used.

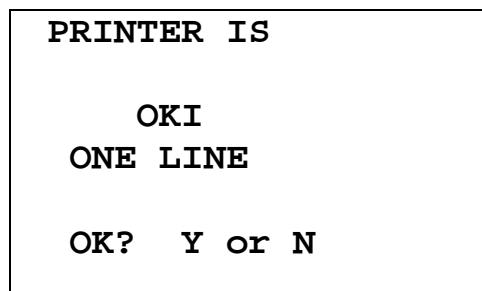


Figure 5-8 Selected Printer Type

Note: If the Okidata Microline 320 or the Epson LX-300+II is used, the calibration measurement can be printed on a ticket or as a single line on regular paper.

If the displayed setting is correct, press **YES**. Figure 5-2 Main Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-9 Printer Type Screen will appear.

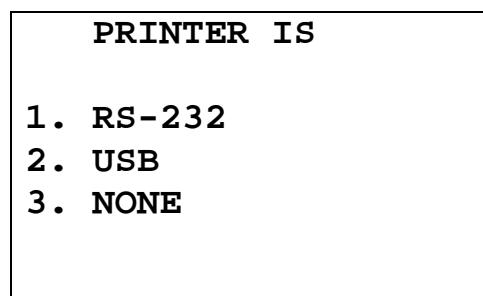


Figure 5-9 Printer Type Screen

RS-232

RS-232 printers are serial printers that use the RS-232 interface. The printers that can be used with the CRC®-25R are the Epson Slip, Epson Roll, Okidata Microline 320 or Epson LX-300.

From Figure 5-9 Printer Type Screen, select *RS-232*. Figure 5-10 RS-232 Printer Selection screen will appear:

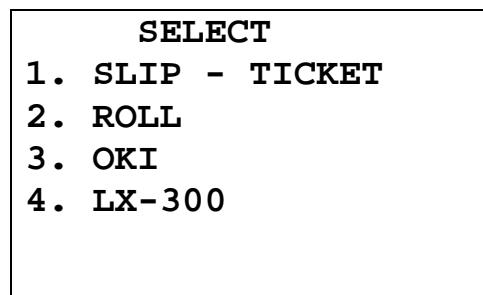


Figure 5-10 RS-232 Printer Selection

Press the number corresponding to your printer.

For this example, the printer being used is an Okidata Microline 320. Select *OKI*. Figure 5-11 Printout Selection will appear.

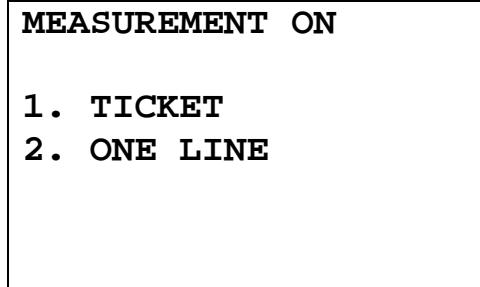


Figure 5-11 Printout Selection

The Okidata Microline 320 can print measurements on a ticket or on regular paper.

If the printing will be done on tickets, select *TICKET*. If printing will not be done on tickets, select *ONE LINE*. For this example, the printing will be done on regular paper; therefore, select *ONE LINE*.

After selecting the printer (and measurement printout for Okidata or Epson LX-300+II) the selection made will be displayed for verification.

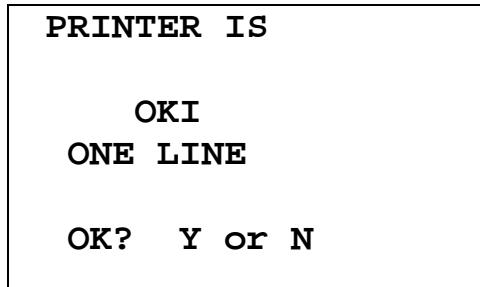


Figure 5-12 Selected Printer Type

If the displayed setting is correct, press **YES**. Figure 5-2 Main Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-9 Printer Type Screen will appear.

The above procedure also applies to the other RS-232 printers except that there is no option for printing on tickets or one line.

Okidata Menu Set-Up

If an Okidata Microline 320 printer was ordered with the CRC®-25R system, the Okidata printer should be set-up to function properly.

Should you experience printer difficulties, such as not printing, improper print spacing, printing the wrong characters, etc., make sure that the printer Setup is exactly as indicated in Figure 5-13 Listing of the *Turbo OKIDATA 320 Printer Setup Data*. If any differences are found, they must be corrected.

The buttons referred to are all located on the front panel of the printer. The Paper Lever is on the right side of the top surface of the printer near the paper roller.

To print and correct the Setup:

1. Make sure that the form paper is properly loaded in the printer.
2. Press the **SEL** button (to take printer off-line).
3. Press **SHIFT + MENU (SEL)** to enter the Setup Menu.
4. Press the **PRINT** button and the entire Setup listing will print.
5. If there are no differences between what just printed and Figure 5-13 Listing of the *Turbo OKIDATA 320 Printer Setup Data* go to step 10.
6. Press the **GROUP** button. The first line of the first group of lines of the Setup will print.
7. If all lines in the group just printed match the corresponding lines in Figure 5-13 Listing of the *Turbo OKIDATA 320 Printer Setup Data*, repeat step 6 for the next group.
8. If any line in the group just printed does not match the corresponding line in Figure 5-13 Listing of the *Turbo OKIDATA 320 Printer Setup Data*, it must be corrected. For example, to change the Baud Rate to 4800:
 - A. Press the **GROUP** button until Serial I/F is printed.
 - B. Press the **ITEM** button until Baud Rate is printed.
 - C. Press the **SET** button until 4800 BPS is printed.
9. If any differences remain, return to step 6 for the next group.
10. Press the **SHIFT + MENU (SEL)** buttons to return to **SEL** (on-line).

Note: The Setup printout shown in Figure 5-13 Listing of the *Turbo OKIDATA 320 Printer Setup Data* is for example only. Your printer Setup may differ slightly from that shown. Verify that the settings, which are the same between your Setup and that shown, concur.

Figure 5-13 Listing of the *Turbo OKIDATA 320 Printer Setup Data*

Printer Control	Emulation Mode	IBM PPR
Font	Print Mode	Utility
Font	DRAFT Mode	HSD
Font	Pitch	10 CPI
Font	Proportional Spacing	No
Font	Style	Normal
Font	Size	Single
Symbol Sets	Character Set	Set I
Symbol Sets	Language Set	American
Symbol Sets	Zero Character	Slashed
Symbol Sets	Code Page	USA
Rear Feed	Line Spacing	6 LPI
Rear Feed	Form Tear-Off	Off
Read Feed	Skip Over Perforation	No
Rear Feed	Page Length	11"
Bottom Feed	Line Spacing	6 LPI
Bottom Feed	Form Tear-Off	Off
Bottom Feed	Skip Over Perforation	No
Bottom Feed	Page Length	11"
Top Feed	Line Spacing	6 LPI
Top Feed	Bottom Margin	Valid
Top Feed	Page Length	11"
Top Feed	Wait Time	1 sec
Top Feed	Page Length Control	by Actual Page Length
Set-Up	Graphics	Uni-directional
Set-Up	Receive Buffer Size	64K
Set-Up	Paper Out Override	No
Set-Up	Print Registration	0
	SET---	SHIFT+SET
Set-Up	Operator Panel Functions	Full Operation
Set-Up	Reset Inhibit	Yes
Set-Up	Print Suppress Effective	No
Set-Up	Auto LF	No
Set-Up	Auto CR	No
Set-Up	SI Select Pitch (10CPI)	17.1 CPI
Set-Up	SI Select Pitch (12CPI)	12 CPI
Set-Up	Time Out Print	Valid
Set-Up	Auto Select	No
Set-Up	Centering Position	DEFAULT
Set-Up	ESC SI Pitch	17.1 CPI
Parallel I/F	I-Prime	Buffer Print
Parallel I/F	Pin 18	+5v
Parallel I/F	Bi-Direction	Enable
Serial I/F	Parity	None
Serial I/F	Serial Data 7/8 Bits	8 bits
Serial I/F	Protocol	Ready/Busy
Serial I/F	Diagnostic Test	No
Serial I/F	Busy Line	SSD-
Serial I/F	Baud Rate	4800 BPS
Serial I/F	DSR Signal	Invalid
Serial I/F	DTR Signal	Ready on Power Up
Serial I/F	Busy Time	200 ms

Epson LX-300+II Menu Set-Up

If an Epson LX-300+II printer was ordered with the CRC®-25R system, the printer should be set-up to function properly.

Should you experience printer difficulties, such as not printing, improper print spacing, printing the wrong characters, etc., make sure that the printer Setup is exactly as shown in Figure 5-15 Epson LX-300+II Printer Current Settings. If any differences are found, they must be corrected.

Follow the steps below to enter Default Setting mode. If single sheets are used, a new sheet of paper will need to be loaded each time the printer ejects a printed page.

The buttons referred to are all located on the front panel of the printer.

1. Make sure that the paper is properly loaded and the printer is off.
2. Hold down the **TEAR OFF (FONT)** button and then turn on the printer.

The printer enters Default Setting mode and prints instructions (as shown in Figure 5-14 Epson LX-300+II Printer Language Selection Instructions) for selecting the language. The current language is indicated by which control panel lights are on. (For English, only the Pause light is on.)

3. If a different language is desired, press the **LF/FF** button until the lights show the preferred language.
4. Press the **TEAR OFF (FONT)** button to print a list of all the current settings as shown in Figure 5-15 Epson LX-300+II Printer Current Settings.

Figure 5-14 Epson LX-300+II Printer Language Selection Instructions

W0007927 2749H

Font LEDs	Pause LED		
Voyants Police	Voyant Pause		
Schriftart LEDs	Pause LED		
Font LEDs	Pausa LED		
Indicadores Font	Indicador Pausa		
Indicadores Fonte	Indicador Pausa		

<input checked="" type="checkbox"/> English			
<input checked="" type="checkbox"/> Français			
<input checked="" type="checkbox"/> Deutsch			
<input type="checkbox"/> Italiano			
<input type="checkbox"/> Español			
<input type="checkbox"/> Português			
<input type="checkbox"/> LED on / Voyant Oui / LED an / Spia acceso / Indicador On			
<input type="checkbox"/> LED off / Voyant Non / LED aus / Spia spenta / Indicador Off			
<input type="checkbox"/> LED blink / Voyant clignote / LED blinkt / Spia lampeggiante / Indicador Intermitente / Indicador intermitente			
<input type="checkbox"/> LED 2-blink / Voyant 2-clignote / LED 2-blinkt / Spia 2-lampeggiante / Indicador 2-Intermitente / Indicador 2-intermitente			
- Press the LF/FF button to move through the languages listed in the table ; then press the Tear Off button to select the language.			
- Appuyez sur le bouton LF/FF afin de choisir la langue à partir du tableau, et validez en appuyant sur le bouton Tear Off.			
- Zur Auswahl einer Sprache aus der Tabelle drücken Sie die Taste LF/FF. Bestätigen Sie Ihre Auswahl durch Drücken der Taste Abtrennkante.			
- Premete il tasto LF/FF per scegliere una delle lingua disponibili nella tabella. Premete quindi il tasto Strappo per confermare la vostra scelta.			
- Pulse LF/FF para seleccionar el idioma de la Tabla y establezcalo pulsando Corte.			
- Pressione a tecla Linha/Página para percorrer as línguas indicadas na tabela; em seguida, pressione a tecla Corte para seleccionar a língua.			

Figure 5-15 Epson LX-300+II Printer Current Settings

Current settings	
Page length for tractor	11 inch
Skip over perforation	Off
Auto tear	Off
Auto line feed	Off
Print direction	Bi-D
Software	ESC/P
0 slash	0
High speed draft	On
I/F mode	Auto
Auto I/F wait time	10 seconds
Baud rate	4800BPS
Parity	None
Data length	8bit
Parallel I/F bidirectional mode	On
Packet mode	Auto
Character table	PC 437
International character set for Italic table	Italic U.S.A.
Manual feed wait time	1.5 seconds
Buzzer	On
Auto CR (IBM 2380 Plus)	Off
IBM character table	Table2

If you want to change any setting, press the Tear Off switch.
If you want not to change any settings, turn off the printer.

5. If there are no differences between what just printed and Figure 5-15 Epson LX-300+II Printer Current Settings, turn off the printer to exit Default Setting mode.
If changes are needed, proceed to step 6.
6. Press the **TEAR OFF (FONT)** button. The printer prints instructions for changing the settings as shown in Figure 5-16a Epson LX-300+II Printer Changing Settings Instructions.

Figure 5-16a Epson LX-300+II Printer Changing Settings Instructions

(1) Select menu by pressing the Tear Off switch.
Following LEDs show menu selected at that time.

Font LEDs

	Pause LED
...	** Menu **
■■□	Page length for tractor
□□□	Skip over perforation
□□□	Auto tear Off
□□□	Auto line feed
□□□	Print direction
□□□	Software
□□□	0 slash
□□□	High speed draft
□□□	I/F mode
□□□	Auto I/F wait time
□□□	Baud rate
□□□	Parity
□□□	Data length
□□□	Parallel I/F bidirectional mode
□□□	Packet mode
□□□	Character table
□□□	International character set for Italic table
□□□	Manual feed wait time
□□□	Buzzer
□□□	Auto CR (IBM 2380 Plus)
□□□	IBM character table

(2) Change setting value pressing the LF/FF switch.
Following LEDs show setting value selected at that time.

(3) Repeat (1) and (2) according to following guide printing.

Font LEDs

	Pause LED
...	** Page length for tractor **
■■□	3 inch
■■□	3.5 inch
■■□	4 inch
□□□	5.5 inch
□□□	6 inch
□□□	7 inch
■■□	8 inch

Font LEDs

■■□	8.5 inch
■■□	11 inch
□□□	70/6 inch
□□□	12 inch
□□□	14 inch
□□□	17 inch
□□□	Others

** Skip over perforation **

■■□	Off
□□□	On

** Auto tear Off **

■■□	Off
□□□	On

** Auto line feed **

■■□	Off
□□□	On

** Print direction **

■■□	Bi-D
□□□	Uni-D

Figure 5-16b Epson LX-300+II Printer Changing Settings Instructions

Font LEDs Pause LED ** Software ** ■■□ ESC/P ■□■ IBM 2380 Plus ** 0 slash ** ■■□ 0 ■□■ Ø ** High speed draft ** ■■□ Off ■□■ On ** I/F mode ** ■■□ Auto ■□■ Parallel ■□□ Serial □■■ USB ** Auto I/F wait time ** ■■□ 10 seconds ■□■ 30 seconds ** Baud rate ** ■■□ 19200BPS ■□■ 9600BPS ■□□ 4800BPS □■■ 2400BPS □□■ 1200BPS □□■ 600BPS ■■□ 300BPS ** Parity ** ■■□ None ■□■ Even ■□□ Odd □■■ Ignore ** Data length ** ■■□ 8bit ■□■ 7bit ** Parallel I/F bidirectional mode ** ■■□ Off ■□■ On ** Packet mode ** ■■□ Auto ■□■ Off	Font LEDs Pause LED ** Software ** ■■□ ESC/P ■□■ IBM 2380 Plus ** 0 slash ** ■■□ 0 ■□■ Ø ** High speed draft ** ■■□ Off ■□■ On ** I/F mode ** ■■□ Auto ■□■ Parallel ■□□ Serial □■■ USB ** Auto I/F wait time ** ■■□ 10 seconds ■□■ 30 seconds ** Baud rate ** ■■□ 19200BPS ■□■ 9600BPS ■□□ 4800BPS □■■ 2400BPS □□■ 1200BPS □□■ 600BPS ■■□ 300BPS ** Parity ** ■■□ None ■□■ Even ■□□ Odd □■■ Ignore ** Data length ** ■■□ 8bit ■□■ 7bit ** Parallel I/F bidirectional mode ** ■■□ Off ■□■ On ** Packet mode ** ■■□ Auto ■□■ Off
---	---

Figure 5-16c Epson LX-300+II Printer Changing Settings Instructions

```

Font LEDs
| | Pause LED
| |
||| ** Character table **
|||| Italic
|||| PC 437
|||| PC 850
|||| PC 860
|||| PC 863
|||| PC 865
|||| PC 861
||||| BRASCI
||||| Abicomp
||||| Roman 8
||||| ISO Latin 1
||||| PC 858
||||| ISO 8859-15
||||| Others

** International character set for Italic table **
|||| Italic U.S.A.
|||| Italic France
|||| Italic Germany
|||| Italic U.K.
||||| Italic Denmark 1
||||| Italic Sweden
||||| Italic Italy
||||| Italic Spain 1

** Manual feed wait time **
|||| 1 seconds
|||| 1.5 seconds
|||| 2 seconds
|||| 3 seconds
|||| Others

** Buzzer **
|||| Off
|||| On

** Auto CR (IBM 2380 Plus) **
|||| Off
|||| On

** IBM character table **
|||| Table2
|||| Table1

(4) Turn off the printer to finish setting.

```

7. Press the **LF/FF** button to scroll through the options for the selected setting until the desired setting is printed. Then press the **TEAR OFF (FONT)** button to select the next setting to be changed.
8. When all changes are complete, turn off the printer to exit Default Setting mode.

The new settings will remain in effect until they are changed again or the printer is reset to the default settings.

Note: *The Setup printout shown in Figure 5-15 Epson LX-300+II Printer Current Settings is for example only. Your printer Setup may differ slightly from that shown. Verify that the settings, which are the same between your Setup and that shown, concur.*

USB

USB printers are printers that use the USB interface. The printers that can be used with the CRC[®]-25R are the HP DeskJet 6000/8000 Series Inkjet (or equivalent) and the Epson Stylus C86 Inkjet (or equivalent).

From Figure 5-9 Printer Type Screen, select *USB*. Figure 5-17 USB Printer Selection screen will appear:

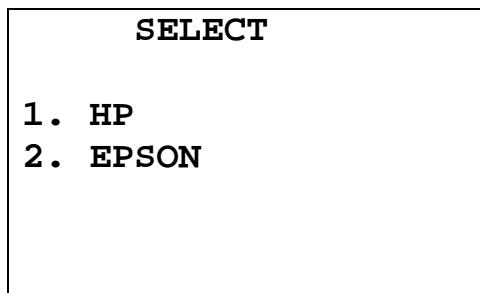


Figure 5-17 USB Printer Selection

Press the number corresponding to your printer.

For this example, the printer being used is an Epson Stylus C86 Inkjet. Select *EPSON*. Figure 5-18 Selected Printer Type will appear.

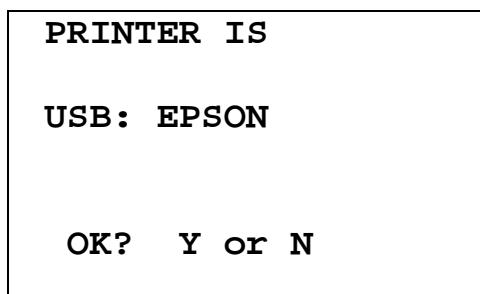


Figure 5-18 Selected Printer Type

If the displayed setting is correct, press **YES**. Figure 5-2 Main Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-9 Printer Type Screen will appear.

The above procedure also applies to the other USB printer.

NONE

The system does not need a printer to function properly.

If no printer is attached to the system, from Figure 5-9 Printer Type Screen select **NONE**. Figure 5-19 Selected Printer Type will appear.

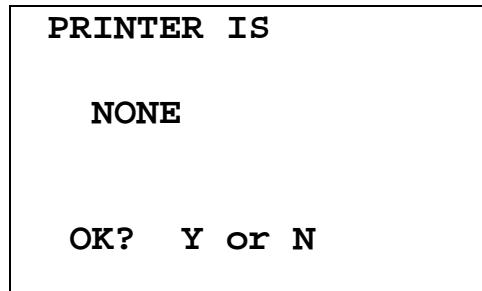


Figure 5-19 Selected Printer Type

If the displayed setting is correct, press **YES**. Figure 5-2 Main Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-9 Printer Type Screen will appear.

SCREEN SETUP

The CRC®-25R's screen contrast and screen saver (backlight) timeout can be set by the user.

To view and/or change the selected screen saver and/or to adjust the screen contrast, press the **MENU** key from the Measurement Screen. Figure 5-1 Main Menu will appear.

From Figure 5-1 Main Menu, select **SETUP**. Figure 5-2 Main Setup Menu will appear.

From Figure 5-2 Main Setup Menu, select **SCREEN**. Figure 5-20 Screen Setup Menu will appear.

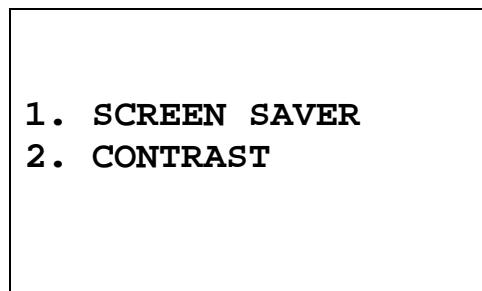


Figure 5-20 Screen Setup Menu

Screen Saver

To adjust the Screen Saver (backlight) timeout, select SCREEN SAVER. The current screen saver time will be displayed for verification (default is 10 minutes).

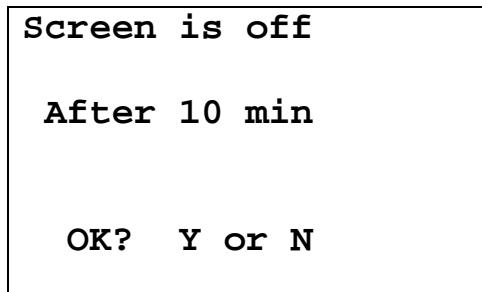


Figure 5-21 Screen Saver Verification Screen

If the displayed setting is correct, press **YES**. Figure 5-20 Screen Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-22 Screen Saver Selection Screen will appear.

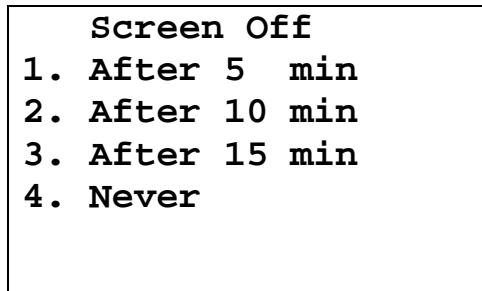


Figure 5-22 Screen Saver Selection Screen

Press the number corresponding to the desired timeout. Figure 5-21 Screen Saver Verification Screen will re-appear showing the chosen timeout period.

If the displayed setting is correct, press **YES**. Figure 5-20 Screen Setup Menu will re-appear.

If the displayed setting is not correct, press **NO**. Figure 5-22 Screen Saver Selection Screen will appear.

Screen Contrast

The screen contrast can be changed to conform to lighting conditions.

From Figure 5-20 Screen Setup Menu, select **CONTRAST** to adjust the Screen Contrast. Figure 5-23 Contrast Adjustment Screen will appear.

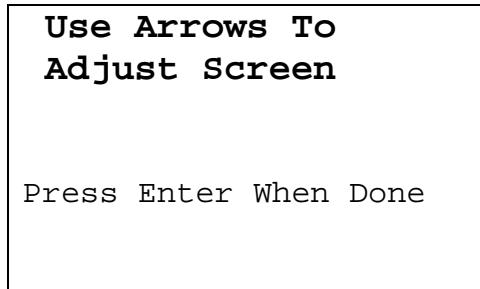


Figure 5-23 Contrast Adjustment Screen

The **UP ARROW (↖)** and **DOWN ARROW (↙)** keys are used to adjust the contrast.

The **UP ARROW (↖)** key will make the background of the screen gradually darker and the **DOWN ARROW (↙)** key will make the background gradually lighter.

When the screen contrast is at an acceptable level, press **ENTER** to save the contrast value and return to Figure 5-20 Screen Setup Menu.

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CHAPTER 6

CHAMBER INITIALIZATION

GENERAL	6-2
USER KEY ASSIGNMENT.....	6-2
Selecting User Key.....	6-2
Current Assignment Display	6-3
Nuclide Name Assignment	6-3
Assignment Confirmation.....	6-4
TEST SOURCES.....	6-4
Source Verification.....	6-5
Entering Serial Number	6-6
Entering Calibration Date	6-6
Entering Calibration Activity	6-7
Indicating Daily Usage	6-8
Confirming Calibration Data.....	6-8
CONSTANCY TEST SOURCE.....	6-9
No Daily Source Chosen.....	6-9
One Daily Source Chosen.....	6-9
More than One Daily Source Chosen.....	6-10
MOLY ASSAY SETUP	6-11
Selecting Moly Assay Method	6-12
Moly Assay Limit.....	6-13
ADDING A NUCLIDE	6-14
Entering Nuclide Name	6-15
Entering Half-Life	6-15
Entering Calibration Numbers.....	6-16
DELETING A NUCLIDE	6-18
CALIBRATION NUMBERS	6-19
Entering New Calibration Numbers	6-20
Changing Calibration Numbers.....	6-21
Restoring Original Calibration Numbers	6-23
LINEARITY TEST DEFINITION.....	6-23
Setting Up Standard Linearity Test.....	6-25
Setting Up Lineator Test.....	6-26
Setting Up Calicheck Test	6-27
REMOTE NUCLIDE ASSIGNMENT (LEGACY SYSTEMS ONLY)	6-29
Remove Nuclides	6-30
Adding Nuclides	6-31
USB PORT SETTINGS	6-31

GENERAL

This section describes initialization and parameter setup for the Chamber.

All of these functions are accessed via the Main Menu.

USER KEY ASSIGNMENT

The **USER Keys** (U1, U2, U3, U4, U5) are a quick way to select a nuclide. A nuclide may be assigned to each key.

To assign keys, press **MENU** from the Measurement Screen.

Select **SETUP**. The *Setup Menu* appears.

Select **OTHER**. Input the password (last 3 digits of the Readout serial number) and press **ENTER**. Figure 6-1 Other Menu appears.

- 1. User Keys**
- 2. Sources**
- 3. Moly Setup**
- 4. Nuclides**
- 5. Linearity**
- 6. Remote / PC**

Figure 6-1 Other Menu

From the *Other Menu*, select **USER KEYS**.

Selecting User Key

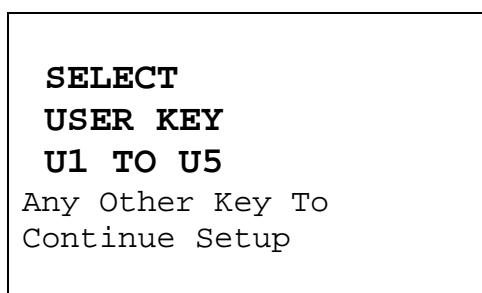


Figure 6-2 User Key Selection

Press any other key (except a **USER** key or the **HOME** key) to exit User Key Assignment and return to Figure 6-1 Other Menu.

Current Assignment Display

Press the **USER** Key to which a nuclide is to be assigned. Figure 6-3 User Key Verification screen will appear showing the current key assignment. In the example, Co60 has been assigned to U1.

Note: From the factory, all **USER** Keys are set to **NONE**.

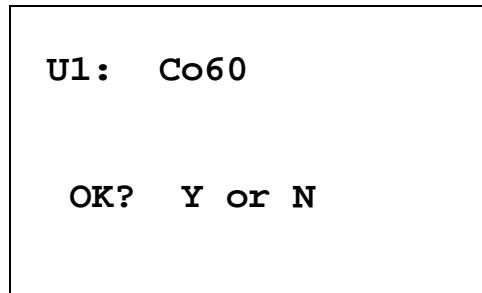


Figure 6-3 User Key Verification

If no assignment has been made, the word "NONE" will appear after the key name.

If the assignment is correct, press **YES** and Figure 6-2 User Key Selection screen will re-appear.

If the assignment is not correct, press **NO**. Figure 6-4 Nuclide Name Assignment Screen will appear.

Nuclide Name Assignment

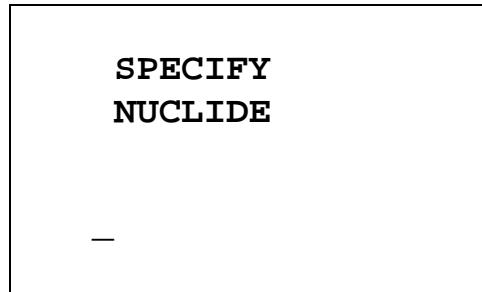


Figure 6-4 Nuclide Name Assignment Screen

Press the alphanumeric keys corresponding to the nuclide name. The number on each key will appear. For example, if Cs137 is entered, 27137 will appear on the screen. Press **ENTER** when the nuclide has been specified.

To change the assignment to NONE, press **ENTER** without specifying a nuclide.

Assignment Confirmation

Figure 6-3 User Key Verification screen will re-appear with the nuclide name that was just input.

If the assignment is correct, press **YES**. Figure 6-2 User Key Selection screen will re-appear.

If the assignment is not correct, press **NO**. Figure 6-4 Nuclide Name Assignment Screen will re-appear.

TEST SOURCES

Test Sources (Standard Sources) are used for the Accuracy and Constancy Tests.

The Accuracy and Constancy may be tested using Co57, Co60, Ba133, Cs137 or Ra226. There can be a Test Source for each of these nuclides. One or more of the Test Sources must be designated as the source(s) to be used in the Daily Test. One of the daily sources must be designated as the source to be used for the Constancy Test.

The *Test Source Menu* allows data to be input for any Test Source and to choose which Test Source will be used as a Constancy Source.

To input Test Source Data, press **MENU** from the Measurement Screen.

Select **SETUP**. The *Setup Menu* appears.

Select **OTHER**. Input the password (last 3 digits of Readout serial number) and press **ENTER**. Figure 6-1 Other Menu appears.

From the *Other Menu*, select **SOURCES**. Figure 6-5 Test Source Menu will appear.

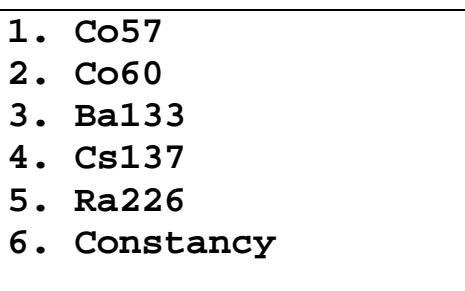


Figure 6-5 Test Source Menu

Press **1, 2, 3, 4 or 5** to input, change or delete the Test Source for the designated nuclide.

When shipped from the factory, the CRC®-25R does not have Test Source information entered. When a source is selected, Figure 6-6 No Source Verification Screen will appear. (Co57 is used in the example.)

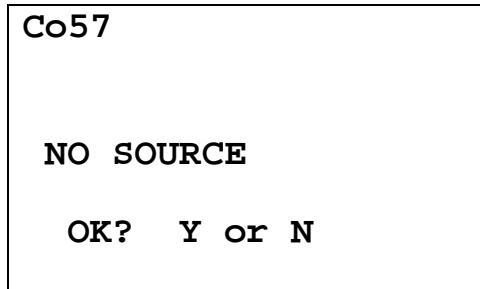


Figure 6-6 No Source Verification Screen

If there is no source for the selected Test Source, press **YES**. Figure 6-5 Test Source Menu will re-appear.

If there is a source for the selected Test Source, press **NO**. Figure 6-9 Entering Serial Number screen will appear.

Source Verification

If the chosen source had data previously entered, the data will be displayed. The example below is for Co57, which will be used in the Daily Test:

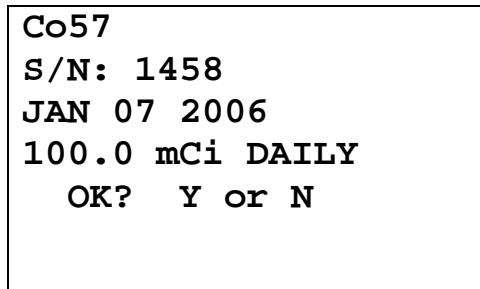


Figure 6-7 Test Source Verification

If the data is correct, press **YES**. Figure 6-5 Test Source Menu will re-appear.

To change the data or to delete the source, press **NO**. Figure 6-8 Source Existence screen will appear.

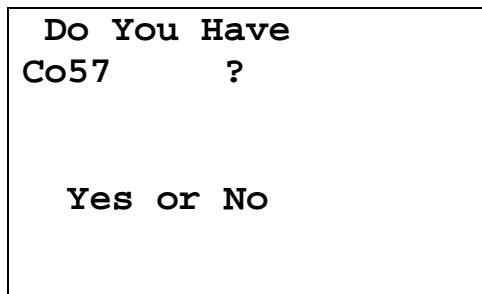


Figure 6-8 Source Existence

If the selected Test Source is no longer being used, press **NO** and it will be deleted. Figure 6-5 Test Source Menu will re-appear.

To input data for the selected Test Source, press **YES**. Figure 6-9 Entering Serial Number screen will appear.

Entering Serial Number

The serial number may be any combination of 10 numbers and letters.

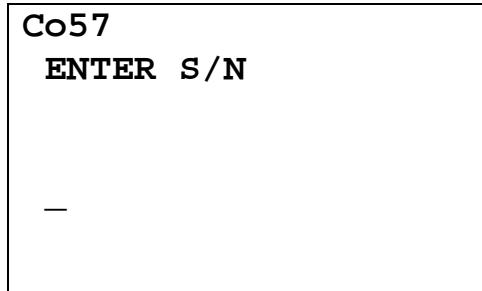


Figure 6-9 Entering Serial Number

To input the serial number of the Test Source, use the NUMBER / LETTER keys. When a key is pressed, the number appears. Press the key again to change the number into one of the letters on the same key (e.g. press the **2** key 3 times to get the letter B). To go to the next character, press another key. If the next character is on the same key, press the **UP ARROW** (↖) to repeat use of that key. The **DOWN ARROW** (↙) is the space key

Press **ENTER** when correct serial number has been input. Figure 6-10 Entering Calibration Date will appear.

Entering Calibration Date

The calibration date is input next.

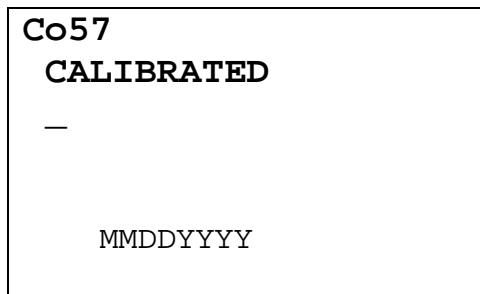


Figure 6-10 Entering Calibration Date

Input the Test Source calibration date in the form MMDDYYYY (example: July 3, 2005 would be 07032005) and press **ENTER**. The date is checked for validity. If the entered date is not valid, a beep will sound and “DATE ERROR” will be displayed. The date must be re-entered.

Figure 6-11 Entering Activity will appear.

Entering Calibration Activity

The calibration activity can now be input:

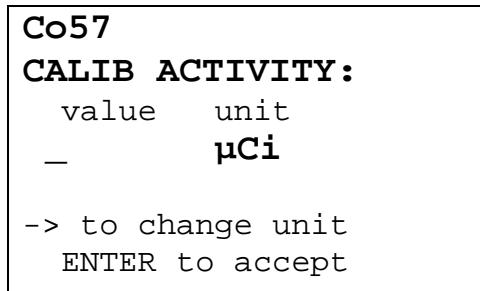


Figure 6-11 Entering Activity

The Calibration activity must be less than 1 Ci. The current activity (calibration activity decayed to the present time) must be greater than the activity in the table below.

Note: Capintec strongly recommends replacing the Test Source when the activity decays below the recommended “Minimum at Current Time” limits

Source	Minimum at Current Time		Maximum	
	Ci	Bq	Ci	Bq
Co57	50.0 μ Ci	1.85 MBq	1.0 Ci	37000 MBq
Co60	50.0 μ Ci	1.85 MBq	1.0 Ci	37000 MBq
Ba133	50.0 μ Ci	1.85 MBq	1.0 Ci	37000 MBq
Cs137	50.0 μ Ci	1.85 MBq	1.0 Ci	37000 MBq
Ra226	10.0 μ Ci	0.37 MBq	1.0 Ci	37000 MBq

Table 6-1 Test Source Calibration Activity Limits

Input the value of the calibrated activity and then press the **RIGHT ARROW (→)**. Use the arrow keys to scroll through the activity units: μ Ci, MBq or mCi. If the value needs to be changed, press **CE**.

When the value and unit are correct, press **ENTER**. Figure 6-12 Daily Use screen will appear.

Indicating Daily Usage

It must now be decided whether the source will be used for the Daily Test.

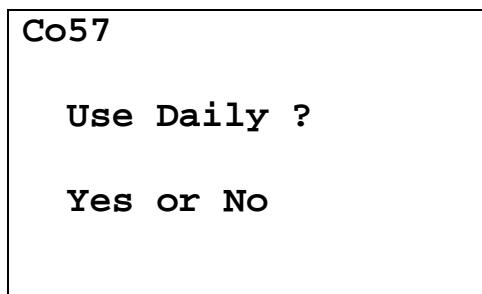


Figure 6-12 Daily Use

If the Test Source will be used in the Daily Test, press **YES**. If the Test Source will not be used in the Daily Test, press **NO**.

Confirming Calibration Data

Figure 6-7 Test Source Verification Screen will now be displayed with the data that has just input.

If the displayed information is not correct, press **NO**. Figure 6-8 Source Existence will appear.

If the displayed information is correct, press **YES**. Figure 6-5 Test Source Menu will re-appear.

CONSTANCY TEST SOURCE

The source for the Constancy Test is chosen from the Test Sources designated as Daily Sources.

From the Figure 6-5 Test Source Menu, select CONSTANCY.

No Daily Source Chosen

If no Test Sources are designated as a Daily Source, Figure 6-13 No Daily Source Was Chosen will appear.

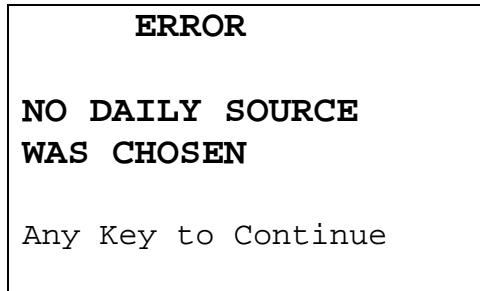


Figure 6-13 No Daily Source Was Chosen

A Daily Test Source must be selected in order to perform the Constancy Test. Reference the TEST SOURCES, SECTION: Indicating Daily Usage on page 6-8 for more information.

Press any key to continue. Figure 6-5 Test Source Menu will re-appear.

One Daily Source Chosen

If only one Test Source has been designated as a Daily Source, it will be set as the default Constancy Test Source as shown in Figure 6-14 Constancy Source Verification. (In the example below, Co57 is the only source.)

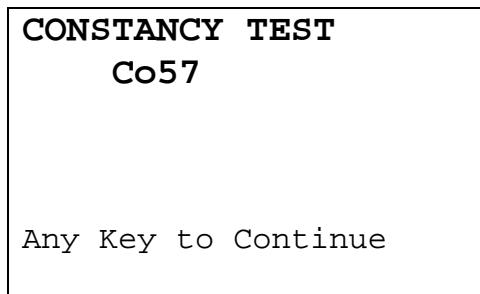


Figure 6-14 Constancy Source Verification

Press any key to continue. Figure 6-5 Test Source Menu will re-appear.

More than One Daily Source Chosen

If more than one Test Source has been designated as Daily Sources, Figure 6-15 Constancy Source Verification will appear. (In the example below, Co57 is set as the Constancy source.)

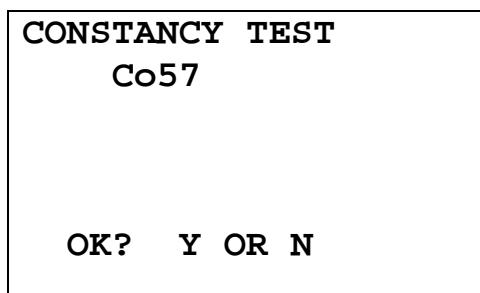


Figure 6-15 Constancy Source Verification

If the displayed source is correct, press **YES**. Figure 6-5 Test Source Menu will re-appear.

If the displayed source is not correct, press **NO**. Figure 6-16 Constancy Test Source Selection will appear. (In the example below, Co57 and Co60 are set to use as Daily Sources.)

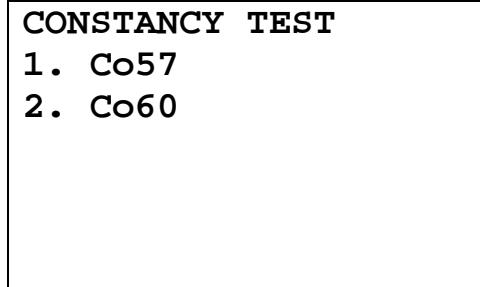


Figure 6-16 Constancy Test Source Selection

Choose the Daily Test Source to be used for the Constancy Test. Figure 6-15 Constancy Source Verification screen will re-appear.

MOLY ASSAY SETUP

Moly Assay can be performed using a CAPMAC or CANISTER.

When Moly Assay is chosen from the *Test Menu* (reference CHAPTER 10: MEASUREMENT PROCEDURES, SECTION: MOLY ASSAY), Figure 6-17 Moly Assay Method Selection the Moly Assay Method Selection screen will appear. However, if only one method is always used (either a CAPMAC or a CANISTER), the Moly Assay Method Selection screen can be omitted by selecting either CAPMAC or CANISTER from the *Other Menu*.

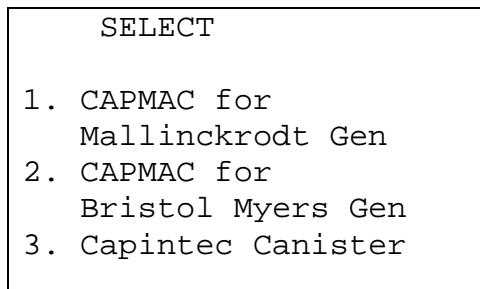


Figure 6-17 Moly Assay Method Selection

Press **MENU** from the Measurement Screen.

Select **SETUP**. The *Setup Menu* appears.

Select **OTHER**. Input the password (last 3 digits of Readout serial number) and press **ENTER**. Figure 6-1 Other Menu appears.

From the *Other Menu*, select **MOLY SETUP**. Figure 6-18 Moly Setup Menu will appear.

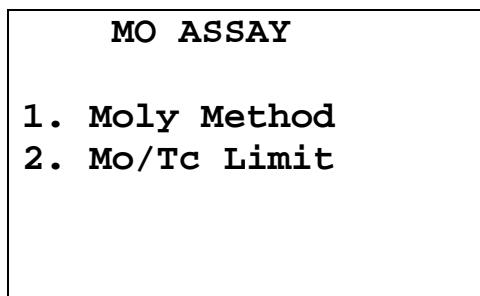


Figure 6-18 Moly Setup Menu

Selecting Moly Assay Method

Select *MOLY METHOD* from the *Moly Setup Menu*. Figure 6-19 Current Moly Assay Methods Screen will appear.

The current selections are displayed (default is all are selected):

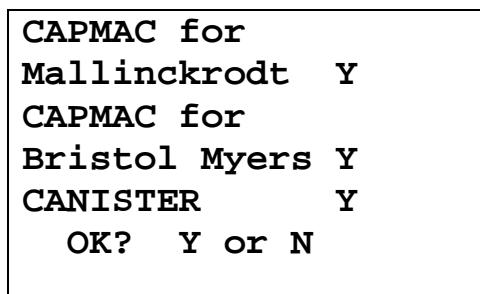


Figure 6-19 Current Moly Assay Methods Screen

If all of the current selections are correct, press **YES**. Figure 6-18 Moly Setup Menu will re-appear.

If any or all of the current selections are not correct, press **NO**. Figure 6-20 Moly Assay Method Selection Screen will appear asking if you will use each of the three possible selections.

Press **YES** if the method will be used, or **NO** if the method will not be used. The example for *CANISTER* is shown:

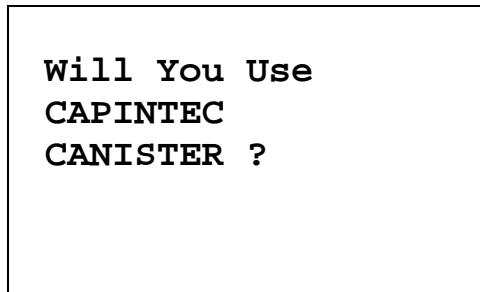


Figure 6-20 Moly Assay Method Selection Screen

After answering for all three methods, Figure 6-19 Current Moly Assay Methods Screen will re-appear showing the current settings.

If all of the current selections are correct, press **YES**. Figure 6-18 Moly Setup Menu will re-appear.

If any or all of the current selections are not correct, press **NO**. Figure 6-20 Moly Assay Method Selection Screen will appear asking if you will use each of the three possible selections again.

Moly Assay Limit

The Moly Assay default limit is set to 0.150 $\mu\text{Ci}/\text{mCi}$ (or 0.150 MBq/GBq). The user may change this value.

Select *MO/TC LIMIT* from Figure 6-18 Moly Setup Menu. The current limit is displayed:

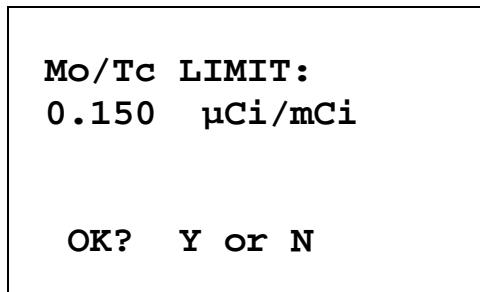


Figure 6-21 Mo/Tc Limit Verification Screen

If the displayed value is acceptable, press **YES** to keep the value and return to Figure 6-18 Moly Setup Menu.

If the displayed value is not acceptable, press **NO**. Figure 6-22 Mo/Tc Limit Entry Screen will appear. The value is input in $\mu\text{Ci}/\text{mCi}$ (or MBq/GBq if in Becquerel mode):

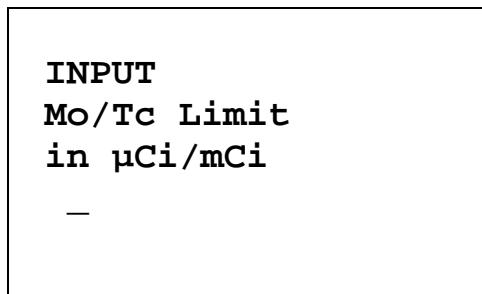


Figure 6-22 Mo/Tc Limit Entry Screen

Input the new value and press **ENTER**. Figure 6-21 Mo/Tc Limit Verification Screen will re-appear displaying the new value.

Note: The minimum value that can be input is 0.001 $\mu\text{Ci}/\text{mCi}$ (0.001 MBq/GBq). The maximum value that can be input is 9.99 $\mu\text{Ci}/\text{mCi}$ (9.99 MBq/GBq).

If the displayed value is acceptable, press **YES** to keep the value and return to Figure 6-18 Moly Setup Menu.

ADDING A NUCLIDE

The CRC®-25R contains nuclide data (name, half-life, calibration number) for over 80 nuclides.

The user may add up to 10 nuclides. The name, half-life and calibration number will be input.

Press **MENU** from the Measurement Screen.

Select **SETUP**. The *Setup Menu* appears.

Select **OTHER**. Input the password (last 3 digits of the Readout serial number) and press **ENTER**. Figure 6-1 Other Menu appears.

From the *Other Menu* select **NUCLIDES**. The *Nuclides Menu* appears.

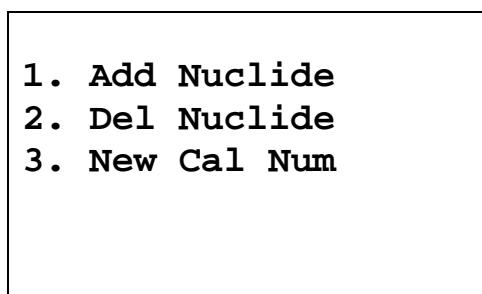


Figure 6-23 Nuclides Menu

Select **ADD NUCLIDE** to add nuclide data.

Entering Nuclide Name

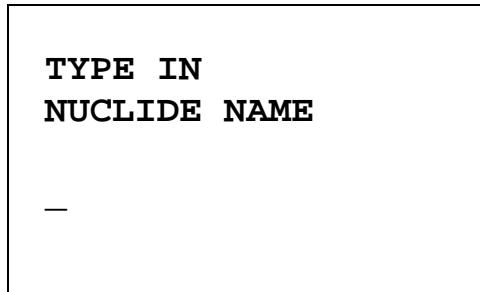


Figure 6-24 Entering Nuclide Name

Use the alphanumeric keys to input the nuclide name. The first 2 characters will be displayed as letters (press the **SPC** key for a blank if there is only 1 character in the name) and the next 3 characters as numbers. If the nuclide is in a metastable state, use the **Tc99m** key on the left of the keyboard for the "m".

Press **ENTER** when the nuclide name has been input. Figure 6-25 Inputting Half-life screen will appear.

Entering Half-Life

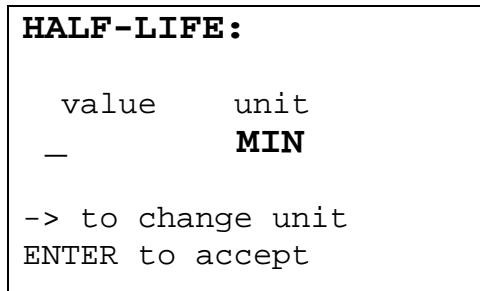


Figure 6-25 Inputting Half-life

Input the value of the half-life and then press the **RIGHT ARROW (→)** key. Use the arrow keys to scroll the half-life from Min to Year to Day to Hour. If the value needs to be changed, press the **CE** key.

When the value and unit are correct, press **ENTER**. Figure 6-26 Nuclide Verification screen will appear.

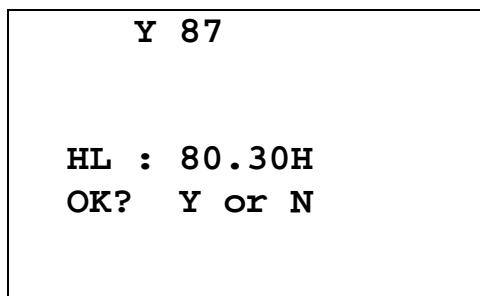


Figure 6-26 Nuclide Verification

If the source name and/or half-life is/are not correct, press **NO**. Figure 6-24 Entering Nuclide Name screen will re-appear.

If the source name and half-life are correct, press **YES**. Figure 6-27 Enter Calibration Number will appear.

Entering Calibration Numbers

A calibration number must be entered in order to perform measurements on the added nuclide.

A calibration number may include a multiplication sign (*) on the keyboard, displayed as X) or a division sign (÷). However, the CRC®-25R is always direct reading and the multiplication or division sign is only used to be consistent with existing Calibration Numbers.

For multiplication, the number can only be multiplied by 10 or 100. For division, the number can only be divided by 2. Refer to Table 6-2 Calibration Number Limits Table.

	Minimum Calibration # (a)	Maximum Calibration # (a)
Direct Entry (a)	10	1200
Multiplication (a × 10)	10	1200
Multiplication (a × 100)	10	999
Division (a ÷ 2)	400	1200

Table 6-2 Calibration Number Limits Table

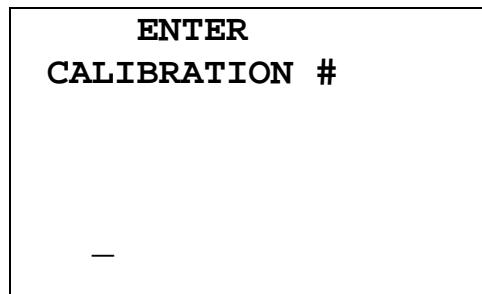


Figure 6-27 Enter Calibration Number

If the calibration number is known, input the number and press **ENTER**. Figure 6-23 Nuclides Menu will appear.

If the calibration number is not known, input 450 and press **ENTER**. The calibration number can then be determined by the following procedure. Figure 6-23 Nuclides Menu will appear.

Determining Calibration Numbers

An initial Calibration Number (as an initial starting point, choose 450) must be input into the CRC®-25R for the nuclide.

Note: *In order to obtain a correct reading for a Vial or Syringe, the supplied liner and dipper must be used to achieve the correct geometry. If the source is contained in a different type of container, then contact Capintec, Inc. for further assistance.*

1. Place the standard source of the nuclide in the chamber and record the displayed activity.
2. If the displayed activity is **higher** than the measured/calculated activity of the standard source, **increase** the Calibration Number. If the displayed activity is **lower** than the measured/calculated activity of the standard source, **decrease** the Calibration Number.
3. Re-measure the activity of the standard source.
4. Continue to increase or decrease the Calibration Number (e.g. repeat steps 2 and 3) until the displayed activity matches the measured/calculated activity of the standard source.
5. Record the Calibration Number of the nuclide for future reference.
6. Input the calibration number following the instructions in the Entering New Calibration Numbers section on page 6-20.

DELETING A NUCLIDE

Any nuclide added by the user may be deleted.

From Figure 6-23 Nuclides Menu, select *DEL NUCLIDE*. Figure 6-28 Nuclide Name Assignment Screen will appear.

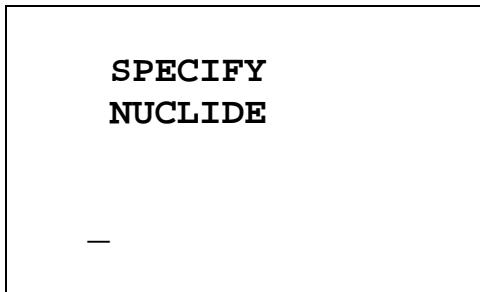


Figure 6-28 Nuclide Name Assignment Screen

To abort deleting a nuclide, press **ENTER** without specifying a nuclide name. Figure 6-23 Nuclides Menu will re-appear.

Press the alphanumeric keys corresponding to the nuclide name. The number on each key will appear. For example, if Cs137 is entered, 27137 will appear. Press **ENTER** when the nuclide has been specified. Figure 6-30 Delete Nuclide Verification Screen will appear showing the selected nuclide name and its half-life.

The entire name does not have to be input. If the nuclide is not uniquely specified, a list of possibilities will appear. For example, if Cesium is the desired source, input **271** (for Cs1) and press **ENTER**. Figure 6-29 Nuclide List Screen will appear.

Note: If there are more than 5 possibilities, the message “SPECIFY FURTHER” will be displayed. Press any key (except **HOME**) to continue.

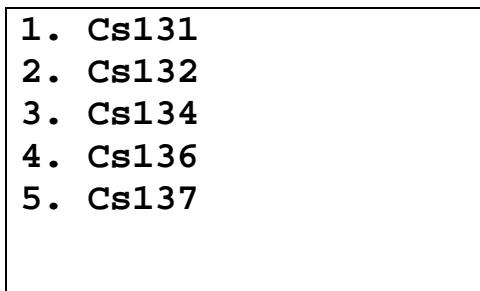


Figure 6-29 Nuclide List Screen

Input the number corresponding to the desired nuclide and press **ENTER**. Figure 6-30 Delete Nuclide Verification Screen will appear showing the selected nuclide name and its half-life.

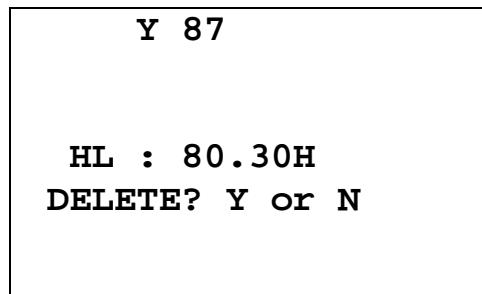


Figure 6-30 Delete Nuclide Verification Screen

If the displayed nuclide is not correct, press **NO**. Figure 6-23 Nuclides Menu will re-appear.

If the displayed nuclide is correct, press **YES**. Figure 6-23 Nuclides Menu will re-appear.

CALIBRATION NUMBERS

Up to 40 nuclides (including user added nuclides) may have their Calibration Numbers changed.

A calibration number may include a multiplication sign (*) on the keyboard, displayed as X) or a division sign (÷). However, the CRC®-25R is always direct reading and the multiplication or division sign is only used to be consistent with existing Calibration Numbers.

For multiplication, the number can only be multiplied by 10 or 100. For division, the number can only be divided by 2. Refer to Table 6-2 Calibration Number Limits Table on page 6-16.

To input a new Calibration Number, change a current Calibration Number or restore the original Calibration Number:

Press **MENU** from the Measurement Screen.

Select **SETUP**. The *Setup Menu* appears.

Select **OTHER**. Input the password (last 3 digits of Readout serial number) and press **ENTER**. Figure 6-1 Other Menu appears.

From the *Other Menu*, select **NUCLIDES**. Figure 6-23 Nuclides Menu will appear.

From the *Nuclide Menu*, select **NEW CAL NUM**. Figure 6-31 Choose Nuclide for Calibration Number screen will appear.

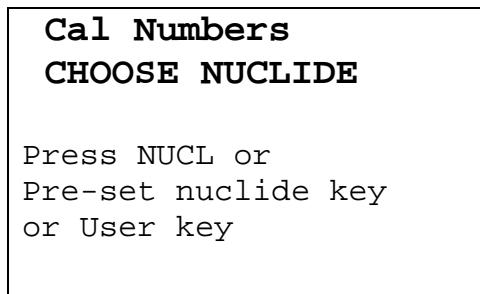


Figure 6-31 Choose Nuclide for Calibration Number

The nuclide can be chosen via the **NUCL** key, Pre-Set Nuclide key or **USER** key.

Entering New Calibration Numbers

If a the selected nuclide does not have a Calibration Number, Figure 6-32 Change Original Cal#? Screen will appear.

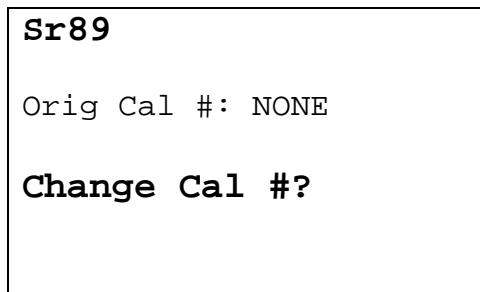


Figure 6-32 Change Original Cal#?

To leave the Calibration Number set to NONE, press **NO**. Figure 6-31 Choose Nuclide for Calibration Number screen will re-appear.

To input the new Calibration Number, press **YES**. Figure 6-33 Enter Calibration Number screen will appear.

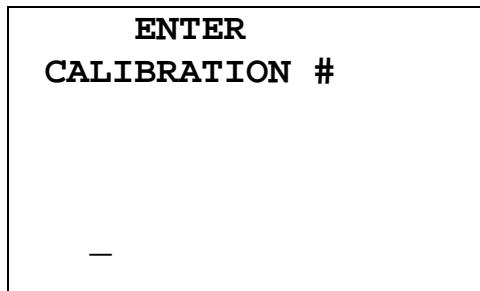


Figure 6-33 Enter Calibration Number

Input the new Calibration Number and press **ENTER**. After the Calibration Number is entered, Figure 6-34 New Cal# Verification Screen will appear.

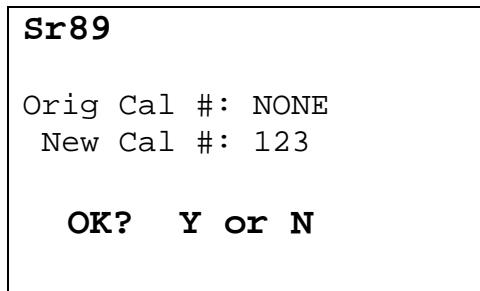


Figure 6-34 New Cal# Verification Screen

If the new Calibration Number is not correct, press **NO**. Figure 6-33 Enter Calibration Number screen will re-appear.

If the new Calibration Number is correct, press **YES**. The new Calibration Number will be stored and Figure 6-31 Choose Nuclide for Calibration Number screen will re-appear.

Changing Calibration Numbers

Calibration Numbers can be changed for any nuclide in memory.

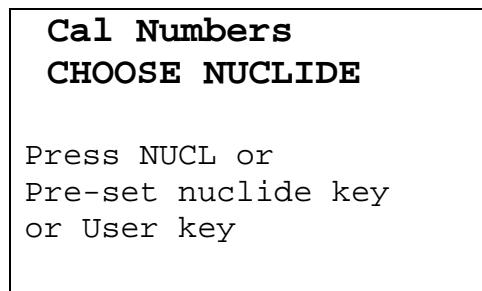


Figure 6-35 Choose Nuclide for Calibration Number

Choose the nuclide whose Calibration Number is to be changed via the **NUCL** key, Pre-Set Nuclide key or **USER** key. Figure 6-36 Change Original Cal#? will appear. (Tc99m is shown in the example.)

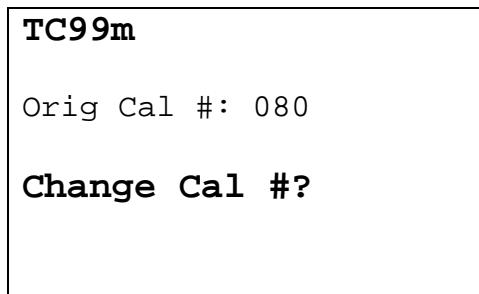


Figure 6-36 Change Original Cal#?

To leave the Calibration Number set to the original value, press **NO**. Figure 6-35 Choose Nuclide for Calibration Number screen will re-appear.

To change the displayed Calibration Number, press **YES**. Figure 6-37 Enter Calibration Number screen will appear.

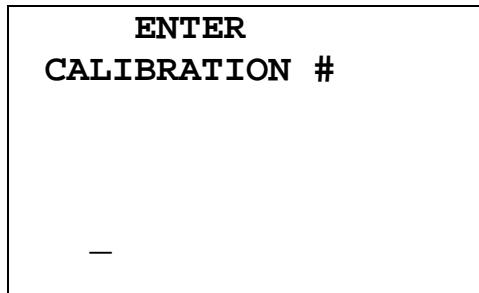


Figure 6-37 Enter Calibration Number

Input the new Calibration Number and press **ENTER**. After the calibration number is entered, the original and new Calibration Numbers will be displayed for verification as shown in Figure 6-38 New Cal# Verification Screen.

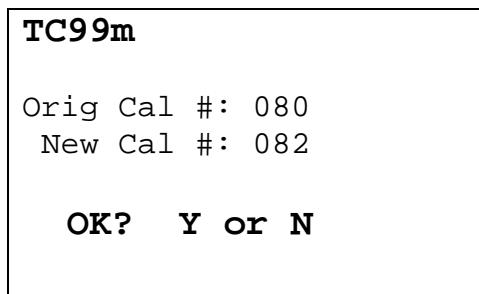


Figure 6-38 New Cal# Verification Screen

If the new Calibration Number is not correct, press **NO**. Figure 6-37 Enter Calibration Number screen will re-appear.

If the new Calibration Number is correct, press **YES**. Figure 6-35 Choose Nuclide for Calibration Number screen will re-appear.

Restoring Original Calibration Numbers

Choose the nuclide whose Calibration Number is to be restored via the **NUCL** key, Pre-Set Nuclide key or **USER** key. Figure 6-39 Restore Cal#? will appear asking if the original calibration number should be restored. (Tc99m is shown in the example with 082 as the new Calibration Number.)

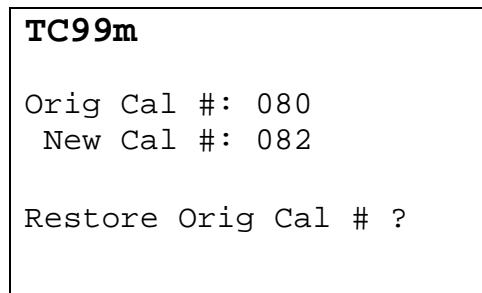


Figure 6-39 Restore Cal#?

To keep the current Calibration Number, press **NO**. Figure 6-35 Choose Nuclide for Calibration Number screen will re-appear.

To restore the original Calibration Number, press **YES**. Figure 6-35 Choose Nuclide for Calibration Number screen will re-appear.

LINEARITY TEST DEFINITION

Three methods of performing Linearity Tests are available: Standard (Decay), Lineator and Calicheck.

In order to perform a Linearity Test from the *Enhanced Test Menu* (reference CHAPTER 11: ENHANCED TESTS, SECTION: PERFORMING LINEARITY TEST), a Linearity Test Method must be defined from the Linearity Setup in the *Other Menu*. If a Linearity Method is not defined, Figure 6-40 Linearity Not Defined Error Screen will appear.

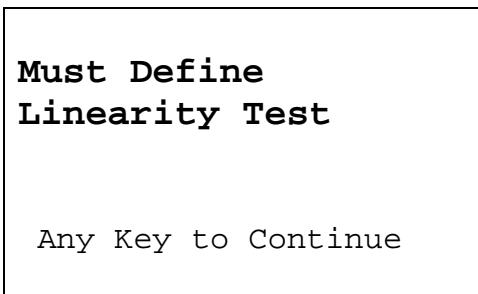


Figure 6-40 Linearity Not Defined Error Screen

Press **MENU** from the Measurement Screen.

Select **SETUP**. The *Setup Menu* appears.

Select **OTHER**. Input the password (last 3 digits of Readout serial number) and press **ENTER**. Figure 6-1 Other Menu appears.

From the *Other Menu*, select **LINEARITY**. If a Linearity Test has previously been defined, Figure 6-41 Message if Test Already Defined will appear; otherwise Figure 6-42 Linearity Test Selection Menu will appear.

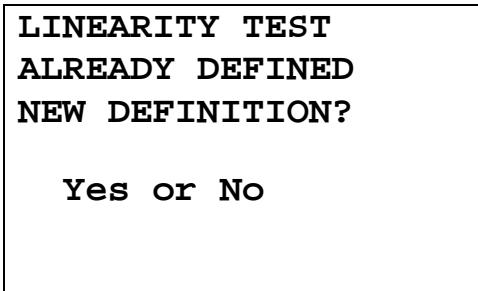


Figure 6-41 Message if Test Already Defined

Press **YES** to change the Linearity Test definition. Figure 6-42 Linearity Test Selection Menu will appear.

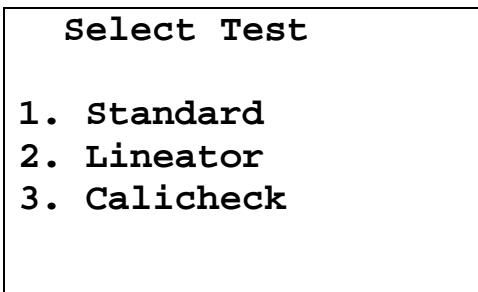


Figure 6-42 Linearity Test Selection Menu

Setting Up Standard Linearity Test

The Standard Test is performed by tracking the decay of a strong Tc99m source.

Select **STANDARD** from Figure 6-42 Linearity Test Selection Menu. Figure 6-43 Number of Tests Entry screen will appear.

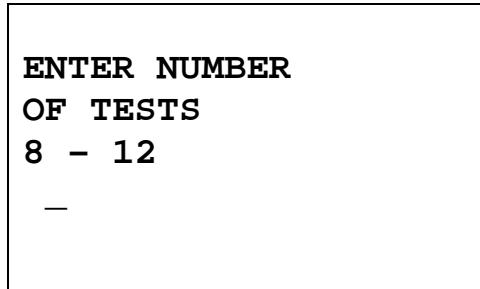


Figure 6-43 Number of Tests Entry

This test can be performed with 8 to 12 measurements.

Input the number of measurements that will be performed and press **ENTER**.

For each measurement (starting with the 2nd measurement), the nominal time (in hours) with respect to the first measurement that the measurement will be performed is input. The minimum time (in hours) is 1 and the maximum time (in hours) is 255. The example below (Figure 6-44 Standard Test – Test Time Entry) is for the second measurement.

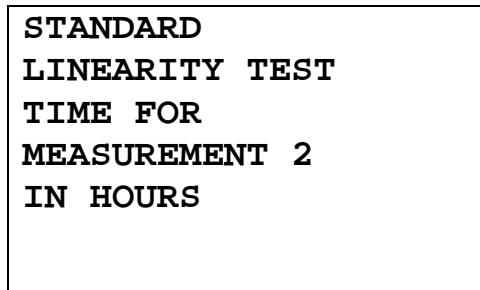


Figure 6-44 Standard Test – Test Time Entry

Input the time (in hours) and press **ENTER**. The above screen will be repeated for each measurement.

After all the times are input, the Standard Test Verification screen will appear. The example shown (Figure 6-45 Standard Test Verification) is for 12 tests at 1 hour increments:

HOURS FOR TESTS							
1:	0	2:	1	3:	2		
4:	3	5:	4	6:	5		
7:	6	8:	7	9:	8		
10:	9	11:	10	12:	11		
OK? Y or N							

Figure 6-45 Standard Test Verification

If the displayed times are incorrect, press **NO**. Figure 6-43 Number of Tests Entry will reappear.

If the displayed times are correct, press **YES**. Figure 6-1 Other Menu will reappear.

Setting Up Lineator Test

This test requires 8 measurements. A Lineator Test Calibration procedure must be performed before any Lineator tests.

Select **L/NEATOR** from Figure 6-42 Linearity Test Selection Menu. Figure 6-46 Lineator Calibration Prompt screen will appear. The example below is given for the 5th measurement.

Measure Tube # 5							
1 + 4							
Any Key to Continue							

Figure 6-46 Lineator Calibration Prompt

Place the Linearity Test Source in the calibrator and press any key to continue the measurement. Figure 6-47 Lineator Measurement Screen will appear.

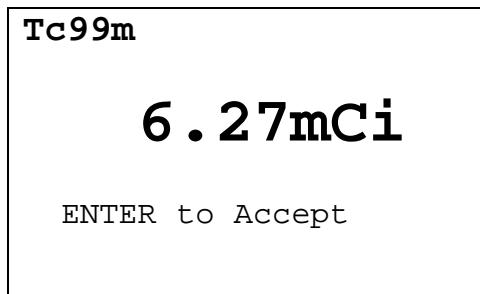


Figure 6-47 Lineator Measurement Screen

Press **ENTER** to accept the measurement. Figure 6-48 Lineator Calibration Measurement Verification screen will appear.

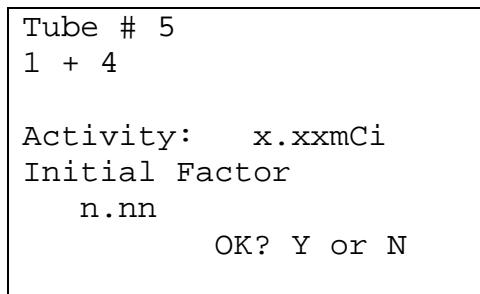


Figure 6-48 Lineator Calibration Measurement Verification

To repeat the measurement, press **NO**. Figure 6-46 Lineator Calibration Prompt will reappear.

To accept the measurement, press **YES**. The next Lineator Calibration Prompt screen will appear until all 8 tubes are measured.

If a printer is attached to the system, a Lineator Test Calibration report will print and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 6-1 Other Menu, press **NO**.

The report will show the measured activity and initial factor for each tube set.

Setting Up Calicheck Test

This test requires 8 to 12 measurements. A calibration procedure must be performed before any Calicheck tests.

Select **CALICHECK** from Figure 6-42 Linearity Test Selection Menu. Figure 6-49 Number of Tests Entry screen will appear.

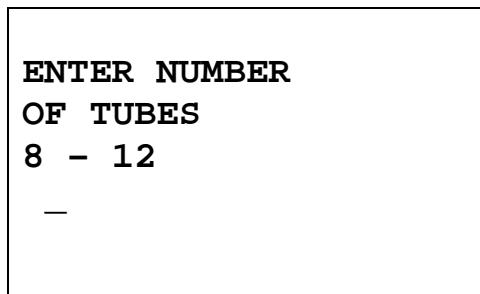


Figure 6-49 Number of Tests Entry

Input the number of measurements that will be performed and press **ENTER**. Figure 6-50 Calicheck Calibration Prompt screen will appear. The example below is given for the 5th measurement.

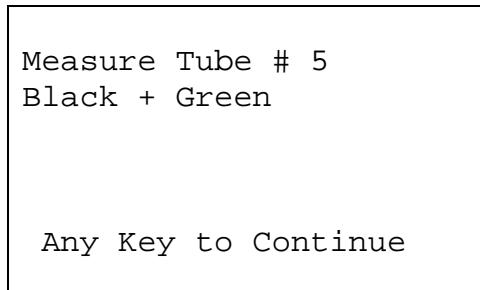


Figure 6-50 Calicheck Calibration Prompt

Place the Linearity Test Source in the calibrator and. press any key to continue the measurement. Figure 6-51 Calicheck Measurement Screen will appear.

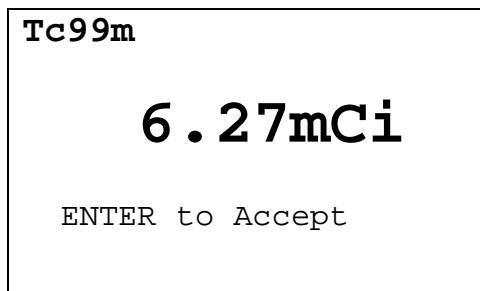


Figure 6-51 Calicheck Measurement Screen

Press **ENTER** to accept the measurement. Figure 6-52 Calicheck Calibration Measurement Verification screen will appear.

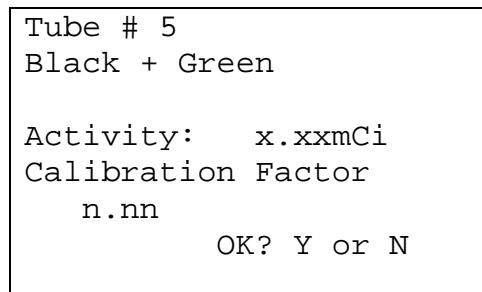


Figure 6-52 Calicheck Calibration Measurement Verification

To repeat the measurement, press **NO**. Figure 6-50 Calicheck Calibration Prompt will re-appear.

To accept the measurement, press **YES**. The next Calicheck Calibration Prompt screen will appear until all tubes are measured.

If a printer is attached to the system, a Calicheck Test Calibration report will print and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 6-1 Other Menu, press **NO**.

The report will show the measured activity and calibration factor for each tube.

REMOTE NUCLIDE ASSIGNMENT (LEGACY SYSTEMS ONLY)

Note: This section is only included for legacy systems. Remote Displays are no longer available as an option.

If a Remote Display unit was part of the legacy CRC®-25R system, up to 8 nuclides can be assigned to the remote. This allows the user to select any one of the assigned nuclides from the Remote Display without having to return to the Main Readout.

Press **MENU** from the Measurement Screen.

Select **SETUP**. The *Setup Menu* appears.

Select **OTHER**. Input the password (last 3 digits of Readout serial number) and press **ENTER**. Figure 6-1 Other Menu appears:

From the *Other Menu*, select **REMOTE / PC**. Figure 6-53 Remote / PC Menu will appear.

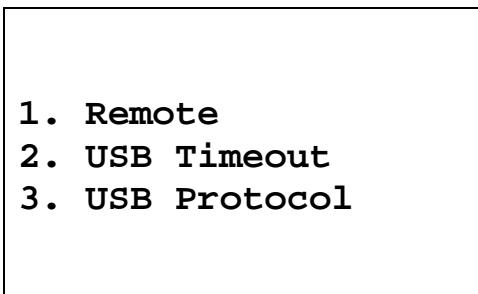


Figure 6-53 Remote / PC Menu

From the *Remote / PC Menu*, select **REMOTE**. Figure 6-54 Remote Choose Nuclide Screen will appear showing the factory default nuclides.

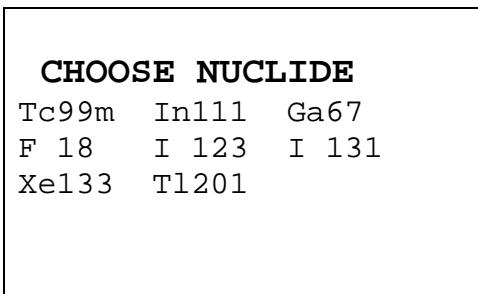


Figure 6-54 Remote Choose Nuclide Screen

Remove Nuclides

To remove a Remote nuclide, at Figure 6-54 Remote Choose Nuclide Screen, select the nuclide via the Pre-Set Nuclide keys, **USER** keys or **NUCL** key. Figure 6-55 Remote Choose Nuclide – Delete Nuclide Screen will appear:

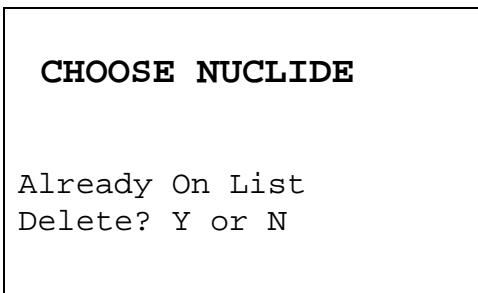


Figure 6-55 Remote Choose Nuclide – Delete Nuclide Screen

Press **YES** to delete the selected nuclide from the Remote Nuclide list. Figure 6-54 Remote Choose Nuclide Screen will re-appear without the selected nuclide.

When all changes are complete, press **ENTER**. Figure 6-1 Other Menu will re-appear.

Adding Nuclides

A maximum of 8 nuclides can be set for Remote Displays. If all locations are used, one or more nuclides must be removed before any more can be added.

At Figure 6-54 Remote Choose Nuclide Screen, select nuclides via the Pre-Set Nuclide keys, **USER** keys or **NUCL** key. The name of each nuclide will be displayed as it is selected.

When all desired nuclides are selected, press **ENTER**. Figure 6-1 Other Menu will re-appear.

USB PORT SETTINGS

Two selections are provided for adjusting the USB port settings when connecting the Calibrator to a Nuclear Management software system. They are USB Timeout and USB Protocol. By default, the USB Timeout is “disabled” and the USB Protocol is “Legacy”. The defaults will work with Capintec’s Communications software. These settings may need to be changed if the Calibrator is connected to some other Nuclear Management software system. Please contact Capintec, Inc. for further assistance with these settings.

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CHAPTER 7

ACCEPTANCE & QUALITY ASSURANCE TESTS

GENERAL	7-1
ACCEPTANCE TESTS	7-1
Diagnostic Test	7-2
Daily Test	7-2
Accuracy Test.....	7-2
Linearity Test.....	7-2
DAILY QUALITY ASSURANCE TESTS.....	7-3
Daily Tests	7-3
Accuracy Test.....	7-3
Contamination Test.....	7-3
QUARTERLY TESTS	7-4
Diagnostic Test	7-4
YEARLY TESTS.....	7-4
Linearity Test.....	7-4

GENERAL

To insure proper operation of the CRC®-25R, the following tests should be performed at the indicated intervals.

ACCEPTANCE TESTS

The following tests must be performed in the following order before the initial use of the CRC®-25R:

- Diagnostics – reference CHAPTER 9: DIAGNOSTICS.
- Daily Test – reference CHAPTER 8: BACKGROUND AND TESTS.
- Accuracy (for those nuclides that are not used in the Daily Test) – reference CHAPTER 8: BACKGROUND AND TESTS.
- Linearity – The linearity should be checked over the entire range of activities which are reasonably anticipated to be used.
- Geometry – A geometry test should be performed to determine the effect of volume changes or container variation for isotopes of interest.

Diagnostic Test

When *DIAGNOSTICS* is selected, the instrument's memories and the programs are checked and the results are displayed. If a printer is attached to the system, the results will also be printed. If any of the tests fail, contact Capintec's only Authorized Service Center at (800) ASK-4CRC. (Reference CHAPTER 9: DIAGNOSTICS)

Daily Test

The Daily Test should be conducted at the beginning of each working day, prior to measuring any samples which will be administered to patients. These tests consist of an Auto Zero operation, a Background Adjustment, a Chamber Voltage Test, a Data Check, an Accuracy Test, and a Constancy Test. (reference CHAPTER 8: BACKGROUND AND TESTS)

If a printer is attached to the system, the test results will automatically be printed at the end of all source measurements.

Accuracy Test

If your Accuracy Test setup includes nuclides that are not used in the Daily Tests, the Accuracy Test should be performed with those nuclides. It will not be necessary to repeat the test for those nuclides that were included in the Daily Test. (reference CHAPTER 8: BACKGROUND AND TESTS)

If a printer is attached to the system, the test results will automatically be printed at the end of all source measurements.

Note: *Accuracy test requires a dedicated check source of known activity which is measured on a daily basis. This test provides both an accuracy value as well as a long term reproducibility check of the instrument.*

Note: *There is no need to perform a constancy test on alternate calibration (nuclide) settings. This provides no value in terms of instrument operation. However, due to numerous procedures which reference this test, operators who prefer to include this test should refer to CHAPTER 8: BACKGROUND AND TESTS.*

Linearity Test

The linearity of the CRC®-25R should be checked over the entire range of activities which are reasonably anticipated to be used. The initial linearity should be performed using decay method of measuring a short lived isotope over time. Thereafter, use of calibrated sleeves is acceptable.

DAILY QUALITY ASSURANCE TESTS

Daily Tests

The Daily Test should be conducted at the beginning of each working day, prior to measuring any samples, which will be administered to patients. These tests consist of an Auto Zero operation, a Background Adjustment, a Chamber Voltage Test, a Data Check, an Accuracy Test, and a Constancy Test. (reference CHAPTER 8: BACKGROUND AND TESTS)

Accuracy Test

If your Accuracy Test includes nuclides that are not used in the Daily Tests, the Accuracy Test should be performed with those nuclides as a part of the Daily Test.

This test is the same as the Accuracy Test described in CHAPTER 8: BACKGROUND AND TESTS, SECTION: ACCURACY and CONSTANCY TEST IN DAILY TEST. This test is performed independently from the other portions of the Daily Test sequence.

The Accuracy Tests cannot be conducted until the Test Source data has been entered (reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES).

If a printer is attached to the system, the test results will automatically be printed at the end of all source measurements.

Note: *Accuracy test requires a dedicated check source of known activity which is measured on a daily basis. This test provides both an accuracy value as well as a long term reproducibility check of the instrument.*

Note: *There is no need to perform a constancy test on alternate calibration (nuclide) settings. This provides no value in terms of instrument operation. However, due to numerous procedures which reference this test, operators who prefer to include this test should refer to CHAPTER 8: BACKGROUND AND TESTS.*

Contamination Test

This tests the Dipper and/or Liner for contamination and is normally performed at the end of each workday. At the very least, it should be performed once per week. To perform a contamination test:

1. Make sure that the dipper is in the Chamber and there is no source in the dipper.
2. From the Chamber Measurement screen, press **NUCL** and input **2657** for Co57 and press **ENTER**.
3. Press the **DOWN ARROW** ().
4. Record the displayed activity.
5. Remove the dipper from the Chamber and record the displayed activity.
6. Subtract the activity in step 5 from the activity in step 4. This is the amount of contamination of the dipper.

7. Remove the liner from the Chamber and record the displayed activity.
8. Subtract the activity in step 7 from the activity in step 5. This is the amount of contamination of the liner.
9. Should either the dipper or the liner exhibit contamination greater than 3 μCi or 0.1 MBq, they should be decontaminated or replaced.
10. Return the liner to the Chamber.



CAUTION: Never use the calibrator without the Chamber liner in place. Liners are inexpensive and easy to replace. A contaminated Chamber is a very costly mistake.

QUARTERLY TESTS

Diagnostic Test

The Diagnostics Test should be performed as a part of the Quarterly Tests. When Diagnostics is selected, the instrument's memories and programs are checked and the results are displayed. If a printer is attached to the system, the results can be printed. If any of the tests fail, contact Capintec's only Authorized Service Center at (800) ASK-4CRC. (Reference CHAPTER 9: DIAGNOSTICS).

YEARLY TESTS

Linearity Test

The linearity of the CRC®-25R should be checked over the entire range of activities which are reasonably anticipated to be used. The initial linearity should be performed using decay method of measuring a short lived isotope over time. Thereafter, use of calibrated sleeves is acceptable.

The three most common methods are described in CHAPTER 6: CHAMBER INITIALIZATION, SECTION: LINEARITY TEST DEFINITION and CHAPTER 11: ENHANCED TESTS, SECTION: PERFORMING LINEARITY TEST.

CHAPTER 8

BACKGROUND AND TESTS

GENERAL	8-1
BACKGROUND	8-1
DAILY TEST.....	8-3
Auto Zero	8-4
Background	8-5
Chamber Voltage.....	8-6
Data Check	8-7
Accuracy and Constancy Test in Daily Test.....	8-8
CHAMBER VOLTS.....	8-10
ACCURACY TEST	8-11

GENERAL

This section describes the tests of the Chamber.

The Enhanced Tests are described in CHAPTER 11: ENHANCED TESTS.

Moly Assay is described in CHAPTER 10: MEASUREMENT PROCEDURES; SECTION: MOLY ASSAY.

BACKGROUND

Background measurements are performed by pressing the **BKG** key from the Measurement screen (Background measurement is also part of the Daily Test function. Reference this chapter, SECTION: DAILY TEST:Background on page 8-5). Figure 8-1 Background No Sources Screen will appear.

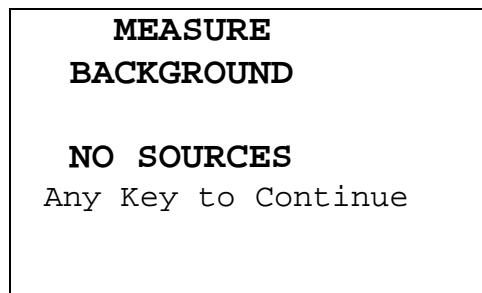


Figure 8-1 Background No Sources Screen

Remove all sources from the vicinity of the Chamber and press any key (except **HOME**) to continue with the Background measurement.

Figure 8-2 Background Please Wait Screen will appear until a measurement is available.

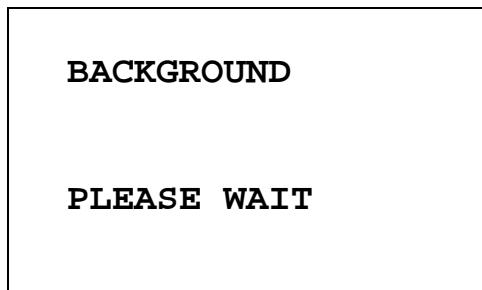


Figure 8-2 Background Please Wait Screen

When a measurement is available, Figure 8-3 Background Results Screen will appear.

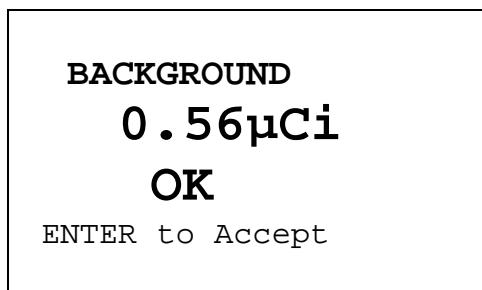


Figure 8-3 Background Results Screen

If the background is high but still acceptable ($> 10\mu\text{Ci}$ [0.4MBq] and $< 530\mu\text{Ci}$ [20MBq]) the message "HIGH" will appear instead of "OK". Although the value is acceptable, the reason for the high value should be investigated. If any sources are found nearby, repeat the measurement.

If the background is above the acceptable range ($> 530\mu\text{Ci}$ [20MBq]), the value will not be shown but Figure 8-11 Background Too High Screen will appear.

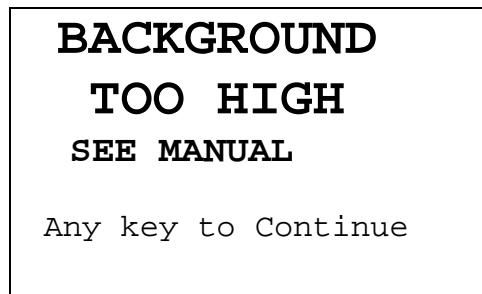


Figure 8-4 Background Too High Screen

This "TOO HIGH" background cannot be accepted by the CRC®-25R. If the cause of the high reading (nearby source, contaminated well etc.) cannot be found, contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

Press **ENTER** to accept the result. The Measurement Screen will re-appear.

DAILY TEST

The Daily Test consists of:

- Auto Zero
- Background
- Chamber Voltage
- Data Check
- Accuracy Test
- Constancy Test

To perform the Daily Test, press **TEST** from the Measurement Screen. Figure 8-5 Tests Menu will appear.

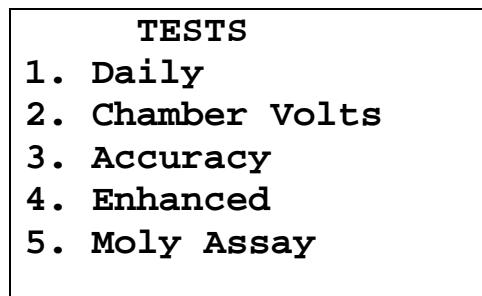


Figure 8-5 Tests Menu

Select **DAI/LY** from Figure 8-5 Tests Menu. Figure 8-6 Auto Zero Instruction screen will appear.

Auto Zero

The first part of the Daily Test is the Auto Zero.

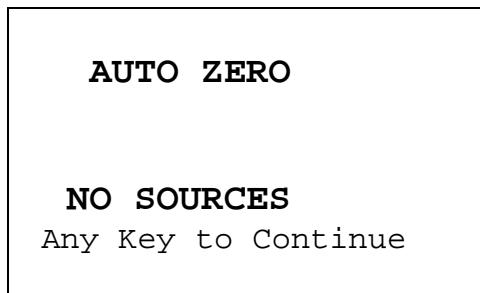


Figure 8-6 Auto Zero Instruction

Remove all sources from the vicinity of the Chamber and press any key (except **HOME**) to continue. Figure 8-7 Auto Zero Please Wait Screen will appear until a measurement is available.

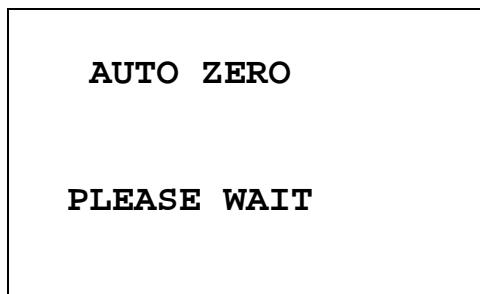


Figure 8-7 Auto Zero Please Wait Screen

When a measurement is available, Figure 8-8 Auto Zero Results Screen will appear.

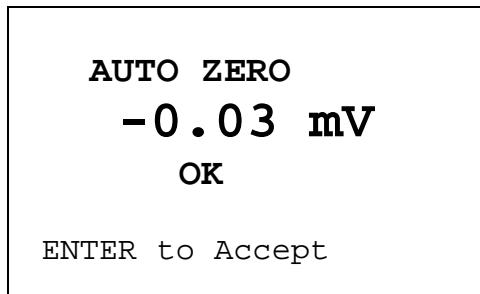


Figure 8-8 Auto Zero Results Screen

If the measured value has drifted since the last measurement ($\pm 0.30\text{mV}$), the message “CAUTION ZERO DRIFT” will be displayed. Check to make sure that no sources are in the area. If any sources are found, remove them and repeat the measurement.

If the measured value is out of range, the error message “ERROR – AUTO ZERO OUT OF RANGE – ANY KEY TO CONTINUE” will appear. Check to make sure that no sources are in the area. If any sources are found, remove them and repeat the measurement. If no sources were found, contact Capintec’s only Authorized Service Center at (800) ASK-4CRC.

Press **ENTER** to accept the result and continue the Daily Test. Figure 8-9 Background Please Wait Screen will appear until a measurement is available.

Background

The second part of the Daily Test is Background measurement.

Background measurement can also be performed by pressing the **BKG** key from the Measurement Screen. If Background is performed via the **BKG** key, you will first be told to remove all sources from the vicinity of the Chamber and press any key to continue.

Figure 8-9 Background Please Wait Screen will appear until a measurement is available.

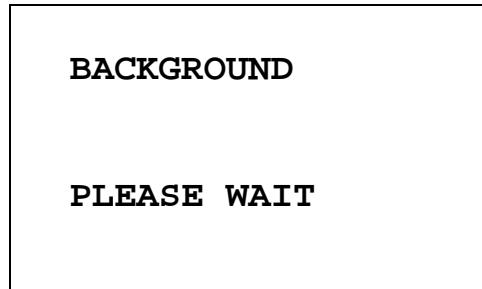


Figure 8-9 Background Please Wait Screen

When a measurement is available, Figure 8-10 Background Results Screen will appear.

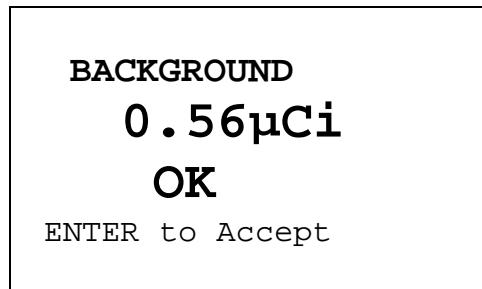


Figure 8-10 Background Results Screen

If the background is high but still acceptable ($> 10\mu\text{Ci}$ [0.4MBq] and $< 530\mu\text{Ci}$ [20MBq]) the MESSAGE "HIGH" will appear instead of "OK". Although the value is acceptable, the reason for the high value should be investigated. If any sources are found nearby, repeat the measurement.

If the background is above the acceptable range ($> 530\mu\text{Ci}$ [20MBq]), the value will not be shown but Figure 8-11 Background Too High Screen will appear.

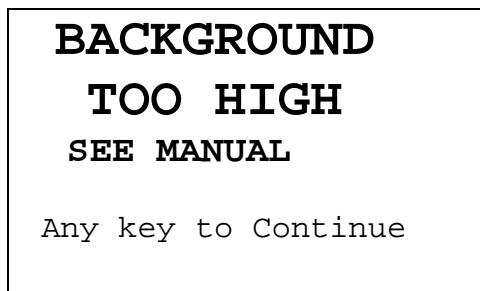


Figure 8-11 Background Too High Screen

This "TOO HIGH" background cannot be accepted by the CRC®-25R. If the cause of the high reading (nearby source, contaminated well etc.) cannot be found, contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

Press **ENTER** to accept the result and continue the Daily Test. Figure 8-12 Chamber Voltage Please Wait Screen will appear.

Chamber Voltage

The third part of the Daily Test is the Chamber Voltage test.

Chamber Voltage test can also be performed by selecting *CHAMBER VOLTS* from Figure 8-5 Tests Menu.

Figure 8-12 Chamber Voltage Please Wait Screen will appear until a measurement is available.

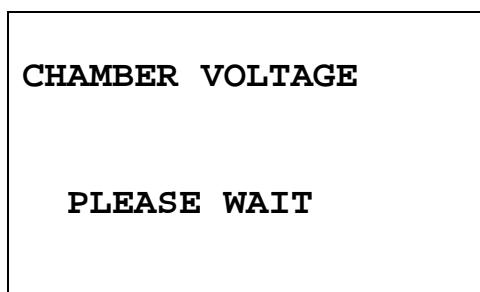


Figure 8-12 Chamber Voltage Please Wait Screen

When a measurement is available, Figure 8-13 Chamber Voltage Results Screen will appear.

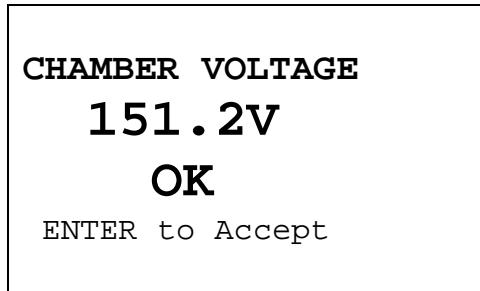


Figure 8-13 Chamber Voltage Results Screen

The measurement is compared with the value input at the factory. If the results are out of range, the message "FAIL SEE MANUAL" appears. If this occurs, contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

Press **ENTER** to accept the result and continue the Daily Test.

Data Check

The next part of the Daily Test is a check of the built-in nuclide data. Figure 8-14 Data Check Results screen will appear.

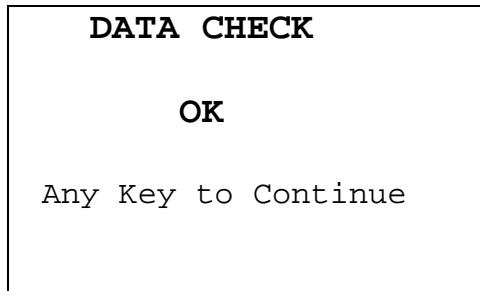


Figure 8-14 Data Check Results

If this test fails, turn the power off and then back on. This will reload the program and data into memory. Repeat the test. If the test continues to fail, contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

Press **ENTER** to accept the result and continue the Daily Test.

Accuracy and Constancy Test in Daily Test

The next part of the Daily Test is the Accuracy Test. The CRC®-25R will step through performing the Accuracy Test for all sources that have been designated as a Daily Source (reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES).

Note: If no sources were designated as Daily Test sources, then the message "NO DAILY SOURCE DATA – Any Key to Continue" will appear and the test will be completed. The Accuracy and Constancy tests will not be performed.

In the example below, Co57 is the Daily Source and the Constancy Source.

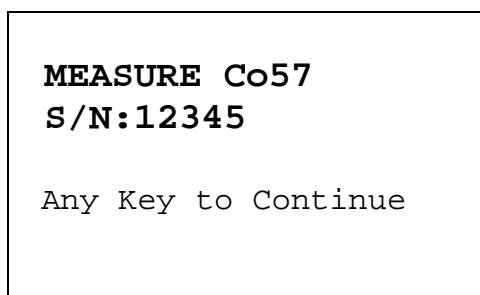


Figure 8-15 Accuracy Test in Daily Test Instruction Screen

Place the requested Test Source into the Chamber and press any key (except **HOME**) to continue with the Accuracy Test. Figure 8-16 Accuracy Test Result Screen will appear and is shown below along with a description of each section.

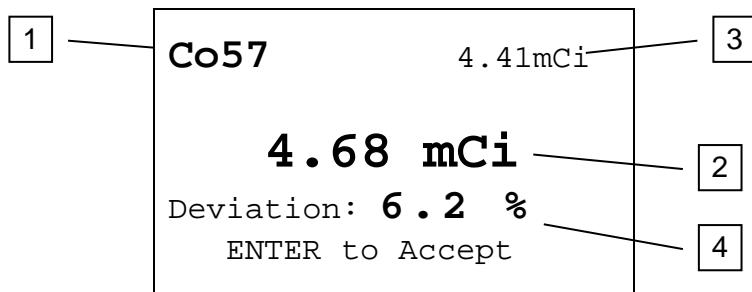


Figure 8-16 Accuracy Test Result Screen

1. The current check source under test.
2. The measured activity of the check source under test.
3. The anticipated actual activity of the check source based upon the initial calibration of the source, corrected for decay.
4. The percent deviation of the measured activity from the anticipated activity. If the deviation is greater than $\pm 20\%$, the reading will be replaced by a dashed line – this indicates an error condition (perhaps the wrong source is being measured).

Deviations greater than $\pm 5\%$ should be investigated. If the deviation is greater than 10%, contact Capintec's only Authorized Service Center. Note that higher than expected deviations may be within the limit of error, depending the accuracy of the check source being used.

Press **ENTER** to accept the measurement.

If the source being measured is not the Constancy Source, Figure 8-15 Accuracy Test in Daily Test Instruction Screen for the next Daily Source will appear.

If the source being measured is the designated Constancy Source, the Constancy Test will be performed next. Figure 8-17 Constancy Test Instruction Screen will appear.

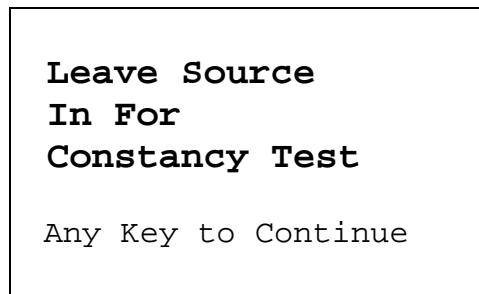


Figure 8-17 Constancy Test Instruction Screen

Press any key (except **HOME**) to continue, Figure 8-18 Constancy Test Measurement Screen for the nuclide that is the Constancy Source will appear.

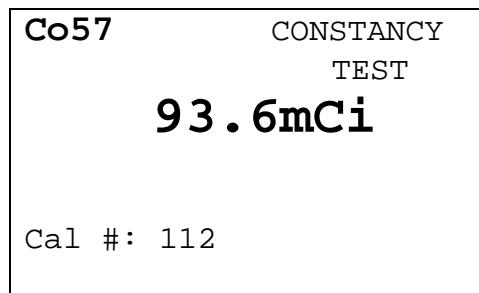


Figure 8-18 Constancy Test Measurement Screen

To perform the Constancy Test for other nuclides, press any Pre-Set Nuclide key, **USER** key or specify nuclide via **NUCL** key.

When all Constancy Tests are complete, press **ENTER** to end the test.

If there is a printer attached to the system, the Daily Test report is printed and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 8-5 Tests Menu, press **NO**.

CHAMBER VOLTS

To perform the Chamber Voltage measurement, press **TEST** from the Measurement Screen. Figure 8-5 Tests Menu will appear. (Chamber Voltage measurement is also part of the Daily Test function. Reference this chapter, SECTION: DAILY TEST: Chamber Voltage on page 8-6).

Select *CHAMBER VOLTS*. Figure 8-19 Chamber Voltage Remove Sources Screen will appear.

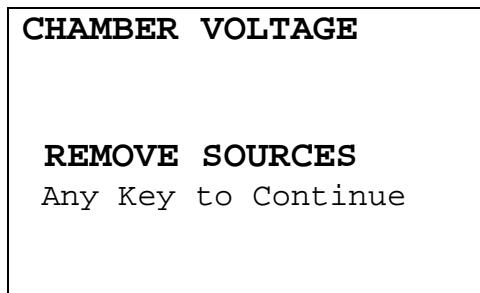


Figure 8-19 Chamber Voltage Remove Sources Screen

Remove all sources from the vicinity of the Chamber and press any key (except **HOME**) to continue with the Chamber Voltage measurement.

Figure 8-20 Chamber Voltage Please Wait Screen will appear until a measurement is available.

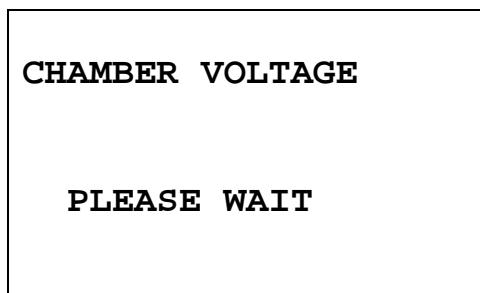


Figure 8-20 Chamber Voltage Please Wait Screen

When a measurement is available, Figure 8-21 Chamber Voltage Results Screen will appear.

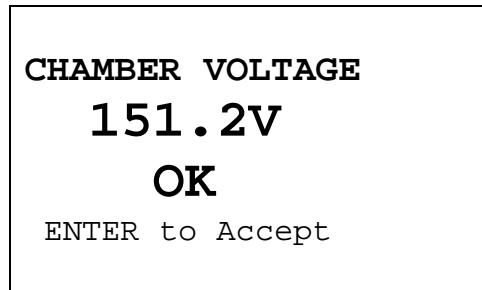


Figure 8-21 Chamber Voltage Results Screen

The measurement is compared with the value input at the factory. If the results are out of range, the message "FAIL SEE MANUAL" appears. If this occurs, contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

Press **ENTER** to accept the result. Figure 8-5 Tests Menu will re-appear.

ACCURACY TEST

To perform an Accuracy Test, press **TEST** from the Measurement Screen. Figure 8-5 Tests Menu will appear. (Accuracy Test is also part of the Daily Test function. Reference this chapter, SECTION: DAILY TEST: Accuracy and Constancy Test in Daily Test on page 8-8).

This will allow you to perform the test using any of the Test Sources.

Select ACCURACY. Figure 8-22 Accuracy Test Measure Screen will appear for each Test Source (Co57 is used in the example).

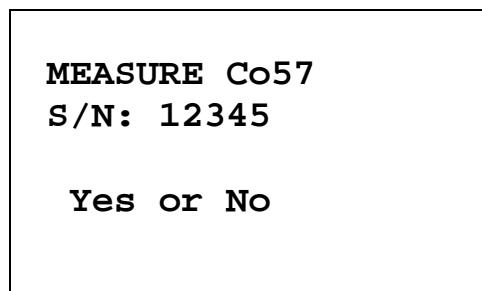


Figure 8-22 Accuracy Test Measure Screen

Press **NO** to skip measurement of the displayed source and proceed to the next Test Source.

Press **YES** to measure the source. Figure 8-23 Accuracy Test Result Screen will appear and is shown below along with a description of each section.

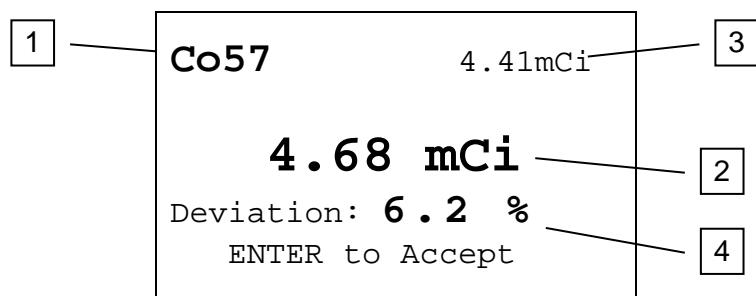


Figure 8-23 Accuracy Test Result Screen

1. The current check source under test.
2. The measured activity of the check source under test.
3. The anticipated actual activity of the check source based upon the initial calibration of the source, corrected for decay.
4. The percent deviation of the measured activity from the anticipated activity. If the deviation is greater than $\pm 20\%$, the reading will be replaced by a dashed line – this indicates an error condition (perhaps the wrong source is being measured).
Deviations greater than $\pm 5\%$ should be investigated. If the deviation is greater than 10%, contact Capintec's only Authorized Service Center. Note that higher than expected deviations may be within the limit of error, depending the accuracy of the check source being used.

Press **ENTER** to accept the measurement and proceed to the next Test Source.

When all chosen sources have been measured, if there is a printer attached to the system, the Accuracy Test Report will be printed and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 8-5 Tests Menu, press **NO**.

CHAPTER 9

DIAGNOSTICS

GENERAL9-1

GENERAL

Diagnostics performs functions to test the integrity of the system. Also, if a printer is attached to the system, a report will be printed containing the system configuration.

Press **MENU** from the Measurement Screen. Figure 9-1 Main Menu will appear.

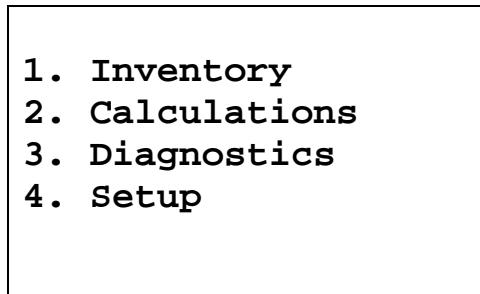


Figure 9-1 Main Menu

When **DIAGNOSTICS** is selected, the system diagnostic testing will begin. The instrument's memories and the programs are checked and the results printed (if a printer is attached to the system) and displayed (Figure 9-2 Diagnostics Screen if OK). If any of the tests fail, contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

The following data is printed:

- A list of the nuclides, their half-lives and calibration numbers.
- User Added Nuclide information.
- The User Key assignments.
- The Test Source data.
- Chamber System Parameters.

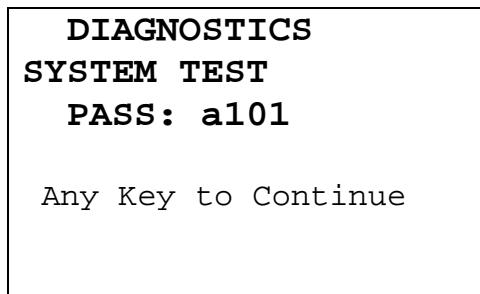


Figure 9-2 Diagnostics Screen if OK

Note: The value displayed after PASS is for example only and is not a real value. The value displayed will depend upon the current revision of the installed software.

Press any key (except **HOME**) to continue. Figure 9-1 Main Menu will re-appear.

If the Diagnostics test fails, Figure 9-3 Diagnostics Screen if fails will appear.

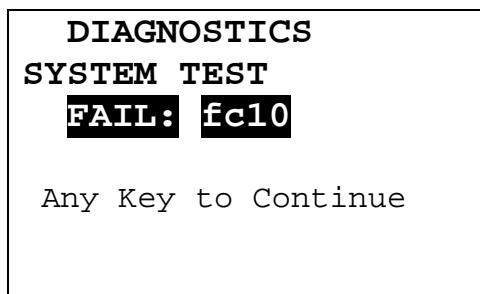


Figure 9-3 Diagnostics Screen if fails

Note: The value displayed after FAIL is for example only and is not a real value.

At power-up, the CRC[®]-25R's program is copied from the SD card into RAM memory. If the System Test fails, restart the unit and perform the test again. If it fails again, contact Capintec's only Authorized Service Center (reference CHAPTER 15: CLEANING AND MAINTENANCE, SECTION: SERVICING) for more information, since this will indicate a SD card error or a system malfunction

Press any key (except **HOME**) to continue. Figure 9-1 Main Menu will re-appear.

CHAPTER 10

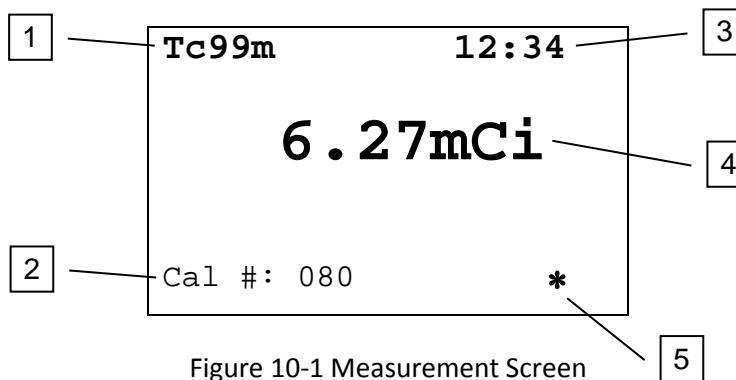
MEASUREMENT PROCEDURES

GENERAL	10-1
MEASUREMENT PROCEDURES.....	10-2
General Activity Measurement Procedure.....	10-2
Optimizing Low Activity Measurements	10-2
Specifying Nuclide	10-3
Entering Calibration Number.....	10-4
SOURCES Key.....	10-5
Selecting Resolution.....	10-6
ACTIVITY AT A DIFFERENT TIME.....	10-6
USER ID	10-8
PRINTING A RECORD OF THE MEASUREMENT	10-9
OKIDATA Printer	10-9
Epson LX-300+II Printer	10-9
Roll Printer.....	10-10
Slip Printer.....	10-10
MOLY ASSAY.....	10-10
Mo99 Background	10-11
Mo99 Assay	10-13
Tc99m Assay	10-14
Moly Assay Results.....	10-14

GENERAL

Instructions for measuring a source are given in this section.

The Measurement Screen is shown below along with a description of each section.



1. The currently selected nuclide.
2. The Calibration Number of the selected nuclide.

3. The current time.
4. The measured activity of the selected nuclide.
5. The “*” indicates that a Remote Display is attached to the Chamber. If there is not a Remote Display connected to the Chamber, this symbol will not be displayed. **Note:** *This applies only to legacy systems. Remote Displays are no longer available as an option.*

If the message “NO CHAMBER” appears on the screen, verify that the Chamber cable is attached securely to the connectors on the Readout and Chamber. If the error message continues to appear, contact Capintec’s only Authorized Service Center (reference CHAPTER 15: CLEANING AND MAINTENANCE, SECTION: SERVICING) for more information.

MEASUREMENT PROCEDURES

Note: *In order to obtain a correct reading for a Vial or Syringe, the supplied liner and dipper must be used to achieve the correct geometry. If the source is contained in a different type of container, then contact Capintec, Inc. for further assistance.*

General Activity Measurement Procedure

To measure the activity of a sample:

- Insert the sample into the Chamber.
- Specify the Nuclide or input a Calibration Number.

To print a record of the measurement (if a printer is attached to the system):

- Press **ENTER**.

To determine what the activity will be at a different time:

- Press **TIME**.

Optimizing Low Activity Measurements

The CRC®-25R Calibrator has a stated resolution of $0.01\mu\text{Ci}$, which means that it is capable of detecting activities in the range of a few hundredths of a microcurie.

However, in order to perform meaningful measurements at such a low level, the following conditions must be met:

- The calibrator must be in excellent (as new) working condition (without excessive low end noise or fluctuations),
- The measurement must be made in a low background area, with constant ambient background rate, and
- The measurement should be made over a 2 minute period, taking measurements every 5-10 seconds and the final value averaged.

A low activity rod source for a long-lived isotope ($0.05\mu\text{Ci}$) would be very useful as a QC source to confirm measurement capabilities at low activities.

Specifying Nuclide

A nuclide may be specified via one of the Pre-Set Nuclide keys, one of the **USER** keys or via the **NUCL** key.

Pre-Set Nuclide key:

Press one of the 8 pre-set nuclide keys

F18, Ga67, Tc99m, In111, I123, I131, Xe133, Ti201

User Key:

Press one of the 5 user assigned nuclide keys

U1, U2, U3, U4, U5

Note: *Before using one of these keys, a nuclide must be assigned to the key.*
(Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: USER KEY ASSIGNMENT)

NUCL Key:

Press **NUCL**. Figure 10-2 Nuclide Name Assignment Screen will appear.

Note: *If a nuclide is requested which does not have a Calibration Number, the error message “CAL # NOT ENTERED FOR NUCLIDE – ANY KEY TO CONTINUE” will appear. (Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: CALIBRATION NUMBERS)*

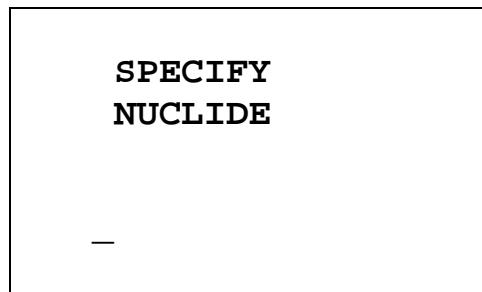


Figure 10-2 Nuclide Name Assignment Screen

Press the alphanumeric keys corresponding to the nuclide name. The number on each key will appear. For example, if Cs137 is entered, 27137 will appear on the screen. Press **ENTER** when the nuclide has been specified. Figure 10-1 Measurement Screen will re-appear showing the new nuclide name.

The entire name does not have to be input. If the nuclide is not uniquely specified, a list of possibilities will appear. For example, if Cesium is the desired source, input **271** (for Cs1) and press **ENTER**. Figure 10-3 Nuclide List Screen will appear.

Note: *If there are more than 5 possibilities, the message “SPECIFY FURTHER” will be displayed. Press any key (except **HOME**) to continue.*

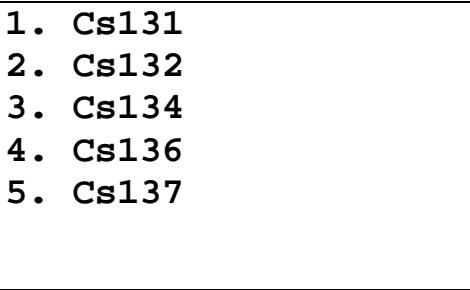
- 
- 1. Cs131
 - 2. Cs132
 - 3. Cs134
 - 4. Cs136
 - 5. Cs137

Figure 10-3 Nuclide List Screen

Input the number corresponding to the desired nuclide and press **ENTER**. Figure 10-1 Measurement Screen will re-appear showing the new nuclide name.

If **NUCL** was accidentally pressed, press **ENTER** without any input or press **HOME**. Figure 10-1 Measurement Screen will re-appear showing the previously selected nuclide name.

Entering Calibration Number

A measurement may also be made by entering a Calibration Number instead of selecting a nuclide from memory.

Press **CAL#**. Figure 10-4 Enter Calibration # Screen will appear.

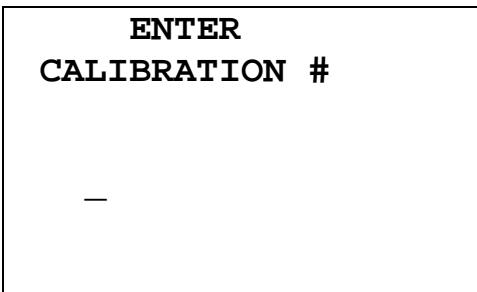


Figure 10-4 Enter Calibration # Screen

A calibration number may include a multiplication sign (*) on the keyboard, displayed as X) or a division sign (÷). However, the CRC®-25R is always direct reading and the multiplication or division sign is only used to be consistent with existing Calibration Numbers.

For multiplication, the number can only be multiplied by 10 or 100. For division, the number can only be divided by 2. Refer to Table 10-1 Calibration Number Limits Table.

	Minimum Calibration # (a)	Maximum Calibration # (a)
Direct Entry (a)	10	1200
Multiplication ($a \times 10$)	10	1200
Multiplication ($a \times 100$)	10	999
Division ($a \div 2$)	400	1200

Table 10-1 Calibration Number Limits Table

Input the desired calibration number and press **ENTER**. Figure 10-5 Measurement Screen after Cal# entered will appear showing the new Calibration Number.

If the **CAL#** key was accidentally pressed, press **ENTER** without any input or press **HOME**. Figure 10-5 Measurement Screen after Cal# entered will re-appear showing the previous Calibration Number.

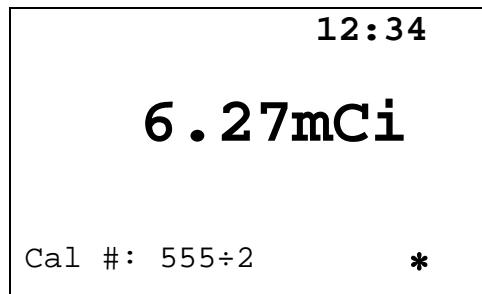


Figure 10-5 Measurement Screen after Cal# entered

SOURCES Key

The **SOURCES** key is used to select the nuclides that have been selected as Test Sources.

Pressing the key will cycle through the selected Test Sources. If no Test Sources have been entered, pressing this key will cause an error beep.

For example – Co57 and Ra226 are the Test Sources:

- Pressing the **SOURCES** key will bring up Co57, pressing a second time will bring up Ra226 and pressing a third time will bring up Co57 again.

Selecting Resolution

When the measured activity is below 140 μ Ci [1.40MBq], the activity can be displayed with greater resolution by pressing the **DOWN ARROW** (\blacktriangleleft) key. The activity will now be displayed as 140.0 μ Ci [1.400MBq]. Press the **UP ARROW** (\blacktriangleright) to reverse the process.

ACTIVITY AT A DIFFERENT TIME

It is often desirable to know the activity of the sample at another time (usually in the future). When another date/time is chosen, the activity at that date and time will be displayed (and can be printed if a printer is attached to the system) along with the measured activity.

This feature is only available when a nuclide is specified because the half-life of the nuclide must be known.

Press **TIME**. Figure 10-6 Time / Date Input Screen will appear.

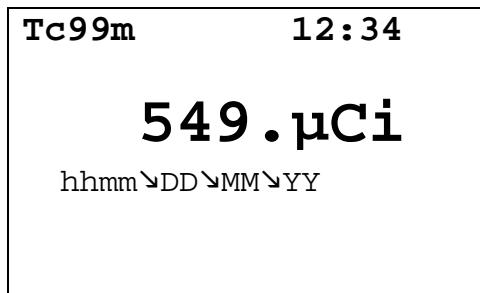


Figure 10-6 Time / Date Input Screen

The time/date entry format is hhmm/DD/MM/YY where:

- hh= hours (24 hour format) (1 or 2 digit)
- mm = minutes (2 digit)
- DD = day (2 digit)
- MM = month (2 digit)
- YY = year (2 digit)

The minimum input required is the time (hhmm). That is, if the future time is sometime later in the same day, then all that needs to be input is the time. For example:

If the current time is 12:00 and the desired future time is 16:00 today;

- input **1600** and
- press **ENTER**. Figure 10-7 Future Activity – Same Day will appear

If the future time is sometime the next day, then all that needs to be input is the time (hhmm) and day (DD). For example:

If today is July 30 and the desired future time is 9:00 tomorrow;

- input **900** (for the time),
- press the **DOWN ARROW (▼)**,
- input **31** (for the day) and
- press **ENTER**. Figure 10-8 Future Activity – Different Day will appear.

If the future time is sometime the day after tomorrow, then the time (hhmm), day (DD) and month (MM) will need to be input. For example:

If today is July 30 and the desired future time is 9:00 the day after tomorrow;

- input **900** (for the time),
- press the **DOWN ARROW (▼)**,
- input **01** (for the day),
- press the **DOWN ARROW (▼)**,
- input **08** (for the month) and
- press **ENTER**.

If only the time was changed, the new time will be shown as in Figure 10-7 Future Activity – Same Day.

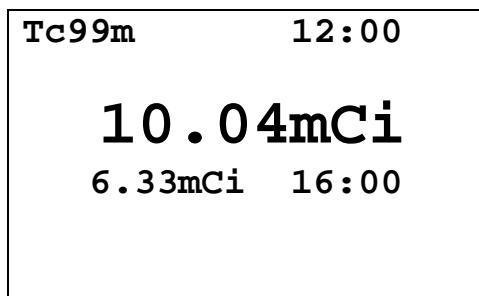


Figure 10-7 Future Activity – Same Day

If the day was changed, the new time and date will be shown as in Figure 10-8 Future Activity – Different Day.

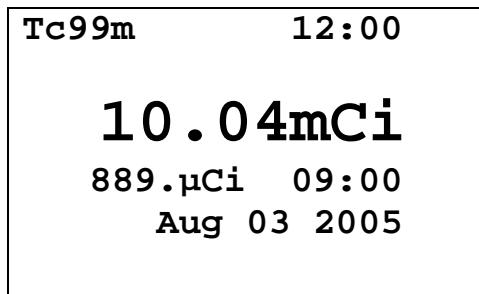


Figure 10-8 Future Activity – Different Day

To input a new time, press the **TIME** key again. Figure 10-6 Time / Date Input Screen will re-appear.

To exit Activity at a Different Time, press the **TIME** key. Figure 10-1 Measurement Screen will re-appear.

USER ID

Note: A printer must be attached to the system in order to use the User ID feature.

A two-digit identification number (01-99) may be assigned to each user of the CRC®-25R. This ID will be included on the printed record after the label "BY".

When the ID is input, the digits will not be displayed on the screen. The **CE** key may be used to correct an entry.

If using an ID number, it must be input before pressing **ENTER** to print a record.

For example, if the user's ID is 12:

- at the Measurement screen, input **12** and

- press the **ENTER** key.

The printed record will list "12" after the label "BY".

PRINTING A RECORD OF THE MEASUREMENT

To print a record of the measurement, a printer must be set up as described in CHAPTER 5: SYSTEM INITIALIZATION; SECTION: PRINTING.

Follow the directions below for the selected printer:

OKIDATA Printer

Ticket Chosen:

- If the printer is set up for continuous feed, press **PARK** (on printer).
- Move the right hand lever back to single-sheet.
- Place the ticket between the guides with CAPINTEC, INC down and facing away from you. The ticket will automatically be advanced into the printer.
- Press the **SEL** pad on the printer so that the **SEL** light is lit.
- Input the User ID if desired.
- Press **ENTER** (on the readout).

Single Line Chosen:

- Input the User ID if desired.
- Press **ENTER** (on the readout).

Epson LX-300+II Printer

Ticket Chosen:

- If the printer is set up for continuous feed, press **LOAD/EJECT** (on printer).
- Move the paper release lever back to single-sheet.
- Slide the left edge guide until it locks in place at the guide mark.
- Adjust the right edge guide to match the width of the ticket.
- Insert the ticket between the guides with CAPINTEC, INC down and facing away from you. The ticket will automatically be advanced into the printer.
- Input the User ID if desired.
- Press **ENTER** (on the readout).

Single Line Chosen:

- Input the User ID if desired.
- Press **ENTER** (on the readout).

Roll Printer

- Input the User ID if desired.
- Press **ENTER** (on the readout).

Slip Printer

- If the **RELEASE** light (on printer) is not lit, press **RELEASE** (on printer).
- Place Ticket in printer, face up.
- Slide the ticket under the mechanism until the **PAPER OUT** light is off.
- Input the User ID if desired.
- Press **ENTER** (on the readout).

Note: *Tickets cannot be printed using an Inkjet printer.*

MOLY ASSAY

The CRC[®]-25R steps the user through a Moly Assay procedure. The assay may be performed in the CapMac or the Canister.

If one method (CAPMAC or CANISTER) is to be used all the time, choose the method in Setup, Other, Moly Setup. (Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: MOLY ASSAY SETUP)

To perform a Moly Assay, press **TEST** from Figure 10-1 Measurement Screen.

Select **MOLY ASSAY**.

If the assay method has not been uniquely specified, Figure 10-9 Moly Assay Method Selection screen will appear. The method must be chosen first.

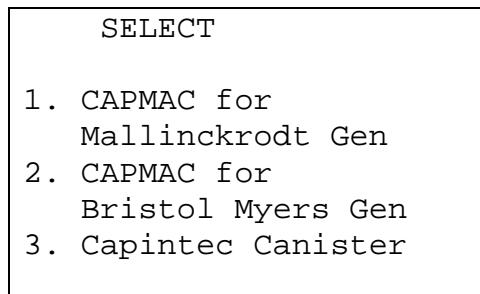


Figure 10-9 Moly Assay Method Selection

Select the method to be used for the current test only.

If only one method (CAPMAC or CANISTER) has been chosen in Moly Setup, Figure 10-9 Moly Assay Method Selection will be skipped and Figure 10-10 Moly Assay Background Choice will appear (example shown is for CAPMAC).

Mo99 Background

Measuring the background for Mo99 is optional. This background will only be used for the current assay. If it is skipped, the background previously measured by pressing **BKG** or during the Daily Test will be used.

The following examples are for CAPMAC. CANISTER will be exactly the same except that the screens will prompt for measurements in the CANISTER.

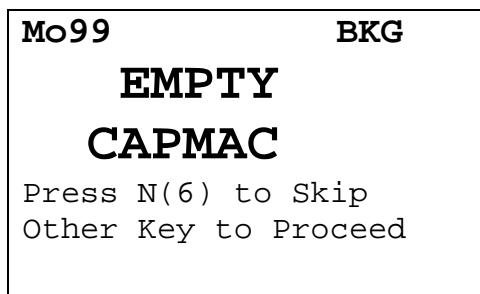


Figure 10-10 Moly Assay Background Choice

To skip the Mo99 background measurement with the CAPMAC or CANISTER, press **NO**. Figure 10-14 Moly Assay Instruction Screen will appear to begin the Mo99 Assay.

To proceed with Mo99 background measurement, remove all sources from the vicinity of the Chamber and press any other key (except **HOME**) to continue. Figure 10-11 Moly Assay Background Wait Screen will appear until a measurement is available.

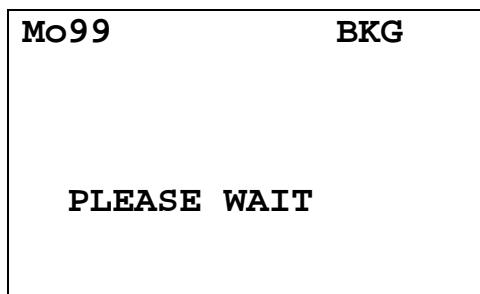


Figure 10-11 Moly Assay Background Wait Screen

When the measurement is available, Figure 10-12 Moly Assay Background Measurement Accept Screen will appear.

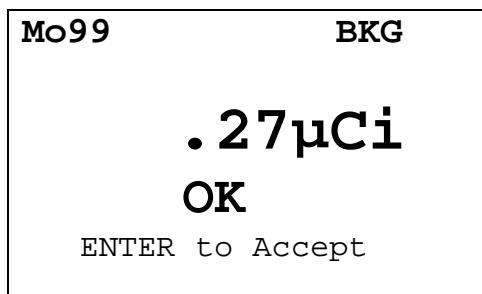


Figure 10-12 Moly Assay Background Measurement Accept Screen

Press **ENTER** to accept measurement and continue to Mo99 Assay. Figure 10-14 Moly Assay Instruction Screen will appear.

If the background is high but still acceptable, the message "HIGH" will appear instead of "OK". Although the value is acceptable, the reason for the high value should be investigated. If any sources are found nearby, repeat the measurement.

If the background is above the acceptable range, the value will not be shown but Figure 10-13 Moly Assay Background Measurement Too High Screen will appear.



Figure 10-13 Moly Assay Background Measurement Too High Screen

This "TOO HIGH" background cannot be accepted by the CRC®-25R. If the cause of the high reading (nearby source, contaminated well etc.) cannot be found, contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

Press any key to terminate the Mo99 background measurement. The *Tests Menu* will re-appear.

Mo99 Assay

The next step is to measure the eluate in the CapMac or Canister.

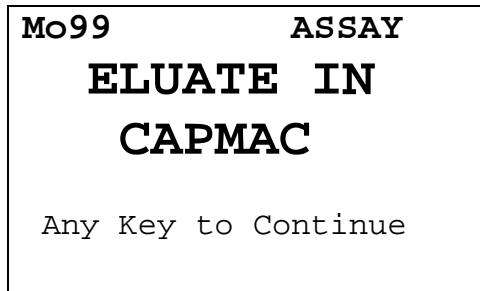


Figure 10-14 Moly Assay Instruction Screen

Press any key (except **HOME**) to begin the measurement. Figure 10-15 Moly Assay Wait Screen will appear until a measurement is available.

Since this is also a measurement of a very low activity, the screens are similar to background:

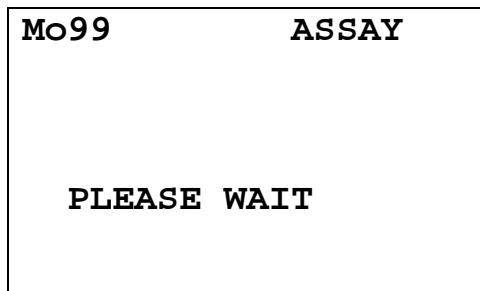


Figure 10-15 Moly Assay Wait Screen

When the measurement is ready, Figure 10-16 Moly Assay Accept Screen will appear.

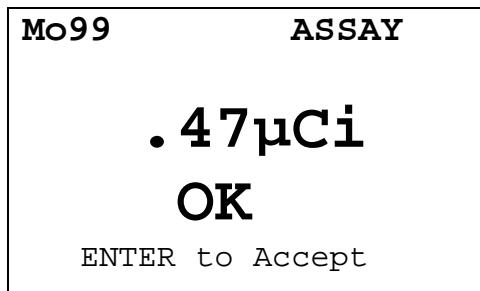


Figure 10-16 Moly Assay Accept Screen

Press **ENTER** to accept the measurement and continue to the Tc99m Assay. Figure 10-17 Moly Assay Tc99m Measurement will appear.

Note: *The activity will be tested to see if it's too high the same way that Mo99 Background is tested.*

Tc99m Assay

The Tc99m Assay is performed next.

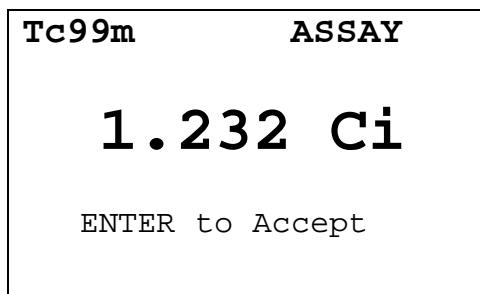


Figure 10-17 Moly Assay Tc99m Measurement

Press **ENTER** to accept the measurement.

Moly Assay Results

If the measured Tc99m activity is below 1.0 mCi, the error message “ACTIVITY TOO LOW – ANY KEY TO CONTINUE” will appear. Press any key (except **HOME**) to continue. The *Tests Menu* will re-appear.

The Mo99/Tc99m ratio is calculated and displayed.

The ratio is compared to the allowable value (which can be changed in Moly Setup – Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: MOLY ASSAY SETUP) and the time when the ratio will exceed this limit is calculated.

If the calculated time limit is less than 12 hours, a usage message is displayed depending upon the useable time for the elution. An example of such a case is Figure 10-18 Mo99/Tc99m Exceeds Limits Screen.

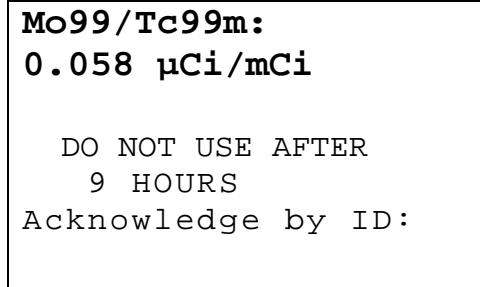


Figure 10-18 Mo99/Tc99m Exceeds Limits Screen

Input the User ID number (reference the USER ID section on page 10-8) and press **ENTER** to acknowledge the usage message.

If the calculated ratio is within limits and is useable for more than 12 hours, Figure 10-19 Mo99/Tc99m with Volume Entry screen will appear.

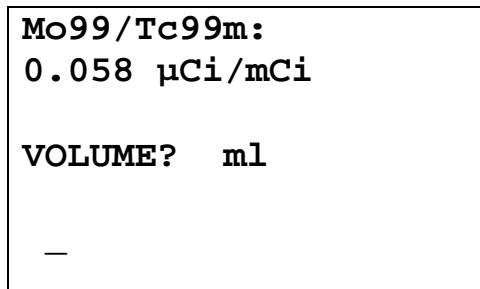


Figure 10-19 Mo99/Tc99m with Volume Entry

Input the volume of the elution in ml and press **ENTER**. The concentration of the elution is calculated and displayed as shown in Figure 10-20 Elution Concentration screen.

Note: *The minimum value that can be input is 1.000. The maximum value that can be input is 100.0.*

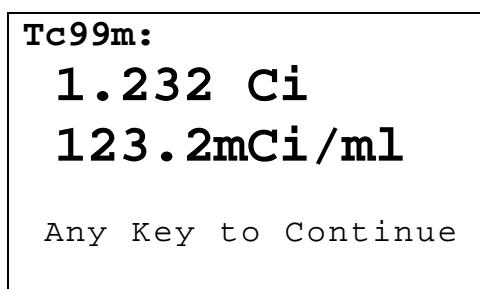


Figure 10-20 Elution Concentration

Press any key (except **HOME**) to print (if a printer is attached to the system) a ticket with the details of the assay.

The prompt "PRINT AGAIN" will appear. If **YES** is pressed, another ticket is printed. If **NO** is pressed, the *Tests Menu* will appear.

CHAPTER 11

ENHANCED TESTS

GENERAL	11-1
ENHANCED TESTS MENU.....	11-1
GEOMETRY TEST	11-2
Measuring with Syringe	11-2
Measuring with Vial.....	11-4
Measurement Results	11-6
PERFORMING LINEARITY TEST.....	11-7
Standard Test	11-7
Lineator Test.....	11-12
Calicheck Test.....	11-13
QUALITY CONTROL (QC).....	11-15
Single Strip Test.....	11-16
Two Strips Test	11-18
HMPAO Test	11-21
MAG3 Test	11-25

GENERAL

This section describes the tests that are accessed via the *Enhanced Tests Menu*

Chamber Background and Tests are described in CHAPTER 8: BACKGROUND AND TESTS.

ENHANCED TESTS MENU

Press **TEST** from the Measurement Screen. Figure 11-1 Tests Menu will appear.

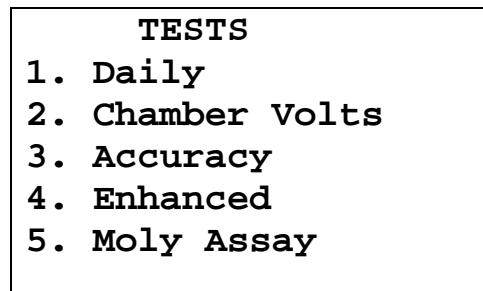


Figure 11-1 Tests Menu

Select *ENHANCED*. Figure 11-2 Enhanced Tests Menu will appear.

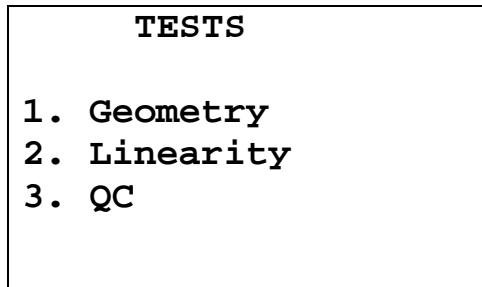


Figure 11-2 Enhanced Tests Menu

GEOMETRY TEST

The Geometry Test determines the effect of volume changes on the calibrator's accuracy. It should be performed on installation.

From Figure 11-2 Enhanced Tests Menu, select *GEOMETRY*. Figure 11-3 Syringe / Vial Selection screen will appear.

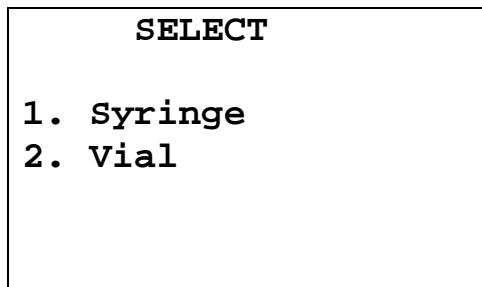


Figure 11-3 Syringe / Vial Selection

A minimum of 2 samples must be measured. The maximum number of samples is 10.

The test can be performed using a syringe or a vial.

Measuring with Syringe

From Figure 11-3 Syringe / Vial Selection screen, select *SYRINGE*. Figure 11-4 Initial Volume Entry screen will appear for each measurement:

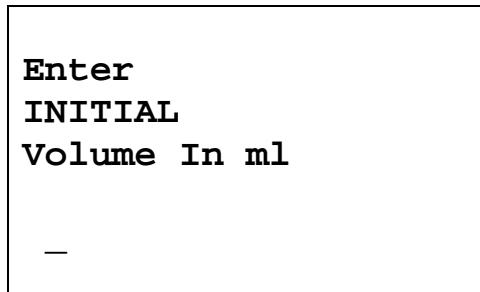


Figure 11-4 Initial Volume Entry

Input the initial volume (up to 4 digits) for the sample and press **ENTER**. Figure 11-5 Geometry Measurement Screen will appear for each measurement:

Note: *The minimum value that can be input is 0.100. The maximum value that can be input is 99.00.*

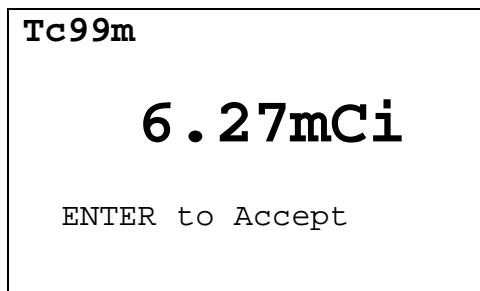


Figure 11-5 Geometry Measurement Screen

Measure the syringe's activity. Press **ENTER** to accept the measurement. Figure 11-6 Added Volume Entry screen will re-appear for the second measurement.

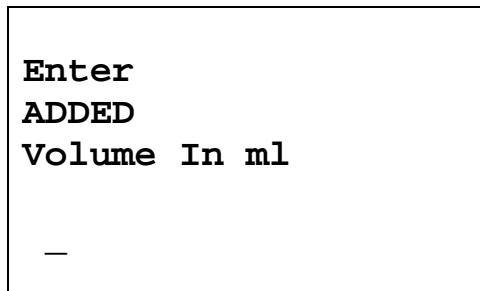


Figure 11-6 Added Volume Entry

A minimum of 2 samples must be measured.

Input the first added volume (up to 4 digits) to the syringe and press **ENTER**. Figure 11-5 Geometry Measurement Screen will re-appear.

After the 2nd and subsequent measurements, Figure 11-7 Another Sample Question Screen will appear asking if another sample will be measured. The maximum number of samples is 10.

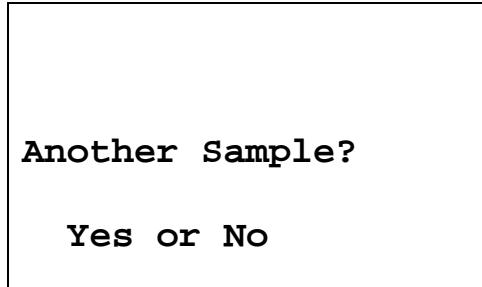


Figure 11-7 Another Sample Question Screen

If the previous sample was not the last sample to be measured, press **YES** to measure another sample. Figure 11-6 Added Volume Entry will re-appear.

Input the added volume (up to 4 digits) for the next sample and press **ENTER**. The total volume input for all samples must be less than 99ml; if it is not less, the message “VOLUME TOO LARGE – ANY KEY TO CONTINUE” will appear.

Press **NO** if the previous sample was the last sample to measured. Figure 11-12 Geometry Test Results Screen will appear.

Measuring with Vial

From Figure 11-3 Syringe / Vial Selection screen, select **VIAL**.

The volume entry screen appears for each measurement. The test begins by entering the initial volume of the vial as shown in Figure 11-8 Initial Volume Entry screen.

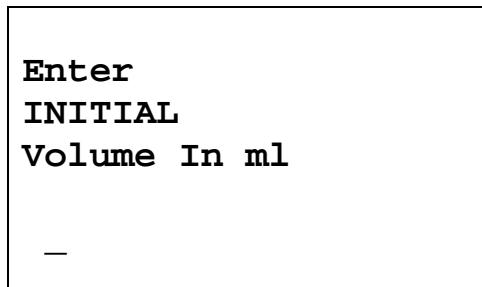


Figure 11-8 Initial Volume Entry

Input the initial volume (up to 4 digits) for the vial and press **ENTER**. Figure 11-9 Geometry Measurement Screen will appear for each measurement:

Note: *The minimum value that can be input is 0.100. The maximum value that can be input is 99.00.*

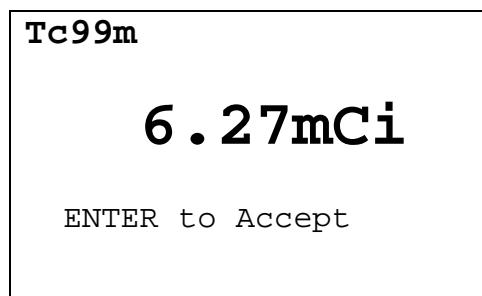


Figure 11-9 Geometry Measurement Screen

Measure the syringe's activity. Press **ENTER** to accept the measurement. Figure 11-10 Added Volume Entry will appear for the second measurement.

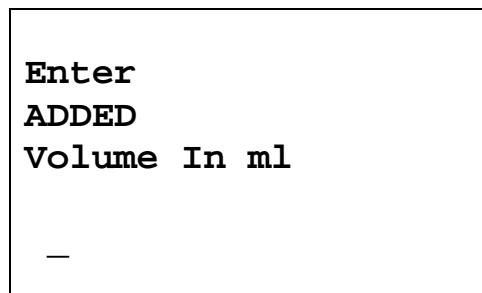


Figure 11-10 Added Volume Entry

A minimum of 2 samples must be measured.

Input the first added volume (up to 4 digits) to the vial and press **ENTER**. Figure 11-9 Geometry Measurement Screen will re-appear.

After the 2nd and subsequent measurements, Figure 11-11 Another Sample Question Screen will appear asking if another sample will be measured. The maximum number of samples is 10.

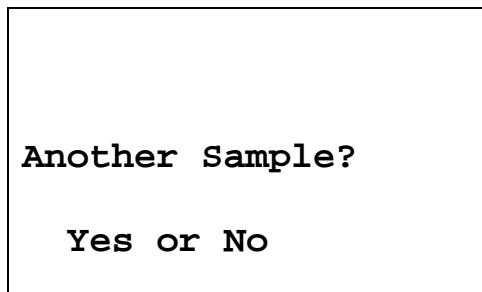


Figure 11-11 Another Sample Question Screen

If the previous sample was not the last sample to be measured, press **YES** to measure another sample. Figure 11-10 Added Volume Entry will re-appear.

Input the added volume (up to 4 digits) for the next sample and press **ENTER**. The total volume input for all samples must be less than 99ml; if it is not less, the message “VOLUME TOO LARGE – ANY KEY TO CONTINUE” will appear.

Press **NO** if the previous sample was the last sample to measured. Figure 11-12 Geometry Test Results Screen will appear.

Measurement Results

After the last sample has been measured, Figure 11-12 Geometry Test Results Screen will appear.

The first measurement made is considered the Base Measurement. The base measurement is the measurement that all other measurements will be compared to. The variance is calculated using the base measurement.

GEOMETRY TEST		
Using: Syringe		
Volume	Assay	%Var
10.0ml	10.9mCi	BASE
11.0ml	11.0mCi	0.9
12.0ml	10.8mCi	-1.8
Any Key to Continue		

Figure 11-12 Geometry Test Results Screen

Press any key (except **HOME**) to continue. If a printer is attached to the system, a report will be printed and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 11-1 Tests Menu, press **NO**.

The report will show the variation of each measurement with respect to the selected base. The variation for the base will be shown as BASE.

PERFORMING LINEARITY TEST

Note: In order to perform a Linearity Test, a Linearity Test Method must be defined from the Linearity Setup in the Other Menu. (Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: LINEARITY TEST DEFINITION), If a Linearity Method is not defined, Figure 11-13 Linearity Not Defined Error Screen will appear.

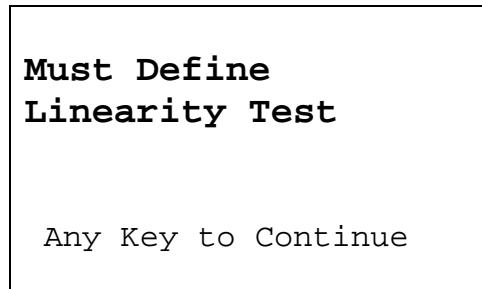


Figure 11-13 Linearity Not Defined Error Screen

To perform a Linearity Test, press **TEST** from the Measurement Screen. Figure 11-1 Tests Menu will appear.

Select *ENHANCED*. Figure 11-2 Enhanced Tests Menu will appear.

Select *LINEARITY*. The defined linearity test will begin.

Standard Test

The Standard Test measures the activity of Tc99m over a period of time. When sufficient measurements have been made, a least-squares fit is performed and the deviation of the results from this fit are reported.

First Measurement

Figure 11-14 Standard Linearity Test First Measurement Prompt will appear for the first measurement.

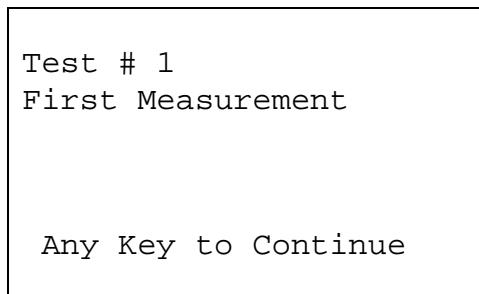


Figure 11-14 Standard Linearity Test First Measurement Prompt

Place the linearity source in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-15 Standard Test Measurement Screen will appear.

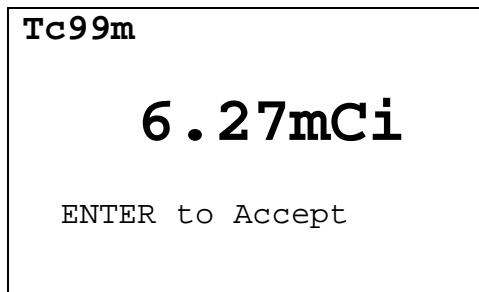


Figure 11-15 Standard Test Measurement Screen

Press **ENTER** to accept the measurement. Figure 11-16 Standard Linearity Test First Measurement Verification will appear.

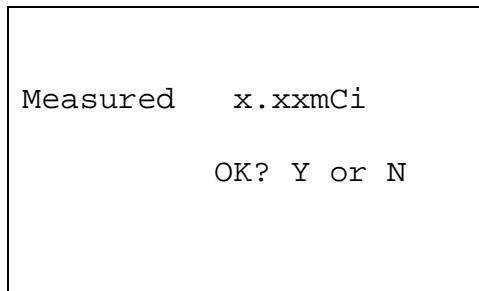


Figure 11-16 Standard Linearity Test First Measurement Verification

To repeat the measurement or if the measurement is not acceptable, press **NO**. Figure 11-14 Standard Linearity Test First Measurement Prompt will re-appear.

If the measurement is acceptable, press **YES**. If a printer is attached to the system, a Standard Linearity Test First Measurement report will print and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 11-1 Tests Menu, press **NO**.

The report will show the predicted and actual activity and the variance.

Second Through Last Measurements

Perform the measurements at time intervals close to that entered when the test was defined. The actual elapsed time will be used in the calculations.

From Figure 11-1 Tests Menu, select *ENHANCED*. Figure 11-2 Enhanced Tests Menu will appear.

Select *LINEARITY*. Figure 11-17 Standard Linearity Test – Previous Test Results Screen will appear.

In the example, 2 measurements have been made.

STANDARD LINEARITY		
#	MEASURED	%VAR
1	x.xxmCi	x.xx
2	x.xxmCi	x.xx
New Test? Y or N		

Figure 11-17 Standard Linearity Test – Previous Test Results Screen

To continue with the previously started test, press **NO**. Figure 11-19 Standard Linearity Test Subsequent Measurement Prompt will appear for the next measurement.

To start a new test, press **YES**. If the test was not complete (measurements performed are less than those entered in test setup), Figure 11-18 Standard Linearity Test – New Test Verification Screen will appear asking to start a new test.

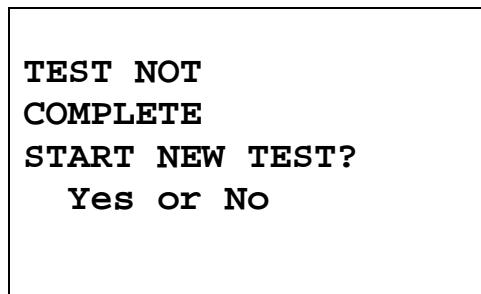


Figure 11-18 Standard Linearity Test – New Test Verification Screen

To abort starting a new test, press **NO**. Figure 11-1 Tests Menu will re-appear.

To continue with starting a new test, press **YES**. Figure 11-14 Standard Linearity Test First Measurement Prompt will appear.

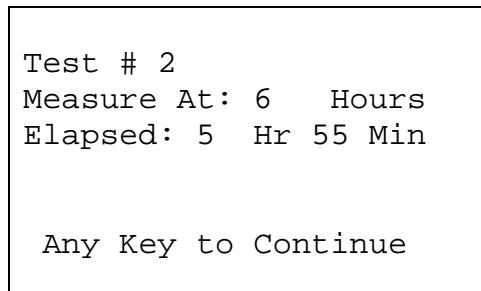


Figure 11-19 Standard Linearity Test Subsequent Measurement Prompt

Figure 11-19 Standard Linearity Test Subsequent Measurement Prompt will appear giving the test number, the time at which the test should be performed and the actual elapsed time. The example is given for the 2nd measurement.

Place the linearity source in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-15 Standard Test Measurement Screen will re-appear.

At the measurement screen, press **ENTER** to accept the measurement. Figure 11-20 Standard Linearity Test Subsequent Measurement Verification screen will appear showing the measured and predicted activity.

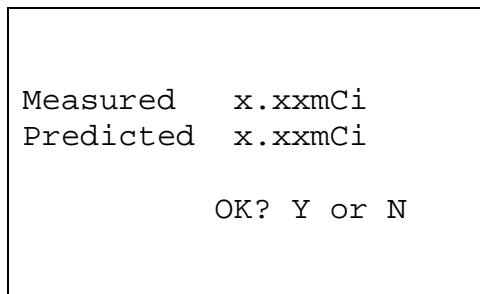


Figure 11-20 Standard Linearity Test Subsequent Measurement Verification

To repeat the measurement or if the measurement is not acceptable, press **NO**. Figure 11-19 Standard Linearity Test Subsequent Measurement Prompt will re-appear.

If the measurement is acceptable, press **YES**. Figure 11-21 Standard Linearity Test – Test Results Screen showing the variation from the predicted results for the measurements that have been performed.

STANDARD LINEARITY		
#	MEASURED	%VAR
1	x.xxmCi	x.xx
2	x.xxmCi	x.xx
Any Key to Continue		

Figure 11-21 Standard Linearity Test – Test Results Screen

Press any key (except **HOME**) to continue. If a printer is attached to the system, a Standard Linearity Test Measurement report will print and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 11-1 Tests Menu, press **NO**.

The report will show the predicted and actual activity and the variance.

After each result screen, a report will be printed.

Lineator Test

The Lineator Test steps the user through the measurement of each tube.

Figure 11-22 Lineator Measurement Prompt will appear for the first measurement. The examples shown are for tube 5.

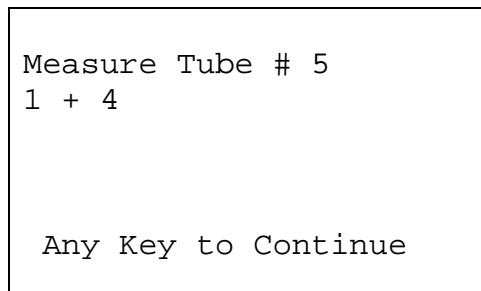


Figure 11-22 Lineator Measurement Prompt

Place the requested tube(s) in the Chamber and press any key (except **HOME**) to perform the specified measurement. Figure 11-23 Lineator Measurement Screen will appear.

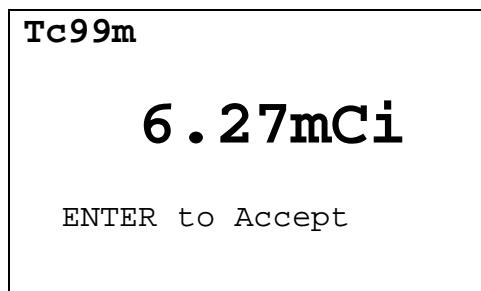


Figure 11-23 Lineator Measurement Screen

Press **ENTER** to accept the measurement. Figure 11-24 Lineator Measurement Verification will appear.

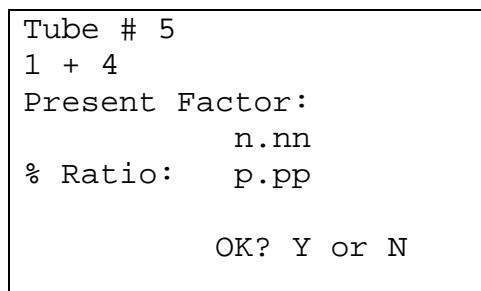


Figure 11-24 Lineator Measurement Verification

To repeat the measurement or if the measurement is not acceptable, press **NO**. Figure 11-22 Lineator Measurement Prompt will re-appear.

If the measurement is acceptable, press **YES**. The next Lineator Measurement Prompt screen will appear until all 8 tubes are measured.

After the last measurement, the results screens will appear.

LINEATOR TEST		
#	FACTOR	%RATIO
1	x.xx	x.xx
2	x.xx	x.xx
3	x.xx	x.xx
4	x.xx	x.xx
Any Key to Continue		

Figure 11-25 Lineator – 1st Test Results Screen

Press any key (except **HOME**) to continue to the next Results screen.

LINEATOR TEST		
#	FACTOR	%RATIO
5	x.xx	x.xx
6	x.xx	x.xx
7	x.xx	x.xx
8	x.xx	x.xx
Any Key to Continue		

Figure 11-26 Lineator – 2nd Test Results Screen

Press any key (except **HOME**) to continue. If a printer is attached to the system, a Lineator Test report will print and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 11-1 Tests Menu, press **NO**.

The report will show the measured activity, the present factor and the ratio for each tube set.

Calicheck Test

The Calicheck Test steps the user through the measurement of each tube.

Figure 11-27 Calicheck Measurement Prompt will appear for the first measurement. The examples shown are for 8 tubes and the 5th measurement.

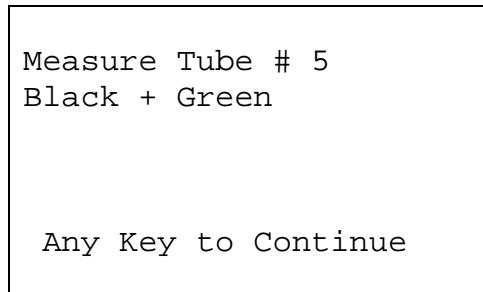


Figure 11-27 Calicheck Measurement Prompt

Place the requested tube(s) in the Chamber and press any key (except **HOME**) to perform the specified measurement. Figure 11-28 Calicheck Measurement Screen will appear.

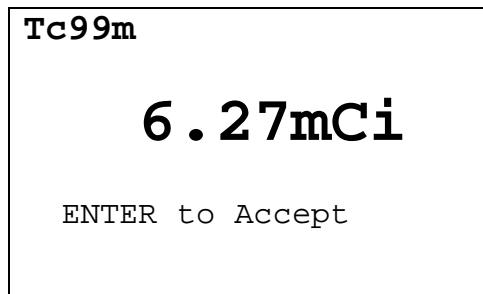


Figure 11-28 Calicheck Measurement Screen

Press **ENTER** to accept the measurement. Figure 11-29 Calicheck Measurement Verification screen will appear:

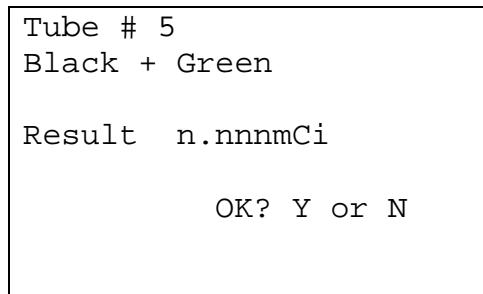


Figure 11-29 Calicheck Measurement Verification

To repeat the measurement or if the measurement is not acceptable, press **NO**. Figure 11-27 Calicheck Measurement Prompt will re-appear.

If the measurement is acceptable, press **YES**. The next Calicheck Measurement Prompt screen will appear until all tubes are measured.

After the last measurement, the results screens will appear.

CALICHECK TEST		
MEAN: n.nnnmCi		
#	RESULT	% VAR
1	x.xxxxmCi	x.xx
2	x.xxxxmCi	x.xx
3	x.xxxxmCi	x.xx
4	x.xxxxmCi	x.xx
Any Key to Continue		

Figure 11-30 Calicheck – 1st Test Results Screen

Press any key (except **HOME**) to continue to the next Results screen.

CALICHECK TEST		
MEAN: n.nnnmCi		
#	RESULT	% VAR
5	x.xxxxmCi	x.xx
6	x.xxxxmCi	x.xx
7	x.xxxxmCi	x.xx
8	x.xxxxmCi	x.xx
Any Key to Continue		

Figure 11-31 Calicheck – 2nd Test Results Screen

If more than 8 tests have been selected in the test setup, a 3rd results screen will appear showing the values for the 9th through last test.

Press any key (except **HOME**) to continue. If a printer is attached to the system, a Calicheck Linearity Test report will print and the prompt to print again will appear.

To print the test results again, press **YES**. To return to Figure 11-1 Tests Menu, press **NO**.

The report will show the result and the variation from mean for each tube.

QUALITY CONTROL (QC)

Radiochromatography Quality Control tests can be performed using four methods.

Press **TEST** from the Measurement Screen. Figure 11-1 Tests Menu will appear.

Select **ENHANCED**. Figure 11-2 Enhanced Tests Menu will appear.

Select QC. Figure 11-32 QC Test Selection Menu will appear.

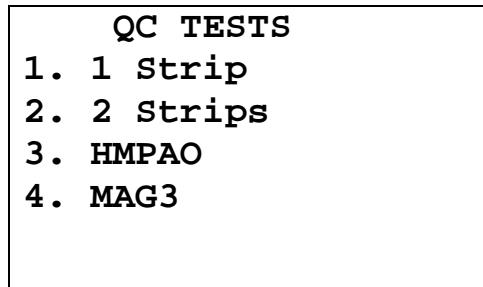


Figure 11-32 QC Test Selection Menu

Single Strip Test

The Single Strip Test consists of 2 measurements: the top of the strip and then the bottom of the strip.

Select **1 STRIP** from Figure 11-32 QC Test Selection Menu. Figure 11-33 1 Strip Measurement Message – Top will appear.

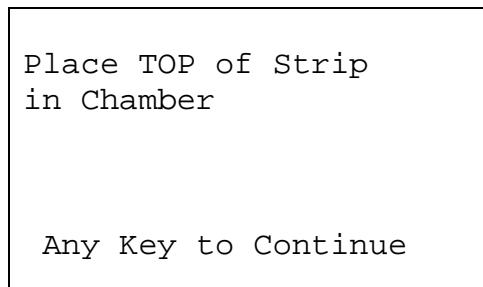


Figure 11-33 1 Strip Measurement Message – Top

Place the Top of Strip in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-34 QC Test Measurement Screen will appear.

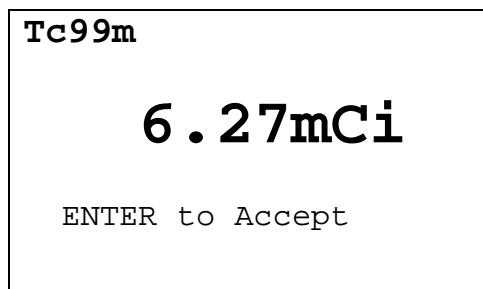


Figure 11-34 QC Test Measurement Screen

Press **ENTER** to accept the measurement. Figure 11-35 1 Strip Measurement Message – Bottom screen will appear.

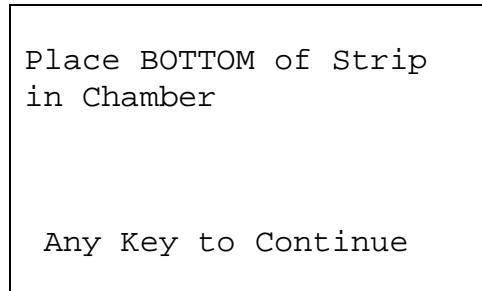


Figure 11-35 1 Strip Measurement Message – Bottom

Place the Bottom of Strip in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-34 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-36 1 Strip Results screen will appear.

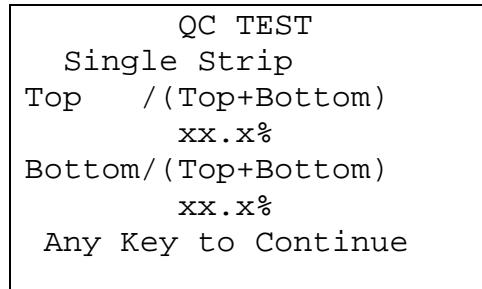


Figure 11-36 1 Strip Results

Press any key (except **HOME**) to continue. If a printer is attached to the system, a QC Test 1 Strip report will print and the prompt to print again will appear.

To print the test results again, press **YES**. Press **NO** to continue. Figure 11-37 Perform Another Test Screen will appear.

The report will show the measured values and results.

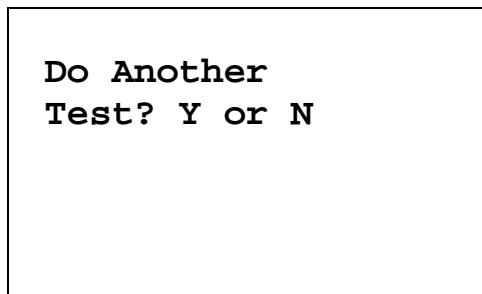


Figure 11-37 Perform Another Test Screen

To perform another test, press **YES**. Figure 11-33 1 Strip Measurement Message – Top will re-appear.

If another test is not desired, press **NO** to exit. Figure 11-1 Tests Menu will appear.

Two Strips Test

The Two Strips Test consists of 4 measurements: the top and then the bottom of strip A, and the top and then the bottom of strip B.

Select 2 STRIPS from Figure 11-32 QC Test Selection Menu. Figure 11-38 2 Strips Measurement Message – Top A will appear.

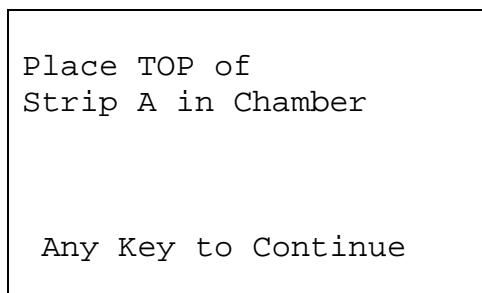


Figure 11-38 2 Strips Measurement Message – Top A

Place the Top of Strip A in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-39 QC Test Measurement Screen will appear.

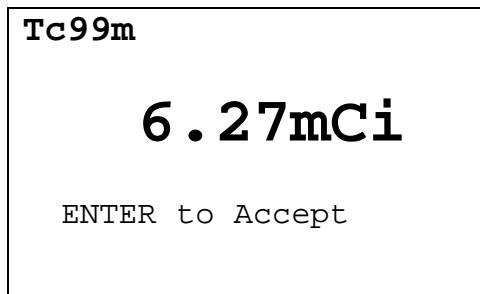


Figure 11-39 QC Test Measurement Screen

Press **ENTER** to accept the measurement. Figure 11-40 2 Strips Measurement Message – Bottom A screen will appear.

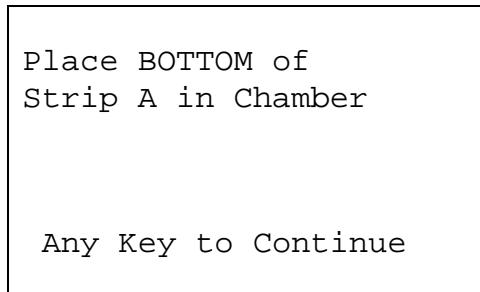


Figure 11-40 2 Strips Measurement Message – Bottom A

Place the Bottom of Strip A in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-39 QC Test Measurement Screen will appear.

Press **ENTER** to accept the measurement. Figure 11-41 2 Strips Measurement Message – Top B screen will appear.

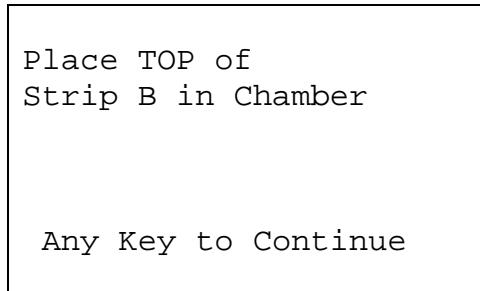


Figure 11-41 2 Strips Measurement Message – Top B

Place the Top of Strip B in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-39 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-42 2 Strips Measurement Message – Bottom B screen will appear:

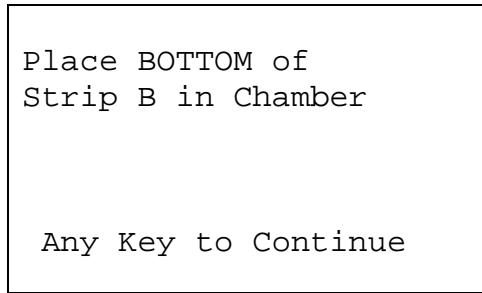


Figure 11-42 2 Strips Measurement Message – Bottom B

Place the Bottom of Strip B in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-39 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-43 2 Strips Results Screen will appear.

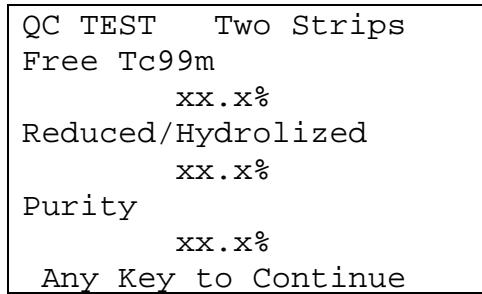


Figure 11-43 2 Strips Results Screen

Press any key (except **HOME**) to continue. If a printer is attached to the system, a QC Test 2 Strip report will print and the prompt to print again will appear.

To print the test results again, press **YES**. Press **NO** to continue. Figure 11-44 Perform Another Test Screen will appear.

The report will show the measured values and results.

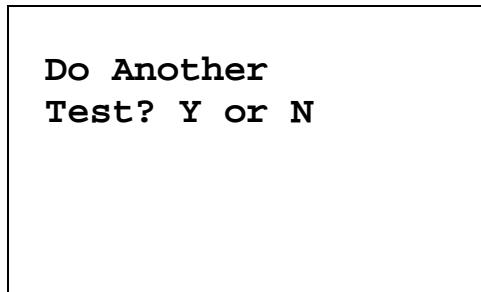


Figure 11-44 Perform Another Test Screen

To perform another test, press **YES**. Figure 11-38 2 Strips Measurement Message – Top A will re-appear.

If another test is not desired, press **NO** to exit. Figure 11-1 Tests Menu will appear.

HMPAO Test

The Tc99m HMPAO Test consists of 6 measurements: the top and then the bottom of strip A, the top and then the bottom of strip B, and the top and then the bottom of strip C.

Select *HMPAO* from Figure 11-32 QC Test Selection Menu. Figure 11-45 HMPAO Measurement Message – Top A screen will appear.

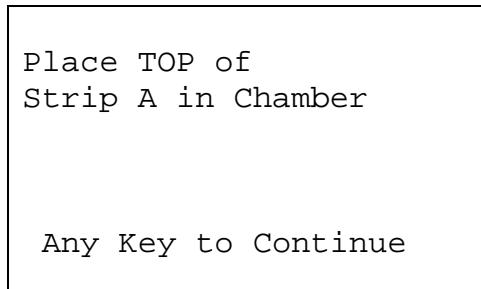


Figure 11-45 HMPAO Measurement Message – Top A

Place the Top of Strip A in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-46 QC Test Measurement Screen will appear.

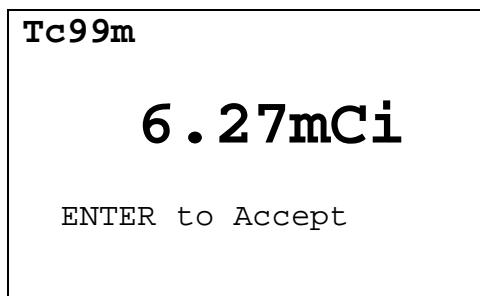


Figure 11-46 QC Test Measurement Screen

Press **ENTER** to accept the measurement. Figure 11-47 HMPAO Measurement Message – Bottom A screen will appear.

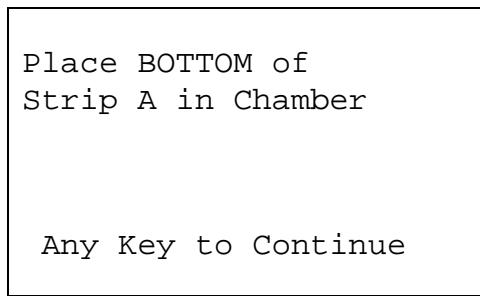


Figure 11-47 HMPAO Measurement Message – Bottom A

Place the Bottom of Strip A in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-46 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-48 HMPAO Measurement Message – Top B screen will appear.

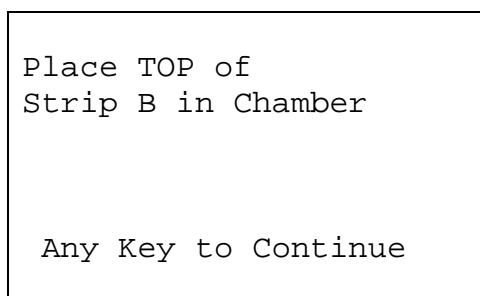


Figure 11-48 HMPAO Measurement Message – Top B

Place the Top of Strip B in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-46 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-49 HMPAO Measurement Message – Bottom B screen will appear:

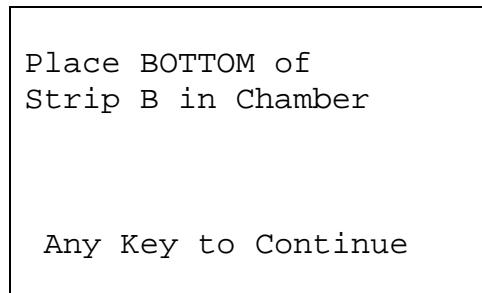


Figure 11-49 HMPAO Measurement Message – Bottom B

Place the Bottom of Strip B in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-46 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-50 HMPAO Measurement Message – Top C screen will appear:

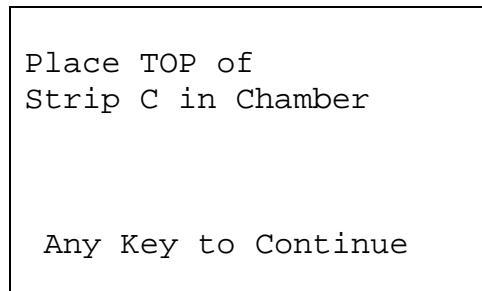


Figure 11-50 HMPAO Measurement Message – Top C

Place the Top of Strip C in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-46 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-51 HMPAO Measurement Message – Bottom C screen will appear:

Place BOTTOM of
Strip C in Chamber

Any Key to Continue

Figure 11-51 HMPAO Measurement Message – Bottom C

Place the Bottom of Strip C in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-46 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-52 HMPAO Results Screen will appear.

QC TEST HMPAO
Free Tc99m
xx.x%
Hydrolized/Reduced
xx.x%
Tc99m HMPAO
xx.x%
Any Key to Continue

Figure 11-52 HMPAO Results Screen

Press any key (except **HOME**) to continue. If a printer is attached to the system, a QC Test HMPAO report will print and the prompt to print again will appear.

To print the test results again, press **YES**. Press **NO** to continue. Figure 11-53 Perform Another Test Screen will appear.

The report will show the measured values and results.

Do Another
Test? Y or N

Figure 11-53 Perform Another Test Screen

To perform another test, press **YES**. Figure 11-45 HMPAO Measurement Message – Top A will re-appear.

If another test is not desired, press **NO** to exit. Figure 11-1 Tests Menu will appear.

MAG3 Test

The Tc99m MAG3 Test consists of 3 measurements: Fraction #1, Fraction #2 and the Cartridge.

Select **MAG3** from Figure 11-32 QC Test Selection Menu. Figure 11-54 MAG3 Measurement Message – Fraction #1 screen will appear.

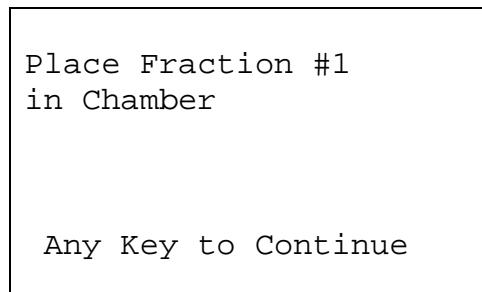


Figure 11-54 MAG3 Measurement Message – Fraction #1

Place the Fraction #1 in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-55 QC Test Measurement Screen will appear.

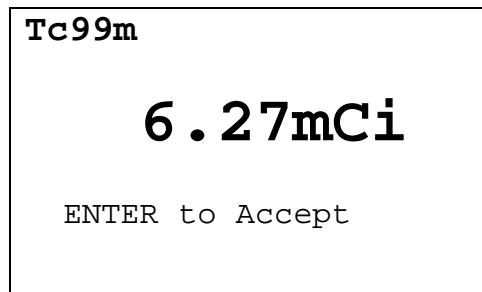


Figure 11-55 QC Test Measurement Screen

Press **ENTER** to accept the measurement. Figure 11-56 MAG3 Measurement Message – Fraction #2 screen will appear.

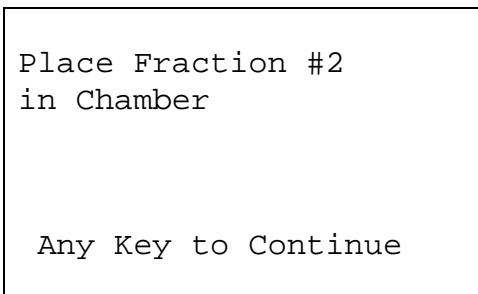


Figure 11-56 MAG3 Measurement Message – Fraction #2

Place the Fraction #2 in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-55 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-57 MAG3 Measurement Message – Cartridge screen will appear:

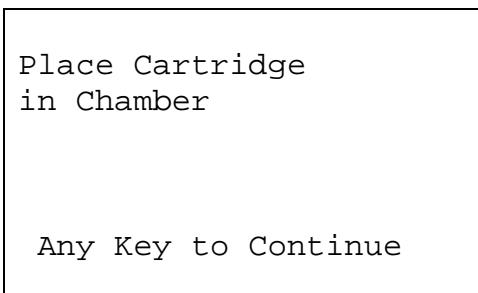


Figure 11-57 MAG3 Measurement Message – Cartridge

Place the Cartridge in the Chamber and press any key (except **HOME**) to perform the measurement. Figure 11-55 QC Test Measurement Screen will re-appear.

Press **ENTER** to accept the measurement. Figure 11-58 MAG3 Results Screen will appear.

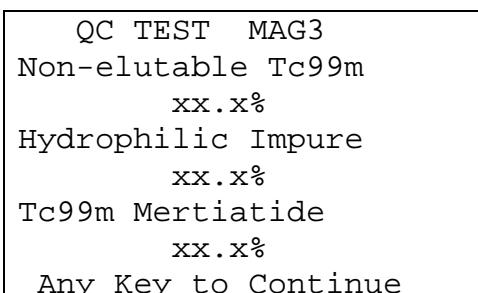


Figure 11-58 MAG3 Results Screen

Press any key (except **HOME**) to continue. If a printer is attached to the system, a QC Test MAG3 report will print and the prompt to print again will appear.

To print the test results again, press **YES**. Press **NO** to continue. Figure 11-59 Perform Another Test Screen will appear.

The report will show the measured values and results.

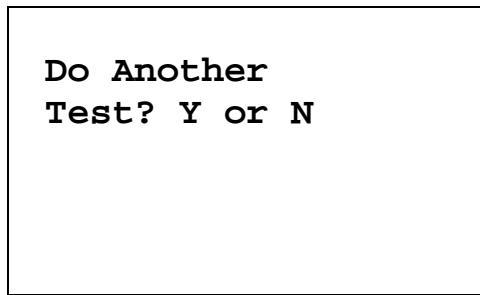


Figure 11-59 Perform Another Test Screen

To perform another test, press **YES**. Figure 11-54 MAG3 Measurement Message – Fraction #1 will re-appear.

If another test is not desired, press **NO** to exit. Figure 11-1 Tests Menu will appear.

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CHAPTER 12

INVENTORY

GENERAL	12-1
INVENTORY MENU	12-1
ADDING TO THE INVENTORY.....	12-2
Input Activity	12-4
Measuring Activity	12-6
Mo/Tc Ratio.....	12-6
MAKING A KIT.....	12-7
WITHDRAWING FROM INVENTORY	12-11
PRINTING THE INVENTORY.....	12-13
DELETING FROM INVENTORY.....	12-13
Deleting Individual Items from the Inventory	12-14
Deleting All Items in the Inventory.....	12-14

GENERAL

Instructions for use of the Inventory feature are given in this section.

INVENTORY MENU

Press **MENU** from the Measurement Screen. Figure 12-1 Main Menu will appear.

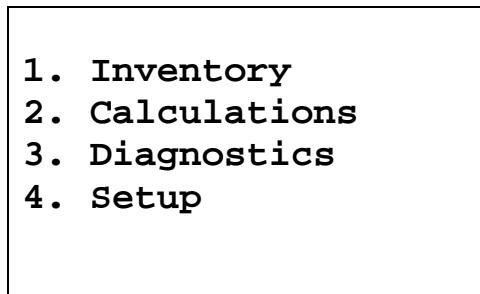


Figure 12-1 Main Menu

Select **INVENTORY**. Figure 12-2 Inventory Menu will appear.

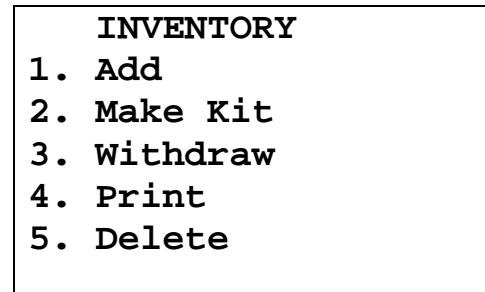


Figure 12-2 Inventory Menu

ADDING TO THE INVENTORY

To add an item to the Inventory, select **ADD** from Figure 12-2 Inventory Menu. Figure 12-3 Choose Nuclide Screen will appear.

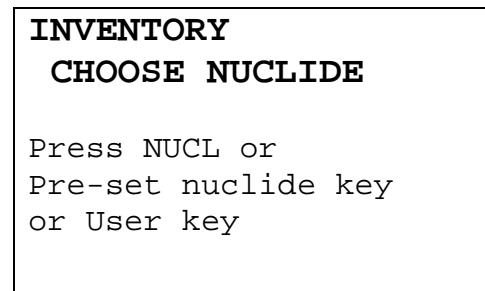


Figure 12-3 Choose Nuclide Screen

Press **MENU** to exit from adding to the Inventory and return to the *Inventory Menu*.

Choose the nuclide of the item to be added to Inventory by pressing one of the 8 Pre-Set Nuclide keys, the **NUCL** key or one of the **USER** keys.

If Tc99m is the selected nuclide, the name of the study will then be selected from Figure 12-4 Tc99m Select Study Screen.

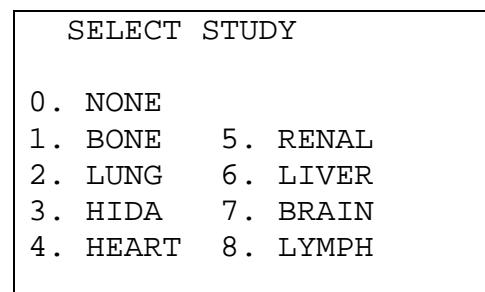


Figure 12-4 Tc99m Select Study Screen

If plain Tc99m (not a kit) is being added, select *NONE*. Otherwise, press the number corresponding to the study for which the kit is intended. Figure 12-5 Enter ID Screen will appear.

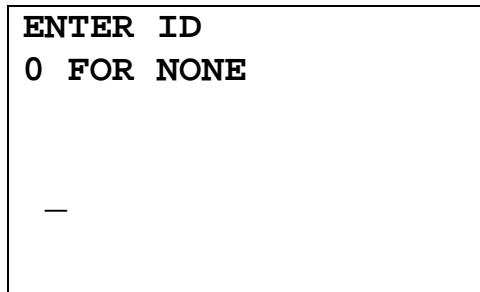


Figure 12-5 Enter ID Screen

An optional 2-digit ID number may be input to distinguish the item being added from another one with the same nuclide and study.

Input the 2-digit ID number and press **ENTER**. If an ID number is not required, input **0** for *NONE* and press **ENTER**. Figure 12-6 Enter Lot Number Screen will appear.

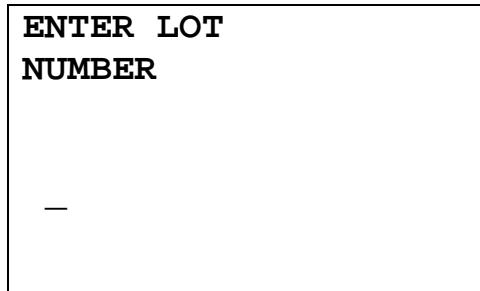


Figure 12-6 Enter Lot Number Screen

An optional Lot Number of up to 15 characters (digits or letters) may be input.

Input the Lot Number and press **ENTER**. If a Lot Number is not required, press **ENTER**. Figure 12-7 Enter Volume Screen will appear.

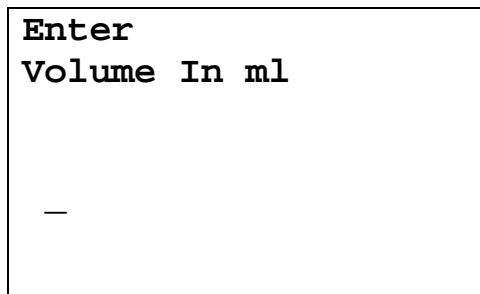


Figure 12-7 Enter Volume Screen

Input the volume in ml and press **ENTER**. Figure 12-8 Measure Activity Question Screen will appear.

Note: *The minimum value that can be input is 1.000. The maximum value that can be input is 100.0.*

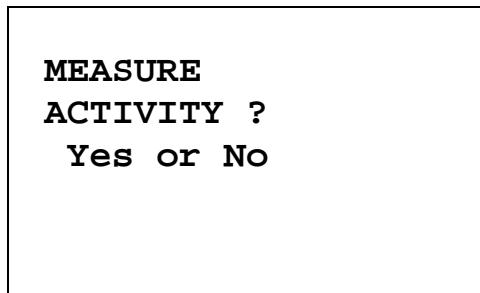


Figure 12-8 Measure Activity Question Screen

The activity may be measured or it may be input if activity and time of a previous measurement are known.

To input the activity and time, press **NO**. Figure 12-9 Inventory Activity Entry Screen will appear.

To measure the activity, press **YES**. Figure 12-12 Inventory Measurement Screen will appear.

Input Activity

If the activity is to be input, Figure 12-9 Inventory Activity Entry Screen will appear:

ENTER ACTIVITY	
value	unit
—	mCi
-> to change unit	
ENTER to Accept	

Figure 12-9 Inventory Activity Entry Screen

Input the value of the activity and then press the **RIGHT ARROW (→)**. Use the arrow keys to scroll the activity units: mCi, μ Ci, Ci if using Curie mode, (or MBq, GBq if using Becquerel mode). If the value needs to be changed, press **CE**.

When the activity value and units are correct, press **ENTER**. Figure 12-10 Inventory Date Entry Screen will appear.

Enter Date	
ENTER for NOW	
—	
MMDDYYYY	

Figure 12-10 Inventory Date Entry Screen

If the date/time is the current date/time, press the **ENTER** key for “NOW”. Figure 12-13 Enter Mo/Tc Screen will appear.

Input the date in the form MMDDYYYY (example: July 3, 2005 would be 07032005) and press **ENTER**. The date is checked for validity. If the input date is not valid, a beep will sound and “DATE ERROR” will be displayed. The date must be re-entered. Figure 12-11 Inventory Time Entry Screen will appear.

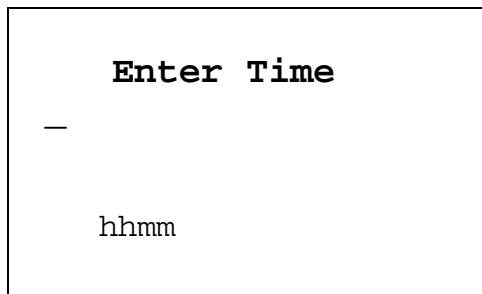


Figure 12-11 Inventory Time Entry Screen

Input the time as hhmm in 24 hour time format (example: 1:25 PM would be 1325, 9:15 AM would be 0915) and press **ENTER**. The time is checked for validity. If the input time is not valid, a beep will sound and "TIME ERROR" will be displayed. The time must be re-entered.

Figure 12-13 Enter Mo/Tc Screen will appear.

Measuring Activity

If the activity is to be measured, Figure 12-12 Inventory Measurement Screen will appear (Tc99m is being measured in the example).

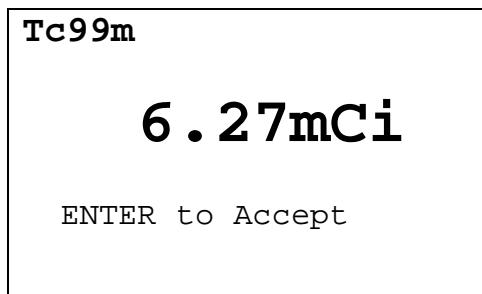


Figure 12-12 Inventory Measurement Screen

When the activity has stabilized, press **ENTER** to accept the measurement. Figure 12-13 Enter Mo/Tc Screen will appear.

Mo/Tc Ratio

If Tc99m is being added (with or without a study), the Mo to Tc ratio may be input.

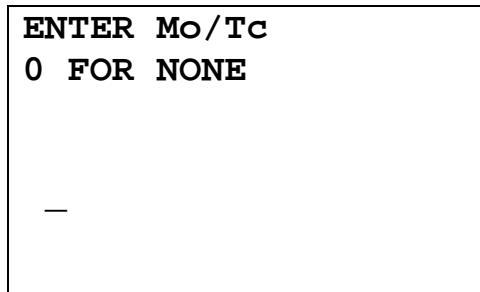


Figure 12-13 Enter Mo/Tc Screen

Input the Mo to Tc ratio. If the value is not known, input 0 and press **ENTER**.

Note: *The minimum value that can be input is 0.000. The maximum value that can be input is 1.000.*

The input/measured values will then be displayed for verification.

If the values are correct, press **YES** and the item will be stored in Inventory. Figure 12-2 Inventory Menu will appear.

If there is an error, press **NO** and the Inventory adding procedure will start again from the beginning (Figure 12-3 Choose Nuclide Screen).

MAKING A KIT

A kit may be made from plain Tc99m in Inventory. To make a kit, select *MAKE KIT* from Figure 12-2 Inventory Menu.

If there is no plain Tc99m stored in the Inventory, Figure 12-14 No Plain Tc99m for Kits in Inventory Screen will appear.



Figure 12-14 No Plain Tc99m for Kits in Inventory Screen

Press any key (except **HOME**) to continue. Figure 12-2 Inventory Menu will re-appear.

If there is more than one plain Tc99m in the Inventory, a list showing the ID number (if one was entered) will be displayed. Press the number corresponding to the desired Tc99m.

Note: When making a kit from the Inventory, the Readout Unit must be in the same units (Ci or Bq) as the source was when added to the Inventory. If the selected item is in the other units (Ci or Bq), the following error message will appear – “Ci/Bq MUST BE SELECTED ON MAIN SCREEN TO WITHDRAW FROM ITEM ENTERED IN Ci/Bq – ANY KEY TO CONTINUE”.

The details of the selected item will be displayed, showing the volume, current activity and the current Mo to Tc ratio (unless the entered ratio was 0; if activity is very low, only Mo/Tc: will be displayed without any value).

Press **NO** to make another selection (or return to the *Inventory Menu* if there is only one Tc99m in inventory).

Press **YES** to use the selection. Figure 12-15 Select Study for kit Screen will appear.

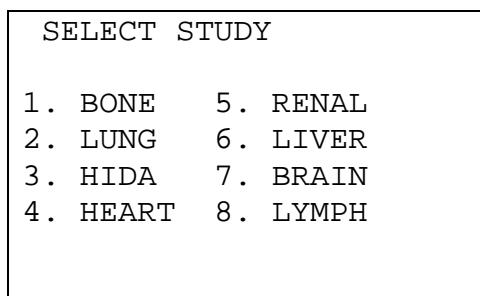


Figure 12-15 Select Study for kit Screen

Select a study for which the kit is intended by pressing the number corresponding to the study name. Figure 12-16 Enter ID for Kit Screen will appear.

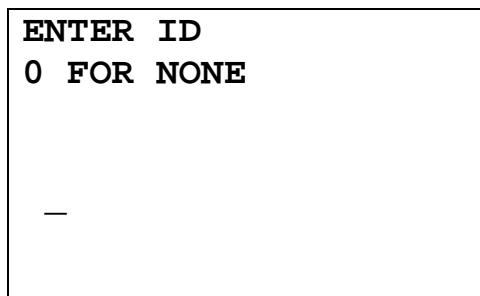


Figure 12-16 Enter ID for Kit Screen

An optional 2-digit ID number may be input to distinguish the item being added from another one with the same nuclide and study.

Input the 2-digit ID number for the kit and press **ENTER**. If an ID number is not required, input **0** for *NONE* and press **ENTER**. Figure 12-17 Enter Lot Number for Kit Screen will appear.

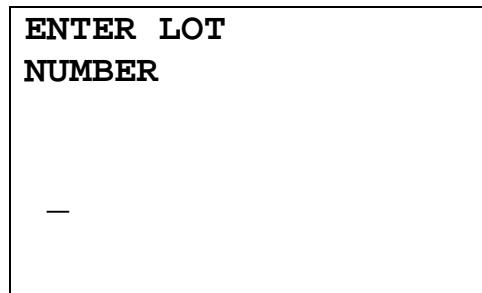


Figure 12-17 Enter Lot Number for Kit Screen

An optional Lot Number of up to 15 characters (digits or letters) may be input.

Input the Lot Number and press **ENTER**. If a Lot Number is not required, press **ENTER**. Figure 12-18 Kit Activity Entry Screen will appear.

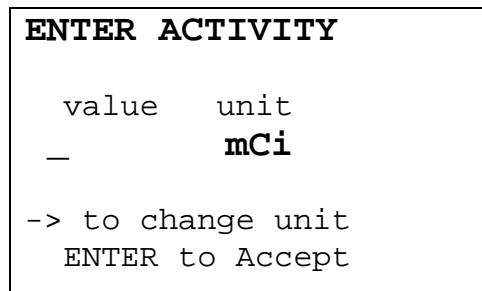


Figure 12-18 Kit Activity Entry Screen

Input the value of the activity needed to make the kit and then press the **RIGHT ARROW (→)** key. Use the arrow keys to scroll the activity units: mCi, μ Ci, Ci if using Curie mode, (or MBq, GBq if using Becquerel mode). If the value needs to be changed, press **CE**.

When the activity value and units are correct, press **ENTER**. The kit input activity and volume required for that activity will be displayed.

Withdraw the displayed volume and prepare the kit. Press any key (except **HOME**) to continue and Figure 12-19 Kit Measure Activity Screen will appear.

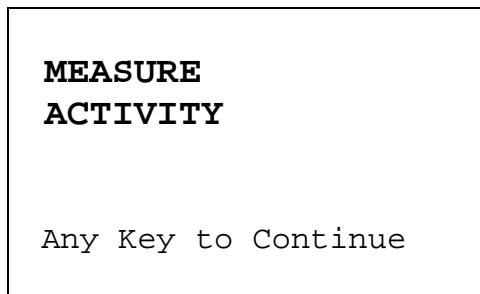


Figure 12-19 Kit Measure Activity Screen

Place the kit in the Chamber and press any key (except **HOME**) to continue. Figure 12-20 Kit Measurement Screen will appear.

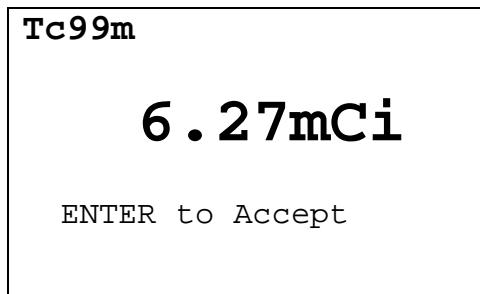


Figure 12-20 Kit Measurement Screen

When the activity has stabilized, press **ENTER** to accept the measurement. Figure 12-21 Kit Volume Entry Screen will appear.

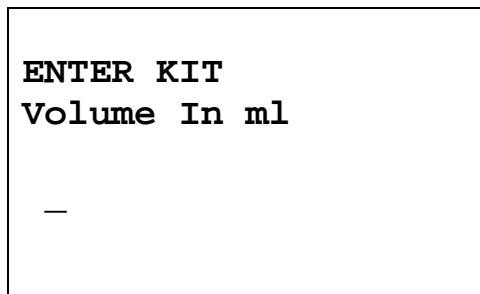


Figure 12-21 Kit Volume Entry Screen

Input the volume of the kit in ml and press **ENTER**. Figure 12-2 Inventory Menu will appear.

The activity, volume and Mo to Tc ratio (unless 0 was entered) for the original Tc99m will be updated in the Inventory. Also, the kit will be added to the Inventory.

WITHDRAWING FROM INVENTORY

To withdraw activity from an item in Inventory to be used for a patient (not for a kit), select **WITHDRAW** from Figure 12-2 Inventory Menu.

A list of items in the Inventory appears, showing the nuclide name, study (if any) and ID (if any). If there is more than one screen, use the **UP ARROW (↖)** and **DOWN ARROW (↙)** keys to navigate between screens. Press the number in front of the item to select it. Press **MENU** to return to Figure 12-2 Inventory Menu.

Note: When withdrawing from the Inventory, the Readout Unit must be in the same units (Ci or Bq) as the source was when added to the Inventory. If the selected item is in the other units (Ci or Bq), the following error message will appear – “Ci/Bq MUST BE SELECTED ON MAIN SCREEN TO WITHDRAW FROM ITEM ENTERED IN Ci/Bq – ANY KEY TO CONTINUE”.

When an item is selected, the details will be displayed, showing current activity, current volume and for Tc99m samples, the current Mo to Tc ratio (unless the input ratio was 0).

Press **NO** to return to the Inventory list to make another selection.

Press **YES** to select the item. Figure 12-22 Required Activity Entry Screen will appear.

ENTER ACTIVITY	
value	unit
—	mCi
→ to change unit	
ENTER to Accept	

Figure 12-22 Required Activity Entry Screen

Input the value of the activity needed to make the kit and then press the **RIGHT ARROW (↗)** key. Use the arrow keys to scroll the activity units: mCi, µCi, Ci if using Curie mode, (or MBq, GBq if using Becquerel mode). If the value needs to be changed, press **CE**.

When the activity value and units are correct, press **ENTER**. Figure 12-23 Date of Use Entry Screen will appear.

Date of Use
ENTER for TODAY
—
MMDDYYYY

Figure 12-23 Date of Use Entry Screen

Input the date in the form MMDDYYYY (example: July 3, 2005 would be 07032005) and press **ENTER**. The date is checked for validity. If the input date is not valid, a beep will sound and “DATE ERROR” will be displayed. The date must be re-entered.

If the date of use is today, press **ENTER**.

Figure 12-24 Time of Use Entry Screen will appear.

Time of Use
—
hhmm

Figure 12-24 Time of Use Entry Screen

Input the time as hhmm in 24 hour time format (example: 1:25 PM would be 1325, 9:15 AM would be 0915) and press **ENTER**. The time is checked for validity. If the input time is not valid, a beep will sound and “TIME ERROR” will be displayed. The time must be re-entered.

The input activity, the date and time of use, and the volume required for that activity will be displayed. The prompt “OK? Y or N” will appear. Press **NO** to return to the Figure 12-22 Required Activity Entry Screen.

If the displayed information is correct, withdraw the displayed volume and press **YES**. Figure 12-25 Measure Activity Screen will appear.

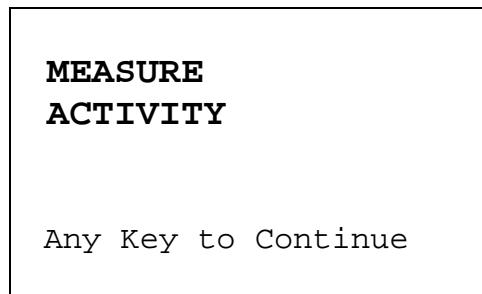


Figure 12-25 Measure Activity Screen

Place the sample in the Chamber and press any key to continue. Figure 12-26 Withdraw Activity Measurement Screen will appear.

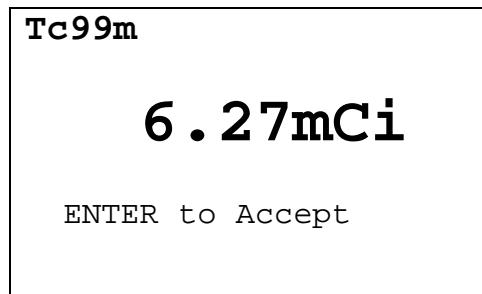


Figure 12-26 Withdraw Activity Measurement Screen

When the activity has stabilized, press **ENTER** to accept the measurement. The Inventory item will update with the new volume and activity and Mo to Tc ratio for Tc99m (unless 0 was entered for the ratio). Figure 12-2 Inventory Menu will re-appear.

PRINTING THE INVENTORY

If a printer is attached to the system, the Inventory can be printed.

To print the Inventory, select *PRINT* from Figure 12-2 Inventory Menu.

The contents of the Inventory will be printed, showing the current activity, current volume and for Tc99m, the current Mo to Tc ratio (unless the entered ratio was 0).

DELETING FROM INVENTORY

To delete one or more items from the Inventory, select *DELETE* from Figure 12-2 Inventory Menu. Figure 12-27 Delete Inventory Menu will appear.

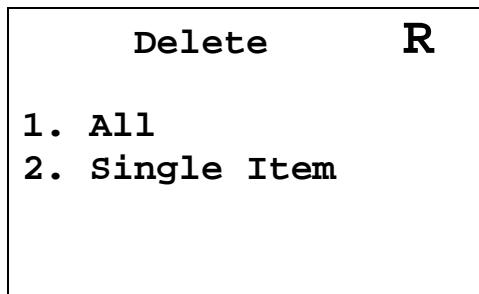


Figure 12-27 Delete Inventory Menu

All the items in the Inventory may be deleted, or the Inventory may be deleted one item at a time.

Deleting Individual Items from the Inventory

To delete individual items from the Inventory, select *SINGLE ITEM* from Figure 12-27 Delete Inventory Menu.

A list of items in the Inventory appears, showing nuclide name, study (if any) and ID (if any). If there is more than one screen, use the **UP ARROW (R)** and **DOWN ARROW (S)** keys to navigate between screens. Press the number in front of the item to select it to be deleted. Press **MENU** to return to Figure 12-2 Inventory Menu.

When an item is selected to be deleted, the details of the selected item will be displayed, showing current activity, current volume and for Tc99m, the current Mo to Tc ratio (unless the entered ratio was 0).

To keep the item in the Inventory, press **NO**. To delete the item from the Inventory, press **YES**.

The Inventory List will re-appear (with the previously selected item no longer on the list, if deletion was confirmed).

Press **MENU** when deletion of individual items has been completed. Figure 12-2 Inventory Menu will re-appear.

Deleting All Items in the Inventory

To delete all the items in the Inventory, select *ALL* from Figure 12-27 Delete Inventory Menu. The option to print the Inventory will be presented allowing a hard copy printout of the Inventory before it is deleted.

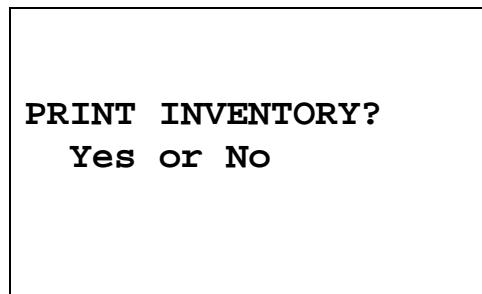


Figure 12-28 Print Inventory Question Screen

To abort deleting the entire Inventory, press **HOME**. The Measurement screen will appear.

Press **YES** to print the Inventory. Press **NO** to skip printing. Figure 12-29 Delete Whole Inventory Confirmation Screen will appear.

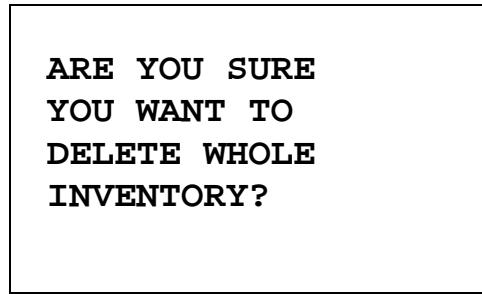


Figure 12-29 Delete Whole Inventory Confirmation Screen

If **NO** is pressed, Figure 12-2 Inventory Menu will appear and the Inventory contents will not be changed.

If **YES** is pressed, all the items in the Inventory will be deleted. Figure 12-2 Inventory Menu will appear.

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CHAPTER 13

DOSE TABLE

The Dose Table function is used to print a table showing the volume to be withdrawn from a measured sample to obtain a desired dose at future times for the activity that is being measured.

Note: A printer must be attached to the system to utilize the Dose Table function.

The Dose Table is accessed by pressing the **TIME** key twice. It is accessible only for Pre-Set Nuclide keys (This does not work with the F18, Xe133 keys or any of the **USER** keys). Figure 13-1 Dose Entry Screen will appear.

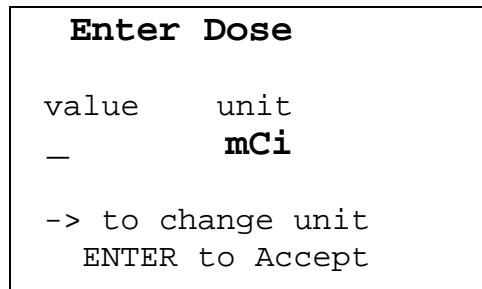


Figure 13-1 Dose Entry Screen

Input the desired dose and then press the **RIGHT ARROW (→)** key. Use the arrow keys to scroll through the activity units: mCi, μ Ci, or Ci for Curie mode (MBq or GBq for Becquerel mode). If the value needs to be changed, press **CE**.

Note: The displayed unit (Ci or Bq) is set outside of the Dose Table function. Reference CHAPTER 5: SYSTEM INITIALIZATION; SECTION: CHOOSING Ci or Bq.

When the value and unit are correct, press **ENTER**. Figure 13-2 Volume Entry Screen will appear.

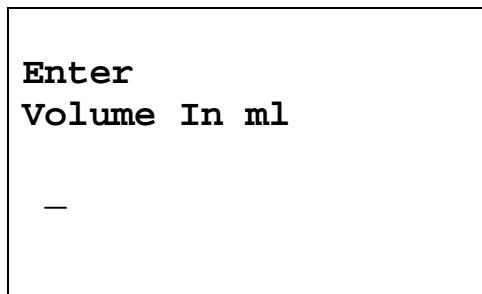


Figure 13-2 Volume Entry Screen

Input the volume of the sample that the dose will be drawn from in ml.

Note: *The minimum value that can be input is 1.000. The maximum value that can be input is 100.0.*

A report will be printed giving the time and required volume for the desired dose at time intervals appropriate to the nuclide for up to 30 time intervals. If there is not enough volume for the dose, the printout will read “REQUIRED VOLUME GREATER THAN EXISTING VOLUME”. A sample printout is shown in Figure 13-3 Dose Table Printout.

CRC-25R	REV 0.09	SN: 000000
Mar 20 2007	13:46	
DOSE TABLE		
I 131		
Mar 20 2007	13:45	
Activity:	6.90mCi	
Volume:	10.0ml	
Dose:	5.00mCi	
TIME	VOL (ml)	
13:45	7.25	
18:45	7.38	
23:45	7.50	
04:45	7.65	
09:45	7.79	
14:45	7.93	
19:45	8.06	
00:45	8.19	
05:45	8.31	
10:45	8.53	
15:45	8.69	
20:45	8.84	
01:45	9.00	
06:45	9.16	
11:45	9.33	
16:45	9.50	
21:45	9.67	
02:45	9.85	
Required volume greater than existing volume.		

Figure 13-3 Dose Table Printout

CHAPTER 14

CALCULATION UTILITIES

GENERAL	14-1
CONVERSION BETWEEN Ci and Bq (Ci ↔ Bq)	14-2
DECAY CALCULATION.....	14-3

GENERAL

Two calculation utilities are provided with the CRC®-25R:

- Conversion between Ci and Bq and
- Decay Calculation.

From the Measurement Screen, press **MENU**. Figure 14-1 Main Menu will appear.

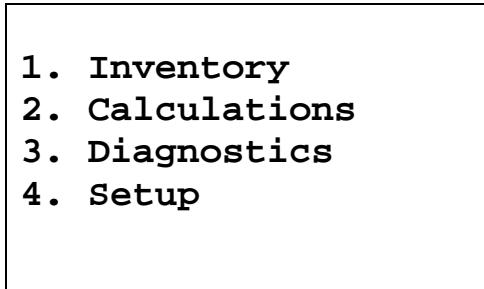
- 
- 1. Inventory**
 - 2. Calculations**
 - 3. Diagnostics**
 - 4. Setup**

Figure 14-1 Main Menu

Select **CALCULATIONS**. Figure 14-2 Calculations Menu will appear.

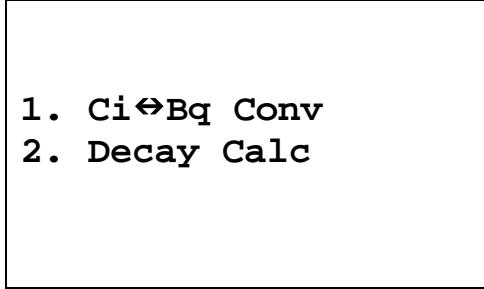
- 
- 1. Ci↔Bq Conv**
 - 2. Decay Calc**

Figure 14-2 Calculations Menu

CONVERSION BETWEEN CI AND BQ (CI ↔ BQ)

An activity is input in Curies and the value is displayed in Becquerels or an activity is input in Becquerels and the value is displayed in Curies.

From Figure 14-2 Calculations Menu, select *Ci ↔ Bq CONV*. Figure 14-3 Ci ↔ Bq Activity Entry Screen will appear.

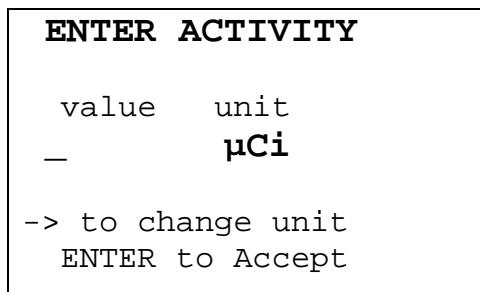


Figure 14-3 Ci ↔ Bq Activity Entry Screen

Input the value of the activity to be converted and then press the **RIGHT ARROW (→)** key. Use the arrow keys to scroll the activity units: μCi, GBq, MBq, Ci, mCi. If the value needs to be changed, press **CE**.

When the activity value and units are correct, press **ENTER**. Figure 14-4 Ci ↔ Bq Result Screen will appear (in the example 100 mCi was entered):

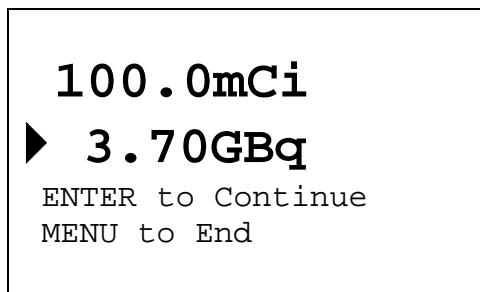


Figure 14-4 Ci ↔ Bq Result Screen

To perform another conversion, press **ENTER**. Figure 14-3 Ci ↔ Bq Activity Entry Screen will re-appear.

To exit the conversion utility, press **MENU**. Figure 14-2 Calculations Menu will re-appear.

DECAY CALCULATION

This utility is used to calculate the activity of a source at a different time (either in the past or the future).

From Figure 14-2 Calculations Menu select *DECAY CALC*. Figure 14-5 Choose Nuclide for Decay Calculation Screen will appear.

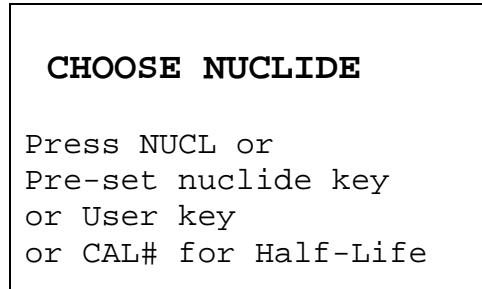


Figure 14-5 Choose Nuclide for Decay Calculation Screen

Choose the nuclide via the **NUCL** key, one of the Pre-Set Nuclide keys or an assigned **USER** key. Figure 14-7 Decay Calculation Activity Entry Screen will appear showing the nuclide name and half-life. In the example, Tc99m was chosen.

If you want to perform the decay calculation for a nuclide which is not in memory, press the **CAL#** key. Figure 14-6 Entering Half-Life for Decay Calculation screen will appear.

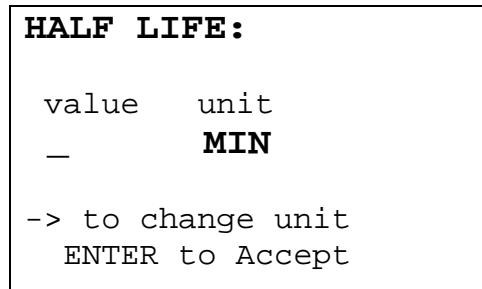


Figure 14-6 Entering Half-Life for Decay Calculation

Input the value of the half-life and then press the **RIGHT ARROW (→)** key. Use the arrow keys to scroll the half-life from Min to Year to Day to Hour. If the value needs to be changed, press the **CE** key.

When the value and unit are correct, press **ENTER**. Figure 14-7 Decay Calculation Activity Entry Screen will appear showing the input half-life. In the example, Tc99m was chosen. (If the **CAL#** key was pressed (to input the half-life), the nuclide name will be blank. Only the half-life will be displayed.)

Tc99m	6.007 H
ENTER ACTIVITY	
value	unit
-	µCi
-> to change unit	
ENTER to Accept	

Figure 14-7 Decay Calculation Activity Entry Screen

Input the value of the activity and then press the **RIGHT ARROW (→)** key. Use the arrow keys to scroll the activity units: µCi, GBq, MBq, Ci, mCi. If the value needs to be changed, press **CE**.

When the activity value and unit are correct, press **ENTER**. Figure 14-8 Decay Calculation Activity Starting Time / Date Screen will appear.

Tc99m	6.007 H
FROM:	
-	
hhmm↓DD↓MM↓YY	
ENTER for NOW	

Figure 14-8 Decay Calculation Activity Starting Time / Date Screen

Input the starting time / date as per the instructions below. If the starting time / date is “NOW”, press **ENTER**. Figure 14-9 Decay Calculation Activity Ending Time / Date Screen will appear:

The time/date entry format is hhmm/DD/MM/YY where:

- hh = hours (24 hour format) (1 or 2 digit)
- mm = minutes (2 digit)
- DD = day (2 digit)
- MM = month (2 digit)
- YY = year (2 digit)

The minimum input required is the time (hhmm). That is, if the future time is sometime later in the same day, then all that needs to be input is the time. For example:

If the current time is 12:00 and the desired future time is 16:00 today;

- input **1600** and
- press **ENTER**. Figure 14-9 Decay Calculation Activity Ending Time / Date Screen will appear.

If the future time is sometime the next day, then all that needs to be input is the time (hhmm) and day (DD). For example:

If today is July 30 and the desired future time is 9:00 tomorrow;

- input **900** (for the time),
- press the **DOWN ARROW (▼)**,
- input **31** (for the day) and
- press **ENTER**. Figure 14-9 Decay Calculation Activity Ending Time / Date Screen will appear.

If the future time is sometime the day after tomorrow, then the time (hhmm), day (DD) and month (MM) will need to be input. For example:

If today is July 30 and the desired future time is 9:00 the day after tomorrow;

- input **900** (for the time),
- press the **DOWN ARROW (▼)**,
- input **01** (for the day),
- press the **DOWN ARROW (▼)**,
- input **08** (for the month) and
- press **ENTER**. Figure 14-9 Decay Calculation Activity Ending Time / Date Screen will appear.

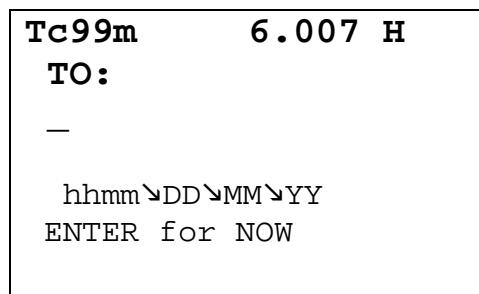


Figure 14-9 Decay Calculation Activity Ending Time / Date Screen

Input the ending time / date as per the above instructions. If the ending time / date is “NOW”, press **ENTER**. Figure 14-10 Decay Calculation Results Screen will appear.

Tc99m	6.007 H
200. μ Ci	15:59
Jul 20 2005	
99.7 μ Ci	22:01
Jul 20 2005	

Figure 14-10 Decay Calculation Results Screen

When finished viewing the results,

- Press the **MENU** key to exit Decay Calculation and return to Figure 14-2 Calculations Menu.
- Press the **HOME** key to return to the Measurement screen.
- Press any other key to return to Figure 14-5 Choose Nuclide for Decay Calculation Screen.

CHAPTER 15

CLEANING AND MAINTENANCE

GENERAL	15-1
CLEANING and DISINFECTING	15-2
Cleaning Instructions.....	15-2
Disinfecting Instructions	15-3
PREVENTATIVE MAINTENANCE	15-4
SERVICING.....	15-4
DISPOSAL	15-5
FUSE SERVICING.....	15-6
Readout Fuses	15-6
Printer Fuse	15-6
BATTERY REPLACEMENT	15-7
TROUBLESHOOTING	15-13
Nothing appears on the display	15-13
Nothing happens when any key is pressed.....	15-13
Buzzer buzzes continuously.	15-13
High background indication.....	15-13
Zero activity is indicated with a source in the Chamber.	15-14
Readings appear overly noisy for low activities.....	15-14
Indication of significant negative activity.....	15-14
The time is reset to 00:00.....	15-14
Printer prints junk or prints with incorrect spacing.....	15-14
Print head hangs up when printing tickets.....	15-14
Printer will not respond.	15-14
RELATED PRODUCTS	15-15
SHIPPING	15-16

GENERAL

This chapter provides the information necessary for the user to perform the basic maintenance of instrument cleaning, fuse replacement, battery replacement and general preventative maintenance. There are no internal adjustments or calibration settings that may be done by the user within the conditions of the warranty.



CAUTION: REFER ALL SERVICING TO A QUALIFIED SERVICE
REPRESENTATIVE!

It is recommended that periodic (every five years) re-calibration of the CRC®-25R be performed only by Capintec's Authorized Service Center to guarantee the instrument's high reliability is maintained. Contact Capintec's only Authorized Service Center for servicing or re-calibration at (800) ASK-4CRC.

CLEANING AND DISINFECTING

**CAUTION:**

- DISCONNECT THE POWER BEFORE CLEANING.
- TO AVOID ELECTRICAL SHOCK OR DAMAGING OF THE CRC®-25R, NEVER ALLOW WATER OR LIQUIDS TO PENETRATE THE CHAMBER OR THE READOUT ENCLOSURE.
- DO NOT USE AEROSOL DISPENSERS TO SPRAY THE EQUIPMENT WITH CLEANING SOLUTIONS OR LIQUIDS.
- TO AVOID DAMAGING THE CASE OR DISPLAY SCREEN, DO NOT USE AROMATIC HYDROCARBONS, CHLORINATED SOLVENTS OR METHANOL-BASED CLEANING SOLUTIONS.
- PRIOR TO CLEANING OR DISINFECTING THE LINER AND/OR DIPPER, THEY MUST BE REMOVED FROM THE CHAMBER. CAUTION: NEVER USE THE CALIBRATOR WITHOUT THE CHAMBER LINER IN PLACE. LINERS ARE INEXPENSIVE AND EASY TO REPLACE. A CONTAMINATED CHAMBER IS A VERY COSTLY MISTAKE.

Cleaning Instructions

Readout Unit and Chamber

Wipe the surfaces clean using a damp, non-abrasive cloth or sponge and a mild detergent and water; do not use solvents or aerosol cleaners. After cleaning, wipe all surfaces dry with a soft, non-abrasive cloth. To avoid scratches, do not use abrasive pads.

Liner/Dipper

Remove the Liner and/or Dipper from the Chamber and wipe the surfaces clean using a damp, non-abrasive cloth or sponge and a mild detergent and water; do not use solvents or aerosol cleaners. After cleaning, wipe all surfaces dry with a soft, non-abrasive cloth. To avoid scratches, do not use abrasive pads.

Replace the Liner and Dipper in the Chamber.



CAUTION: Never use the calibrator without the Chamber liner in place. Liners are inexpensive and easy to replace. A contaminated Chamber is a very costly mistake.

Printer

If a printer was included with the system, refer to the printer owner's manual for proper cleaning procedures.

Remote Display

If a Remote Display Unit was included with a legacy system, refer to the Remote Display owner's manual for proper cleaning procedures. **Note:** This applies only to legacy systems. Remote Displays are no longer available as an option.

Disinfecting Instructions

All surfaces can be disinfected with bleach using a mixture of 1 cup of bleach per gallon of water. Wipe all surfaces using a non-abrasive cloth lightly dampened with the bleach mixture. After disinfecting, wipe dry with a soft, non-abrasive cloth.

All surfaces can also be wiped with soft cloth lightly dampened with alcohol, such as an alcohol prep pad. After wiping, the surface can be left to air dry.

Liner/Dipper

Remove the Liner and/or Dipper from the Chamber and disinfect as directed above.

Replace the Liner and Dipper in the Chamber.



CAUTION: Never use the calibrator without the Chamber liner in place. Liners are inexpensive and easy to replace. A contaminated Chamber is a very costly mistake.

PREVENTATIVE MAINTENANCE

The following preventative maintenance should be performed at the specified intervals. General cleaning is at the discretion of the user (see Cleaning Instructions above). It is recommended to periodically perform the Quality Assurance Tests as described in CHAPTER 7: ACCEPTANCE & QUALITY ASSURANCE TESTS.

Tests must be performed in an environment where the temperature is stable within a range of +50°F to +85°F (+10°C to +30°C) and the maximum relative humidity is 90% non-condensing. The unit should be powered-up for at least one-half hour prior to performing any measurements. No other precautions need to be observed.

 **CAUTION:** If these environmental requirements are not followed, the instrument may display erroneous readings.

The Quality Assurance Tests should be immediately performed if:

- The equipment has been subjected to extreme physical stress,
- Liquids enter the Readout unit, and/or Chamber, or
- Any cable shows signs of damage

SERVICING

The system is covered by a two year limited warranty, under normal conditions of use.

Other than the Readout Unit fuses (reference FUSE SERVICING on page 15-6) and internal Lithium Coin Battery (reference BATTERY REPLACEMENT on page 15-7), there are no user serviceable parts contained in the system.

Every five years, the system should be returned to Capintec's only Authorized Service Center for a complete verification.

CAPINTEC, Inc.
7 Vreeland Road
Florham Park, NJ 07932
Phone (800) ASK-4CRC
Fax (201) 825-1336

DISPOSAL

The following items should be taken into consideration before disposing. These items should be disposed of in accordance with local and national regulations. Please contact Capintec, Inc. or an authorized disposal company to decommission your equipment.

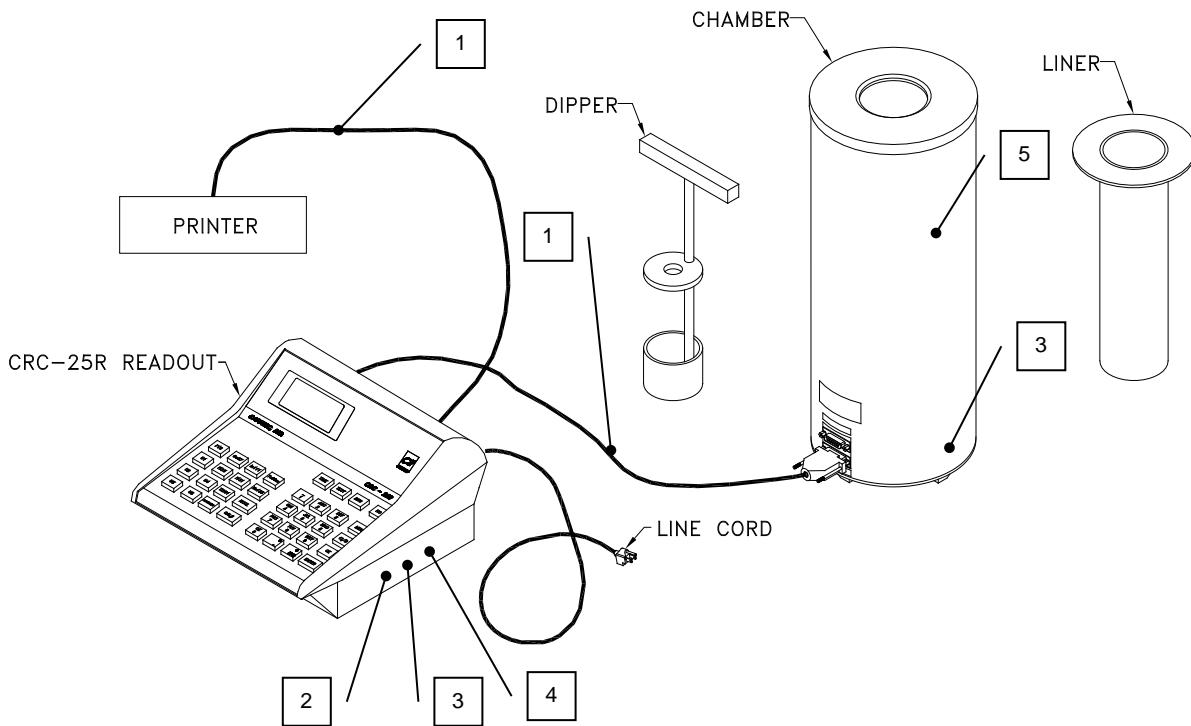


Figure 15-1

No.	Recycling/Material Code	Important Information
1	External Electrical Cables	
2	Lithium Battery	Contained on the CPU printed circuit board inside of the readout unit.
3	Printed Circuit Boards	Iometer, CPU, Power Supply, LCD Controller
4	Electrolytic Capacitor	Power Supply Printed Circuit Board
5	Lead	Lead Shielding around Chamber

FUSE SERVICING

Readout Fuses



CAUTION: FOR CONTINUED PROTECTION, REPLACE ONLY WITH SAME TYPE AND RATING OF FUSE(S). A FIRE HAZARD MAY EXIST IF THE WRONG SIZE OF FUSE IS INSTALLED.

Two fuses are located in the power entry module next to the power cord connector on the back panel of the Readout Unit. These fuses are rated at 2.0A 250Vac delayed type as specified on the label located directly below the power entry module.

To change these fuses:

1. Turn off the CRC®-25R power switch and unplug the line cord from the power entry module.
2. Insert the tip of a small flat bladed screwdriver into the notch of the power entry module just to the left of the switch. Twist the screwdriver to open the fuse cover door. (Refer to Figure 15-2 Readout Fuse Replacement).
3. To remove the first of the two fuse carriers, insert the tip of the screwdriver behind the arrow and pull it out. Repeat this process for the second fuse.
4. Remove the blown fuse(s) from the carrier and replace it (them) with T 2.0AL 250 Volt fuse(s).
5. Re-insert the fuse carriers with the arrows pointing up.

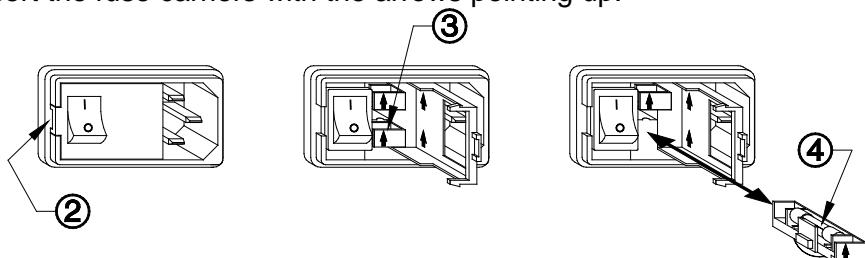


Figure 15-2 Readout Fuse Replacement

6. Close the fuse cover door and snap it into place.
7. Replace the line cord and turn on the power switch for the CRC®-25R.
8. Verify the CRC®-25R System is functioning correctly by performing the Daily Test as specified in CHAPTER 7: ACCEPTANCE & QUALITY ASSURANCE TESTS.

Printer Fuse

The printer fuse is not accessible from the outside of the printer case and must be replaced by a qualified service representative.

BATTERY REPLACEMENT

 **CAUTION:** The replacement battery must be a CR2032 3 volt Lithium Coin.

When the internal 3 Volt Lithium Coin Battery falls below 2.75 Volts, the Low Battery symbol () will appear in the lower left corner of the display indicating that the battery needs to be replaced.

The procedure outlined below describes how to remove and install the battery and then reconfigure the CRC®-25R Calibrator. Only qualified service personnel should perform this procedure. If there are any questions, please contact Capintec's only Authorized Service Center at (800) ASK-4CRC.

The following question must be answered before proceeding with replacing the battery:

Since the Low Battery symbol appeared on the display, has the time reset to 00:00?

- If the answer is NO, then proceed to step 1 – Save System Data.
- If the answer is YES, then proceed to step 2 – Battery Removal.

1. Save System Data

- a. If a printer is attached to the system, obtain a Diagnostic Printout by pressing the **MENU** key, and then selecting the *DIAGNOSTIC* function. All stored data will be printed. This information will be re-entered in steps 5 and 9 after the new battery has been installed.
- b. If a printer is not available, locate a copy of the original Calibration Sheet that was supplied with the unit and record the following:
 - Any new or changed Calibration Numbers,
 - Any Container Correction Factors,
 - Any User Added Nuclide information,
 - The isotope information that has been stored for all of the User Keys (U1-U5), and
 - All Test Source information.

This information will be re-entered in steps 5 and 9 after the new battery has been installed.

2. Battery Removal

- a. Turn off the power switch on the back of the Readout Unit and disconnect the power cord and ALL other cables.
- b. Turn the console upside down with the keypad facing down. Locate the rectangular access panel on the bottom of the readout unit. Remove the 3 flat head screws securing the access panel as shown in Figure 15-3.

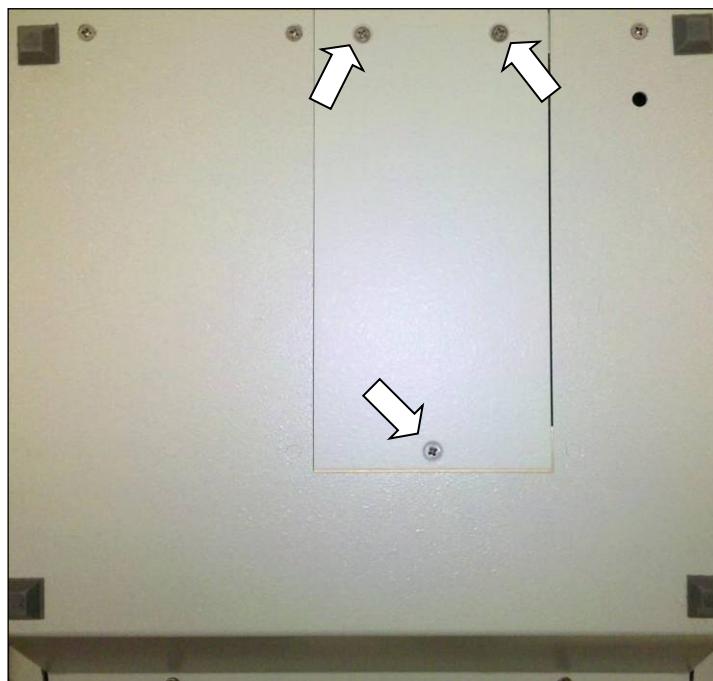


Figure 15-3

- c. Remove the access panel as shown in Figure 15-4.



Figure 15-4

- d. Gently press the battery in the direction of the arrow (toward the end of the battery holder with the three prongs) as shown in Figure 15-5.

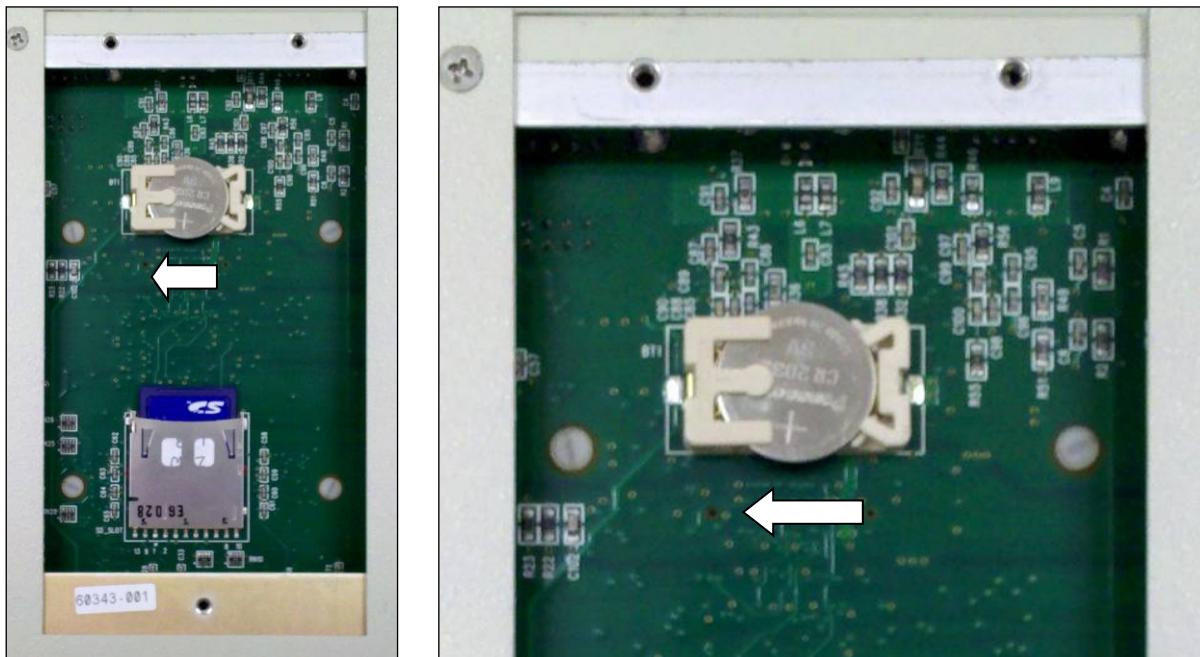


Figure 15-5

- e. Lift the other end of the battery up and slide it out. The battery holder will appear as shown in Figure 15-6.

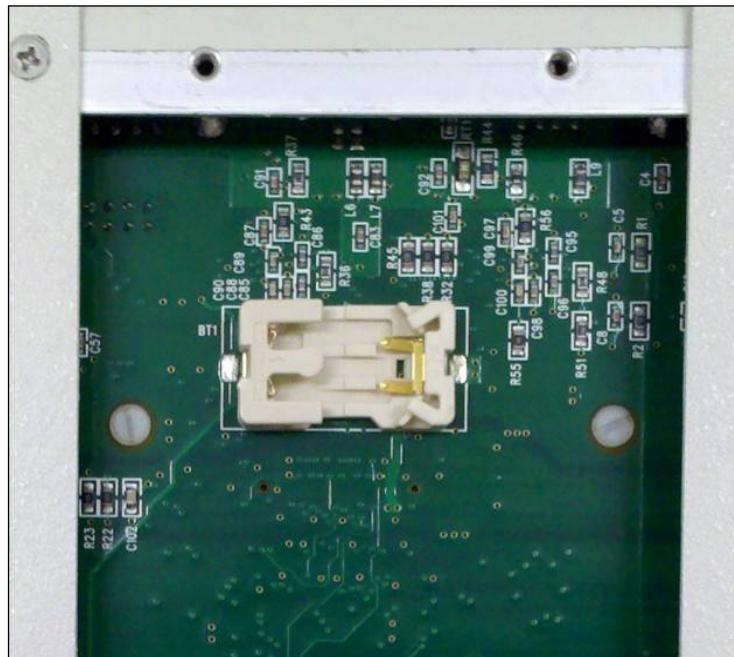


Figure 15-6

3. Battery Installation

- a. Locate the new battery and verify the proper orientation as shown in Figure 15-7 – the positive (+) side of the battery must face up.

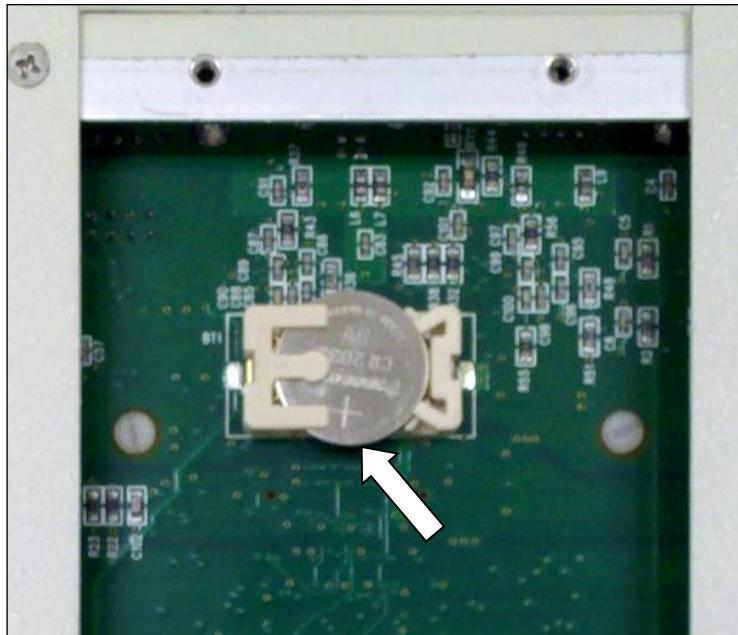


Figure 15-7

- b. Slide the battery into the battery holder under the three prongs as shown in Figure 15-8.

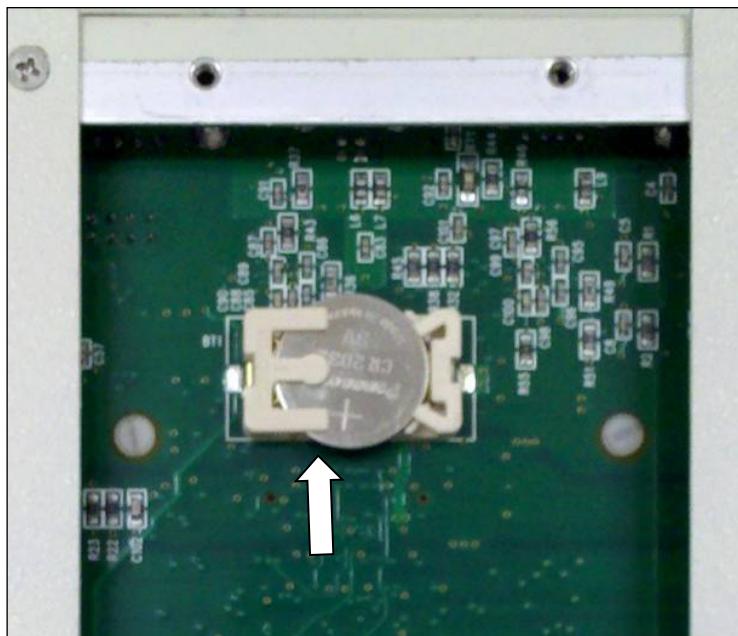


Figure 15-8

- c. Press down on the battery as shown in Figure 15-9 until a click is heard.

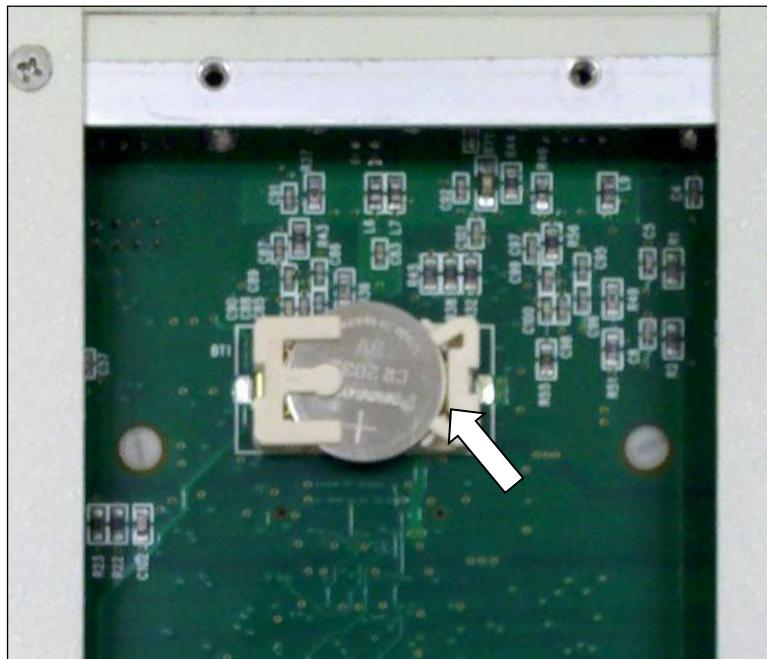


Figure 15-9

- d. Verify that the battery is secure in the connector and not loose.
 - e. Replace the rectangular access panel using the 3 flat head screws.
4. System Power-Up
- a. Reconnect the power cord and ALL other cables.
 - b. Turn on the power to the Readout Unit and verify that Low Battery symbol does not appear on the display.
5. Initialize the System
- a. From the Sign-On screen, press **ENTER**.
 - b. From the Measurement Screen, press **MENU**.
 - c. The Factory Password must now be entered. When the menu appears on the display, press the **MENU** key again.
 - d. When the display goes blank, press **5, SPC, 1, 3**. (Asterisks will appear on the display while you are typing.)
 - e. Press **ENTER**. The display will appear as illustrated in Figure 15-10.

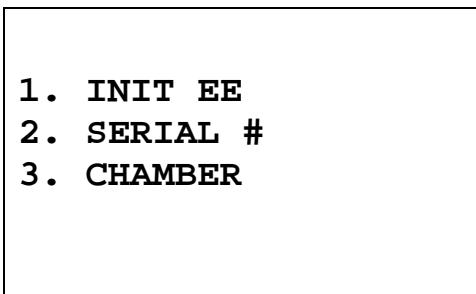


Figure 15-10

- f. Press **1** to select *INIT EE* to initialize the system. Figure 15-11 will appear for several seconds. After the program initialization is complete, Figure 15-10 will re-appear.

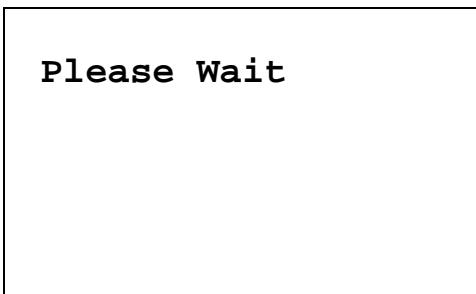


Figure 15-11

- g. Press **2** to select *SERIAL #* to re-enter the Readout Unit's Serial Number. Figure 15-12 will appear.

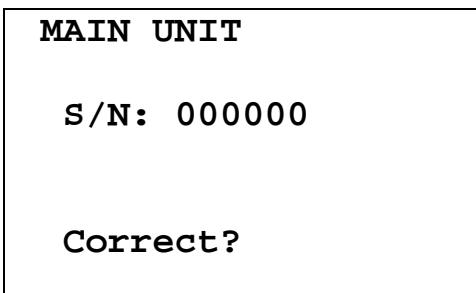


Figure 15-12

- h. Press **6(NO)** to answer no to the Main Unit Serial Number.
- i. Input the serial number of the Main Unit and press **ENTER**.
- j. Press **9(YES)** to answer yes to the new serial number. Figure 15-10 will re-appear.
- k. Turn off the power switch on the back of the Readout Unit.

6. Re-Initialize the Chamber
 - a. Turn on the power to the Readout Unit.
 - b. Press **ENTER** at the Sign-On screen to proceed to the Measurement screen.
 - c. Perform a Daily Test as specified in CHAPTER 7: ACCEPTANCE & QUALITY ASSURANCE TESTS to restore the Chamber's parameters to the Readout Unit.
7. Set the date and time as described in CHAPTER 5: SYSTEM INITIALIZATION.
8. If a printer is attached to the system, set the correct printer as described in CHAPTER 5: SYSTEM INITIALIZATION.
9. Re-enter Chamber Data
 - a. Re-enter any new or changed Calibration Numbers, Container Correction Factors, user added nuclide information, User keys and Test Source information (as described in CHAPTER 6: CHAMBER INITIALIZATION).

TROUBLESHOOTING

Some problems may be very easy to diagnose and correct in the field with little or no equipment. If a problem should occur, check here before you call for service. You may be able to save a considerable amount of time and money.

Nothing appears on the display.

- Make sure calibrator is plugged into a live outlet and is turned on.
- Check fuse and replace if necessary. Reference the FUSE SERVICING section on page 15-6.

Nothing happens when any key is pressed.

- One of the keys may be stuck. Try wiggling each key.
- A brief power line disruption may have caused the program to "lose its place". Try turning the power off and then on again.

Buzzer buzzes continuously.

- A brief power line disruption may have caused the program to "lose its place". Try turning the power off and then on again. If the buzzing continues, turn the power off and consult the factory. DO NOT leave the unit buzzing longer than necessary.

High background indication.

- Chamber Well, liner, or dipper may have become contaminated. Reference CHAPTER 7: ACCEPTANCE & QUALITY ASSURANCE TESTS, SECTION: CONTAMINATION TEST.
- Background may actually be high. Check by removing the dipper and placing a lead sheet over the top of the well.

Zero activity is indicated with a source in the Chamber.

- System may not be in lowest range. Try pressing **SPC**.

Readings appear overly noisy for low activities.

- Make sure that the chamber is on a solid surface and is not subject to vibration.

Indication of significant negative activity.

- Background level may have changed. Re-do the Background Adjust. Reference CHAPTER 8: BACKGROUND AND TESTS, SECTION: BACKGROUND.

The time is reset to 00:00.

- The internal Lithium Coin Battery may be depleted. Reference the BATTERY REPLACEMENT procedure on page 15-7.

Printer prints junk or prints with incorrect spacing.

- Make sure that the Printer Menu Setup is correct. Reference CHAPTER 5: SYSTEM INITIALIZATION, SECTION: PRINTING.

Print head hangs up when printing tickets.

- On the Okidata Microline 320 printer, the lever on left side of print head must be set to position 2.

Printer will not respond.

- Make sure printer is plugged into a live outlet, turned on, and “selected”.
- Make sure that either paper or a ticket is in the paper path.
- Run the Diagnostic Test and make sure that the system expects to have a printer. If not, Make sure that the Printer Menu Setup is correct. Reference CHAPTER 5: SYSTEM INITIALIZATION, SECTION: PRINTING.

RELATED PRODUCTS

The following products are available from Capintec. Call Capintec's only Authorized Service Center at (800) ASK-4CRC for answers to your questions or to place an order.

- CAPMAC Moly Assay Kit (specify generator)CALL
- Dose Calibrator Reference SourcesCALL
- Shielded products for PETCALL
- Standard Moly Assay Kit5130-0006
- Calicheck Linearity Test Kit5120-2144
- Ionization Chamber Well Inserts (liners)7300-2004
- Plastic Sample Holders (dippers)7300-2005
- Syringe Dipper Adaptor (to 1cc)7310-1109
- Environmental Shield7300-2450
- Flush Mount Mounting Flange7310-2307
- Shielded Platform with 2mm shielded glass5150-3010
- Shielded Platform with 4mm shielded glass5150-3011
- CAP-Lift remote lowering/raising of syringes or vials5130-30251
- Okidata 320 Ticket and Report Printer5110-1150
- Epson LX-300+II Ticket and Report Printer5110-0126
- Epson Roll Printer5430-0058
- Epson Ticket Printer5430-0100
- HP Inkjet Printer5430-0146
- Printer RibbonsCALL
- Inkjet CartridgesCALL
- Multi-part Tickets, Paper, etc.CALL
- Fuse: T 2 Amp. 250 Volts. (Readout Unit) 2 Req.2110-0083
- 3V Lithium Coin Battery (CR2032)0500-0039
- Additional copies of Owner's Manual9250-0122

Note: *Circuit diagrams, component parts lists, descriptions and calibration instructions are available to appropriately qualified personnel.*

SHIPPING

If for any reason the CRC®-25R must be returned to Capintec, the shipping carton must contain the following or equivalent labeling as shown in Figure 15-13 and Figure 15-14. Label stipulating the maximum environmental conditions for safe storage and shipment.

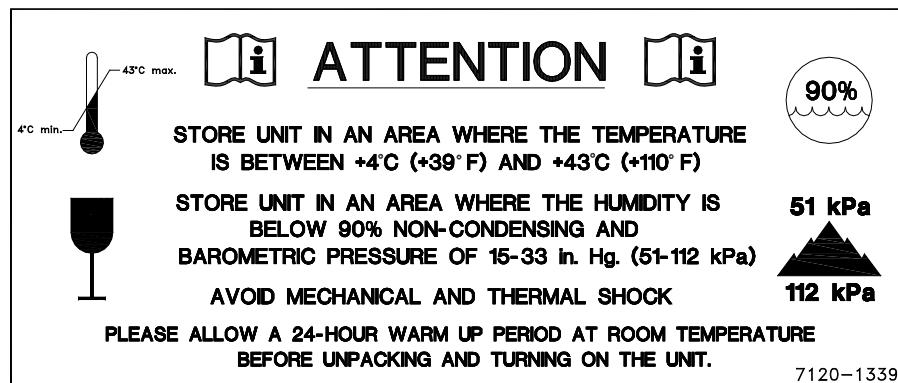


Figure 15-13



Figure 15-14

In order to ship this product, all appropriate Department of Transportation (DOT) and, if shipped by air, the International Aviation and Transportation Administration (IATA) requirements for the shipment of the pressurized (12 Atmosphere) Ionization Chamber Detector must be met.

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APPENDIX I

PRINCIPLE OF THE CALIBRATOR

GENERAL	I-1
DEFINITION OF ACTIVITY	I-1
Activity	I-1
Types of Transformations	I-2
MEASUREMENT OF ACTIVITY	I-3
α-Particle Radiation	I-3
β^+ Radiation	I-3
β^- Radiation	I-3
Electron Capture	I-4
Photon Radiation	I-4
PHOTONS	I-5
γ-Rays.....	I-5
X-Rays.....	I-5
Bremsstrahlung.....	I-5
Interactions of Photons with Matter.....	I-5
IONIZATION CHAMBER MEASURING PROCESS	I-6
DETAILED DISCUSSIONS	I-7
Effects of the Integral Shield	I-7
Effects of the Container	I-7
Effects of Impurities.....	I-8

GENERAL

The definition of activity, the basic principle of the calibrator, and the detailed discussion on the calibration are presented in this section.

DEFINITION OF ACTIVITY

Activity

Activity is defined as:

The activity, A, of a quantity of a radioactive nuclide is the quotient of dN by dt, where dN is the number of spontaneous nuclear transformations which occur in this quantity in time interval dt.

$$A = \frac{dN}{dt}$$

The special unit of activity is Curie (Ci):

$$1 \text{ Ci} = 3.7 \times 10^{10} \text{ s}^{-1} \text{ (exactly)}$$

Note: *The term nuclear transformation is meant to designate a change of nuclide of an isomeric transition. (ICRU REPORT 19, 1971)*

The SI (International System of Units) unit for activity is the reciprocal second, s^{-1} , and is named the Becquerel (Bq), i.e.;

$$1 \text{ Bq} = 1 \text{ Nuclear Transformation per second}$$

$$1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$$

Types of Transformations

α -decay

The nucleus emits a helium nucleus (α -particle).

Electron Capture (ε -decay)

The nucleus captures one of its own orbital electrons, usually from the K shell, and a neutrino is emitted.

β^- Decay

The nucleus emits an electron (β^- particle), and a neutrino.

β^+ decay

The nucleus emits a positron (β^+ particle) and a neutrino.

Nuclear Transition

A photon (electromagnetic radiation, γ -decay), electron (Internal Conversion Electron Emission, CE) or electron-positron pair (Internal-pair emission, $e\pm$) is emitted by a nucleus in a transition from a higher to lower energy state.

No nuclear transformation occurs if there is no change in the atomic number or the mass number. The de-excitation of a nucleus in its unstable state (metastable state) is, however, included in the definition of activity.

MEASUREMENT OF ACTIVITY

A Nuclear Transformation is always associated with one or more of the following types of radiation:

α , β^+ , β^- and γ Photons

We can, therefore, measure activity by detecting one or more of the above radiations.

α -Particle Radiation

The most energetic α -particle emitted by a radionuclide has an energy of less than 10MeV, which corresponds to a range of about 10mg/cm² (8cm in air). Because of its short range, an α -particle from a radionuclide cannot penetrate to the ionization chamber's sensitive volume and therefore, cannot be detected.

All α -decays, however, are accompanied by photon radiation as the daughter nucleus decays to its ground state. The activity of a nuclide that decays through α radiation can therefore, be measured by detecting the associated photon radiation.

β^+ Radiation

β^+ particle (positron) emitted from a nucleus comes to rest in the media by losing its kinetic energy mainly by direct ionization processes and then annihilates with an electron to produce two photons of 511keV each. These photons are easily detected by the ionization chamber. De-excitation photons are also associated with β^+ decay.

β^- Radiation

The ejected electron loses kinetic energy in matter mainly by direct ionization.

The range of most emitted β 's is very short. It should be noted that in β^+ and β^- emission, the emitted electron or positron has a continuous energy spectrum, which ranges from E_{\max} to zero, where E_{\max} is the maximum transition energy. β -rays (with the exception of a small portion of very high energy β s) will be stopped in the sample, in the chamber liner, and in the chamber wall.

As the electron decelerates, it also produces continuous low energy photon emission called Bremsstrahlung (stopping or braking radiation).

Many radionuclides that decay by β emission also emit de-excitation photons (x-rays, γ -rays), which can be detected by the ionization chamber.

Electron Capture

The actual electron capture process cannot be detected since the electron is not emitted but is captured by the nucleus. The capture of the orbital electron, however, leaves a vacancy in the atomic orbital shell, resulting in x-rays as the atom de-excites.

The energy of K x-ray is approximately

$$E_k \cong \frac{Z^2}{100} \text{ keV}$$

where Z is the atomic number of the daughter nucleus.

γ -rays are also often given off as the daughter nucleus de-excites.

Photon Radiation

Photon radiation is associated with most nuclear transformations. A high-energy photon interacts with matter very weakly. Photon intensity is therefore, not altered substantially by the surrounding media, i.e., measurement of activity can be accomplished with a minimum of disturbance from the sample configuration.

As can be seen from the above, in all cases we are detecting photons. We will therefore, discuss photons and their interactions with matter in detail.

PHOTONS

Photon is the general term for a quantum of radiation. Photons are classified according to their method of production.

γ -Rays

Photons resulting from nuclear transitions, nuclear reaction or annihilation of particles (e.g., electron-positron annihilation) are called Gamma-rays (γ -rays). Radioisotope sources (radionuclides) are the most common means of γ -ray production. Radioisotope γ -sources emit photons of one or more discrete energies.

X-Rays

X-rays are associated with the deceleration of electrons or with orbital electron transitions in atoms.

The radiation from a γ -source is often accompanied by characteristic x-rays from transitions of the orbital electrons in the daughter atom.

Bremsstrahlung

When very fast electrons are brought to rest in a medium (or pass through media) a continuous low energy photon spectrum occurs. This is called Bremsstrahlung ("stopping or braking radiation").

The intensity and the energy spectrum of Bremsstrahlung are highly dependent upon the source configuration and media surrounding the sample.

In this manual, the term photon will be used when the method of production of the radiation has no bearing on the discussion.

Interactions of Photons with Matter

There are three mechanisms by which photons can interact with matter and, thus, deposit their energy. These mechanisms are: Photoelectric effect, Compton Effect, and, pair production. The energy of the photon determines which process (or processes) is possible.

Photoelectric Effect

The photoelectric effect is an interaction between a photon and an electron that is bound to an atom. In the photoelectric process, the photon is absorbed by the atom and a bound electron is ejected. The kinetic energy of the ejected electron is equal to the photon energy minus the binding energy of the electron. The binding energy of an electron is the energy that must be supplied in order to remove the electron from the atom.

In nuclear medicine, we are interested in photon energies of 20keV or greater. At these energies, all the electrons in the materials used for the chambers are able to

participate in the photoelectric process. The photoelectric effect is the most important process at low energies. However, for photon energies much greater than electron binding energies, the processes described below become more important and the number of photoelectric interactions occurring becomes small. At a given energy, the number of photoelectric interactions per unit mass varies as the 4th power of the atomic number and is inversely proportional to the atomic weight of the medium (Z^4/A).

Compton Effect

The Compton Effect is a collision between a photon and an electron that can be considered unbound. An electron can be considered to be unbound (or "free") if the energy of the incident photon is much greater than the binding energy of the electron. The kinetic energy of the scattered electron is not constant, but is a function of the angle through which it is scattered. The scattered photon must interact again in order to impart all of its energy to the medium.

The Compton Effect is the dominant process for photon energies from 100keV to about 10MeV in the region of the atomic numbers for detector materials. At 100keV, the maximum kinetic energy of the scattered electron is about 30 percent of that of the incident photon; at 1MeV, it is about 80 percent; and at 10MeV, it is about 98%. The number of Compton interactions per unit mass varies directly as the atomic number and inversely as the atomic weight of the medium (Z/A).

Pair Production

The process of pair production is difficult to comprehend because it is strictly a relativistic quantum mechanical effect. What is observed to take place is that in the presence of the electric field of a nucleus, the incident photon disappears and an electron and a positron appear. (A positron is a particle with the same properties as an electron, except that it has a positive charge.)

In order to produce an electron-positron pair, the incident photon must have an energy of at least twice the mass of an electron, i.e., 1.022MeV. This process dominates for very high energies, that is, above about 10MeV. The number of pair production interactions per unit mass is proportional to the square of the atomic number and inversely proportional to the atomic weight of the medium (Z^2/A).

IONIZATION CHAMBER MEASURING PROCESS

An ionization chamber consists of two or more electrodes. The electrodes confine a volume of gas and collect the charge (ions) produced by radiation within the volume. Thus, ionization chambers can be used to measure radiation fields if the relationship between the radiation field and the charge produced is known.

The radiation enters the chamber through the chamber wall and interacts with the gas in the chamber or with the chamber wall. It must be pointed out that photons cannot produce ionization directly, but must first interact with the chamber material (gas and wall) producing electrons. That is, through a series of interactions, the photon transfers its energy to one or more electrons.

The electron is slowed down through collisions with the chamber gas (argon). The collisions knock electrons off the molecules producing positive ions (this is the ionization process).

The collection voltage across the chamber sets up an electric field. The positive ions will drift towards the negative electrode and the electron (and negative ions if they are formed) will drift towards the positive electrode, thus producing a current. The electronic circuitry then measures either the current or the total charge produced during the period of interest.

The number of ions produced in the chamber is directly related to the energy deposited in the chamber by the radiation.

DETAILED DISCUSSIONS

Effects of the Integral Shield

The advantage of the shield is the reduction of radiation exposure to the personnel handling the radioisotopes, as well as reduction of the background effects on the activity measurements.

It is important to note, however, that if a shield is placed around or near a calibrator, the sensitivity of the ionization chamber is enhanced due to backscattering of photons by the shielding. Above about 250keV, the scattering of photons is mainly forward and at the low energy region, attenuation of photons by the outer wall of the chamber becomes significant. For a CRC® calibrator, the backscattering effects are more significant for photons of energies between 70keV and 250keV than photons in other energy regions.

Effects of the Container

The radioactive standard materials in the ampoules now being provided by NIST are a good approximation to an assay of a radiopharmaceutical in a plastic syringe or in a glass syringe (a wall thickness of about 1.2mm), even for radioisotopes that decay with a significant abundance of low-energy photons.

The user should select, whenever possible, a standardized procedure, volume, and container for all radioactivity measurements. The plastic syringe is convenient since it represents the delivery vehicle to the patient in most clinical situations.

Significant errors will occur in some instances, e.g., if the radioisotope is assayed in an appreciably different material and/or wall thickness than that of the standards.

The ampoules of recently available standards from NIST are uniform. Plastic syringes also have a rather uniform wall thickness and absorption is low. However, a random sampling of 5, 10, 25, 50, and 125ml size multi-injection dose vials from several sources indicated that the wall thickness varied randomly from 1 to 3mm quite independently of the volume of glass vial.

The assay of radioisotopes having a significant abundance of low- energy gamma-, x-, and/or high-energy beta-ray radiation may be affected by changes in the sample configuration used to assay the radio-pharmaceutical if the samples are severely different from the standard source. In such cases, an independent check or determination of a calibration appropriate to a user's needs is advised. Fortunately, most radioisotopes can be accurately assayed independently of the sample size.

Effects of Impurities

An Ionization chamber itself does not have intrinsic energy- discrimination capability. The presence of radioisotope impurities will affect the reading of the instrument unless the effect of impurities is eliminated by photon filtration as is done with Mo99 breakthrough in Tc99m. However, the presence of low-level radionuclide impurity does not negate the usefulness of a radioisotope calibrator, if the user is aware of its presence and has an independently determined calibration including photons arising from the impurities.

APPENDIX II

CALIBRATION NUMBERS

DETERMINING CALIBRATION SETTING NUMBERS	II-1
Response and Sensitivity.....	II-1
Calibration Setting Numbers	II-2
CALIBRATION SETTING NUMBERS	II-4
ABBREVIATIONS USED IN TABLE I	II-5
UNCERTAINTY DUE TO SYRINGE CORRECTION	II-5
UNCERTAINTY DUE TO PUBLISHED DATA.....	II-5
HALF-LIFE	II-6
REFERENCES	II-6
TABLE I.....	II-7

DETERMINING CALIBRATION SETTING NUMBERS

A method of determining a calibration setting number is described in this section.¹

Response and Sensitivity

It is very convenient to express the response of the detector to a radioisotope, A, relative to that of a standard reference material, e.g. Co60.

$$R_A \equiv \frac{\left(\frac{\text{Detector Output due to Sample A}}{\text{Activity of Sample A}} \right)}{\left(\frac{\text{Detector Output due to SRM Co60}}{\text{Certified Activity of SRM Co60}} \right)} \quad (1)$$

The sensitivity of the detector for a photon of energy E_i is defined as:

$$S_i \equiv \frac{\text{Detector Output due to } 3.7 \times 10^{10} \text{ Photons of } E_i}{\text{Detector Output due to one Curie of Co60}} \quad (2)$$

The detector response and the sensitivity have the following relation:

$$R_i \equiv \sum_i I_i S_i \quad (3)$$

¹ See Suzuki, A., Suzuki M.N., and Weis A.M.: Analysis of a Radioisotope Calibrator; Journal of Nuclear Medicine Technology Dec. 1976 for more detailed discussions.

Where I_i is the intensity of the photon whose energy is E_i .

The procedure is to measure the response of the detector to all the available primary standard samples and to establish the sensitivity of the detector as a function of photon energy so as to satisfy equation (3) for all standards.

Once the sensitivity curve has been determined, the response of the detector to any radioisotope may be calculated using equation (3), provided that the decay data are known.

The sensitivity curve for a CRC® Ionization Chamber is given in Figure II-1.

The figure depicts the sensitivity of the ionization chamber as a function of photon energy up to 1.9MeV. Above a photon energy of 200keV, the ionization in the chamber is mainly due to electrons resulting from Compton scattering of photons by the filling gas (argon) and the chamber walls (aluminum).

The peak in the low-energy region of the sensitivity curve is due to the rapid increase in photoelectric effect as photon energy decreases and to the attenuation of low energy photons by the sample holder, the chamber liner and the chamber walls, as well as the absorption of photons in the sample material and its container.

Although a significant fraction of photons with energies below 50keV are stopped in the chamber wall, some photons could enter the sensitive volume of the chamber and could, therefore, contribute to the activity measurement. All photons with energies below about 13keV are stopped before they reach the sensitive volume of the chamber and, therefore, these photons do not contribute to the activity measurement.

Calibration Setting Numbers

The relationship between the response of the detector and the gain setting (relative to that for Co60, in order for the instrument to give a direct reading of the activity) is given by:

$$G_A \equiv \frac{1}{R_A} \quad (4)$$

The calibration setting number is linearly related to the chamber response.

All the calibrators are calibrated with certified Cobalt 60 and Cobalt 57 standard source.

A calibration setting number of 990 was assigned to Co60 and 112 was chosen for Co57.

The calibration setting number of CRC® Calibrator for radioisotope A, N_A , is given by:

$$N_A = \left(R_A - \left(1 - \frac{(R_{Co60} - R_{Co57})}{(N_{Co60} - N_{Co57})} * N_{Co60} \right) \right) * \frac{(N_{Co60} - N_{Co57})}{(R_{Co60} - R_{Co57})} \quad (5)$$

Entering numerical values:

$$\begin{aligned} N_{Co60} &= 990 & N_{Co57} &= 112 \\ R_{Co60} &= 1.000 & R_{Co57} &= 0.189 \pm 2\% \\ \text{one obtains : } N_A &= 1076(R_A - 0.080) \end{aligned} \quad (6)$$

The accuracy of the sensitivity curve and the calibration number determination was tested by calculating calibration numbers for all the radioisotope standards used for the studies of the sensitivity. The agreement between the calculated and the observed responses were all within $\pm 3\%$.

The accuracy of the chamber response calculation for a particular radioisotope, hence the accuracy which can be attained by using a calculated Calibration Setting Number depends not only on the accuracy of the available primary standards used to determine Figure II-1, on the nuclear data, on the variation in the chamber sensitivity and electrometer gain setting, but also on the sample configuration due to low energy photon absorption.

The calibration Setting Numbers for pure and equilibrium state radioisotopes for the CRC® Calibrators are listed in this Appendix. Appendix IV contains tables of multiplication factors for obtaining the activity of a parent nuclide when it is not in equilibrium with the daughter nuclide. A general equation for this situation is also given in that appendix.

Since the determination of the Calibration Numbers and the calibrations (normalization) of the instrument are performed using standard reference materials issued by the NIST and/or the LMR, the Calibration Numbers for radioisotopes are given for sample configuration similar to those issued by the NIST.

All of the NIST standards, with the exception of Xe133, were of the liquid solution form. Approximately 5g of radioactive liquid were sealed in borosilicate glass ampoules having a diameter of about 17mm, a length of 40mm, and a wall thickness of 0.6mm. The Xe133 standard was sealed together with inactive xenon gas in a borosilicate glass ampoule having a volume of about 5ml, a length of 45mm, a diameter of 15mm, and a wall thickness of 1.3mm.

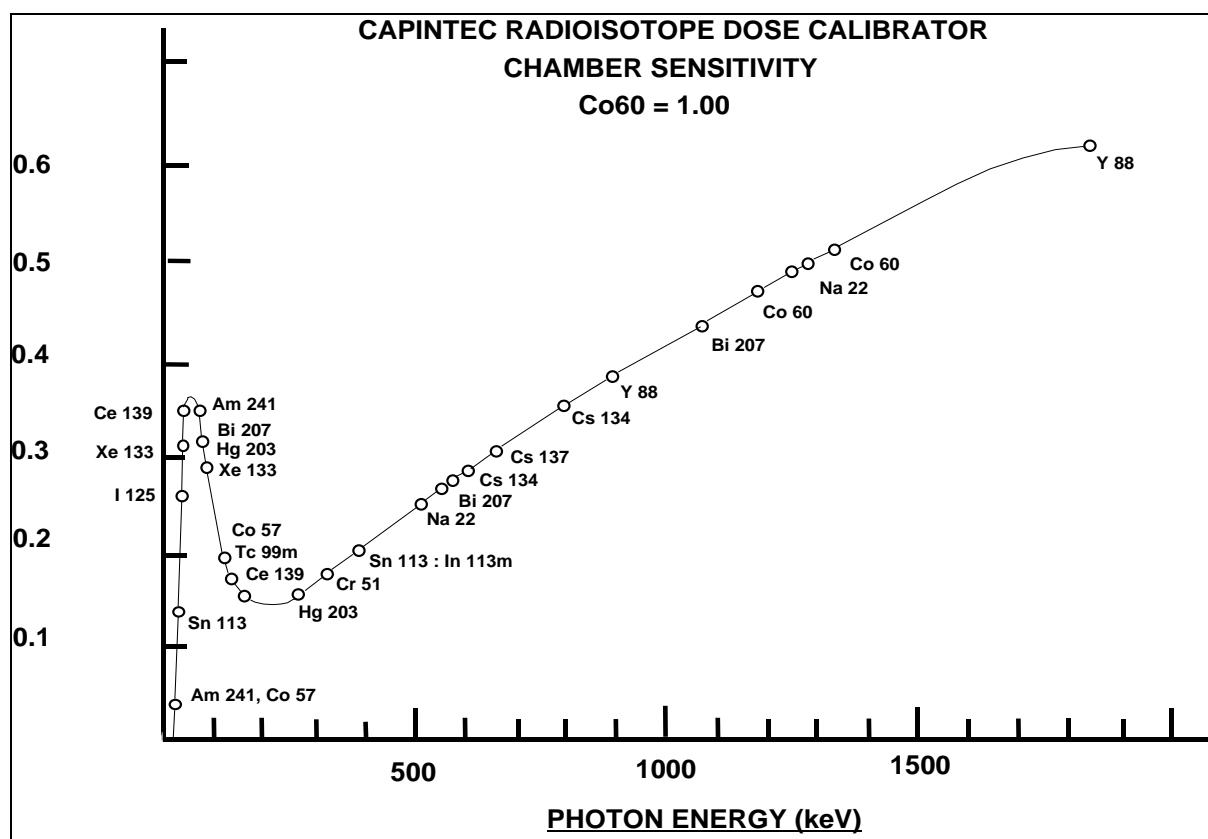


Figure II-1

CALIBRATION SETTING NUMBERS

The Calibration Setting Numbers in Table I are applicable to the Capintec Radioisotope Calibrator only.

The CRC®-25R is a direct reading instrument. No manual multiplication or division should be performed, even if the Calibration Setting Number is followed by a multiplication sign "×" or a division sign "÷" and a number.

If the sample contains radioactive impurities, the meter indication will always be higher than the actual activity of the principal isotope. It will not, however, be the total activity of the principal isotope and the impurities.

If a Radium Needle is measured, the reading will be lower than the true activity in the needle due to the shielding effects (filtration) of the needle. To estimate the true activity in a needle, increase the reading obtained with a calibration number for Ra226 (778) by 2% for each 0.1mm of platinum wall thickness. For example, add 10% to the reading for a 0.5mm wall platinum needle and add 20% to the reading for a 1.0mm wall platinum needle to estimate the true Radium activity.

ABBREVIATIONS USED IN TABLE I

Abbreviation	Meaning	Abbreviation	Meaning
eqb.	equilibrium	D	days
S	seconds	Y	years
H	hours	E	exponential, i.e., 3E5 = 3 × 10 ⁵
M	minutes		

UNCERTAINTY DUE TO SYRINGE CORRECTION

The Calibration Setting Numbers are given for approximately 5 grams of radioactive solution in a standard source ampoule made of about 0.6mm thick borosilicate glass. The standard radioactive source in the ampoule is, however, a good approximation for a radiopharmaceutical in a plastic syringe or a glass syringe (wall thickness about 1.2mm) for most radioisotopes.

In general, the attenuation of radiation by a plastic syringe is less than for the standard ampoule, while for most glass syringes, the attenuation will be greater than for the standard ampoule.

The anticipated syringe corrections are listed on the table under the column "Uncertainty Due to Syringe Correction". For example, the required correction for I125 activity is estimated to be about, ±25%. This means that you should add 25% to the meter reading if the I125 is in a glass syringe or subtract 25% if it is in a plastic syringe.

Since the attenuation of low energy radiation is very dependent upon the material of the container, the value given in the syringe correction column should be used mainly as a guide giving relative magnitude.

If a measurement of activity in a glass vial is anticipated, the container correction for low energy isotopes will be substantial. It could be about 3 to 5 times that for a syringe.

If no value is given in this column, the correction is not significant, except for a container differing greatly from the standard ampoule (e.g. very thick glass container, vial made of glass which contains lead, etc.).

UNCERTAINTY DUE TO PUBLISHED DATA

This is the uncertainty on the value of the activity. From calibration numbers calculated from decay data, the uncertainty given is calculated using only the reported errors on the intensity of the γ and/or x-rays. For calibration numbers measured from NBS standard reference materials (known as SRMs), the uncertainty given is the reported uncertainty on the activity of the SRM. For these numbers, the reference is given as NBS (or LMR - Laboratoire de Metrologie de la Radioactivite - France), and year of source.

HALF-LIFE

The number before the letter is the value of the half-life. The number following the letter is the reported uncertainty on the half-life.

Examples:

12.34	D1	means	12.34 days	± 0.01 days
12.34	D11	means	12.34 days	± 0.11 days
12.340	D1	means	12.340 days	± 0.001 days
1.234	D1	means	1.234 days	± 0.001 days

REFERENCES

This is the source of the data from which the calibration number was calculated. NBS or LMR means that the calibration number was obtained by measuring a standard reference material (SRM).

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TABLE I

CAUTION: The calibration numbers given in this table are based upon the NIST SRM geometry (5ml of solution in glass ampoule with 0.6mm wall thickness). Listed numbers should provide an accuracy of $\pm 5\%$ when compared to a NIST SRM. Different source geometries (e.g. capsules, seeds, ribbons) may require geometry correction factors or different calibration numbers. However, no warranty of any kind can be made as to their accuracy, since there are many other uncontrollable factors (as well as the accuracy of the published data) involved in the determination of the overall accuracy of an assay. Reference previous sections of this manual for a discussion of some of the conditions under which the calibration numbers are valid.

Radioisotopes	Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
⁷ Be	Beryllium	179 x 10		53.284 D 4	NM75	
¹¹ C	Carbon	457		20.38 M 2	ORNL76	
¹³ N	Nitrogen	457		9.965 M 4	ORNL76	
¹⁵ O	Oxygen	462		122.24 S 14	ORNL76	
¹⁸ F	Fluorine	472		109.71 M 2	NIST 08	
²² Na	Sodium	957		2.602 Y 1	NBS73	Ref. for 0.51, 1.27 MeV
²⁴ Na	Sodium	658 ÷ 2		14.959 H 4	ORNL76	
²⁶ Al	Aluminum	481 ÷ 2		7.2E5 Y 3	ORNL76	
²⁷ Mg	Magnesium	331		9.458 M 12	ORNL76	
²⁸ Mg	Magnesium	719	3	20.91 H 3	ORNL76	Pure; NOTE: NM75 yields a Cal. No. of 804
²⁸ Al	Aluminum	583		2.244 M 3	ORNL76	Pure
²⁸ Mg	Magnesium (Eqb. ²⁸ Al)	656 ÷ 2	3	20.91 H 3	ORNL76	Reading gives ²⁸ Mg Act. in eqb. sample. Teqb after 15 minutes.
²⁸ Al	Aluminum (Eqb. ²⁸ Mg)	656 ÷ 2		2.244 M 3	ORNL76	Reading gives ²⁸ Al Act. in eqb. sample. Teqb. after 15 minutes
²⁸ Mg	Magnesium Eqb.	656	3		ORNL76	Reading gives sum of ²⁸ Mg & ²⁸ Al activity in equilibrium sample.
²⁸ Al	Aluminum					
³² P	Phosphorus	750 x 100		14.29 D 2	NBS76	Estimation use only.
³⁸ Cl	Chlorine	470		36.51 M 4	NDT70	
⁴⁰ K	Potassium	520 x 10		1.28E9 Y 1	NM75	
⁴¹ Ar	Argon	468		1.827 H 7	ORNL76	
⁴² K	Potassium	033 or 152 x 2		12.36 H 1	ORNL76	
⁴³ K	Potassium	430		22.3 H 1	ORNL76	
⁴⁴ Sc	Scandium	938		3.927 H 8	ORNL76	

Radioisotopes	Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
⁴⁴ Ti	Titanium	514	2	47.3 Y 12	ORNL76	
⁴⁶ Sc	Scandium	822		83.79 D 2	ORNL76	
⁴⁷ Ca	Calcium	373		4.536 D 2	ORNL76	Pure; ⁴⁷ Ca decays to ⁴⁷ Sc. Eqb. in 90 days.
⁴⁷ Sc	Scandium	026 or 618 × 2		3.351 D 2	ORNL76	Pure; see App. IV for non-eqb.
⁴⁸ V	Vanadium	569 ÷ 2		15.974 D 3	ORNL76	
⁴⁹ Ca	Calcium	956	2	8.72 M 2	NDT70	Pure; decays to ⁴⁹ Sc
⁵¹ Cr	Chromium	100 × 10		27.702 D 4	NBS76	Ref. for 320 keV
⁵² Mn	Manganese	676 ÷ 2		5.591 D 3	ORNL76	
^{52m} Mn	Manganese	461 ÷ 2		21.1 M 2	ORNL76	Decays to ⁵² Mn
⁵² Fe	Iron	374		8.275 H 8	ORNL76	^{52m} Mn will contribute to dose.
⁵⁴ Mn	Manganese	309		312.14 D 5	ORNL76	
⁵⁵ Fe	Iron	374		2.72 Y 2	ORNL76	
⁵⁵ Co	Cobalt	481	7	17.54 H	NDS76	
⁵⁶ Co	Cobalt	648 ÷ 2		77.9 D 12	NDT70	
⁵⁶ Ni	Nickel	844	4	6.1 D 3	NDT70	Decays to ⁵⁶ Co; See App. IV
⁵⁶ Mn	Manganese	627	2	2.577 H 1	ORNL76	
⁵⁷ Co	Cobalt	112	1.9	271.7 D 2	NBS76	Ref. for 122 keV Capintec Low Energy Reference.
⁵⁸ Co	Cobalt	389		70.82 D 3	ORNL76	
⁵⁹ Fe	Iron	430		44.51 D 2	ORNL76	
⁶⁰ Co	Cobalt	990	1.0-NBS 1.5-LMR	5.2714 Y 5	NBS75	Ref. for 1.17, 1.33 MeV Capintec High Energy Reference
⁶² Cu	Copper	448		9.74 M 2	NM75	Pure
⁶² Zn	Zinc	217		9.22 H	NM75	Pure
⁶² Zn	Zinc (Eqb. ⁶² Cu)	760				Reading gives ⁶² Zn Act. in eqb. sample. Eqb. after 1.5 hours.
⁶² Cu	Copper (Eqb. ⁶² Zn)	745				Reading gives ⁶² Cu Act. in eqb. sample. Eqb. after 1.5 hours.
⁶² Zn	Zinc Eqb. Copper	333			NM75	Reading gives sum of ⁶² Zn & ⁶² Cu activity in equilibrium sample.
⁶² Cu						

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
⁶⁴ Cu	Copper	015 or 115×2			12.701 H 2	ORNL76	
⁶⁵ Zn	Zinc	172			243.9 D 1	ORNL76	
⁶⁶ Ga	Gallium	903		2	9.40 H 7	ORNL76	
⁶⁷ Cu	Copper	052		4	2.575 D 3	ORNL76	
⁶⁷ Ga	Gallium	100		1.4	3.261 D 1	NBS78	
⁶⁸ Ga	Gallium	416			68.0 M 2	ORNL76	
^{69m} Zn	Zinc	143			13.76 H 3	ORNL76	
⁷² As	Arsenic	795			26.0 H 1	ORNL76	
⁷² Ga	Gallium	$470 \div 2$		2	14.10 H 1	ORNL76	
⁷³ As	Arsenic	324×10	4	3	80.30 D 6	ORNL76	
⁷³ Se	Selenium	748			7.15 H 8	ORNL76	Decays to ⁷³ As.
⁷⁴ As	Arsenic	304		5	17.78 D 3	ORNL76	
⁷⁵ Se	Selenium	258		2.5	119.8 D 1	NBS75	
⁷⁶ As	Arsenic	110		6	26.32 H 7	ORNL76	
⁷⁷ As	Arsenic	481×100		26	38.8 H 3	ORNL76	Estimation use only.
⁷⁷ Br	Bromine	091		3	56 H 2	ORNL76	
⁷⁹ Kr	Krypton	050		3	35.04 H 10	ORNL76	
⁸¹ Rb	Rubidium	174			4.58 H	NM75	Pure
^{81m} Kr	Krypton	915×10			13 S 1	NM75	Pure
⁸¹ Rb	Rubidium					NM75	Reading gives act. of ⁸¹ Rb or ^{81m} Kr in equilibrium sample.
^{81m} Kr	Krypton	Eqb.	270				Eqb. after 2 minutes.
⁸² Br	Bromine	$536 \div 2$		2	35.34 H 2	ORNL76	
⁸² Rb	Rubidium	504			1.273 M 2	NM75	
⁸⁴ Rb	Rubidium	347			32.77 D 4	NM75	
^{85m} Kr	Krypton	065		1	4.480 H 8	ORNL76	Decays to ⁸⁵ Kr
⁸⁵ Kr	Krypton	031×100		2	10.72 Y 1	ORNL76	
⁸⁵ Sr	Strontium	193		1.0	64.854 D 3	NBS75	
⁸⁶ Rb	Rubidium	411×10			18.64 D 2	ORNL76	
⁸⁶ Y	Yttrium	$711 \div 2$			14.74 H 2	ORNL76	
⁸⁶ Zr	Zirconium	167	18	3	16.5 H 1	ORNL76	
⁸⁷ Kr	Krypton	250		6	76.3 M 5	ORNL76	
^{87m} Sr	Strontium	095			2.805 H 3	ORNL76	Pure
⁸⁷ Y	Yttrium	170		1	80.3 H 3	ORNL76	Pure

Radioisotopes	Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
⁸⁷ Y	Yttrium (Eqb. ^{87m} Sr)	357			ORNL76	Reading gives ⁸⁷ Y Act. in eqb. sample. Eqb. after 18 hours.
⁸⁷ Y	Yttrium Eqb.	341	2		ORNL76	Reading gives sum of ⁸⁷ Y & ^{87m} Sr activity in equilibrium sample.
^{87m} Sr	Strontium					
⁸⁸ Rb	Rubidium	189	14	17.8 M 1	ORNL76	
⁸⁸ Y	Yttrium	465 ÷ 2	1.8	106.61 D 2	NBS73	
⁸⁹ Rb	Rubidium	768	1	15.2 M 1	ORNL76	
⁹⁰ Y	Yttrium	48 × 10		64.0 H 1	NIST92	Estimation use only.
⁹¹ Y	Yttrium	850 × 10		58.5 D 4	NDT70	Almost pure β decay. Estimation use only.
⁹⁴ Nb	Niobium	673		2.03E4 Y 16	ORNL76	
⁹⁵ Nb	Niobium	285		34.97 D 1	NDT70	Pure
⁹⁵ Zr	Zirconium	271		64.02 D 5	NDT70	Pure
⁹⁵ Zr	Zirconium Eqb.	145		^{95m} Nb 3.61 D 1	NDT70	Reading gives sum of ^{95m} Nb & ⁹⁵ Nb activity in equilibrium sample. Eqb. after 2 years.
^{95m} ⁹⁵ Nb	Niobium					
⁹⁷ Nb	Niobium	249		72.1 M 7	ORNL76	
⁹⁷ Zr	Zirconium Eqb.	341	12	16.90 H 5	ORNL76	Reading gives sum of ⁹⁷ Zr & ^{97m} Nb activity in equilibrium sample. Eqb. after 10 minutes.
^{97m} Nb	Niobium					
^{97m} Nb	Niobium	271		60 S 1	ORNL76	
⁹⁷ Ru	Ruthenium	116	15	2.9 D 1	ORNL76	Decays to ^{97m} Tc
^{97m} Tc	Technetium	256 × 10	65	91.0 D	NM75	Estimation use only.
⁹⁹ Mo	Molybdenum (in Std. Mo Kit)	080 × 5 or 246 × 10 or 030 × 3.5			NTS78	
⁹⁹ Mo	Molybdenum (in CAP-MAC)	030 × 4 or 204 × 10			NBS78	
⁹⁹ Mo	Molybdenum (in MAC-S)	030 × 4 or 204 × 10			NBS78	
⁹⁹ Mo	Molybdenum (Eqb. ^{99m} Tc)	165	2	1.9	65.92 H 2	NBS78
^{99m} Tc	Technetium	080	2	6.007 H 1	NBS76	
^{99m} Tc	Technetium (in CAP-MAC)	042		6.007 H 1	NBS76	

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
^{99m} Tc	Technetium (Eqb. ⁹⁹ Mo)	175	2			NBS78	
⁹⁹ Mo	Molybdenum Eqb.	145	2			NBS78	Reading gives sum of ⁹⁹ Mo & ^{99m} Tc activity in equilibrium sample.
^{99m} Tc	Technetium						
¹⁰³ Pd	Palladium	562 × 10	50	4	16.97 D 2	ORNL76	Pure
¹⁰³ Pd	Palladium Eqb.	634 × 10	50	5		ORNL76	Reading gives sum of ¹⁰³ Pd & ^{103m} Rh activity in equilibrium sample.
^{103m} Rh	Rhodium						Eqb. after 9 hours.
^{103m} Rh	Rhodium						
^{103m} Rh	Rhodium	631 × 100	50	5	56.114 M 6	ORNL76	
¹⁰³ Ru	Ruthenium	165	50	3	39.26 D 2	ORNL76	
¹⁰³ Ru	Ruthenium Eqb.	172	50			ORNL76	Reading gives sum of ¹⁰³ Ru & ^{103m} Rh activity in equilibrium sample.
^{103m} Rh	Rhodium						Eqb. after 9 hours.
¹⁰⁶ Ru	Ruthenium (Eqb. ¹⁰⁶ Rh)	027 or 140 × 2			369 D 2	NDT70	Reading gives ¹⁰⁶ Ru Act. in eqb. sample. Eqb. after 5 minutes.
¹⁰⁶ Ru	Ruthenium Eqb.	480 × 10			369 D 2	NDT70	Reading gives sum of ¹⁰⁶ Ru & ¹⁰⁶ Rh activity in equilibrium sample.
¹⁰⁶ Rh	Rhodium						
^{108m} Ag	Silver	830	3		127 Y 21	ORNL76	
¹⁰⁸ Ag	Silver	099 × 10	6	15	2.37 M 1	ORNL76	Large β contribution.
¹⁰⁹ Cd	Cadmium	047 or 180 × 2	40	4	462.6 D 4		Reading gives act of ¹⁰⁹ Cd, ^{109m} Ag, or Total
^{109m} Ag	Silver				39.8 S		Act. in eqb. sample. Eqb. after 6 minutes.
¹⁰⁹ Pd	Palladium				13.427 H 14		Reading gives act of ¹⁰⁹ Pd, ^{109m} Ag, or Total
^{109m} Ag	Silver	435 × 10			39.8 S		Act. in eqb. sample. Eqb. after 6 minutes.
^{110m} Ag	Silver	554 ÷ 2		2	249.8 D 1	ORNL76	
¹¹¹ Ag	Silver	054 × 10		30	7.45 D 1	ORNL76	
¹¹¹ In	Indium	303	10	1.36	2.805 D 1	NBS77	
¹¹³ Sn	Tin	022 or 129 × 2	35	5	115.08 D 3	MARTIN77	For pure ¹¹³ Sn.
^{113m} In	Indium	076	7	2	1.658 H 1		Separated for pure ^{113m} In.
¹¹³ Sn	Tin Eqb.	180	15	3.2	NBS73,77		Reading gives act. of ¹¹³ Sn, ^{113m} In, or Total
^{113m} In	Indium						Act. in eqb. sample. Eqb. after 15 hours.
^{115m} In	Indium	058	15	2	4.486 H 4	ORNL76	

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
^{116m} In	Indium	974		3	54.15 M 6	ORNL76	
^{117m} Sn	Tin	180	15	2	13.61 D 4	ORNL76	
¹¹⁷ Sb	Antimony	082	3	2	2.80 H 1	ORNL76	
^{119m} Sn	Tin	657 × 10	35	4	293.0 D 13	ORNL76	
^{121m} Te	Tellurium	187	12	9	154 D 7	ORNL76	Pure
¹²¹ Te	Tellurium	373	10	3	17 D 1	ORNL76	Pure
^{121m} Te	Tellurium						Reading gives act. of ^{121m} Te or ¹²¹ Te in eqb. sample. Eqb. in 120 days. See App. IV for non-eqb. samples.
¹²¹ Te	Tellurium	Eqb.	645				
¹²¹ Te	Tellurium						
^{121m} Te	Tellurium						Reading gives sum of ^{121m} Te or ¹²¹ Te in eqb. sample.
¹²¹ Te	Tellurium	Eqb.	572				
¹²¹ Te	Tellurium						
¹²² Sb	Antimony	146		6	2.70 D 1	ORNL76	
¹²³ I	Iodine	277	15	1.9	13.221 H 3	NBS77	Ref. for 28 keV x-ray.
^{123m} Te	Tellurium	177	12		119.7 D 1	NDT70	
¹²⁴ Sb	Antimony	720			60.20 D 3	ORNL76	
¹²⁴ I	Iodine	570	5		4.18 D 2	ORNL76	
¹²⁵ I	Iodine	319	25	1.45	59.6 D 2	NBS76	
¹²⁵ Sb	Antimony	289	10		2.758 Y 1	NDT70	Pure
¹²⁵ Sb	Antimony	371	12		2.758 Y 1	NDT70	Reading gives ¹²⁵ Sb Act. in eqb. sample. Eqb. after 1 year.
¹²⁵ Sb	Antimony						
¹²⁵ Sb	Eqb.	364	12			NDT70	Reading gives sum of ¹²⁵ Te and ^{125m} Te in eqb. sample. See App. IV for non-eqb. activity.
^{125m} Te	Tellurium						
^{125m} Te	Tellurium						
^{125m} Te	Tellurium	259	25		57.40 D 5	NDT70	
¹²⁶ I	Iodine	240	10	18	13.02 D 7	ORNL76	
¹²⁷ Xe	Xenon	371	12	5	36.4 D 1	ORNL76	
^{129m} Te	Tellurium	817 × 10	20	5	33.6 D 1	ORNL76	Pure
¹²⁹ Te	Tellurium	679 × 10	15	13	69.6 M 2	ORNL76	Pure
^{129m} Te	Tellurium						
¹²⁹ Te	Eqb.	054					
¹²⁹ Te	Tellurium						
¹²⁹ Cs	Cesium	397	15	20	32.06 H 6	ORNL76	NM75 gives 488
¹²⁹ I	Iodine	166	20		1.57E7 Y 4	ORNL76	
^{129m} Xe	Xenon	362	20	3	8.0 D 2	ORNL76	

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
¹³⁰ I	Iodine	984			12.36 H 1	ORNL76	
¹³¹ I	Iodine	151		1.65	8.021 D 1	NBS76	Decays to ^{131m} Xe. 1.1% feeding.
^{131m} Xe	Xenon	089	20	3	11.9 D 1	ORNL76	
¹³¹ Cs	Cesium	148	20	3	9.69 D 1	ORNL76	
¹³¹ Ba	Barium	505	10	7	11.8 D 2	ORNL76	
¹³² Te	Tellurium	315	10	5	76.3 H 2	ORNL76	Pure
¹³² I	Iodine	999			2.30 H 3	ORNL76	Pure
¹³² Te	Tellurium (Eqb. ¹³² I)	675 ÷ 2					Reading gives ¹³² Te Act. in eqb. sample. Eqb. after 1 day.
¹³² I	Iodine (Eqb. ¹³² Te)	653 ÷ 2					Reading gives ¹³² I Act. in eqb. sample.
¹³² Te	Tellurium					ORNL76	Reading gives sum of ¹³² Te and ¹³² I in eqb. sample.
¹³² I	Iodine	663					
¹³² Cs	Cesium	485	10	2	6.475 D 10	ORNL76	
¹³³ I	Iodine	225			20.8 H 1	ORNL76	Decays to ^{133m} Xe.
^{133m} Xe	Xenon	100	20	3	2.19 D 1		Decays to ¹³³ Xe. See App. IV.
¹³³ Xe	Xenon	188	12	1.95	5.243 D 1	NBS76	
^{133m} Ba	Barium	132	12	3	38.9 H 1	ORNL76	Decays to ¹³³ Ba.
¹³³ Ba	Barium	591	10	3	10.5 Y 1	ORNL76	
¹³⁴ Te	Tellurium	533	3	6	41.8 M 8	ORNL76	
^{134m} Cs	Cesium	037 or 160 × 2	15		2.91 H	NM75	Decays to ¹³⁴ Cs.
¹³⁴ Cs	Cesium	726		2.3	2.065 Y 1	NBS73	
^{135m} Xe	Xenon	181	3		15.29 M 3	ORNL76	Decays to ¹³⁵ Xe. See App. IV.
¹³⁵ Xe	Xenon	085	2		9.09 H 1	ORNL76	
^{135m} Ba	Barium	130	15	4	28.7 H 2	ORNL76	
¹³⁶ Cs	Cesium	489 ÷ 2		4	13.1 D 1	ORNL76	
¹³⁷ Cs	Cesium			2.0	30.0 Y 2		Ref: 661.6 & 32.9 keV. Reading gives ¹³⁷ Cs or Total Activity of eqb. sample. Often referred to as "Cs-137" Source.
^{137m} Ba	Barium	220			2.553 M 1	NBS73	
¹³⁹ Ba	Barium	445 × 10	5	12	82.8 M 2	ORNL76	
¹³⁹ Ce	Cerium	352	5	2.6	137.64 D 2	NBS73	Ref: 36.8 keV
¹⁴¹ Ce	Cerium	061	5	5	32.50 D 1	ORNL76	

Radioisotopes	Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
¹⁴² Pr	Praseodymium	226 × 10		14	19.13 H 4	ORNL76
¹⁴⁴ Pr	Praseodymium	137 × 10		5	17.28 M 5	ORNL76
¹⁴⁴ Ce	Cerium					Estimation use only. β dominant.
¹⁴⁴ Pr	Eqb. Praseodymium	387 × 10	5	2.8	285.0 D 1	NBS73 Ref: 36.7 & 133.5 keV. Reading gives sum of ¹⁴⁴ Ce & ¹⁴⁴ Pr Act. in equilibrium sample. Eqb. after 2 hours.
¹⁴⁵ Pm	Promethium	207	10	3	17.7 Y 4	ORNL76
¹⁴⁷ Nd	Neodymium	213	5	4	10.98 D 1	ORNL76
¹⁵⁷ Dy	Dysprosium	424	5		8.1 H 1	NM75
¹⁶⁹ Yb	Ytterbium	948	3	2.5	32.03 D 1	NBS78
¹⁷¹ Tm	Thulium	292 × 100	4		1.92 Y 1	NM75
¹⁷⁵ Yb	Ytterbium	308 × 10	2	13	4.19 D 1	ORNL76
¹⁷⁷ Lu	Lutetium	450 × 10	2	7	6.71 D 1	ORNL76
¹⁸¹ Hf	Hafnium	387		6	42.4 D 1	ORNL76
¹⁸¹ W	Tungsten	165	3	11	121.2 D 3	ORNL76
¹⁸⁸ W	Tungsten	111 × 100		69.4 D 5	NM75	Decays to ¹⁸⁸ Re. Eqb. after 7 days. See App. IV
¹⁸⁸ Re	Rhenium	496 × 10		16.98 H 2	NM75	
¹⁸⁸ W	Tungsten (Eqb. ¹⁸⁸ Re)	522 × 10				Reading gives ¹⁸⁸ W Act. in eqb. sample. Eqb. after 5 days.
¹⁸⁸ Re	Rhenium (Eqb. ¹⁸⁸ W)	516 × 10				Reading gives ¹⁸⁸ Re Act. in eqb. sample.
¹⁸⁸ W	Tungsten Eqb. Rhenium	217 × 10				Reading gives sum of ¹⁸⁸ W & ¹⁸⁸ Re activity in equilibrium sample.
¹⁸⁸ Re	Osmium	858		9.90 M	NM75	
^{190m} Os	Osmium	250	2	13	15.4 D 2	ORNL76
¹⁹¹ Os	Osmium	408		73.83 D 1	NDS73	
¹⁹² Ir	Iridium	469 × 10		18	19.15 H 3	ORNL76
¹⁹⁷ Pt	Platinum	686 × 10	2	6	18.3 H 3	ORNL76
¹⁹⁷ Hg	Mercury	197	2	2.9	64.1 H 1	NBS76
¹⁹⁸ Au	Gold	149		1.65	2.696 D 2	NBS78
¹⁹⁹ Au	Gold	053		6	3.139 D 7	ORNL76
²⁰¹ Tl	Thallium	205	2	2.0	72.91 H 2	NBS76
²⁰³ Hg	Mercury	093		1.1	46.60 D 1	NBS73
²⁰³ Pb	Lead	344		2	51.88 H 1	ORNL76

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %	Published Data %	Half-Life (NCRP-58)	Ref.	Comments
²⁰⁴ Tl	Thallium	420 × 100	2	2	3.78 Y 2	NDT70	
²⁰⁷ Bi	Bismuth	846		1.7	32.2 Y 9	NBS73	Ref. for 1064, 569.7, 76.7, & 1772 keV.
²⁰⁸ Tl	Thallium	571 ÷ 2			3.053 M 4	NM75	
²¹² Pb	Lead	101			10.64 H 1	NM75	Decays to ²¹² Bi. Eqb. after 1 hr. See App. IV.
²¹² Bi	Bismuth	489 × 10			60.55 M 6	NM75	
²¹² Pb	Lead (Eqb. ²¹² Bi)	158					Reading gives ²¹² Pb Act. in eqb. sample. Eqb. after 8 hours.
²¹² Bi	Bismuth (Eqb. ²¹² Pb)	135					Reading gives ²¹² Bi Act. in eqb. sample.
²¹² Pb	Lead Eqb. Bismuth	030 or 146 × 2					Reading gives sum of 212Pb & 212Bi activity in equilibrium sample.
²²⁴ Ra	Radium	646 × 100			3.66 D 4	NM75	
²²⁶ Ra	Radium + chain of daughters	778		0.5	1600 Y 7	NBS73	Reading in grams. Commonly referred to as "Radium" Source. 1.025 g/Ci of Ra-226.
²³⁹ Np	Neptunium	147		6	2.355 D 4	ORNL76	
²⁴¹ Am	Americium	055	4	1	432.2 Y 5	LMR69	Ref. for 59.5 & 14 keV.

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APPENDIX III

MULTIPLICATION FACTORS FOR NON-EQUILIBRIUM RADIOISOTOPES

Ca47 Measurements	III-2
Ni56 Measurements	III-2
Zn62 Measurements	III-3
Y87 Measurements	III-3
Zr95 Measurements	III-4
Te121m Measurements	III-4
Sb125 Measurements	III-5
Te129m Measurements	III-5
Te132 Measurements.....	III-6
Xe133m Measurements	III-6
Xe135m Measurements	III-7
W188 Measurements	III-7
Pb212 Measurements	III-8

Note: These Multiplication Factors apply to the R Chamber only.

The activity in a non-equilibrium sample can be determined by using the following equation:

$$\text{Activity of "A"} = \frac{\text{Meter Reading with Cal. Number for Pure "A"}}{1 + F \frac{T_A}{T_A - T_B} \left[1 - \exp \left(-\frac{T_A - T_B}{T_A \times T_B} \times t \times \ln 2 \right) \right] \frac{R_B}{R_A}}$$

where "A" and "B" are parent and daughter nuclide respectively, T's are half-lives, and R_A and R_B are the chamber responses to the isotopes A and B, "t" is the elapsed time after the pure parent isotope was produced, and "F" is the decay branching ratio.

The chamber response, "R" may be obtained from the calibration number "N," using the following equation:

$$R = \frac{N}{1075.8} + 0.0797$$

When the half-life of the parent nucleus (T_A) is much shorter than that of the daughter nucleus (T_R), the parent decays down to the daughter. After about $10 \times T_A$, we can assume that only the daughter is left (except if the original activity of the parent was exceptionally high). The equation above for the Activity of "A" can be used to obtain the activity of the parent while it has measurable activity.

Multiplication factors obtained by using the equation are given in the following tables for selected isotopes.

CA47 MEASUREMENTS

Use a Calibration Number of 373 and a multiplication factor as indicated in the following table to obtain Ca47 activity at time "t" days after an initially pure source of Ca47 is obtained.

Ca47			
t [days]	Multiplication Factor	t [days]	Multiplication Factor
0	1.000	12	0.672
1	0.950	14	0.648
2	0.906	16	0.627
3	0.869	18	0.609
4	0.836	20	0.594
5	0.806	25	0.566
6	0.781	30	0.545
7	0.757	40	0.519
8	0.737	50	0.496
9	0.718	100	0.485
10	0.701	150	0.484

Ni56 MEASUREMENTS

Use a Calibration Number of 844 and a multiplication factor as indicated in the following table to obtain Ni56 activity at time "t" days after an initially pure source of Ni56 is obtained.

Ni56			
t [days]	Multiplication Factor	t [days]	Multiplication Factor
0	1.000	9	0.824
1	0.985	10	0.799
2	0.969	12	0.745
3	0.952	15	0.659
4	0.934	20	0.508
5	0.915	25	0.366
6	0.894	30	0.249
7	0.872	40	0.101
8	0.849	60	0.013

ZN62 MEASUREMENTS

Use a Calibration Number of 217 and a multiplication factor as indicated in the following table to obtain Zn62 activity at time "t" minutes after an initially pure source of Zn62 is obtained.

Zn62			
t [minutes]	Multiplication Factor	t [minutes]	Multiplication Factor
0	1.000	45	0.368
10	0.526	60	0.361
20	0.425	75	0.359
30	0.389	90	0.358

Y87 MEASUREMENTS

Use a Calibration Number of 170 and a multiplication factor as indicated in the following table to obtain Y87 activity at time "t" hours after an initially pure source of Y87 is obtained.

Y87			
t [hours]	Multiplication Factor	t [hours]	Multiplication Factor
0	1.000	5	0.664
0.25	0.960	6	0.644
0.50	0.926	8	0.618
0.75	0.893	10	0.602
1.00	0.866	12	0.593
1.5	0.820	18	0.582
2.0	0.784	24	0.580
3.0	0.729	48	0.579
4.0	0.691	∞	0.579

ZR95 MEASUREMENTS

Use a Calibration Number of 271 and a multiplication factor as indicated in the following table to obtain Zr95 activity at time "t" days after an initially pure source of Zr95 is obtained.

Zr95			
t [days]	Multiplication Factor	t [days]	Multiplication Factor
0	1.000	40	0.592
2	0.961	50	0.548
4	0.925	60	0.513
6	0.893	80	0.462
8	0.863	100	0.426
10	0.836	150	0.374
15	0.776	200	0.347
20	0.727	300	0.322
25	0.685	600	0.309
30	0.650	∞	0.308

TE121M MEASUREMENTS

Use a Calibration Number of 187 and a multiplication factor as indicated in the following table to obtain Te121m activity at time "t" days after an initially pure source of Te121m is obtained.

Te121m			
t [days]	Multiplication Factor	t [days]	Multiplication Factor
0	1.000	40	0.437
1	0.943	50	0.415
2	0.895	60	0.401
5	0.782	70	0.392
10	0.661	80	0.386
15	0.586	90	0.382
20	0.535	100	0.379
25	0.499	120	0.376
30	0.472	140	0.374

SB125 MEASUREMENTS

Use a Calibration Number of 289 and a multiplication factor as indicated in the following table to obtain Sb125 activity at time "t" days after an initially pure source of Sb125 is obtained.

Sb125			
t [days]	Multiplication Factor	t [days]	Multiplication Factor
0	1.000	90	0.878
10	0.977	120	0.861
20	0.958	150	0.849
30	0.941	180	0.841
40	0.927	360	0.824
50	0.914	540	0.822
60	0.903	∞	0.821

TE129M MEASUREMENTS

Use a Calibration Number of 817 and a multiplication factor as indicated in the following table to obtain Te129m activity at time "t" hours after an initially pure source of Te129m is obtained.

Te129m			
t [hours]	Multiplication Factor	t [hours]	Multiplication Factor
0	10.0	6	6.55
1	8.04	8	6.50
2	7.25	10	6.49
4	6.701	12	6.48
			Equilibrium

TE132 MEASUREMENTS

Use a Calibration Number of 315 and a multiplication factor as indicated in the following table to obtain Te132 activity at time "t" hours after an initially pure source of Te132 is obtained.

Te132			
t [hours]	Multiplication Factor	t [hours]	Multiplication Factor
0	1.000	4	0.342
0.25	0.836	5	0.318
0.50	0.725	10	0.275
1.00	0.586	15	0.266
2.00	0.447	20	0.265
3.00	0.380	24	0.264
Equilibrium			

XE133M MEASUREMENTS

Use a Calibration Number of 100 and a multiplication factor as indicated in the following table to obtain Xe133m activity at time "t" days after an initially pure source of Xe133m is obtained.

Xe133m			
t [days]	Multiplication Factor	t [days]	Multiplication Factor
0	1.000	4	0.465
1	0.824	5	0.385
2	0.680	10	0.151
3	0.562	20	0.024

XE135M MEASUREMENTS

Use a Calibration Number of 181 and a multiplication factor as indicated in the following table to obtain Xe135m activity at time "t" minutes after an initially pure source of Xe135m is obtained.

Xe135m

t [minutes]	Multiplication Factor	t [minutes]	Multiplication Factor
0	1.000	60	0.807
10	0.990	75	0.676
20	0.975	90	0.514
30	0.952	120	0.217
45	0.897	180	0.019

W188 MEASUREMENTS

Use a Calibration Number of 111 and a multiplication factor as indicated in the following table to obtain W188 activity at time "t" hours (or days) after an initially pure source of W188 is obtained.

W188

t [hours]	Multiplication Factor	t [days]	Multiplication Factor
0	100.0	1	5.09
1	45.6	2	3.75
2	29.9	3	3.40
4	18.2	4	3.30
6	13.4	5	3.26
12	8.0	6	3.25
18	6.0	7	3.24

PB212 MEASUREMENTS

Use a Calibration Number of 101 and a multiplication factor as indicated in the following table to obtain Pb212 activity at time "t" hours after an initially pure source of Pb212 is obtained.

Pb212			
t [hours]	Multiplication Factor	t [hours]	Multiplication Factor
0	1.000	5	0.772
0.5	0.924	6	0.768
1.0	0.875	7	0.766
2.0	0.820	8	0.765
3.0	0.793	9	0.765
4.0	0.779	10	0.764
Equilibrium			

APPENDIX IV

OPERATIONAL SUMMARY

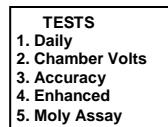
QUALITY CONTROL & DAILY TESTS	IV-1
BACKGROUND ADJUSTMENT	IV-1
MEASURING NUCLIDE ACTIVITY	IV-2
Selecting a Nuclide for Measurement	IV-2
Future Activity	IV-3
ENTER TEST SOURCE DATA	IV-3

Thank you for choosing CAPINTEC. This “Start-Up” aid is designed to allow you to use the CRC®-25R to perform immediate nuclide measurements.

QUALITY CONTROL & DAILY TESTS

Prior to making any activity measurements, Daily Tests must be performed.

From the Measurement screen, press  . The *Tests Menu* will appear.

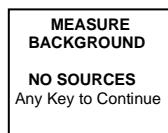


Select Daily by pressing  . The **Daily Tests** include **Auto Zero**, **Background Adjustment**, **Chamber Voltage Test**, **Data Check**, **Accuracy** and **Constancy**. You will be required to perform your normal or manual Accuracy and Constancy tests if you have not entered your **Reference Source** data in the CRC®-25R. To input **Reference Source** data, refer to CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES.

BACKGROUND ADJUSTMENT

Background adjustment is performed automatically in the Daily Test sequence. It can also be performed by pressing the Background key.

To perform a Background Adjustment, press  . The following screen will appear.



Make sure that no sources are in the vicinity of the Chamber. Press any key, other than the **HOME** key, to begin. When a measurement is ready, the message "OK – ENTER to Accept" will appear.

Press . The background value will be stored and automatically subtracted from all measurements.

MEASURING NUCLIDE ACTIVITY

To measure the activity of a sample, simply place the sample in the dipper, lower it into the Chamber, and select the nuclide from the keypad.

Selecting a Nuclide for Measurement

When measuring the activity of a nuclide, you must indicate the nuclide being measured. This can be accomplished in four (4) simple ways:

1. **PRE-SET NUCLIDE KEYS:** There are 8 pre-defined nuclide keys. Each key is labeled to indicate the corresponding nuclide as shown below.



Example: To measure Tc99m, place the sample in the Chamber and press . The activity for Tc99m is automatically displayed.

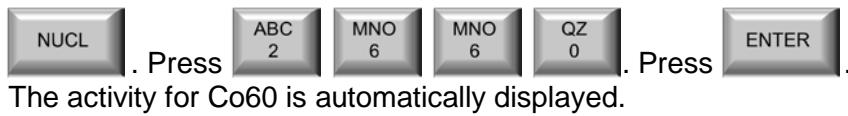
2. **USER DEFINED KEYS:** There are 5 User defined keys. You can assign nuclides to these keys. (See CHAPTER 6: CHAMBER INITIALIZATION, SECTION: USER KEY ASSIGNMENT)



Example: If the assignment for **U1** is Co57, place the sample in the Chamber and press . The activity for Co57 is automatically displayed.

3. **NUCLIDE KEY:** The Nuclide Key allows you to select a nuclide from the list of nuclides that have been stored in the memory. Simply press the **NUCL** key and use the alphanumeric (number/letter) keys to specify the nuclide. After inputting the values press the **ENTER** key.

Example: To measure Co60, place the sample in the Chamber and press

 . Press **NUCL**. Press **ABC 2**, **MNO 6**, **MNO 6**, **QZ 0**. Press **ENTER**.
The activity for Co60 is automatically displayed.

4. **CALIBRATION NUMBERS:** To measure the activity of a nuclide that is not stored in the memory, Pre-Set keys, or User defined keys, press the **CAL#** key, input the Calibration Number for the nuclide using the alphanumeric (number/letter) keys, and press the **ENTER** key. The activity can then be measured. Simply place the sample in the Chamber.

Note: Calibration Numbers for R Chambers are listed in Appendix II.

Example: Press  . Input the Calibration Number. Press .

Future Activity

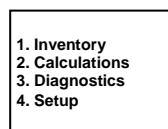
The CRC®-25R has a special feature that allows you to automatically determine the activity of a sample at some point in the future. From the Measurement screen, press **TIME**.

Example: Press  . Input the new time & date in the 24-hour format. Press  . The “FUTURE” activity is displayed.

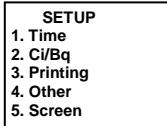
ENTER TEST SOURCE DATA

(Reference CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES)
The Test Source Data must be entered from the *Main Setup Menu*. To access this menu,

press  to return to the Measurement Screen. Press  to display the *Main Menu*.



Select **SETUP**. The *Setup Menu* will appear.

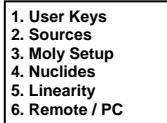


Select OTHER. Input the password (last 3-digits of the readout serial number) and press

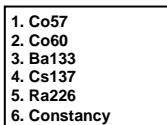


. The *Other Menu* will appear.

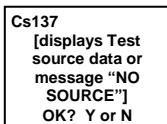
ENTER



Select SOURCES. The *Test Sources Menu* will appear.



Select Cs137. The system will display



If the Test Source data has been input in the system, verify that these are the dates from your Cs137 Test Source and press YES. Press NO if the dates are incorrect or if no source data has been entered in the system.

Input the serial number of the Test Source and press ENTER. Input the Calibration Day and press ENTER. Input the Calibration Activity and press ENTER. Press YES to answer yes to "Use Daily?".

The system will display the entered data. Verify the data and confirm with YES. To correct any errors, press NO.



Press HOME to return to the Measurement Screen.

**For Technical Assistance, contact
Capintec's only Authorized Service Center at (800) ASK-4CRC.**

INDEX

A

Acceptance Testing, 4-9, 7-1
Accredited Dosimetry Calibration
 Laboratory, 1-3
Accuracy Test, 7-2, 7-3, 8-11
 in Daily Test, 8-8
ADCL, 1-3
Adding to Inventory, 12-2
adjustments, 1-4
Alphanumeric
 entering Data, 3-4
 keys, 3-3
ARROW Keys, 3-3
Assembly, 4-3
Auto Zero, 8-4

B

Background, 8-1, 8-5
backlight, 5-17, 5-18
Battery, 15-14
 low, 15-7
 Replacement, 15-7
BKG key, 3-2
Brachytherapy, 1-3, 1-4

C

CAL# key, 3-2, 10-4, 14-3
Calculation Utilities, 14-1
 Ci /Bq Conversion, 14-2
 Decay Calculation, 14-3
Calibration Numbers, 6-16, 6-19, 10-4
 changing, 4-8, 6-21
 determining, 6-17
 entering, 6-16, 10-4
 entering new, 6-20
 Limits, 6-16, 10-5
 restoring, 6-23
Calicheck Test, 11-13
 defining, 6-27
Canister, 4-8, 10-10
CapMac, 4-8, 10-10
CE key, 3-3
Chamber Initialization, 6-1
Chamber Measurement Procedures, 10-2
Chamber Voltage, 8-6, 8-10

Ci / Bq

Choosing, 5-3
Conversion, 14-2
key, 3-3
Cleaning, 15-1, 15-2
Cleaning Instructions, 15-2
Constancy Test, 8-8
 Source, 4-8, 6-9
Contamination Test, 7-3
contrast, 5-17
 screen, 5-19

D

Daily Test, 7-2, 7-3, 8-3
 Accuracy Test, 8-8
 Auto Zero, 8-4
Background, 8-5
Chamber Voltage, 8-6
Constancy Test, 8-8
Data Check, 8-7
 Report, 8-9
Data Check, 8-7
Date
 entering, 5-1
Decay Calculation, 14-3
Deleting from Inventory, 12-13
Description
 Functional, 2-2
 Technical, 2-4
Diagnostics, 9-1
 Test, 7-2, 7-4
Dimensions, 2-6
 Cables, 2-6
 Chamber, 2-6
 Console, 2-6
Dipper, 1-4, 4-5, 15-2
Disinfecting, 15-2
Disinfecting Instructions, 15-3
Disposal, 15-5
division factors, 1-4
Dose Table, 13-1

E

Electromagnetic Interference, 1-5
EMC, 2-7
EMI, 1-5, 5-4

Enhanced Tests, 11-1
Enhanced Tests Menu, 11-1
ENTER key, 3-3
Environment Requirements, 2-4, 4-6
ETL Listed, 2-7

F

Functional Description, 2-2
Fuse Servicing, 15-6

G

Geometry, 7-1
Geometry Test
 Measurement Results, 11-6
Geometry Test, 11-2
Ground Current, 2-5

H

HMPAO Test, 11-21
Holders, optional, 4-5
HOME key, 3-3

I

ID
 User, 10-8
Installation, 4-1
Intended Use, 2-1
Inventory, 12-1
 adding to, 12-2
 deleting from, 12-13
 making a kit, 12-7
 Menu, 12-1
 printing, 12-13
 withdrawing activity from, 12-11
IVBT, 1-3, 1-4

K

Keyboard, 3-1

L

Labels
 Caution, 1-2
 High Voltage, 1-3
 Shipping, 15-16
 Warning, 1-2
Line Filter, 2-5
Line Voltage, 2-5
Linearity Test, 7-1, 7-2, 7-4
 Calicheck-defining, 6-27
 definition, 6-23

Lineator-defining, 6-26
performing, 11-7
Standard-defining, 6-25
Lineator Test, 11-12
 defining, 6-26
Liner, 1-4, 4-5, 15-2
liners, 15-2
Low Activity Measurements, 10-2
Low Battery, 1-1, 15-7

M

MAG3 Test, 11-25
Main Menu, 5-1, 9-1, 12-1, 14-1
maintenance, 15-1
Measurement
 Activity at a Different Time, 10-6
 Calibration Number, 10-4
 Nuclide Specification, 10-3
 Procedures:, 10-2
Measurement Results
 Geometry Test, 11-6
Menu
 Enhanced Tests, 11-1
 Inventory, 12-1
 Main, 5-1, 9-1, 12-1, 14-1
 Nuclides, 6-14
 Other, 6-2
 Screen Setup, 5-17
 Select, 11-2
 Selections, 3-4
 Setup, 5-2
 Test Source, 6-4
 Tests, 8-3, 11-1
MENU key, 2-3, 3-3
Mo/Tc Limit, 4-8
Mo99

 Assay, 10-13
 Background, 10-11
Moly Assay, 4-8, 10-10
CapMac or Canister, 6-11
Limit, 6-13
Results, 10-14
Selecting method, 6-11
multiplication factors, 1-4

N

NUCL key, 3-2, 10-3
Nuclide
 keys, 3-2
 specification, 10-3

Nuclides
adding, 4-8, 6-14
deleting, 6-18
Menu, 6-14
Number / Letter keys, 3-3
Numeric Data
entering, 3-4

O

On / Off Switch, 2-4
Operational Setup, General, 4-7
Operational Summary, 4-9
Operator
Profile, 2-1
Training, 2-2
Other Menu, 6-2

P

Performance, 2-6
Power Requirements, 2-5, 4-6
Preliminary Procedures, 2-4
Pre-Set Nuclide keys, 10-3
Preventative Maintenance, 15-4
Quality Assurance Tests, 15-4
PRINT key, 3-3
printer
None, 5-17
power requirements, 5-5
RS-232, 5-6
selection, 5-5
types, 4-8
USB, 5-16
Printing, 5-4
Record of measurement, 10-9
Printing Inventory, 12-13
Profile
Operator, 2-1
Program Flow, 2-3

Q

QC Tests, 11-15
HMPAO Test, 11-21
MAG3 Test, 11-25
Single Strip Test, 11-16
Two Strips Test, 11-18
Quality Assurance Tests, 7-3, 15-4
Quality Control, 11-15
HMPAO Test, 11-21
MAG3 Test, 11-25
Single Strip Test, 11-16

Two Strip Test, 11-18
Quarterly Tests, 7-4

R
Radiochromatography, 11-15
Range
limits, 2-6
recalibration, 1-5
Receiving Condition Examination, 4-1
Regulatory Listings, 2-7
Electrical, 2-7
EMC, 2-7
ETL Listed, 2-7
Related Products, 15-15
Remote (Legacy Systems Only)
Adding Nuclides, 6-31
Nuclide Assignment, 6-29
Remove Nuclides, 6-30
Requirements
Environment, 2-4, 4-6
Power, 2-5, 4-6
Resolution
Selecting, 10-6

S

Safety, 1-1
Safety Tips, 1-6
screen
contrast, 5-17, 5-19
saver, 5-17, 5-18
setup, 5-17
Screen Setup Menu, 5-17
Select Menu, 11-2
Selecting Resolution, 10-6
Servicing, 15-4
Fuse, 15-6
Setup
General Operational, 4-7
Setup Menu, 5-2
Shipping, 15-16
Single Strip Test, 11-16
SOURCES key, 3-2, 10-5
Standard Linearity Test, 11-7
Defining, 6-25
Symbol Definitions, 1-1
Syringe
Measuring with, 11-2
System Initialization, 5-1
System Setup, 4-1

T

Table

Calibration Number Limits, 6-16, 10-5
Disposal Information, 15-5
Test Source calibration activity limits, 6-8

Tc99m

Assay, 10-14
Technical Description, 2-4

Test

Report, 7-2, 7-3, 8-9

TEST Key, 3-2

Test Source, 4-8, 6-4
calibration activity limits, 6-8
Constancy, 6-9
Daily usage, 6-8
Entering Calibration Activity, 6-7
Entering Calibration Date, 6-6
Entering Serial Number, 6-6
Menu, 6-4

Testing

Acceptance, 4-9, 7-1
Accuracy, 7-2, 7-3, 8-11
Contamination, 7-3
Daily, 7-2, 7-3, 8-3
Diagnostics, 7-2, 7-4
Linearity, 7-2, 7-4
Quality Assurance, 7-3
Quality Control (QC), 11-15

Quarterly, 7-4

Yearly, 7-4

Tests Menu, 8-3, 11-1

Time

entering, 5-1

TIME key, 3-2, 10-6

Training

Operator, 2-2

Troubleshooting, 15-13

Two Strip Test, 11-18

U

Unpacking, 4-1
USB Port Settings, 6-31
User ID number, 10-8, 10-15
User Key Assignment, 4-8, 6-2
USER keys, 3-2, 10-3

V

Voltage
High, 1-3, 1-4

W

Warm Up Period, 2-4
Withdrawing activity from Inventory, 12-11

Y

Yearly Tests, 7-4
Yes or No, 3-4

NEW PRODUCT WARRANTY

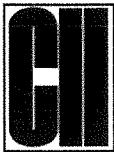
Conditions and Limitations

CAPINTEC warrants our products to be free from defects in material and workmanship for a period of 24 months after delivery to the original buyer (unless indicated otherwise). Our obligation under this warranty is limited to servicing or adjusting products returned to our factory for that purpose promptly upon any claim under this warranty, provided our examination discloses to our satisfaction that the affected parts were originally defective and have not been subjected to misuse, abuse, mishandling or improper operation. This warranty extends to every part of the product except batteries, fuses, ink, magnetic storage media, toner, transistors, tubes or any other normally consumable item. In no event shall we liable for transportation, installation, adjustment or any other expenses which may arise in connection with such products or their servicing or adjustment.

This warranty is expressly in lieu of any other express or implied warranties, and we make no warranty that the products sold herein are merchantable or are suitable for any particular purpose. The benefits of this warranty shall extend only to the buyer and to none other. We shall have no liability of any nature arising out of the use or application of the product in conformity with this warranty. If the product shall fail to perform in conformity with the warranty made herein, we shall be liable solely for the repair and replacement of the product as provided hereinabove, and shall have no other liability in respect of such failure or performance, or any consequences therefrom, including, without limitation, business impairment or loss, personal injury or property damage.

No agent, employee, or representative of ours has any authority to bind us to any representation or warranty concerning the product sold herein, and unless a representation or warranty made by an agent, employee or representative is specifically included herein, it shall not be enforceable by the buyer. No waiver, alteration or modification of the foregoing conditions shall be valid, unless made in writing and signed by an executive officer of our corporation.

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CAPINTEC, INC.

DECLARATION OF CONFORMITY
THE EC DIRECTIVE AND CE MARKING

We, Capintec, Inc.
7 Vreeland Road
Florham Park, NJ 07932
Phone (800) ASK-4CRC
Fax (201) 825-1336

declare under our sole responsibility that the product CRC®-25R RADIOISOTOPE DOSE CALIBRATOR (including use with Epson Roll and Epson Slip printers) to which this declaration relates is in conformity with the Medical Device Directive 93/42/EEC.

This product is in conformity with the following standards or other normative documents following:

1. EN61010-1
2. EN61326-1
3. EN61326-2-6

Certified to Annex V of the Directive 93/42/EEC on Medical Devices
Dose Calibrators, Class I with measuring function

Certified through Intertek Semko AB, Notified Body MDD
CE Mark as shown denotes conformance to the above statement.



The Technical Construction File is maintained at:

Capintec, Inc. Phone: (800) ASK-4CRC
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