

CRC[®]-15W Enhanced

OWNER'S MANUAL

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WARRANTY

DECLARATION OF CONFORMITY

PREFACE

Thank you for purchasing the Capintec, Inc. CRC®-15W Enhanced 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.

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SYSTEM DESCRIPTION

The basic CRC®-15W Enhanced Radioisotope Dose Calibrator consists of the following:

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

The CRC®-15W Enhanced has the capability to perform dose calibration, wipe tests and lab tests such as Schilling, Dicapac®, and Blood Volume.

The CRC®-15W Enhanced is a CRC®-15W with the following enhancements:

- Dose Table
- Inventory Functions
- Geometry Test
- Linearity Tests
 - o Standard Test
 - o Lineator
 - o Calicheck
- QC Tests
 - o 1 Strip
 - o 2 Strips
 - o Tc99m HMPAO
 - o Tc99m MAG3

YEAR 2000 COMPLIANCE

The CRC®-15W Enhanced measurement systems contain 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.
- 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 EN 60601-1-2 "Medical electrical equipment: Part 1: General safety requirements; 2. Supplementary standard: Electromagnetic compatibility".

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 Authorized Service Center.

IMPORTANT SAFETY INFORMATION

The CRC®-15W Enhanced measurement system has been carefully designed to give you years of safe and reliable performance. As with all electrical equipment, however, there are basic precautions you must observe to avoid injuring yourself, the patient or damaging the equipment.

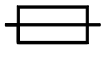
- **Follow** the unpacking and assembly instructions document, and **read** this manual carefully before using this equipment. Be sure to save all provided documents for future reference.
- **Understand all** warning and caution labels as explained in the “**SAFETY**” chapter before operating this equipment.

CHAPTER 1

SAFETY

These warnings and instructions for use form an integral part of the CRC®-15W Enhanced 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
	Protective Earth Ground
	Attention: consult owner's manual for further information
	Fuse
	AC Voltage
	"ON" (power)
	"OFF" (power)
	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.

Please reference CHAPTER 18: CLEANING AND MAINTENANCE for instructions on how to change the fuses of the CRC®-15W Enhanced.

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

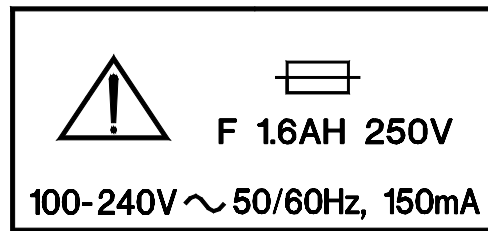


Figure 1-1

Located on the bottom of the chamber are 2 labels.

The first label, (Figure 1-2), contains statements denoting not to remove the cover because there are no adjustments that the user can perform in the chamber.

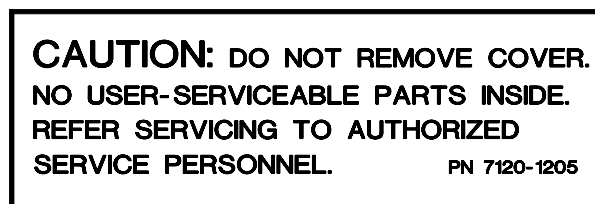


Figure 1-2

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



Figure 1-3

Located on the back of the Well Detector is a label (Figure 1-3) which pertains to the electrical safety of the Well Detector. It is necessary because of the high voltage present (approximately 1000 volts) on the inside of the Well Detector. A screwdriver is necessary to remove the cover.

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

High voltage is present inside the chamber (up to 180 Volts) and the Well Detector (up to 1000 Volts). Due to the presence of these high voltages, 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

Never use the calibrator without the well liner in place. Liners are inexpensive and easy to replace. A contaminated chamber is a very costly mistake. If unit becomes contaminated remove liner and clean unit as stated in CHAPTER 18: CLEANING AND MAINTENANCE 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 well. Dropping any heavy object into the well 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®-15W Enhanced 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 three 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[®]-15W Enhanced or the CRC[®]-15W Enhanced 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 by Capintec's Authorized Service Center (see CHAPTER 18: 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®-15W Enhanced calibrator.
- The CRC®-15W Enhanced 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.
- Do not subject the Detectors to rough handling, or rapid temperature changes, as the NaI Scintillation Crystal can be damaged.

CHAPTER 2

FUNCTIONAL & TECHNICAL DESCRIPTION

FUNCTIONAL DESCRIPTION

The CRC®-15W Enhanced 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 one of the detectors (ionization chamber or counter) 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, see 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 (0.1 megabecquerel) for most radioisotopes to as high as 8 curies [200 giga (10⁹) Becquerel] 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.

With its NaI drilled-well crystal detector, the Well Counter offers greater sensitivity and faster results than other wipe test monitors that use Geiger-Mueller (GM) tubes.

The microprocessor-controlled CRC®-15W Enhanced has an automatic internal energy calibration feature, which permits self-calibration of the keV per channel ratio.

It also automatically calculates the conversion factor and converts readings in cpm [counts per minute] to dpm [disintegrations per minute]. Most federal and state regulations require survey monitoring results in dpm.

Capabilities and Features	NaI Drilled-Well Crystal	GM-Tube Detector
Counting time required to achieve sensitivity of 1 nCi (2220 dpm), required by regulations	6 to 180 sec (0.1 to 3.0 min)	300 to 6,000 sec (5 min to 10 min)
Counting time recommended for low background levels	1 to 3 min	at least 20 min
Offers energy discrimination, which helps users identify radionuclide contaminants with gamma spectroscopy	Yes	No
Achieves sensitivity of 200 dpm, required for iodine therapy	Yes	No
Handles high count rates (60,000 cps) before exceeding 30% dead time	Yes	No
Evaluates identity of radiopharmaceuticals and brachytherapy sources, helps identify contaminants	Yes	No

The CRC®-15W Enhanced stores conversion factors and gamma spectroscopy data for 68 radionuclides. Users can add ten more radionuclides to the CRC®-15W Enhanced memory.

Note: *The CRC®-15W Enhanced is not designed to provide conclusive identification of radionuclides in samples. The CRC®-15W Enhanced is designed to provide the first step for users who need to identify contaminants by narrowing down the possibilities of which isotopes are contained in wipe test samples.*

The CRC®-15W Enhanced can also give “generic” results for a wipe sample by grouping all six channels together as one open energy window. The generic count indicates whether a sample exceeds trigger levels, but does not help identify the contaminant.

OVERALL PROGRAM FLOW

When the power is turned on, the Sign-On Screen appears. When the **ENTER** key is pressed, the Chamber Measurement Screen is displayed and the CRC®-15W Enhanced begins measuring the activity in the Chamber. All Chamber measurements and the Main Utility Menu are accessed from this screen. The **WELL** key is used to access Counter measurements and utilities for the Counter. These features are illustrated in Figure 2-1.

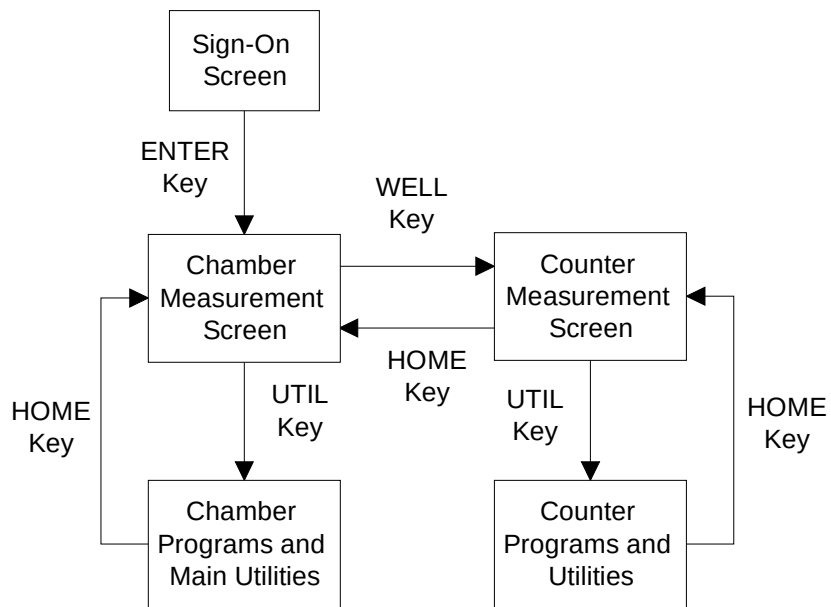


Figure 2-1 Overall Program Flow

Utility Programs

Utility Programs can be accessed by pressing the **UTIL** key from the Chamber Measurement Screen or the Counter Measurement Screen. The Main Utilities consists of calculation utilities, utilities for the Chamber and utilities for both the Chamber and Counter and are accessed from the Chamber Measurement Screen. Utilities accessed from the Counter Measurement Screen relate only to the Counter. Figure 2-2 illustrates the utilities available from the Main Utility Menu. Figure 2-3 illustrates the utilities available from the Counter Utility Menu.

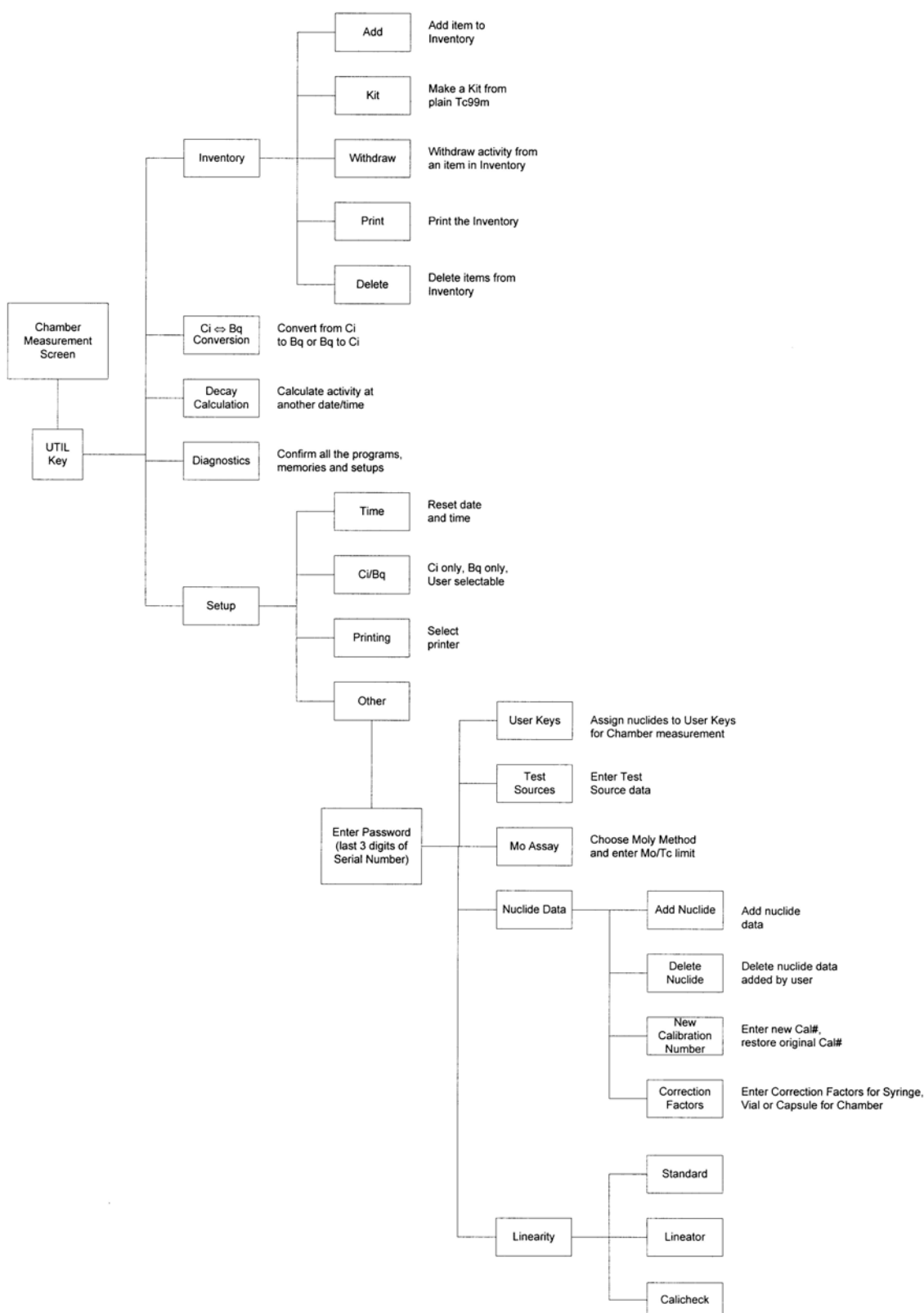


Figure 2-2 Utilities Accessed From Chamber Measurement Screen

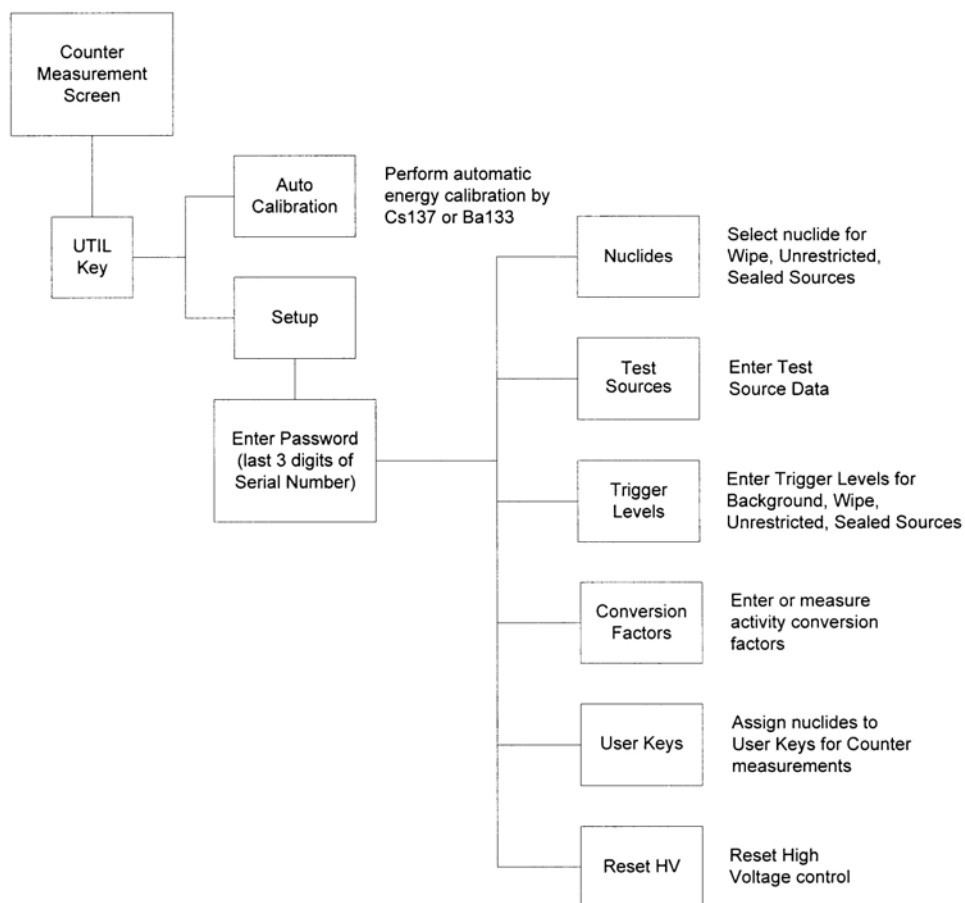


Figure 2-3 Utilities Accessed From Counter Measurement Screen

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®-15W Enhanced.

Environment Requirements

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, 150mA, 50/60Hz

Printers

Okidata Microline 320

120VAC, 60Hz, 0.9A or

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

Epson TM-295II Slip Printer (optional)

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

Epson TM-U200D Roll Printer (optional)

Input: 120VAC, 60Hz, 0.45A; **Output:** 33VDC, 1.2A or

Input: 220VAC, 50/60Hz, 1.2A; **Output:** +24VDC, 0.8A

Remote Display Unit

Input: 90~264VAC, 47-63Hz, 0.40A; **Output:** +5.0 VDC, 2.4A

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	12.1cm	(4.75in)
Width	25.4cm	(10.0in)
Depth	26.7cm	(10.5in)
Weight	1.9kg	(4.2lb)

Well Counter:

Height	23.8cm	(9.38in.)
Diameter	15.2cm	(6in.)
Weight	6.9kg	(15.2lb.)
Well Diameter	1.7cm	(.67in.)
Well Depth	3.8cm	(1.5in.)
Cable Length	2.7m	(9ft.)

Chamber:

Height	41.9cm	(16.5in)
Diameter	17.2cm	(6.76in)
Weight	13.6kg	(30lb)
Well Diam.	6.1cm	(2.4in)
Well Depth	25.4cm	(10.0in)
Cable Length ²	2.4m	(8ft)

Cables:

Power	1.8m	(6ft)
Printer ¹	1.8m	(6ft)

Performance

Chamber Performance:

Resolution	.001 MBq (.01 μ Ci)
Electrometer Accuracy ³	better than $\pm 2\%$
System Precision	better than $\pm 0.1\%$ of FSD
System Linearity	within $\pm 2\%$
Response Time (Low activity sample)	within 4 or 16 sec.
Response Time (All other samples)	within $\pm 1\%$

Counter Performance:

Type	Drilled-well crystal, NaI(Tl) scintillator
Crystal Dimensions	3.8cm (1.5") $\times$ 4.4cm (1.75")
Shielding	1.3cm (0.5") lead
Cabling	2.75m (9 ft) interconnecting cable
Counting Rate	60 kcps, max
Energy Discrimination	Fixed 6 channel MCA
Channel Ranges	Ch 1: 15-100 keV Ch 2: 100-200 keV Ch 3: 200-400 keV Ch 4: 400-660 keV Ch 5: 660-800 keV Ch 6: Over 800 keV

¹ Optional² Longer cables are available. Consult factory.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®-15W Enhanced has been independently tested and is manufactured in compliance with the following Standards:

EMC

- European Union Norm EN 60601-1-2: Medical Electrical Equipment – Part 1 General Requirements for Safety – Section 1.2 Collateral Standard: Electromagnetic Compatibility – Requirements and Tests

Electrical

- European Union Norm EN 60601-1: Medical Electrical Equipment – Part 1 General Requirements for Safety
- European Union Norm EN 60601-1-1: Medical Electrical Equipment – Part 1 General Requirements for Safety – Section 1.1 Collateral Standard: Safety Requirements for Medical Electrical Systems

ETL Listed

CHAPTER 3

GENERAL OPERATING INSTRUCTIONS

GENERAL

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

KEYBOARD

Layout

CRC®-15W Enhanced keyboard is shown below.

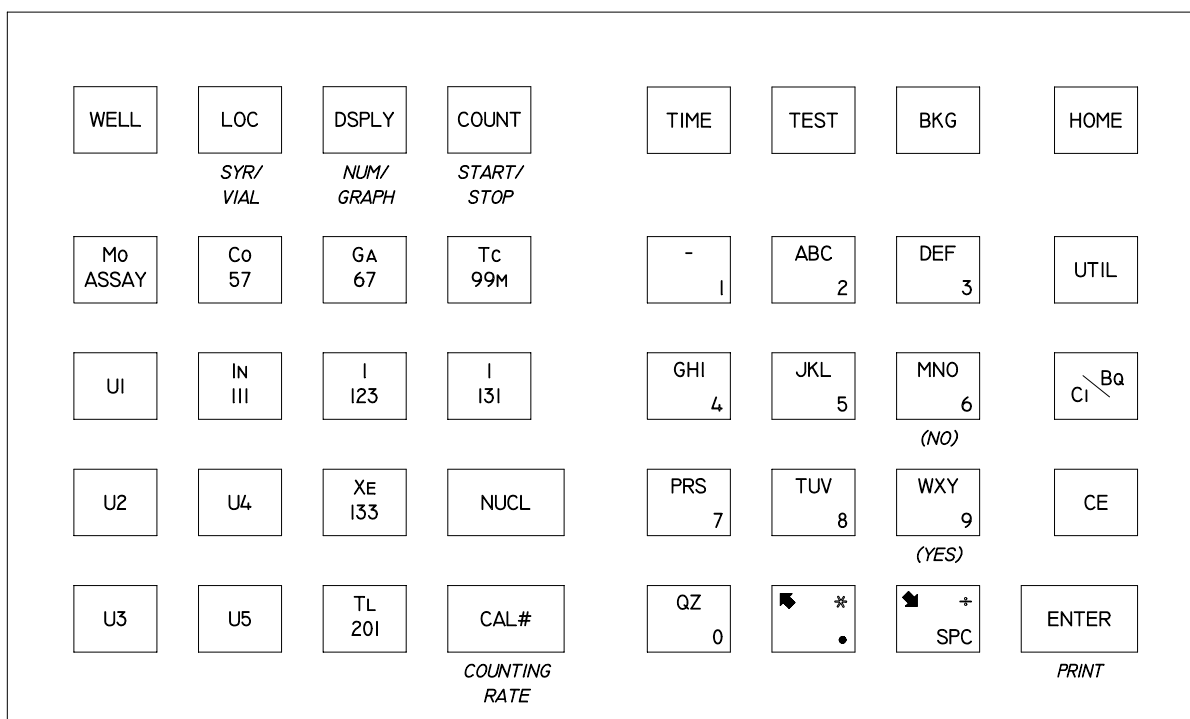


Figure 3-1 Keyboard

Key Usage

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

WELL Key

When the instrument is first powered up, it is in Chamber mode. That is, it is set up to make measurements using the Chamber. Pressing the **WELL** key will put the instrument in the Well Counter mode, which means it will be set up to make measurements using the Well Counter.

NUCLIDE Keys: Co57, Ga67, Tc99m, In111, I 123, I 131, Xe133, TI201

Pressing one of these keys selects that nuclide.

USER Keys: U1, U2, U3, U4, U5

Any nuclide in memory (including nuclides added by the user) may be assigned to each User Key. One set of User Keys can be set up for the Chamber and a different set can be set up for the Well Counter. When a key is assigned, it acts just like a Nuclide Key.

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

Pressing this key in Chamber mode allows the user to input a calibration number to be used for the current measurement.

Pressing this key in Well Counter mode will calculate and display the cpm (or cps) for all the channels (i.e., no nuclide selected).

TIME Key

This key is only used in Chamber Mode. 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.

Pressing this key twice selects the Dose Table function. (See CHAPTER 13: DOSE TABLE)

TEST Key

Pressing this key in Chamber mode brings up the Chamber Test Menu.

Pressing this key in Well Counter mode performs the Well Counter Test.

BKG Key

Pressing this key steps the user through the Background Measurement. The background will be measured and stored for the Chamber when background is measured in the Chamber mode and will be measured and stored for the Well Counter when background is measured in the Well Counter Mode.

HOME Key

Pressing this key in Chamber Mode or at the Well Counter Measurement Screen will return the user to the Chamber Measurement Screen.

Pressing this key while in Well Counter Mode (but not in the Measurement Screen) will return the user to the Well Counter 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).

UTIL Key

Pressing this key in Chamber mode brings up the Main Utility Menu. This includes functions for the Chamber, functions for the printing of the Well Counter results and type of printer.

Pressing this key in Well Counter mode brings up the Well Counter Utility Menu. This includes functions used only for the Well Counter.

LOC Key

In the Well Counter mode, pressing this key allows the user to change the location number of the wipe.

In the Chamber mode, pressing this key allows the user to select the container type being measured. (i.e. Syringe, Vial, Capsule)

DSPLY Key

This key is only used in Well Counter mode. Pressing this key switches between text display and graphic display.

COUNT Key

This key is only used in Well Counter mode. Pressing this key begins a measurement. Pressing it during a measurement stops the measurement.

MO ASSAY Key

This key is only used in Chamber mode. Pressing this key steps the user through a Molyassay procedure.

NUMBER / LETTER Keys

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

CE Key

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

ENTER Key

This is used to accept entered data and print a record of the measurement.

ARROW Keys (↵ and ⏮)

When alphanumeric input is being entered, the Arrow keys are used to scroll through the possible values on each number/letter key.

During a Chamber 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.

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.

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 also entered via the NUMBER/LETTER keys.

When a NUMBER / LETTER key is pressed, the number appears. Use the **ARROW** keys to change the number into one of the letters on the same key. When the **UP ARROW** (↶) is pressed, the letters appear in the clockwise direction. When the **DOWN ARROW** (↷) is pressed, the letters appear in the counter-clockwise direction.

Making Menu Selections

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

To make a selection, press the NUMBER/LETTER 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

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 carton. (If an optional printer or remote display is included, they will be in separate cartons)

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
 - Well Detector
 - Power Cord
 - Remote Display and cable (if ordered)
 - Printer (if ordered)
 - o OKIDATA MICROLINE 320, or
 - o EPSON SLIP PRINTER, or
 - o EPSON ROLL 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

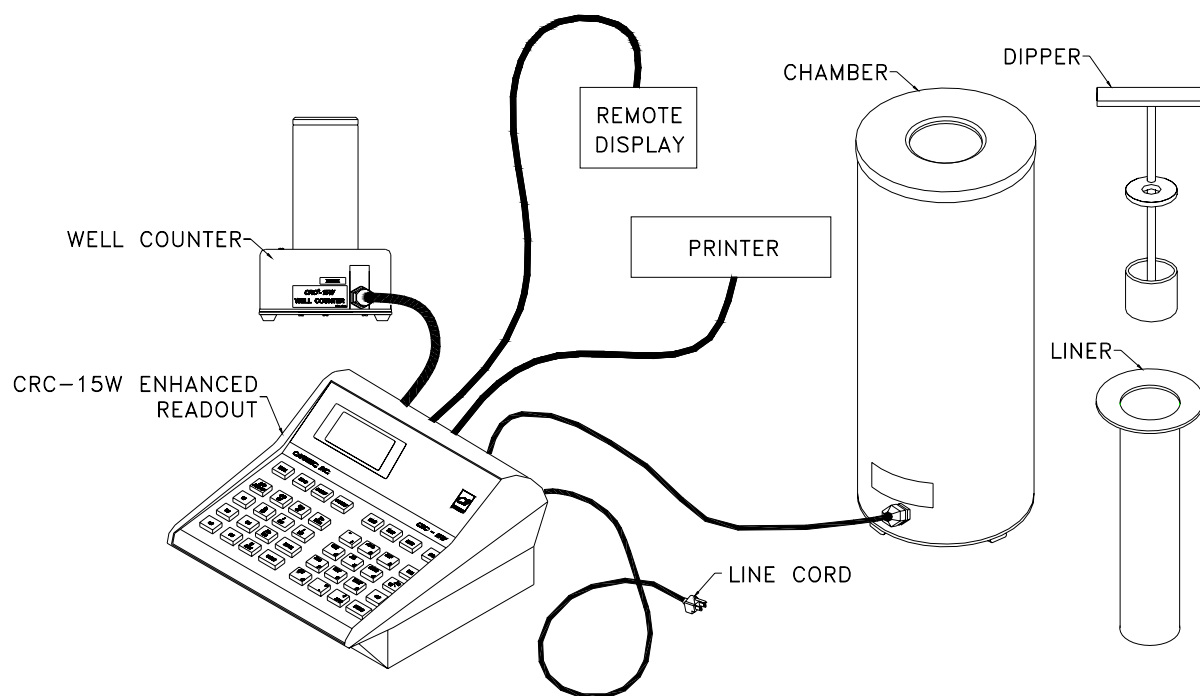


Figure 4-1

1. Verify that all power switches (Readout, Printer, and Remote Display) 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®-15W Enhanced Readout labeled "CHAMBER".

3. Connect the Well Counter Cable to the connector at the rear of the CRC[®]-15W Enhanced Readout labeled "DETECTOR".
4. Attach the Power Cable to the receptacle on the Power Module located on the back of the Readout Unit.

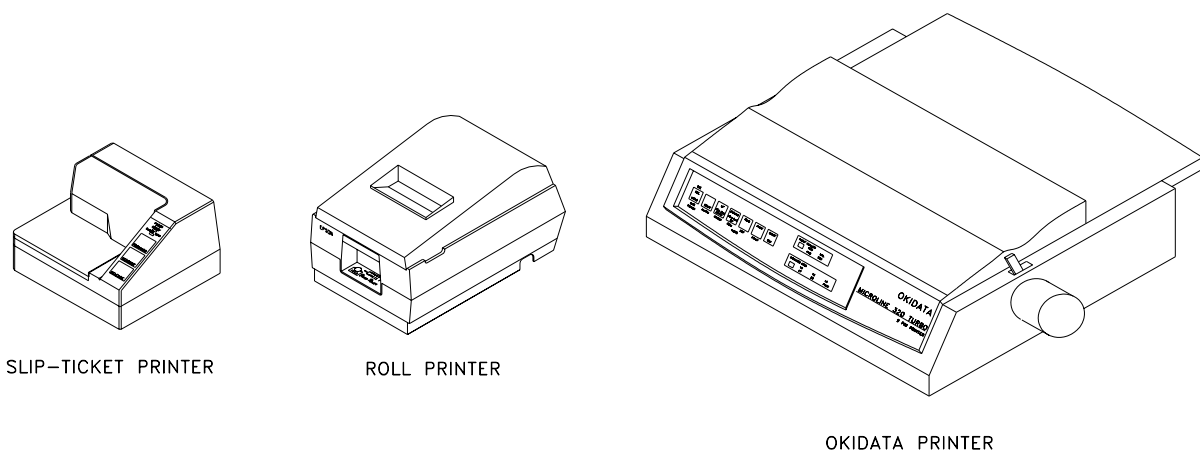


Figure 4-2 Printers

5. 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[®]-15W Enhanced Readout marked "PRINTER". Attach the other end to the printer.

Note: Do not attach the printer cable to the "RS-232" connector.

6. 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.

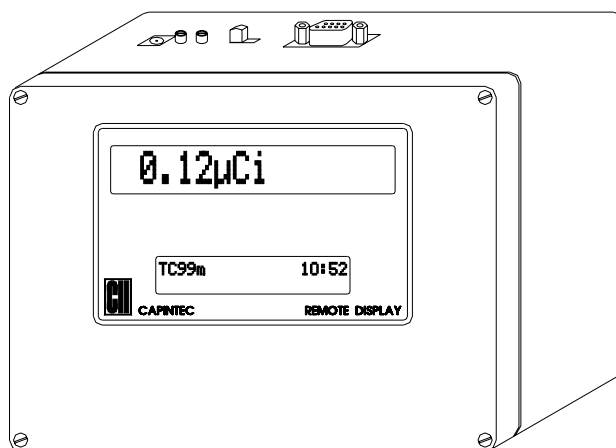


Figure 4-3 Remote Display

7. Connect the Remote Display Cable (both ends have a 9 pin "D" connector) to the connector at the rear of the CRC®-15W Enhanced labeled "RS-232". Attach the other end to the Remote Display labeled "DATA".

Note: Do not attach the Remote Display cable to the "PRINTER" connector.

8. Attach the Remote Display Power Supply to the Remote Display power input jack labeled as "DC IN".

ENVIRONMENT REQUIREMENTS

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, 150mA, 50/60Hz

Printers

Okidata Microline 320

120VAC, 60Hz, 0.9A or
230/240VAC, 50/60Hz, 0.5A

Epson TM-295II Slip Printer (optional)

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

Epson TM-U200D Roll Printer (optional)

Input: 120VAC, 60Hz, 0.45A; **Output:** 33VDC, 1.2A or

Input: 220VAC, 50/60Hz, 1.2A; **Output:** +24VDC, 0.8A

Remote Display Unit

Input: 90~264VAC, 47-63Hz, 0.40A; **Output:** +5.0 VDC, 2.4A

TURN ON PROCEDURES

1. Be sure the interconnecting cable from the Chamber and Well Detector assemblies are properly plugged into the back of the main unit.
2. Confirm the power requirements of the instrument.
3. Be sure the power switch is off. (Push lower part of the toggle 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 Display Unit using the power switch located at the rear of the unit.
6. The unit should now display the CRC[®]-15W Enhanced Sign-On screen (see Figure 4-4)

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.

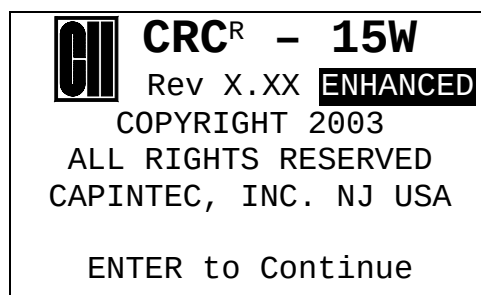


Figure 4-4

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®-15W Enhanced 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. See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: ENTERING 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. See 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. See 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. See CHAPTER 6: CHAMBER INITIALIZATION, SECTION: CONSTANCY TEST SOURCE.
- Verify correct printer setting: The CRC®-15W Enhanced may be used with three printers: See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: PRINTING.
 - o OKIDATA MICROLINE 320
 - o EPSON TM-U295 SLIP PRINTER
 - o EPSON TM-U200D ROLL PRINTER

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. See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: USER KEY ASSIGNMENT.
- Adding a Nuclide: The CRC®-15W Enhanced contains nuclide data (name, half-life, calibration number) for over 80 nuclides. The user may add up to 10 nuclides. The name and half-life and calibration number will be added for each one. See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: ADDING A NUCLIDE.
- Changing Calibration Numbers: The user is allowed to change the calibration number of up to 10 built-in nuclides. See CHAPTER 6: CHAMBER INITIALIZATION, SECTION: CHANGING CALIBRATION NUMBERS.
- Selecting Moly Assay Method: Moly Assay can be performed using the CAPMAC or CANISTER. See CHAPTER 6: CHAMBER INITIALIZATION, SECTION: SELECTING MOLY ASSAY METHOD.
- Setting MO/MT Limit: The Mo/Tc limit is set at the factory to 0.15µCi/mCi. The user can change this value. See CHAPTER 6: CHAMBER INITIALIZATION, SECTION: VIEWING OR CHANGING Mo/Tc LIMIT.

ACCEPTANCE TESTING

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

Diagnostics Test

See CHAPTER 11: DIAGNOSTICS for instructions on how to perform this test.

Daily Test

See CHAPTER 9: CHAMBER TESTS, SECTION: DAILY TEST for instructions on how to perform this test.

Accuracy Test

See CHAPTER 9: CHAMBER TESTS, SECTION: DAILY TEST for instructions on how to perform this test.

Well Counter Test

See CHAPTER 10: COUNTER TESTS for instructions on how to perform this test.

OPERATIONAL SUMMARY

While all users the CRC®-15W Enhanced 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 refer to Appendix IV. These very simplified instructions are intended to assist in getting you familiar with the basic operation of the CRC®-15W Enhanced. 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.

CHAPTER 5

SYSTEM INITIALIZATION

GENERAL

This section describes initialization and parameter setup, which are common to the Chamber and the Counter.

All of these functions are accessed via the Main Utility Menu.

Press **UTIL** from the Chamber Measurement Screen.

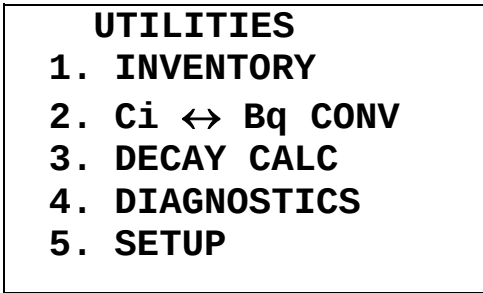
- 
- UTILITIES**
- 1. INVENTORY**
 - 2. Ci ↔ Bq CONV**
 - 3. DECAY CALC**
 - 4. DIAGNOSTICS**
 - 5. SETUP**

Figure 5-1 Main Utility Menu

ENTERING DATE AND TIME

To view and/or change the date and/or time, press **UTIL** from the Chamber Measurement Screen and then press **5** to select **SETUP**. The Setup Menu screen should be displayed (Figure 5-2).

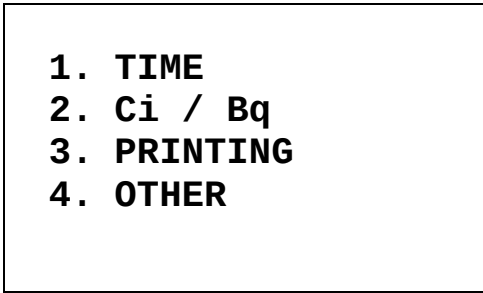
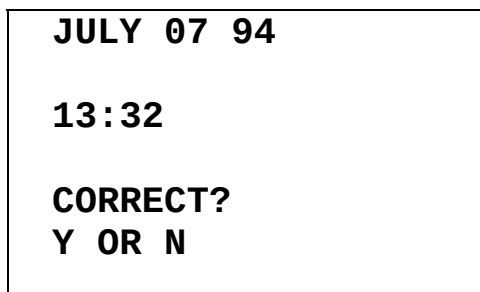
- 
- 1. TIME**
 - 2. Ci / Bq**
 - 3. PRINTING**
 - 4. OTHER**

Figure 5-2 Setup Menu

Press **1** to view and change the date and/or time.

The current date and time will be displayed:



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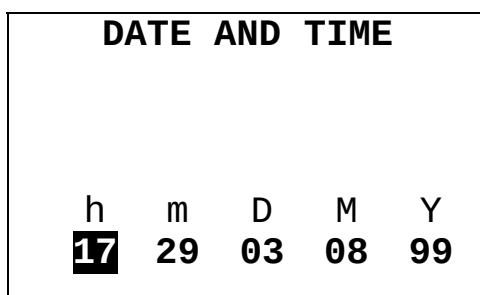
13:32

CORRECT?
Y OR N

Figure 5-3 Date and Time Verification

If the date or time is not correct, press **N**.

The date/time entry screen will appear with the current date and time displayed in the order hour, minute, day, month, year:



DATE AND TIME

h	m	D	M	Y
17	29	03	08	99

Figure 5-4 Date/Time Entry Screen

Note that time is input in 24 hour format (e.g., 5:29am is 05 29, 5:29pm is 17 29).

Use the arrow keys to highlight the field that you want to change (you can back up by using the left arrow) and then enter the new value.

The date and time are checked for validity. If an invalid date or time is entered, a beep sounds and the current date and time is displayed again.

Press **ENTER** when the correct date and time has been entered.

The Date and Time Verification Screen will appear with the date and time just entered.

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 **UTIL** from the Chamber Measurement Screen.

Press **5** to select Setup.

From the Setup Menu, Press **2** to 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)

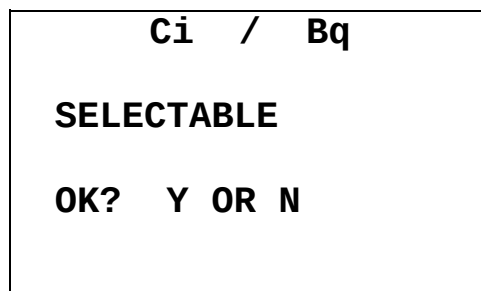


Figure 5-5 Ci / Bq Verification Screen

If it is correct, press **Y**.

If it is not correct, press **N**. The Ci / Bq Selection Menu will appear:

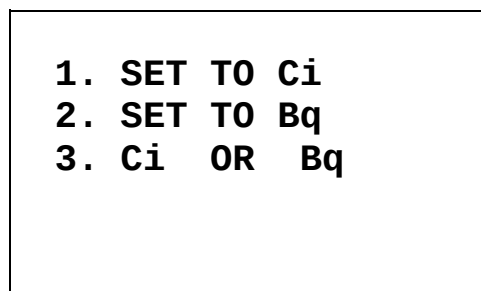


Figure 5-6 Ci / Bq Selection Screen

Press **1**, **2** or **3** to make the correct selection.

The Ci/Bq Verification Screen will re-appear with the new selection.

If **1** was pressed, the selection will be: FIXED TO Ci.

If **2** was pressed, the selection will be: FIXED TO Bq.

If **3** was pressed, the selection will be: Ci / Bq Selectable.

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. One set of nuclides is assigned for Chamber measurements and another set is assigned for Counter measurements.

To assign keys for Chamber measurements:

Press **UTIL** from Chamber Measurement Screen.

Press **5** to select SETUP.

Press **4** to select OTHER.

Enter your password (last 3 digits of serial number).

From the Other Menu (Figure 5-7), press **1** to select USER KEYS.

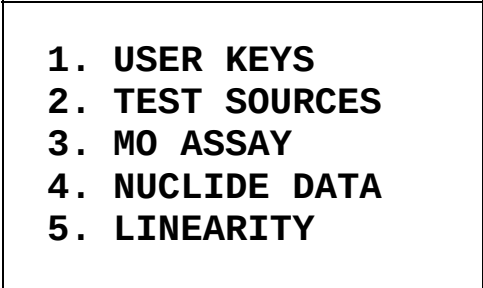
- 
- 1. USER KEYS**
 - 2. TEST SOURCES**
 - 3. MO ASSAY**
 - 4. NUCLIDE DATA**
 - 5. LINEARITY**

Figure 5-7 Chamber Other Menu

To assign keys for Counter measurements:

Press **UTIL** from Counter Measurement Screen.

Press **2** to select SETUP.

Enter your password (last 3 digits of serial number).

From the Counter Setup Menu (Figure 5-8) press **5** to select USER KEYS.

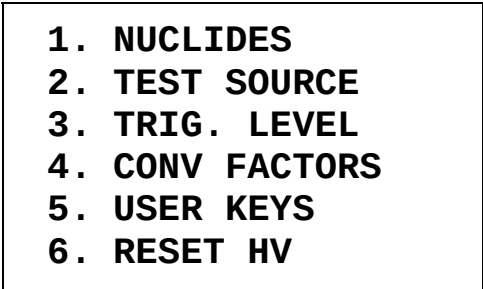
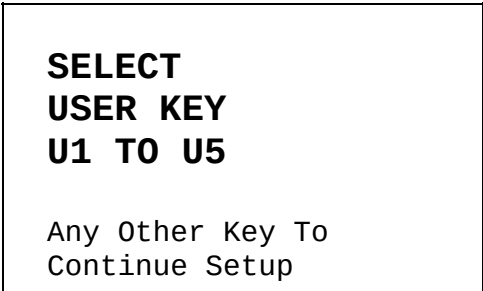
- 
- 1. NUCLIDES**
 - 2. TEST SOURCE**
 - 3. TRIG. LEVEL**
 - 4. CONV FACTORS**
 - 5. USER KEYS**
 - 6. RESET HV**

Figure 5-8 Counter Setup Menu

Selecting User Key



**SELECT
USER KEY
U1 TO U5**

Any Other Key To
Continue Setup

Figure 5-9 User Key Selection

Press the User key to which a nuclide is to be assigned.

Press any other key to exit User Key Assignment.

Current Assignment Display

The current key assignment will be displayed. In the example, Co60 has been assigned to U1.

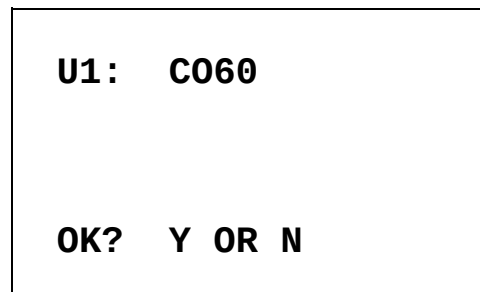


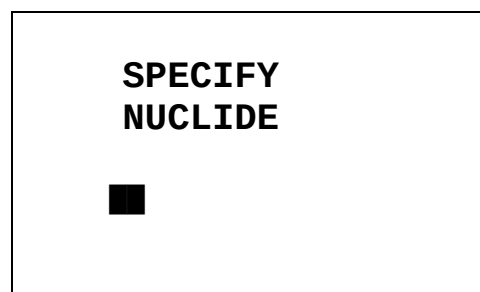
Figure 5-10 User Key Verification

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

If the assignment is correct, press **Y** and you will be returned to User Key Selection Screen.

Press **N** to change the assignment.

Nuclide Name Assignment



5-11 Nuclide Name Assignment Screen

Press the keys on the right hand side of the keyboard 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.

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

Assignment Confirmation

The User Key Verification Screen will appear with the nuclide just entered.

If it is correct, press **Y**.

If it is not correct, press **N** and Nuclide Name Assignment Screen will re-appear.

ADDING A NUCLIDE

The CRC®-15W Enhanced contains nuclide data (name, half-life, calibration number, conversion factor) for over 80 nuclides.

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

Press **UTIL** from the Chamber Measurement Screen.

Press **5** to select SETUP.

Press **4** to select OTHER.

Enter your password (last 3 digits of the serial number) and press **ENTER**.

From the Other Menu (Figure 5-7) press **4** to select NUCLIDE DATA.

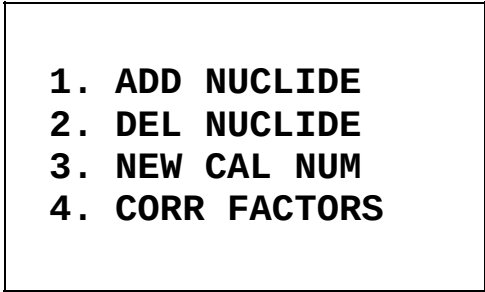
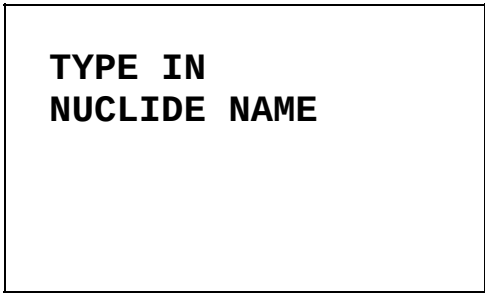
- 
- 1. ADD NUCLIDE**
 - 2. DEL NUCLIDE**
 - 3. NEW CAL NUM**
 - 4. CORR FACTORS**

Figure 5-12 Nuclides Menu

Press **1** to add nuclide data.

Entering Nuclide Name

**TYPE IN
NUCLIDE NAME**

Figure 5-13 Entering Nuclide Name

User the NUMBER / LETTER keys to enter the nuclide name. The first 2 characters will be displayed as letters (use the 1 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 entered.

Entering Half-Life

HALF - LIFE :	
value	unit
■	MIN
→ to change unit	
ENTER to accept	

Figure 5-14 Entering Half-life

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

When the value and unit are correct, press **ENTER**.

Entering Calibration Number

ENTER
CALIBRATION #

Figure 5-15 Enter Calibration Number

Enter the calibration number if known. If the calibration number is not known then it can be determined by the following procedure.

Determining Calibration Numbers

An initial Calibration Number (as an initial starting point choose 450) must be entered into the CRC®-15W Enhanced 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. Enter the calibration number.

DELETING A NUCLIDE

Any nuclide added by the user may be deleted.

When the Nuclide Menu appears, press **2**.

When "SPECIFY NUCLIDE" appears, specify the nuclide to be deleted via the Number/Letter keys.

The name of the nuclide and its half-life will be displayed.

If this is the correct nuclide to delete, press **Y**; if not, press **N**.

PRINTING

CAUTION

If any printer other than one of the three models supplied by Capintec is used, Electromagnetic Interference (EMI) may be introduced into other devices located in the same general area as the CRC®-15W Enhanced.

The CRC®-15W Enhanced may be used with three printers:

- OKIDATA MICROLINE 320
- EPSON TM-295II SLIP PRINTER
- EPSON TM-U200D ROLL PRINTER

Printer Power Requirements

Okidata Microline 320

120VAC, 60Hz or
230/240VAC, 50/60Hz

Epson TM-295II Slip Printer (optional)

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

Epson TM-U200D Roll Printer (optional)

Input: 120VAC, 60Hz, 0.45A; **Output:** 33VDC, 1.2A or
Input: 220VAC, 50/60Hz, 1.2A; **Output:** +24VDC, 0.8A

Printer Selection

If OKIDATA 320 is used, the calibration measurement can be printed on a ticket or as a single line.

To view and/or change the selected printer (and the type of measurement printout if OKIDATA is used):

Press **UTIL** from the Chamber Measurement Screen and then press **4** to select SETUP.

When the Setup Menu (Fig. 5-2) appears, press **3** to select PRINTING.

The currently selected printer will be displayed. If OKIDATA is selected, TICKET or ONE LINE will be displayed. You will be asked if the display is correct. If the display is not correct, press **N** (no).

The Printer Selection Screen will appear:

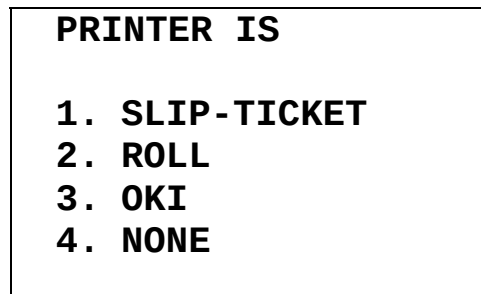


Figure 5-16 Printer Selection

Press the number corresponding to your printer, or press **4** if you do not have a printer.

If OKI is selected, you must now choose to print the measurement as a TICKET or a SINGLE LINE:

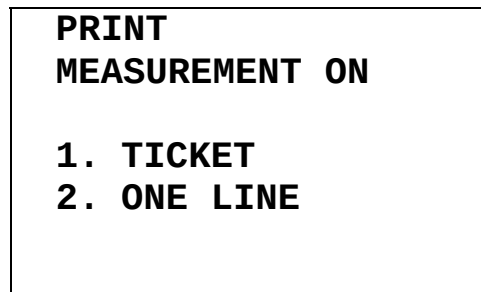


Figure 5-17 Printout Selection

Select the type of measurement printout.

After selecting the printer (and measurement printout) your selection will be displayed for verification.

Okidata Menu Set-Up

As it comes from the factory, the Okidata printer should be set-up to function properly with the CRC®-15W Enhanced. 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 5-18. 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 5-18 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 5-18, repeat step 6 for the next group.
8. If any line in the group just printed does not match the corresponding line in Figure 5-18, 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 5-18 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 5-18 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	8 LPI
Rear Feed	Form Tear-Off	Off
Read Feed	Skip Over Perforation	No
Rear Feed	Page Length	11"
Bottom Feed	Line Spacing	8 LPI
Bottom Feed	Form Tear-Off	Off
Bottom Feed	Skip Over Perforation	No
Bottom Feed	Page Length	11"
Top Feed	Line Spacing	8 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	16K
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	Decollator	No
Parallel I/F	I-Prime	Buffer Print
Parallel I/F	Pin 18	+5v
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

CHAPTER 6

CHAMBER INITIALIZATION

GENERAL

This section describes initialization and parameter setup for the Chamber.

All of these functions are accessed via the Main Utility Menu.

TEST SOURCES

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

The Chamber 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 you to enter data for any Test Source and to choose a Constancy Source.

When the Chamber Measurement Screen appears, press **UTIL**.
From the Main Utility Menu (Figure 5-1) press **5** to select SETUP.
From the Setup Menu (Figure 5-2), press **4** to select OTHER.

When the password entry screen appears, enter your password (last 3 digits of your serial number) and press **ENTER**.

- 1. USER KEYS**
 - 2. TEST SOURCES**
 - 3. MO ASSAY**
 - 4. NUCLIDE DATA**
 - 5. LINEARITY**

Figure 6-1 Other Menu

Press **2** to select TEST SOURCES.

The Test Source Menu will appear:

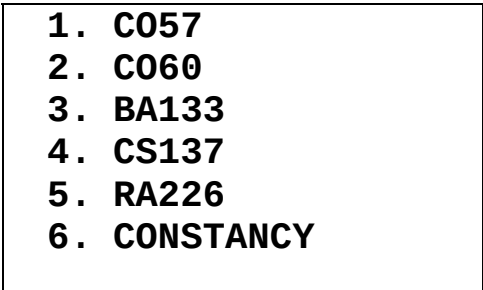
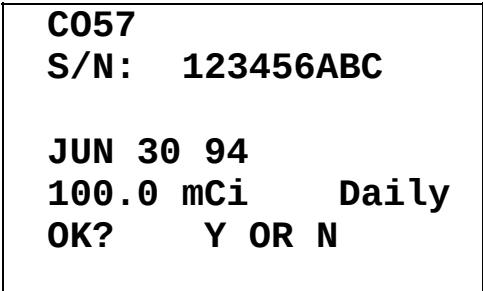
- 
- A rectangular box containing a numbered list of six test source options.
1. C057
 2. C060
 3. BA133
 4. CS137
 5. RA226
 6. CONSTANCY

Figure 6-2 Test Source Menu

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

Source Verification

The previously entered data will be displayed. If there is no data for that nuclide, the words "NO SOURCE" will be displayed. The example below is for Co57, which will be used in the Daily Test:



A rectangular box containing source verification data for C057.

C057
S/N: 123456ABC

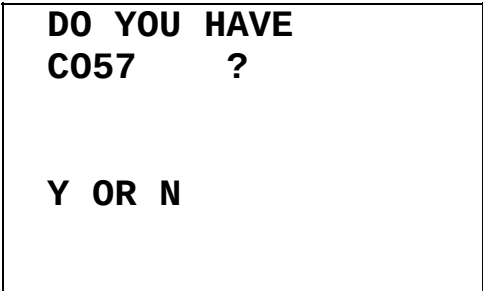
JUN 30 94
100.0 mCi Daily
OK? Y OR N

Figure 6-3 Test Source Verification

If the data is correct press **Y**.

To change the data, press **N**. To add a source (if NO SOURCE) or delete a source which is no longer being used, press **N**.

If **N** was pressed and there was data displayed, you will have the opportunity to delete the source.



A rectangular box containing a question about source existence.

DO YOU HAVE
C057 ?

Y OR N

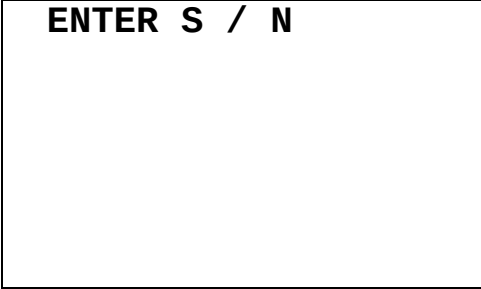
Figure 6-4 Source Existence

If you are no longer using the source, press **N** and it will be deleted.

Press **Y** to enter data for the source.

Entering Serial Number

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



ENTER S / N

Figure 6-5 Entering Serial Number

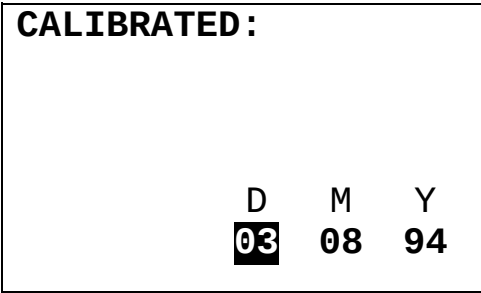
Follow the directions in CHAPTER 3: GENERAL OPERATING INSTRUCTIONS, SECTION: ALPHANUMERIC DATA for entering alphanumeric data.

Press **ENTER** when correct serial number has been entered.

Entering Calibration Date

The calibration date is entered next.

The date entry screen will appear with the current date displayed in the order: day month year. The day is highlighted.



CALIBRATED:

D	M	Y
03	08	94

Figure 6-6 Entering Calibration Date

The entry format is similar to entering date and time (See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: ENTERING DATE AND TIME) except that only the date is entered.

Enter the Source calibration date and press **ENTER**.

The date is checked for validity. If an invalid date is entered a beep sounds and the current date is displayed again.

Entering Calibration Activity

The calibration activity can now be entered:

CALIB ACTIVITY:	
value	unit
■	μCi
→ to change unit	
ENTER to accept	

Figure 6-7 Entering Activity

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

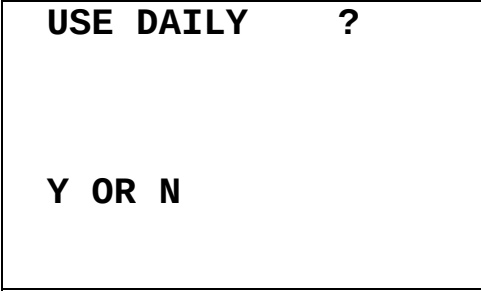
When the value and unit are correct, press **ENTER**.

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.

	Minimum at Current Time
Co57	50. μCi
Co60	50. μCi
Ba133	50. μCi
Cs137	50. μCi
Ra226	10. μCi

Indicating Daily Usage

You must now indicate whether the source will be used for the daily test.



USE DAILY ?

Y OR N

Figure 6-8 Daily Use

If the source is to be used in the Daily Test, press **Y**.

If it will not be used in the Daily Test, press **N**.

Confirming Calibration Data

The Test Source Verification Screen will now be displayed with the data you have just entered. If the data is correct, press **Y**. If there is any error, press **N**.

If **N** is pressed, you will be returned to the Source Existence Screen.

CONSTANCY TEST SOURCE

To select the source to use in the Constancy Test:

When the Chamber Measurement Screen appears, press **UTIL**.

From the Main Utility Menu press **5** to select SETUP.

From the Setup Menu, press **4** to select OTHER.

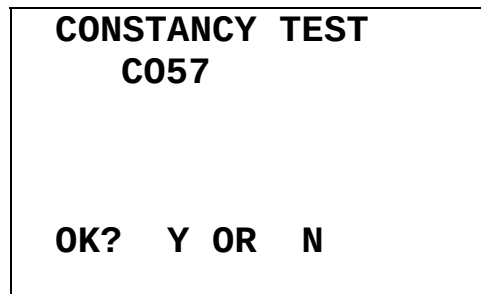
When the password entry screen appears, enter your password (last 3 digits of your serial number) and press **ENTER**.

Press **2** to select TEST SOURCES.

Press **6** to select CONSTANCY.

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

If there is a current Constancy Test Source, you will be asked if it is OK. In the example below, Co57 is the current source.



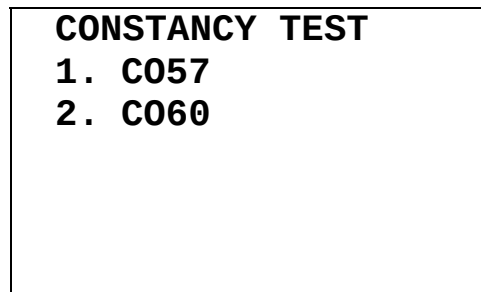
CONSTANCY TEST
C057

OK? Y OR N

Figure 6-9 Constancy Source Verification

If you answer No (or if there is no current source), you will be asked to select Constancy Test Source from the Daily Sources. (If there are no Daily Sources, an error message will appear.)

In the example below, Co57 and Co60 were designated as Daily Sources:



CONSTANCY TEST
1. C057
2. C060

Figure 6-10 Constancy Test Source Selection

Enter the number corresponding to the source to be used for the Constancy Test.

CHANGING CALIBRATION NUMBERS

The user is allowed to change the calibration number of up to 20 built-in nuclides.

To change a calibration number or restore the original number:

Press **UTIL** from the Chamber Measurement Screen.

Press **5** to select SETUP.

Press **4** to select OTHER.

Enter your password (last 3 digits of the serial number) and press **ENTER**.

From the Other Menu, press **4** to select NUCLIDE DATA.

When the Nuclide Menu appears, press **3** for NEW CAL NUM.

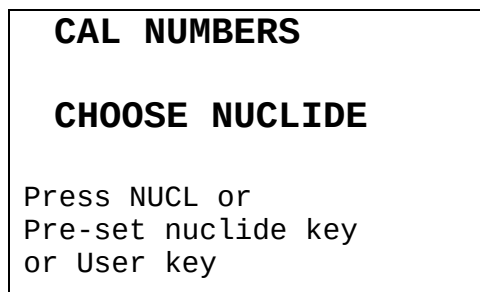


Figure 6-11 Choose Nuclide for New Calibration Number

Choose the nuclide via **NUCL** key, pre-set nuclide key or user key.

Entering New Calibration Number

If the nuclide does not have a new calibration number, the following screen appears (example is for Tc99m):

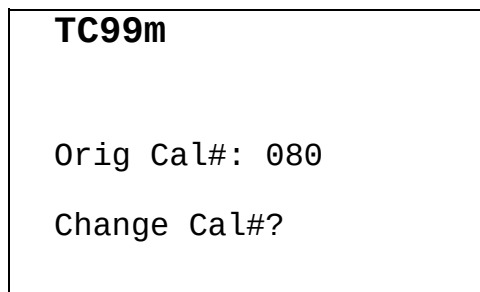


Figure 6-12 Change Original Cal#?

If you want to change the calibration number press **Y**; if not press **N**.

If **Y** is pressed, you will enter the new calibration number.

After the calibration number is entered, the original and new calibration numbers will be displayed for verification.

Restoring Original Calibration Number

If a new calibration number has been entered for the chosen nuclide, the following screen appears (in the example, 082 is the new cal# for Tc99m)

TC99m

Orig Cal#: 080
New Cal#: 082

Restore Orig Cal#?

Figure 6-13 Restore Cal#?

Press **Y** to restore the original calibration number. Press **N** to keep the new calibration number.

CORRECTION FACTORS

A container correction factor for Chamber measurements may be input for up to 20 nuclides. These corrections factors are for Syringe, Vial or Capsule.

When the Nuclide Menu appears, press **4** for CORR FACTORS.

CORR. FACTOR

CHOOSE NUCLIDE

Press NUCL or
Pre-set nuclide key
or User key

Figure 6-14 Choose Nuclide for Correction Factors

Choose the nuclide via **NUCL** key, pre-set nuclide key or user key.

Determining Correction Factors

To determine the Correction Factor for a nuclide in a particular container, perform the following steps:

1. Obtain a calibrated source of the nuclide.
2. Calculate the current activity of the calibrated source, using the Decay Calculation Utility (See CHAPTER 17: CALCULATION UTILITIES, SECTION: DECAY CALCULATION)
3. Measure the source in the container whose correction factor is to be determined.
4. The Correction Factor (CF) is then calculated as:

$$CF = \frac{\text{Calculated Activity of Calibrated Source}}{\text{Measured Activity}}$$

Entering Correction Factors

If there are no correction factors for the chosen nuclide:

ENTER CORR. FACTOR FOR SYRINGE ? YES OR NO
--

Figure 6-15 Enter Correction Factor For Syringe?

If you want to enter a correction factor for syringe, press **Y**. If not, press **N**.

If **Y** is pressed, YES OR NO is erased.

Enter the desired correction factor and press **ENTER**.

Figure 6-15 will be repeated for VIAL and CAPSULE.

Verifying Correction Factors

After all correction factors have been entered, the verification screen will appear (in the example, a correction factor of 1.05 has been entered for syringe for Tc99m).

TC99m CORR FACS SYRINGE 1.05 VIAL NONE CAPSULE NONE OK? Y OR N

Figure 6-16 Correction Factor Verification

Press **Y** to save the Correction Factors. Press **N** if there is an error; the Correction Factors will not be saved.

Changing / Deleting Correction Factors

If there are already correction factors for the chosen nuclide the Correction Factor Verification Screen will appear.

If you want to change or delete the Correction Factors for the chosen nuclide, press **N**.

For each container type, if a correction factor has been entered, it will be displayed for verification:

CORR. FACTOR FOR SYRINGE 1.050 OK? Y OR N

Figure 6-17 Correction Factor For Syringe

Press **Y** to keep the current Correction Factor. Press **N** to change the Correction Factor. If **N** is pressed, OK? Y OR N will be erased and ENTER will appear on the top line. Input the new Correction Factor and press **ENTER**.

To delete the Correction Factor, enter 0.

If a correction factor has not been entered for the container type, you will be asked if you want to enter a correction factor.

After correction factors have been accepted or entered for all three container types, the Correction Factor Verification Screen will appear.

If NONE is displayed for all the correction factors, the correction factor setting for that nuclide will be deleted.

SELECTING MOLY ASSAY METHOD

Moly Assay can be performed using the CAPMAC or CANISTER. When Moly Assay is chosen, the Moly Assay Method Selection Screen will appear. However, if you always use either CAPMAC or CANISTER, the Moly Assay Method Selection screen can be skipped by making this choice in utilities.

From the Other Menu press **3** to select MO ASSAY.

MO ASSAY

- 1. MOLY METHOD**
- 2. MO/TC LIMIT**

Figure 6-18 Mo Assay Menu

Press **1** to select MOLY METHOD.

**CAPMAC FOR
MALILINCKRODT Y
CAPMAC FOR
BRISTOL MYERS Y
CANISTER Y
OK? Y OR N**

Figure 6-19 Moly Assay Method Verification

Press **N** to change the selection.

You will then be asked if you will use CAPMAC FOR MALLINCKRODT GENERATOR.
Press **Y** or **N**.

You will next be asked if you will use CAPMAC FOR BRISTOL MYERS GENERATOR.
Press **Y** or **N**.

You will next be asked if you will use CANISTER. Press **Y** or **N**.

The Moly Assay Method Verification Screen will reappear.
Press **Y** if the selection is correct. Press **N** to change the selection.

VIEWING AND CHANGING MO/TC LIMIT

The Mo/Tc limit is set at the factory to 0.15 μ Ci/mCi. This value can be changed by the user.

From the Moly Assay Menu, press **2** to select MO/TC LIMIT.

The current value will be displayed:

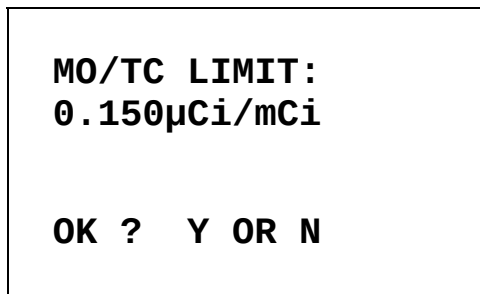


Figure 6-20 Mo/Tc Limit Verification Screen

Press **Y** to keep the value.

Press **N** to change the value.

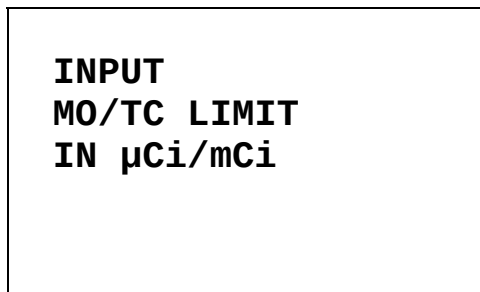


Figure 6-21 Mo/Tc Limit Entry Screen

Input the new value and press **ENTER**. You will be returned to the Mo/Tc Limit Verification Screen.

Note: *If Bq had been chosen before entering Utilities, the Mo/Tc limit would be displayed and entered in MBq/GBq.*

CHAPTER 7

COUNTER INITIALIZATION

GENERAL

This section describes initialization and parameter setup for the Counter.

To access these functions, press **UTIL** from the Counter Measurement Screen.

- 
- A rectangular box containing a numbered list of two options: 1. AUTO CAL and 2. SETUP.
1. **AUTO CAL**
 2. **SETUP**

Figure 7-1 Counter Utility Menu

Press **2** to select **SETUP**.

Enter the password (last three digits of the serial number) and press **ENTER**.

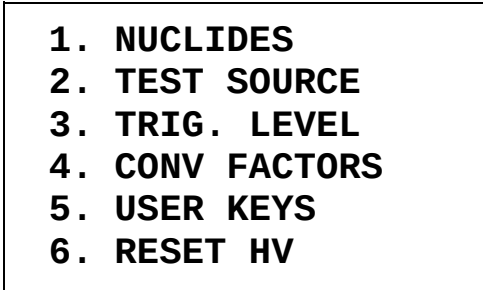
- 
- A rectangular box containing a numbered list of six options: 1. NUCLIDES, 2. TEST SOURCE, 3. TRIG. LEVEL, 4. CONV FACTORS, 5. USER KEYS, and 6. RESET HV.
1. **NUCLIDES**
 2. **TEST SOURCE**
 3. **TRIG. LEVEL**
 4. **CONV FACTORS**
 5. **USER KEYS**
 6. **RESET HV**

Figure 7-2 Counter Setup Menu

NUCLIDES

In order to find the activity of any nuclides that might be present in a wipe, the nuclides must be chosen for Wipe, Unrestricted and Sealed Sources.

When the Counter Setup Menu is displayed, press **1** to select **NUCLIDES**.
The Nuclide Menu is displayed:

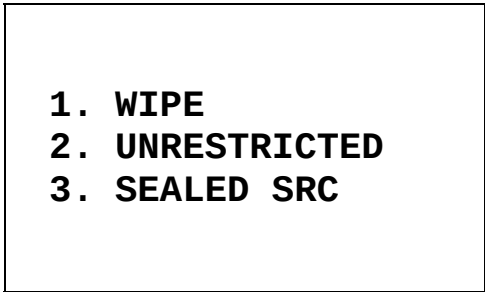
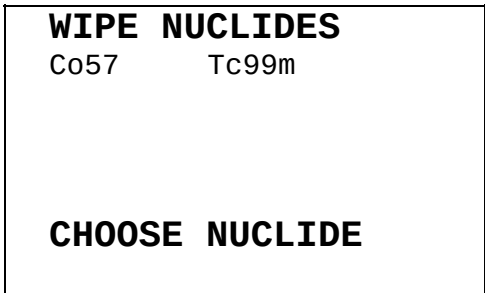
- 
- 1. WIPE**
 - 2. UNRESTRICTED**
 - 3. SEALED SRC**

Figure 7-3 Nuclide Menu

Wipe

Press **1** to View/Change nuclides for Wipes.

Up to 10 nuclides can be selected for Wipes. The currently selected nuclides will be displayed (in the example, Co57 and Tc99m have been selected).



WIPE NUCLIDES
Co57 Tc99m

CHOOSE NUCLIDE

Figure 7-4 Wipe Nuclides

Use the Nuclide keys, User keys and **NUCL** key to select the nuclides. As nuclides are selected, they will be displayed.

If a nuclide that is already on the list is selected, you will be asked if you want to delete it.

When all the desired nuclides are selected, press **ENTER** and you will be returned to the Nuclide Menu (Fig. 7-3).

Unrestricted

Press **2** to View/Change nuclides for Unrestricted wipes.

Up to 10 nuclides can be selected for Unrestricted. The procedure is the same as for Wipes.

Sealed Source

Press **3** to View/Change nuclides for Sealed Sources.

One nuclide is selected for each Sealed Source.

Sealed Source #1 is displayed with the current nuclide (blank if not yet selected).

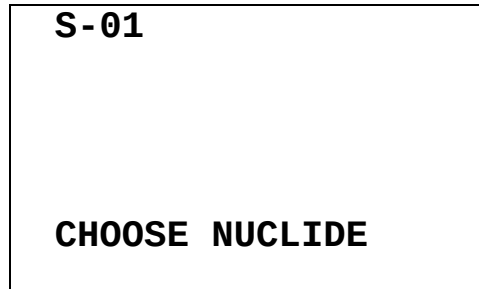


Figure 7-5 Sealed Source – no nuclide

Use the Nuclide keys, User keys and **NUCL** key to select the nuclide. The selected nuclide will be displayed:

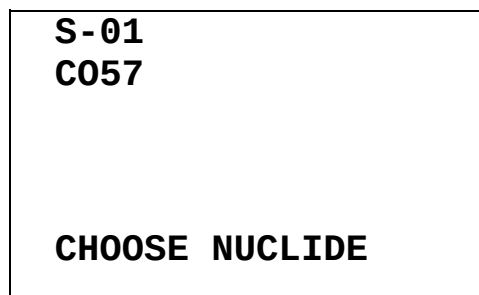


Figure 7-6 Sealed Source – Co57 Selected

Press **ENTER** to accept the nuclide.

The data for the next Sealed Source (e.g. S-02) will be displayed.

To select the nuclide for a specific Sealed Source:

Press **LOC** (Location)

Input Sealed Source # (e.g. 03) and press **ENTER**.

Then select nuclide as above.

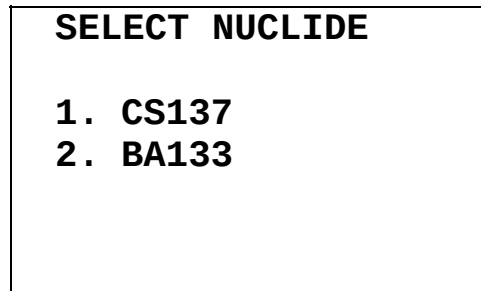
When nuclides for all desired Sealed Sources have been selected, press **UTIL** to return to the Nuclide Menu.

TEST SOURCE

A Test Source is used for the Counter calibration and test. The Test Source may be Cs137 or Ba133.

When the Counter Setup Menu is displayed, press **2** to select SOURCES.

If no Test Source data has been entered, the Counter Test Source Menu will appear:



A rectangular box containing the text 'SELECT NUCLIDE' at the top, followed by a numbered list: '1. CS137' and '2. BA133'.

```
SELECT NUCLIDE

1. CS137
2. BA133
```

Figure 7-7 Counter Test Source Menu

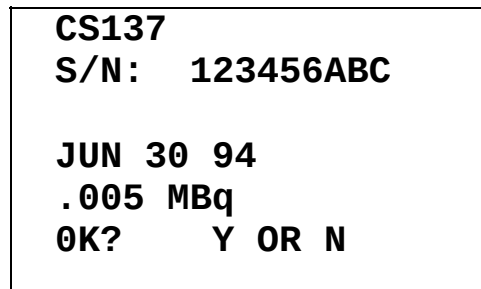
Press the number corresponding to the Counter Test Source.

Source Verification

The previously entered data will be displayed.

If a Counter Test Source has already been entered, the data for the source will be displayed.

The example below is for Cs137.



A rectangular box containing the following text: 'CS137', 'S/N: 123456ABC', 'JUN 30 94', '.005 MBq', and 'OK? Y OR N'.

```
CS137
S/N: 123456ABC

JUN 30 94
.005 MBq
OK? Y OR N
```

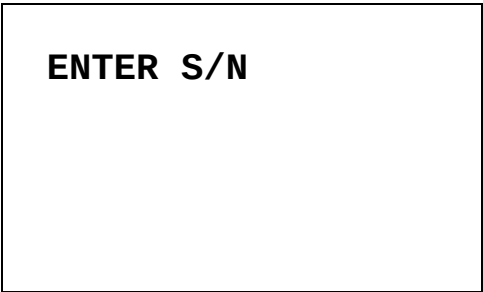
Figure 7-8 Test Source Verification

If the data is correct press **Y**.

To change the data, press **N**. The Counter Test Source Menu will appear.

Entering Serial Number

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



ENTER S/N

Figure 7-9 Entering Serial Number

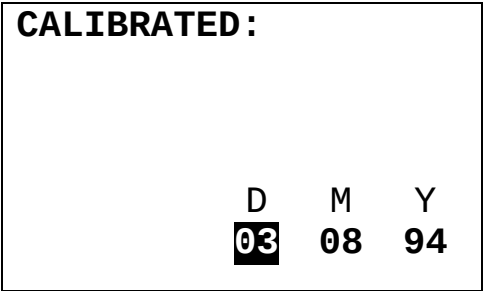
Follow the directions in CHAPTER 3: GENERAL OPERATING INSTRUCTIONS, SECTION: ALPHANUMERIC DATA for entering alphanumeric data.

Press **ENTER** when the correct serial number has been entered.

Entering Calibration Date

The calibration date is entered next:

The date entry screen will appear with the current date displayed in the order: day month year. The day is highlighted.



CALIBRATED:

D	M	Y
03	08	94

Figure 7-10 Entering Calibration Date

The entry format is similar to entering date and time (See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: ENTERING DATE AND TIME) except that only the date is entered.

Enter the Source calibration date and press **ENTER**.

The date is checked for validity. If an invalid date is entered a beep sounds and the current date is displayed again.

Entering Calibration Activity

The calibration activity can now be entered:

CALIB ACTIVITY:

value	unit
■	MBq

→ to change unit
ENTER to accept

Figure 7-11 Entering Activity

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

When the value and unit are correct, press **ENTER**.

The activity must not be greater than 0.37 MBq.

TRIGGER LEVEL

The default trigger levels set at the factory are:

Type	Trigger Levels	
	Bq	Ci
Background	50.0 cps	3000.0 cpm
Wipe (Work Areas)	33.3 Bq	2000. dpm
Unrestricted Areas	3.3 Bq	200.0 dpm
Sealed Source	185.0 Bq	5.0 nCi

These values can be changed by the user if so desired.

When the Counter Setup Menu is displayed, press **2** to select Trigger Level.

The Trigger Level Menu is displayed:

- 1. BACKGROUND**
- 2. WIPE**
- 3. UNRESTRICTED**
- 4. SEALED SRC**

Figure 7-12 Trigger Level Menu

Background Trigger Level

When the measured background is greater than the background trigger level, an error message is displayed and the background result will not be accepted.

When the Trigger Level Menu is displayed, press **1** to select BACKGROUND.

If the maximum allowed background has never been entered, the default value (3000cpm for Curie mode, 50cps for Becquerel mode) is displayed.

Otherwise the previously entered value is displayed.

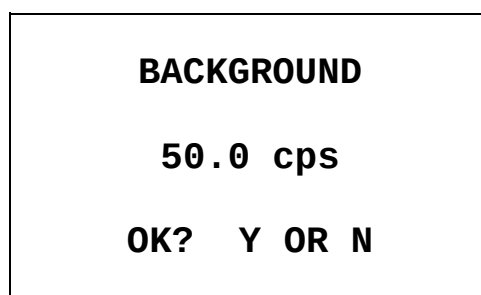


Figure 7-13 Background Trigger Level Verification

If the current Trigger Level is correct, press **Y**. Press **N** to change it.

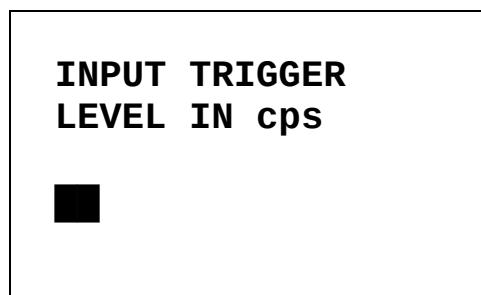


Figure 7-14 Background Trigger Level Entry

Input the desired background Trigger Level and press **ENTER**.

Note: If Bq has been selected, cps will be displayed instead of cpm.

The Background Trigger Level Verification screen will reappear.

Typical background level of CRC[®]-15W Enhanced is approximately 3cps or less in a clean room. If the instrument must be located where high level of high-energy γ -emitters are handled while measurements are made by CRC[®]-15W Enhanced, additional shielding may be placed around the detector assembly to reduce background.

If the instrument is contaminated, background will be increased.

Wipe Trigger Level

When the activity of a Wipe for a particular nuclide exceeds the Wipe Trigger Level, its activity will be displayed and printed as EXCEEDS.

When the Trigger Level Menu is displayed, press **2** to select WIPE.

If the maximum allowed background has never been entered, the default value (2000dpm, 33.3 Bq) is displayed.

Otherwise the previously entered value is displayed.

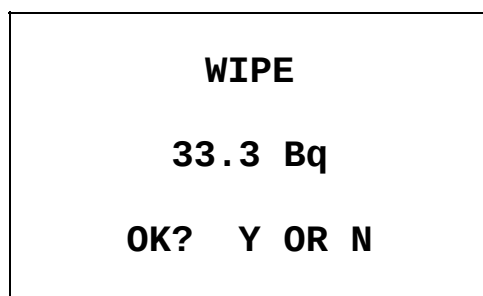


Figure 7-15 Wipe Trigger Level Verification

If the current Trigger Level is correct, press **Y**. Press **N** to change it.

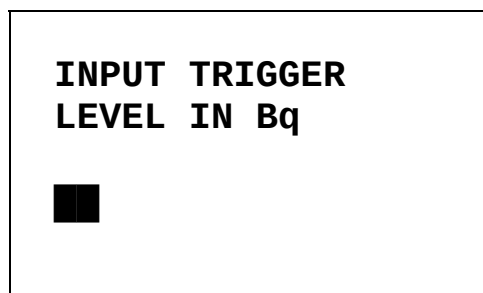


Figure 7-16 Wipe Trigger Level Entry

Input the desired Wipe Trigger Level and press **ENTER**.

The Wipe Trigger Level Verification screen will reappear.

Unrestricted Trigger Level

When the activity of a particular nuclide exceeds for a wipe from an Unrestricted area is greater than the Unrestricted Trigger Level, its activity will be displayed and printed as EXCEEDS.

When the Trigger Level Menu is displayed, press **3** to select UNRESTRICTED.

If the maximum allowed background has never been entered, the default value (3.3 Bq) is displayed.

Otherwise the previously entered value is displayed.

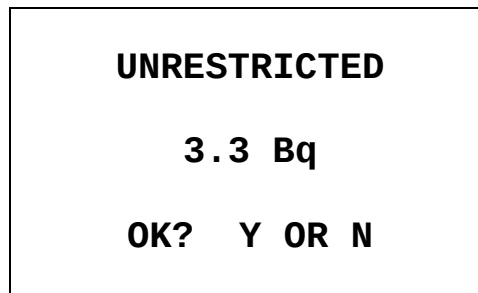


Figure 7-17 Unrestricted Trigger Level Verification

If the current Trigger Level is correct, press **Y**. Press **N** to change it.

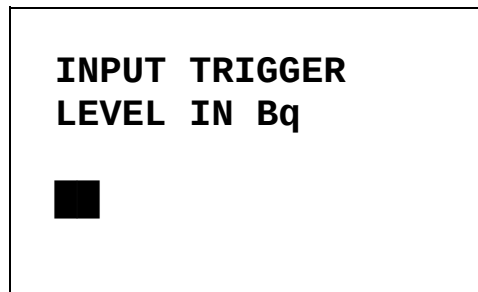


Figure 7-18 Unrestricted Trigger Level Entry

Input the desired Unrestricted Trigger Level and press **ENTER**.

The Unrestricted Trigger Level Verification screen will reappear.

Sealed Source Trigger Level

When the activity of the wipe of a Sealed Source exceeds the Sealed Source Trigger Level, its activity will be displayed and printed as EXCEEDS.

When the Trigger Level Menu is displayed, press **4** to select SEALED SRC.

If the maximum allowed background has never been entered, the default value (185 Bq) is displayed.

Otherwise the previously entered value is displayed.

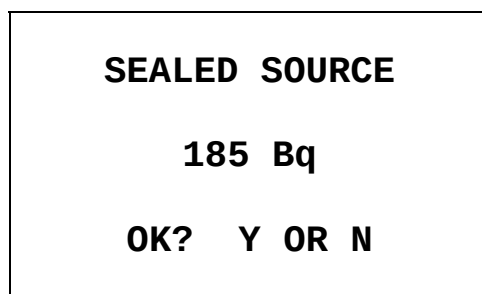


Figure 7-19 Sealed Source Trigger Level Verification

If the current Trigger Level is correct, press **Y**. Press **N** to change it.

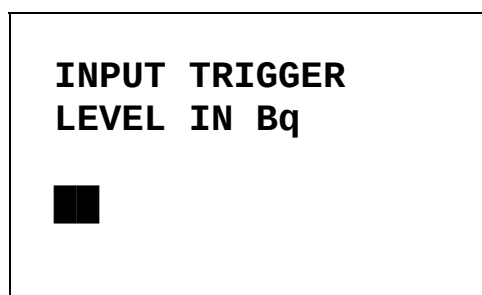


Figure 7-20 Sealed Source Trigger Level Entry

Input the desired Sealed Source Trigger Level and press **ENTER**.

The Sealed Source Trigger Level Verification screen will reappear.

CONVERSION FACTORS

When the Counter Setup Menu is displayed, press **3** to select CONV. FACTORS.

Conversion Factors are used to convert the observed counting rate to the activity value. The Conversion Factor unit is dpm/cpm (Bq/cps if Bq has been selected).

Conversion Factors that are known are built into the system.

Existing Conversion Factors may be changed and/or new ones may be added for nuclides that do not have any.

The Conversion Factors may be entered or measured.

The nuclide is chosen from all nuclides in memory or from those added by the user.

Generic Nuclide

Besides the built-in and user added nuclides, there is also a “generic” nuclide. This is an artificial construct and corresponds to the counting rate in all the channels. The activity of the “generic” nuclide is always reported for Wipe and Unrestricted categories.

The Conversion Factor for the generic nuclide cannot be measured. The default value for the generic Conversion Factor is 2.7 Bq/cps. In order to change it, select INPUT CF from the Conversion Factor Entry Method screen.

Choosing Nuclide

CHOOSE NUCLIDE

Press NUCL or
Pre-set nuclide key
or User key
or CAL# for Generic

Figure 7-21 Choose Nuclide for Conversion Factor

If there is no conversion data for the nuclide, Fig 7-7 (choose INPUT CF or MEASURE CF) will appear.

If conversion factor data already exists for that nuclide, the conversion factor and chosen channels will appear:

CF: 1.2000 Bq/cps
CH: 2
OK? Y OR N

Figure 7-22 Conversion Factor and Channels Verification

Press **Y** if the data is correct.

Press **N** to change the conversion factor data.

If **N** is pressed from Conversion Factor and Channel Verification, you will be given a choice of inputting or measuring Conversion Factor data.

1. **INPUT CF**
2. **MEASURE CF**

Figure 7-23 Conversion Factor Entry Method

Input CF

If INPUT CF is chosen, the following screen will appear:

**ENTER ACTIVITY
CONV. FACTOR
IN Bq/cps**

■

Figure 7-24 Conversion Factor Entry

Enter the Conversion Factor in dpm/cpm (or Bq/cps) and press **ENTER**.

You must then choose the channels that will be used to calculate activity. If previous data has been input, the previous selection will be highlighted.

Y select channel
N de-select channel

▶	CH 1	CH 4
	CH 2	CH 5
	CH 3	CH 6

ENTER when finished

Figure 7-25 Channel Selection

Use the **UP** (⬆) and **DOWN** (⬇) arrows to move the Right Arrow (➡) so that it points to the channel to be selected (or de-selected) and then press the **Y** key.

Conversion Factor and Channels Verification screen will re-appear.

Measure CF

In order to measure the conversion factor, the calibrated activity and date/time of calibration for the source to be used in the measurement, must be entered.

The date/time entry screen will appear with the current date and time displayed in the order: hour min day month year. The hour is highlighted.

CALIBRATED :				
h	m	D	M	Y
17	29	03	08	99

Figure 7-26 Entering Calibration Date / Time

Enter the calibration date and time as described in CHAPTER 5: SYSTEM INITIALIZATION, SECTION: ENTERING DATE AND TIME.

If the source is long-lived and the calibration time is not known, the time is not important (just use the arrow keys to go to day).

The date and time are checked for validity. If an invalid date or time is entered a beep sounds and the current date and time are displayed again.

The calibration activity can now be entered:

CALIB ACTIVITY:	
value	unit
■	MBq
→ to change unit	
ENTER to accept	

Figure 7-27 Entering Calibration Activity

Enter the value of the calibrated activity and then press the **RIGHT ARROW**. Use the arrow keys to scroll the activity units: MBq or GBq. If the value needs to be changed, press **CE**.

When the value and unit are correct, press **ENTER**.

The calibration data (activity, date and time), which has been entered, will now be displayed for verification. Press **Y** if data is correct; press **N** if there are any errors. If **N** is pressed, you will be returned to Calibration Activity Unit Selection.

If **Y** is pressed, you will be instructed to measure the source. Place the calibration source in the Counter, select the counting time and press **COUNT**.

After the measurement is finished, the calibration data and the graphic display will be printed.

The Channel Selection screen will then appear. Use the printed results as a guide to choosing the correct channels for measuring the nuclide.

Conversion Factor and Channel Verification will re-appear.

CHAPTER 8

ACCEPTANCE & QUALITY ASSURANCE TESTS

GENERAL

To insure proper operation of the CRC®-15W Enhanced, the following tests should be preformed at the indicated intervals.

ACCEPTANCE TESTS

The following tests must be preformed in the following order before the initial use of the CRC®-15W Enhanced:

- Diagnostics
- Chamber Daily Test
- Accuracy (for those nuclides that are not used in the Daily Test)
- Well Counter Test
- Geometry

Diagnostic Test

When **DIAGNOSTICS** is selected, the system diagnostic testing will begin. The instrument's memories and the programs are checked (this takes about 1 to 2 minutes) and the results printed and displayed. If any of these tests (RAM, PROM or EEPROM) fail, call the factory. See CHAPTER 11: DIAGNOSTICS for detailed instructions.

Chamber Daily Test

The Daily Tests 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 System Test, a Data Check, an Accuracy Test, and a Constancy Test. See CHAPTER 9: CHAMBER TESTS, SECTION: DAILY TEST for detailed instructions.

When **TEST** is pressed from the Measurement Screen, the Test Menu appears:

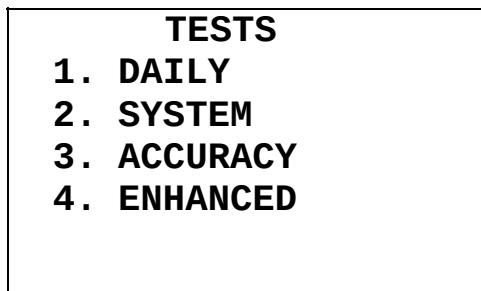


Figure 8-1 Test Menu

Press the **1** key to begin the Daily Test.

When the test is complete, if a printer is connected to the system, a report is printed.

Accuracy Test

If your Accuracy Test setup (CHAPTER 9: CHAMBER TESTS, SECTION: ACCURACY and CONSTANCY TEST) includes nuclides that are not used in the Daily Tests, you should perform the Accuracy Test with those nuclides. It will not be necessary to repeat the test for those nuclides that were included in the Daily Test.

Geometry Test

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

The test can be performed using a syringe or a vial. If a vial is used, the original volume is entered and then the added volume is entered for each measurement. If a syringe is used, the total volume for each measurement is entered.

Counter Test

The Counter Test should be performed every day. It cannot be performed unless Counter Background has been measured for the current day.

To perform the Counter Test, press **TEST** key from the Counter Measurement Screen.

When the test is complete, a report is printed.

QUALITY ASSURANCE TESTS

Daily Tests

The Daily Tests 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 System Test, a Data Check, an Accuracy Test, and a Constancy Test. See CHAPTER 9: CHAMBER TESTS, SECTION: DAILY TEST for detailed instructions.

Contamination Test

This test is normally performed at the end of each workday. At the very least, it should be performed once per week. To test for contamination of the dipper and/or well liner:

1. Make sure that the dipper is in the well and there is no source in the dipper.
2. Press **Co57** and then **SPC**.
3. Record the displayed activity.
4. Remove the dipper from the well and record the displayed activity.
5. Subtract the activity in step 4 from the activity in step 3. This is the amount of contamination of the dipper.
6. Remove the liner from the well and record the displayed activity.
7. Subtract the activity in step 6 from the activity in step 4. This is the amount of contamination of the liner.
8. Should either the dipper or the liner exhibit contamination greater than 3 μCi or 0.1 MBq, they should be decontaminated or replaced.
9. Return the liner to the well.

CAUTION

Never use the calibrator without the well liner being in place. Liners are inexpensive and easy to replace. A contaminated chamber is a very costly mistake.

QUARTERLY TESTS

The Quarterly Tests consist of:

- Diagnostic Test
- Chamber Daily Test
- Accuracy Test (for those nuclides that are not used in the Daily Test)
- Linearity Test
- Counter Test

Daily and Diagnostic Tests

The normal Daily Tests should be performed as a part of the Quarterly Tests. The operation of the Daily Tests is fully described in CHAPTER 9: CHAMBER TESTS, SECTION: DAILY TEST. At least one accuracy measurement (CHAPTER 9: CHAMBER TESTS, SECTION: ACCURACY and CONSTANCY TEST) must be included in the test sequence.

The Diagnostic Test (CHAPTER 11: DIAGNOSTICS) should be done as a part of the Quarterly Test sequence.

Accuracy Test

If your Accuracy Test setup (CHAPTER 9: CHAMBER TESTS, SECTION: ACCURACY and CONSTANCY TEST) includes nuclides that are not used in the Daily Tests, you should perform the Accuracy Test with those nuclides as a part of the Quarterly Test. It will not be necessary to repeat the test for those nuclides, which were included in the Daily Test.

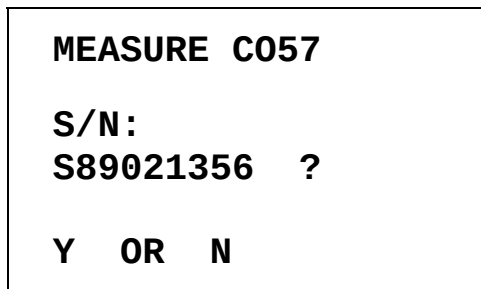
This test is essentially the same as the Accuracy Test described in CHAPTER 9: CHAMBER TESTS, SECTION: ACCURACY and CONSTANCY TEST. There are, however, three differences. First, this test is performed independently from the other portions of the Daily Test sequence. Second, it may be set up to use nuclides other than those used in the Daily Tests. Third, as you are doing the test you can opt to skip some nuclides.

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

The Accuracy Tests cannot be conducted until the Reference Source data has been entered. To start the Accuracy Tests, press **TEST**. You will then see the display illustrated in Figure 8-1.

Select the ACCURACY option by pressing **3**.

The test will start with a display similar to that illustrated in Figure 8-2. The actual nuclide and serial number of the check source will, of course, depend upon how you have initially defined the test.



MEASURE C057

S/N:
S89021356 ?

Y OR N

Figure 8-2

If you want to test with this source press the **9** key. If not, press **6**.

If you answered, "Yes", you will see a display similar to that illustrated in Figure 8-3. If not, you will continue with the next source.

Begin the test by inserting the requested check source into the well. The number in the center of the display is the measured activity. The number in the upper right corner of the display is the anticipated actual activity of the check source based upon the initial calibration of the source, corrected for decay. The number on the bottom of the display is 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.

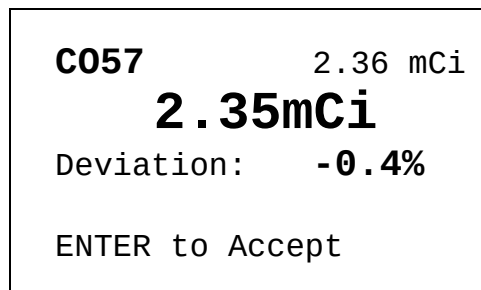


Figure 8-3

Press **ENTER** to accept the measurement.

If the Reference Source data for the Accuracy Test includes more than one nuclide, the test sequence will repeat as many times as required. At the end of the last test, if there is a printer attached, the test results will be printed and you will be asked if you wish to print again.

Press **9** to answer Yes and the test results will be printed again.

Press **6** to answer No and you will return to the Measurement mode.

Linearity Test

The linearity of the CRC®-15W Enhanced should be checked over the entire range of activities which are reasonably anticipated to be used. This can be done by any of several methods. The three available methods are Standard, Lineator and Calicheck.

CAUTION

Initially the activity of the Mo99 contamination in the sample will be insignificant compared to the activity of the Tc99m. However, Mo99 has a much longer half-life than Tc99m. If the test is continued down to very low levels, the activity of the Mo99 may become significant by the end of the test. If this is not taken into account, it may adversely affect the results of the test.

CHAPTER 9

CHAMBER TESTS

GENERAL

This section describes the Tests to be performed using the Chamber. The CRC®-15W Enhanced can step the user through Daily Test, System Test and Accuracy Test.

When **TEST** is pressed from the Chamber Measurement Screen, the Test Menu appears:

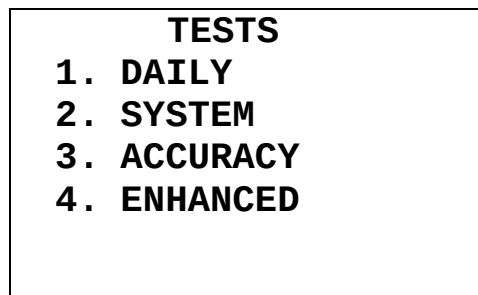


Figure 9-1 Test Menu

DAILY TEST

The Daily Test is selected by pressing the “1” key on the keypad.

The Daily Test consists of:

- Auto Zero
- Background
- System Test
- Data Check
- Accuracy Test
- Constancy Test

Auto Zero

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

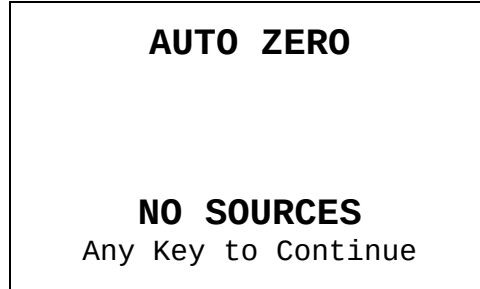


Figure 9-2 Auto Zero Instructions

Remove all sources from the vicinity of the Chamber and press any key.

You will be told to wait until a measurement is available.

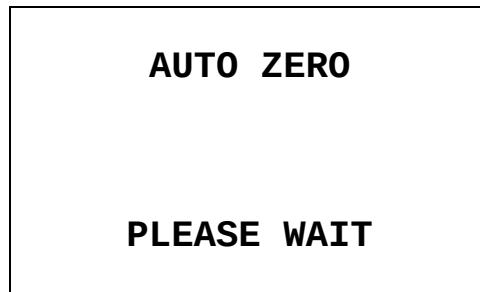


Figure 9-3 Auto Zero Please Wait Screen

The results screen will appear:

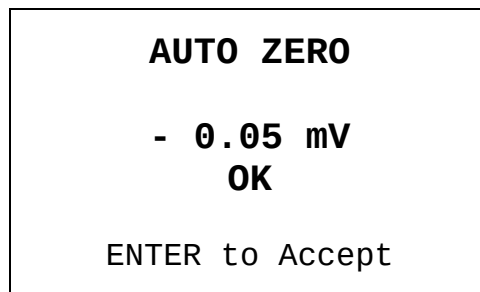


Figure 9-4 Auto Zero Results Screen

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

If the value has drifted since the last measurement, it will be indicated. Check to make sure no sources are in the area. If any sources are found, remove them and repeat the measurement.

If the value is out of range, an error message will appear. Check to make sure no sources are in the area. If any sources are found, remove them and repeat the measurement. If no sources were found, consult the factory.

Background

The second part of the Daily Test is Background measurement. Background measurement can also be performed by pressing the **BKG** key. If Background is performed via the **BKG** key, you will first be told to remove all sources.

You will be told to wait until a measurement is available.

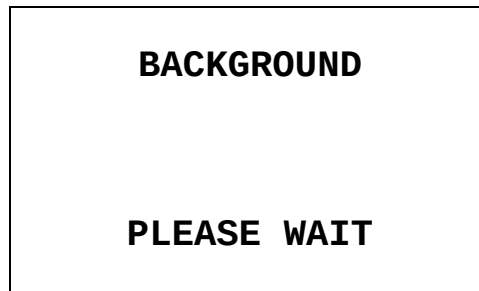


Figure 9-5 Background Please Wait Screen

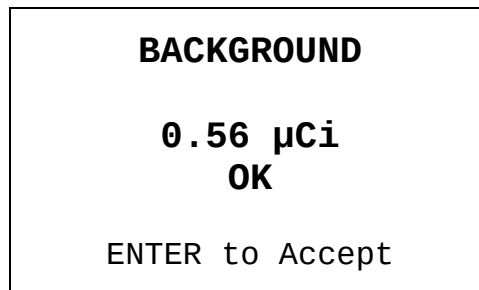


Figure 9-6 Background Results Screen

If the background is high but still acceptable ($> 27\mu\text{Ci}$ and $< 500\mu\text{Ci}$ or $> 1\text{MBq}$ and $< 20\text{MBq}$) the word **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 ($> 500\mu\text{Ci}$ or $> 20\text{MBq}$), the value will not be shown but the Background Too High Screen will appear:

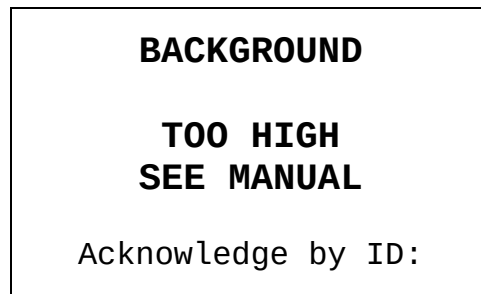


Figure 9-7 Background Too High Screen

This background cannot be accepted by the CRC®-15W Enhanced. If the cause of the high reading (nearby source, contaminated well etc.) cannot be found, consult the factory.

System Test

The third part of the Daily Test is the System Test. The System Test can also be performed by pressing the **2** key on the keypad when at the Test Menu (Figure 9-1).

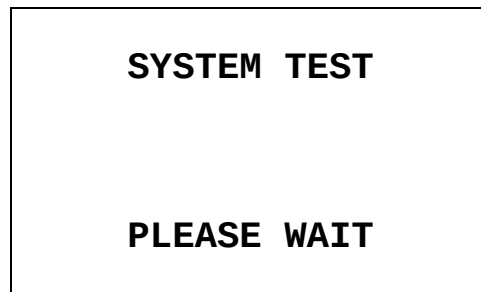


Figure 9-8 System Test Please Wait Screen

When a measurement is available, it is compared with the value entered at the factory and displayed:

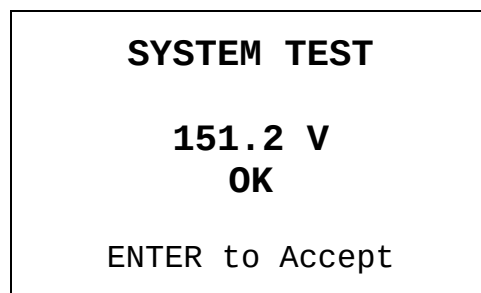


Figure 9-9 System Test Results Screen

If the results are out of range, the message "FAIL SEE MANUAL" appears. If this happens, consult the factory.

Data Check

The next part of the Daily Test is a check of the built-in nuclide data.

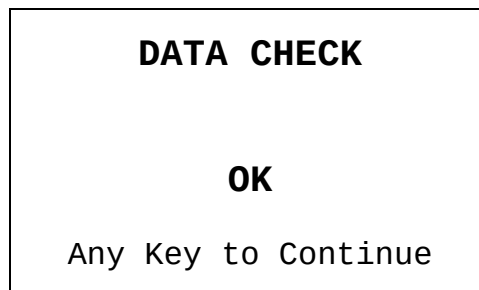


Figure 9-10 Data Check Results

If this test ever fails, consult the factory.

Accuracy and Constancy Test**Accuracy and Constancy Test in Daily Test**

The next part of the Daily Test is the Accuracy Test. You will be stepped through performing the accuracy test for all sources that have been designated as a Daily Source (See CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES). When the source designated as the Constancy Source has been measured, you will be instructed to perform the Constancy Test.

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

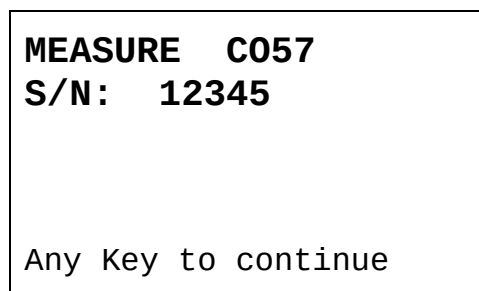
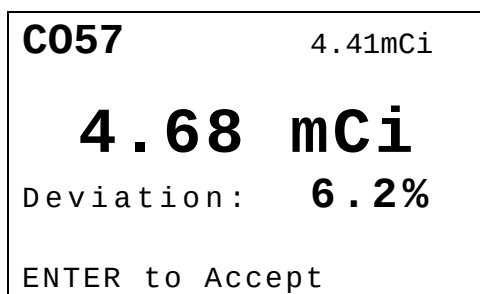


Figure 9-11 Accuracy Test in Daily Test Instruction Screen

The measurement screen will appear with the current activity of the source in the upper right hand corner. The deviation between the measured activity and the current activity will be displayed. If the deviation is greater than 20%, dashes will be shown instead of the deviation – this indicates an error condition (perhaps the wrong source is being measured).



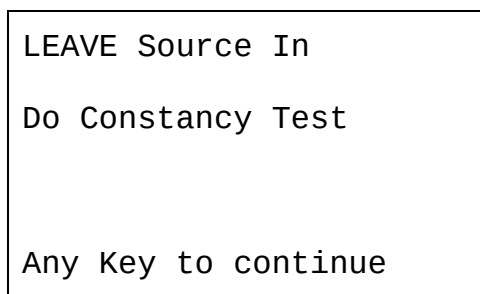
A rectangular screen with a black border. The text is as follows:
C057 4.41mCi
4.68 mCi
Deviation: 6.2%
ENTER to Accept

Figure 9-12 Accuracy Test Measurement Screen

Press **ENTER** to accept the measurement.

If the source being measured is not the Constancy Source, the Instruction Screen for the next Daily Source will appear.

If the source being measured is the Constancy Source, the Constancy Test Instruction Screen will appear:

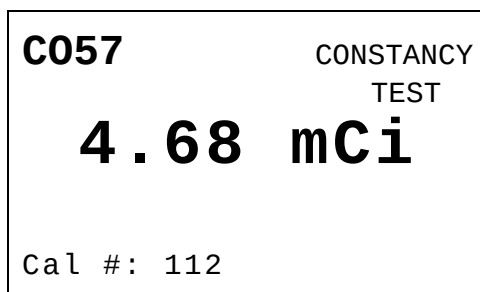


A rectangular screen with a black border. The text is as follows:
LEAVE Source In
Do Constancy Test

Any Key to continue

Figure 9-13 Constancy Test Instruction Screen

When any key (except **HOME**) is pressed, the Constancy Measurement Screen for the nuclide that is the Constancy Source will appear:



A rectangular screen with a black border. The text is as follows:
C057 CONSTANCY
TEST
4.68 mCi
Cal #: 112

Figure 9-14 Constancy Test Measurement Screen

To perform Constancy Test for other nuclides, press any pre-set nuclide key, user key or specify nuclide via **NUCL** key.

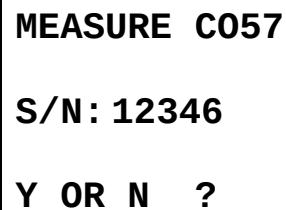
When all constancy tests are done, press **ENTER** to end the test.

The Daily Test report will be printed.

Accuracy Test from Menu

Accuracy Test can also be performed by pressing the **3** key on the keypad when at the Test Menu (Figure 9-1). This will allow you to perform the test using any of the Test Sources.

The “Accuracy Test Measure?” Screen will appear for each Test Source (Co57 is again used as the example):



MEASURE C057

S/N: 12346

Y OR N ?

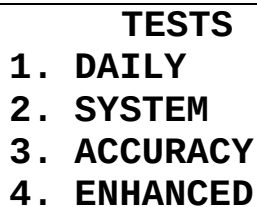
Figure 9-15 Accuracy Test Measure? Screen

Press **Y** to measure the source. Press **N** to skip the measurement and proceed to the next Test Source.

When all desired sources have been measured, the Accuracy Test Report will be printed.

ENHANCED TESTS

Press the **TEST** key to access the Tests Menu.



TESTS

- 1. DAILY**
- 2. SYSTEM**
- 3. ACCURACY**
- 4. ENHANCED**

Figure 9-16 Tests Menu

Press **4** to select ENHANCED from the TESTS Menu. The Enhanced Tests Menu appears as shown below.

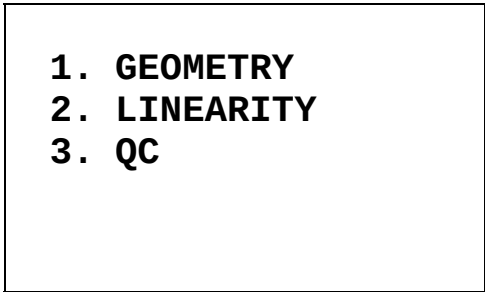
- 
- A rectangular box containing a numbered list of three items: 1. GEOMETRY, 2. LINEARITY, and 3. QC.
- 1. GEOMETRY**
 - 2. LINEARITY**
 - 3. QC**

Figure 9-17 Enhanced Tests Menu

Geometry Test

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

The test can be performed using a syringe or a vial. If a vial is used, the original volume is entered and then the added volume is entered for each measurement. If a syringe is used, the total volume for each measurement is entered.

Selecting Syringe or Vial

When Geometry Test is selected, the Syringe / Vial Selection screen appears:

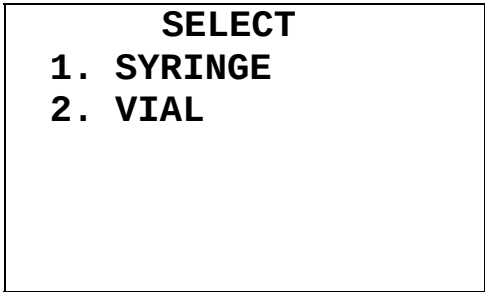
- 
- A rectangular box containing the word 'SELECT' at the top, followed by a numbered list of two items: 1. SYRINGE and 2. VIAL.
- SELECT**
- 1. SYRINGE**
 - 2. VIAL**

Figure 9-18 Syringe / Vial Selection Screen

Measuring with Syringe

The volume entry screen appears for each measurement.

A rectangular screen with a black border. Inside, the text "ENTER TOTAL VOLUME IN ml" is displayed in a bold, black, sans-serif font, arranged in three lines. Below the text is a small black square cursor.

**ENTER
TOTAL
VOLUME IN ml**

Figure 9-19 Total Volume Entry Screen

Enter the total volume (up to 4 digits) for the sample and then measure the syringe's activity.

Measuring with Vial

The test begins by entering the original volume of the vial.

A rectangular screen with a black border. Inside, the text "ENTER ORIGINAL VOLUME IN ml" is displayed in a bold, black, sans-serif font, arranged in three lines. Below the text is a small black square cursor.

**ENTER
ORIGINAL
VOLUME IN ml**

Figure 9-20 Original Volume Entry Screen

The Added Volume Entry screen appears for each measurement.

A rectangular screen with a black border. Inside, the text "ENTER ADDED VOLUME IN ml" is displayed in a bold, black, sans-serif font, arranged in three lines. Below the text is a small black square cursor.

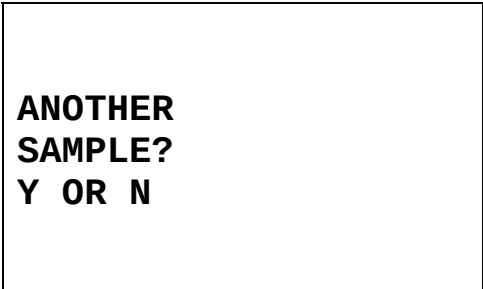
**ENTER
ADDED
VOLUME IN ml**

Figure 9-21 Added Volume Entry Screen

Enter the volume added to the vial and then measure the vial's activity.

Measurement Results

A minimum of 2 samples must be measured. After the second and subsequent measurements, you will be asked if another sample will be measured. The maximum number of samples is 10.



**ANOTHER
SAMPLE?
Y OR N**

Figure 9-22 Another Sample ? Screen

Press **N** if it was the last sample, otherwise press **Y** to measure another sample.

After the last sample has been measured, the screen to select the Base (Reference) measurement appears.

SELECT BASE

- | | | |
|----|--------|---------|
| 1. | 10.0ml | 10.5mCi |
| 2. | 11.0ml | 11.0mCi |
| 3. | 12.0ml | 10.7mCi |

Figure 9-23 Select Base Screen

Press the number corresponding to the sample to be used as the base.

The report will then be printed. 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.

Linearity Test

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

Note: *In order to use the Linearity Test, a Linearity Method must be defined in the setup.
If a Linearity Method is not defined, the message "MUST DEFINE LINEARITY TEST" is displayed.*

To select (or change) the Linearity test and perform any necessary setup, select OTHER from the Setup Menu. After the password is entered, the Other Menu appears.

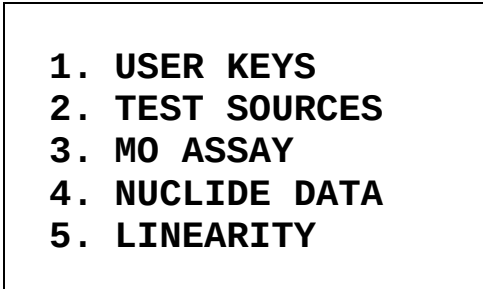
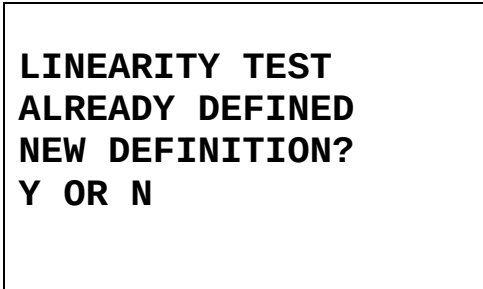
- 
- 1. USER KEYS**
 - 2. TEST SOURCES**
 - 3. MO ASSAY**
 - 4. NUCLIDE DATA**
 - 5. LINEARITY**

Figure 9-24 Other Menu

Select LINEARITY.

If a Linearity Test has previously been defined, the following message appears:



**LINEARITY TEST
ALREADY DEFINED
NEW DEFINITION?
Y OR N**

Figure 9-25 Message if Test Already Defined

Press **Y** to change the Linearity Test definition.

The Linearity Test Selection Menu appears.

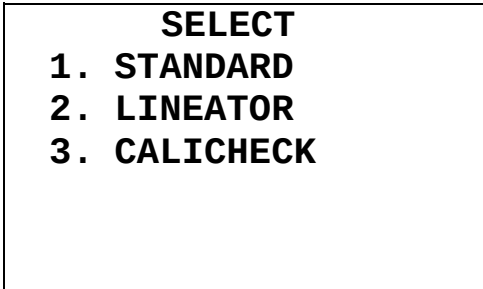
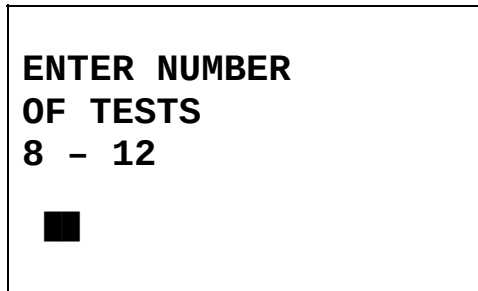
- 
- SELECT**
- 1. STANDARD**
 - 2. LINEATOR**
 - 3. CALICHECK**

Figure 9-26 Linearity Test Selection Menu

Setting Up Standard Linearity Test

Press **1** to select the Standard Test which is performed by tracking the decay of a strong Tc99m source.

The test can be performed with 8 to 12 measurements.



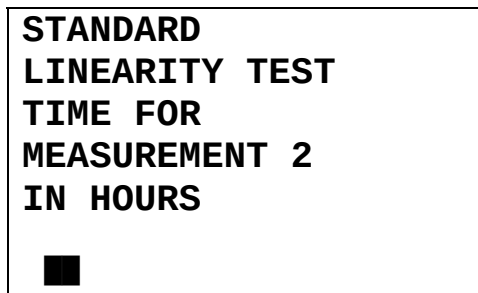
**ENTER NUMBER
OF TESTS**
8 - 12

■

Figure 9-27 Number of Tests Entry

Enter the number of measurements that will be performed.

For each measurement (starting with the second measurement), the nominal time (in hours) with respect to the first measurement that will be performed is entered. The example below is for the second measurement.



**STANDARD
LINEARITY TEST**
**TIME FOR
MEASUREMENT 2**
IN HOURS

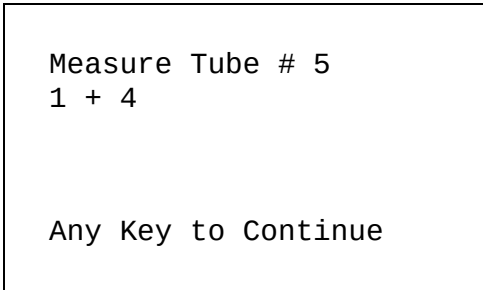
■

Figure 9-28 Standard Test – Test Time Entry

Setting Up Lineator Test

Press **2** to select the Lineator Test. This test requires eight measurements. A calibration procedure must be performed before any Lineator tests.

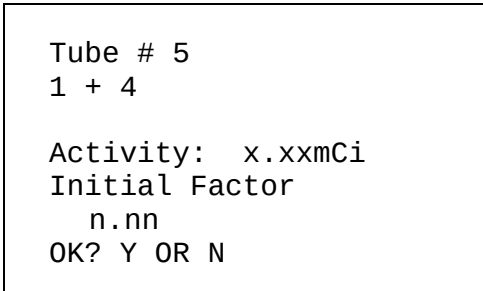
Place the Linearity test source in the calibrator and follow the measurement prompts. The example below is given for the 5th measurement.



```
Measure Tube # 5
1 + 4

Any Key to Continue
```

Figure 9-29 Lineator Calibration Prompt



```
Tube # 5
1 + 4

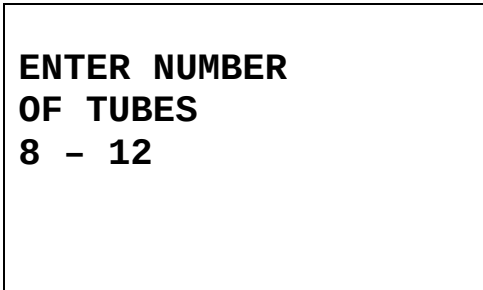
Activity: x.xxmCi
Initial Factor
n.nn
OK? Y OR N
```

Figure 9-30 Lineator Calibration Measurement Verification

Press **Y** to accept the measurement. Press **N** to repeat the measurement.

Setting Up Calicheck Test

Press **3** to select the Calicheck Test. This test requires 8 to 12 measurements. A calibration procedure must be performed before any Calicheck tests.



```
ENTER NUMBER
OF TUBES
8 - 12
```

Figure 9-31 Number of Tests Entry

Enter the number of measurements to be performed.

Place the Linearity test source in the calibrator and follow the measurement prompts. The example below is given for the 5th measurement.

```
Measure Tube # 5
Black + Green

Any Key to Continue
```

Figure 9-32 Calicheck Calibration Prompt

```
Tube # 5
Black + Green

Activity:  x.xmCi
Calibration Factor
      n.nn
OK? Y OR N
```

Figure 9-33 Calicheck Calibration Measurement Verification

Press **Y** to accept the measurement. Press **N** to repeat the measurement.

Performing Linearity Test

To perform a Linearity Test, press the **TEST** button. Press **4** to select ENHANCED. Press **2** to select LINEARITY.

If no Linearity Test has been defined, the message "MUST DEFINE LINEARITY TEST" is displayed. Otherwise, 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 is reported.

First Measurement

The following prompt will appear for the first measurement.

```

Test #1
First Measurement

Any Key to Continue

```

Figure 9-34 Standard Linearity Test First Measurement Prompt

Place the linearity source in the calibrator and press any key to perform the measurement. The verification screen will appear.

```

Measured  x.xxmCi

OK? Y or N

```

Figure 9-35 Standard Linearity Test First Measurement Verification

Press **Y** to accept the measurement. Press **N** to repeat the measurement.

Second Through Last Measurements

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

The previous results will be displayed. In the example, two measurements have been made.

```

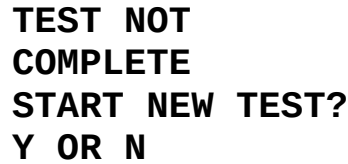
      STANDARD LINEARITY
#    MEASURED    %VAR
1    x.xxmCi     x.xx
2    x.xxmCi     x.xx

New Test? Y or N

```

Figure 9-36 Standard Linearity Test – Previous Test Results Screen

To start a new test press **Y**. If the test was not complete (measurements performed are fewer than those entered in test setup) a verification message will appear.



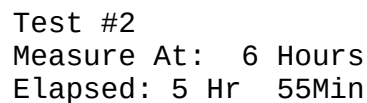
**TEST NOT
COMPLETE
START NEW TEST?
Y OR N**

Figure 9-37 Standard Linearity Test – New Test Verification Screen

Press **Y** to start a new test.

In either screen, press **N** to continue the test.

A message 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 second measurement.

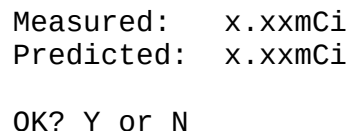


Test #2
Measure At: 6 Hours
Elapsed: 5 Hr 55Min

Any Key to Continue

Figure 9-38 Standard Linearity Test – Subsequent Measurement Prompt

Place the linearity source in the calibrator and press any key to perform the measurement. The verification screen will appear displaying the predicted activity and the measured activity.



Measured: x.xxmCi
Predicted: x.xxmCi

OK? Y or N

Figure 9-39 Standard Linearity Test – Subsequent Measurement Verification

Press **Y** to accept the measurement. Press **N** to repeat the measurement.

When the measurement is accepted, test result screen(s) will appear giving the variation from the predicted results for the measurements that have been performed.

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

Figure 9-40 Standard Linearity Test – Test Results Screen

After the last result screen, a report will be printed.

Lineator Test

The Lineator Test steps the user through the measurement of each tube. The examples given are for tube 5.

```
Measure Tube # 5
1 + 4

Any Key to Continue
```

Figure 9-41 Lineator Measurement Prompt

Press any key to perform the measurement. After the measurement, the measurement verification screen appears.

```
Tube # 5
1 + 4

Present Factor:
      n.nn
% Ratio:  p.pp%

OK? Y or N
```

Figure 9-42 Lineator Measurement Verification

Press **Y** to accept the measurement. Press **N** to repeat the measurement.

After the last measurement, the results screens will appear.

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

Figure 9-43 Lineator – 1st Test Results Screen

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

Figure 9-44 Lineator – 2nd Test Results Screen

Press any key to obtain a printed report.

Calicheck Test

The Calicheck Test steps the user through the measurement of each tube. The examples given are for tube 5.

Measure Tube # 5
Black + Green
Any Key to Continue

Figure 9-45 Calicheck Measurement Prompt

Press any key to perform the measurement. After the measurement, the measurement verification screen appears.

```

Tube # 5
Black + Green

Result:  x.xxmCi

OK? Y or N

```

Figure 9-46 Calicheck Measurement Verification

Press **Y** to accept the measurement. Press **N** to repeat the measurement.

After the last measurement, the results screens will appear.

```

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

```

Figure 9-47 Calicheck – 1st Test Results Screen

```

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

```

Figure 9-48 Calicheck – 2nd Test Results Screen

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

After the last test results screen, press any key to obtain a printed report.

Quality Control (QC)

Radiochromatography Quality Control tests can be performed using four methods.

QC Test Selection

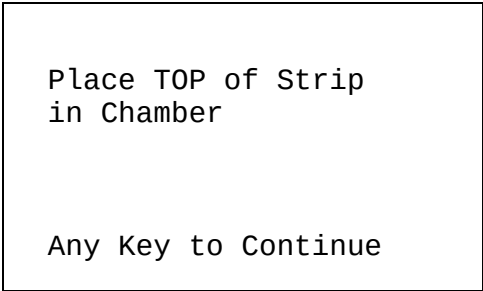
When QC is selected from the Enhanced Tests Menu, the QC Test Selection Menu appears.

- 
- A rectangular box containing a numbered list of four options:
- 1. SINGLE STRIP**
 - 2. TWO STRIPS**
 - 3. TC99m HMPAO**
 - 4. TC99m MAG3**

Figure 9-49 QC Test Selection Menu

Single Strip Test

The Single Strip Test consists of two measurements: the top of the strip and then the bottom of the strip. The prompt screens and the results screen are shown below.

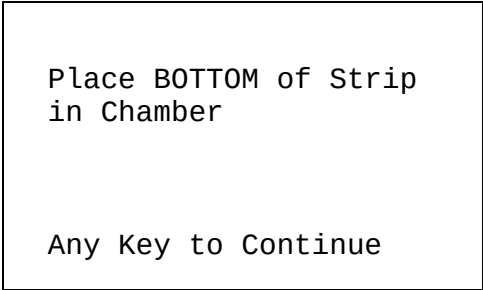


A rectangular box containing two lines of text:

Place TOP of Strip
in Chamber

Any Key to Continue

Figure 9-50 Single Strip Measurement #1 Message

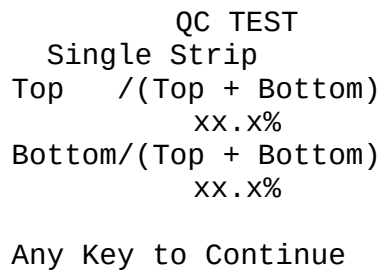


A rectangular box containing two lines of text:

Place BOTTOM of Strip
in Chamber

Any Key to Continue

Figure 9-51 Single Strip Measurement #2 Message

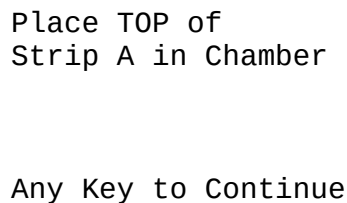
A rectangular box containing text for a single strip test result screen. The text is centered and reads: "QC TEST", "Single Strip", "Top / (Top + Bottom)", "xx.x%", "Bottom / (Top + Bottom)", "xx.x%", and "Any Key to Continue".

QC TEST
Single Strip
Top / (Top + Bottom)
xx.x%
Bottom / (Top + Bottom)
xx.x%
Any Key to Continue

Figure 9-52 Single Strip Result Screen

Two Strips Test

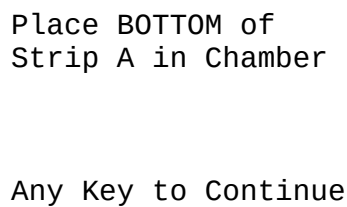
The Two Strips Test consists of 4 measurements: the top and then the bottom of strip A, the top and then the bottom of strip B. The prompt screens and the results screen are shown below.

A rectangular box containing text for the first measurement prompt. The text is centered and reads: "Place TOP of Strip A in Chamber" and "Any Key to Continue".

Place TOP of
Strip A in Chamber

Any Key to Continue

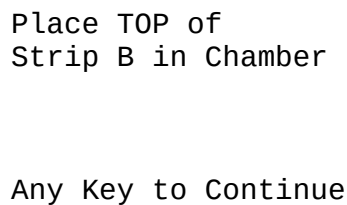
Figure 9-53 Two Strips Measurement #1 Message

A rectangular box containing text for the second measurement prompt. The text is centered and reads: "Place BOTTOM of Strip A in Chamber" and "Any Key to Continue".

Place BOTTOM of
Strip A in Chamber

Any Key to Continue

Figure 9-54 Two Strips Measurement #2 Message

A rectangular box containing text for the third measurement prompt. The text is centered and reads: "Place TOP of Strip B in Chamber" and "Any Key to Continue".

Place TOP of
Strip B in Chamber

Any Key to Continue

Figure 9-55 Two Strips Measurement #3 Message

Place BOTTOM of
Strip B in Chamber

Any Key to Continue

Figure 9-56 Two Strips Measurement #4 Message

QC TEST Two Strips
Free Tc99m
 xx.x%
Reduced/Hydrolyzed
 xx.x%
Purity
 x.xx%
Any Key to Continue

Figure 9-57 Two Strips Result Screen

Tc99m 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, the top and then the bottom of strip C. The prompt screens and the results screen are shown below.

Place TOP of
Strip A in Chamber

Any Key to Continue

Figure 9-58 Tc99m HMPAO Measurement #1 Message

Place BOTTOM of
Strip A in Chamber

Any Key to Continue

Figure 9-59 Tc99m HMPAO Measurement #2 Message

Place TOP of
Strip B in Chamber

Any Key to Continue

Figure 9-60 Tc99m HMPAO Measurement #3 Message

Place BOTTOM of
Strip B in Chamber

Any Key to Continue

Figure 9-61 Tc99m HMPAO Measurement #4 Message

Place TOP of
Strip C in Chamber

Any Key to Continue

Figure 9-62 Tc99m HMPAO Measurement #5 Message

Place BOTTOM of
Strip C in Chamber

Any Key to Continue

Figure 9-63 Tc99m HMPAO Measurement #6 Message

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

Figure 9-64 Tc99m HMPAO Result Screen

Tc99m MAG3 Test

The Tc99m MAG3 Test consists of 3 measurements: Fraction #1, Fraction #2 and the Cartridge. The prompt screens and the results screen are shown below.

Place Fraction #1
in Chamber

Any Key to Continue

Figure 9-65 Tc99m MAG3 Measurement #1 Message

Place Fraction #2
in Chamber

Any Key to Continue

Figure 9-66 Tc99m MAG3 Measurement #2 Message

Place Cartridge
in Chamber

Any Key to Continue

Figure 9-67 Tc99m MAG3 Measurement #3 Message

QC TEST MAG3
Non-elutable Tc99m
 xx.x%
Hydrophilic Impure
 xx.x%
Tc99m Mertiatide
 xx.x%
Any Key to Continue

Figure 9-68 Tc99m MAG3 Result Screen

CHAPTER 10

COUNTER TESTS

GENERAL

This section describes measuring the Well Counter Background, performing the Well Counter Auto Calibration and performing the Well Counter Test.

BACKGROUND

When the **WELL** key is pressed from the Calibrator Measurement Screen, the system checks to see if the background has been measured for the current day.

If the background has not yet been measured, the Background Instruction Screen will appear.

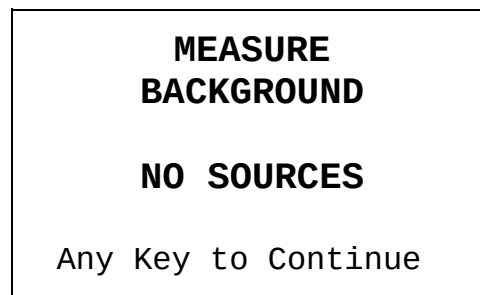


Figure 10-1 Background Instruction Screen

Background can also be measured by pressing **BKG** from the Well Counter Measurement Screen (Fig. 15-2).

Any presence of contamination may be confirmed by counting without a sample in the sample chamber.

To measure Background, press any key except **HOME**.

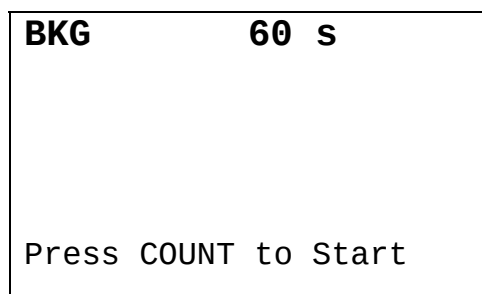


Figure 10-2 Background Measurement Screen

Enter the counting period via the numeric keypad and press **ENTER**.

Counting the background for 20 seconds or longer is recommended.

Press **COUNT** to begin background counting.

When **COUNT** is pressed, the counts and the counting rate will be displayed and updated every second.

A Bar Graph of the counting rate per channel may also be shown and updated every second. The remaining counting period is shown.

To switch to the Bar Graph, press **DSPLY**.

The background counting screen will be displayed:

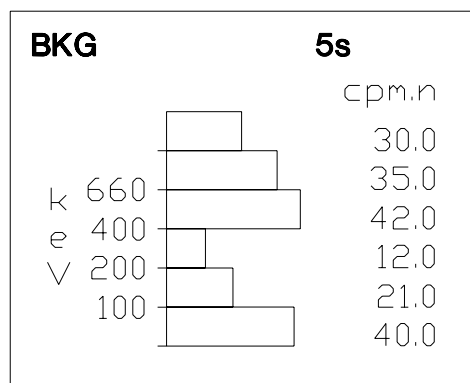


Figure 10-3 Background Bar Graph Counting Screen

To end the measurement before the requested time, press **COUNT**.

To abort the measurement, press **HOME**.

When the measurement is finished, the background counting rate, together with the precision, is displayed.

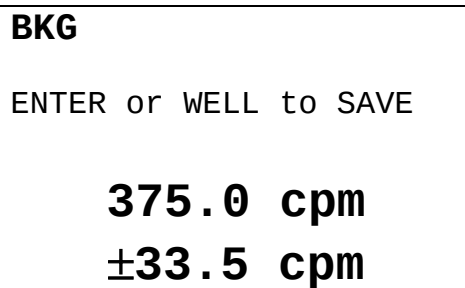


Figure 10-4 Background Result Screen

Press **DSPLY** to view the bar graph again.

To accept the background (i.e., store it for future measurements) and print a record of the background measurement press **ENTER**.

When background measurement has been completed, press **WELL** to save the data and proceed to the Well Counter Measurement Screen.

To go to the measurement screen without accepting the background, press **HOME**.

If the background is greater than the background trigger level, **TOO HIGH** will appear in the upper right hand corner of Figure 10-4. Make sure that there are no sources of radiation near the detector and re-measure the background. If the background is still too high, the background trigger level may be too low for your environment. See CHAPTER 7: COUNTER INITIALIZATION, SECTION: TRIGGER LEVEL for instructions to change the background trigger level.

To measure background again using the same counting period, press **COUNT**.

To measure background again using a different counting period, press **BKG**.

Note: If **HOME** is pressed before pressing **ENTER** or **WELL**, the result of the new background measurement will not be stored.

AUTO CALIBRATION

The CRC[®]-15W Enhanced uses an automatic calibration (AUTO CAL) procedure for its Well Counter, to adjust the high voltage to maintain the correct relationship between energy and channel.

Auto Calibration must be performed prior to performing Well Counter Test for the first time and whenever the Well Counter Test fails. Auto Calibration should preferably be performed with the same source as in Well Counter Test.

The calibration is performed automatically by use of a Cs137 source or a Ba133 source. See CHAPTER 7: COUNTER INITIALIZATION, SECTION: TEST SOURCE for instructions for entering Well Counter Test Source Data.

When the Utility Menu appears, select AUTO CAL and press **ENTER**.
If Cs137 has been selected as the Test Source, Fig 10-5a will appear.
If Ba133 has been selected as the Test Source, Fig 10-5b will appear.

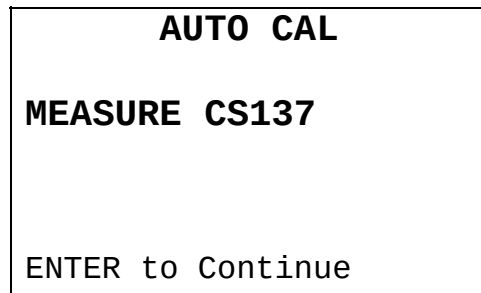


Figure 10-5a Cs137 Calibration Instruction Screen

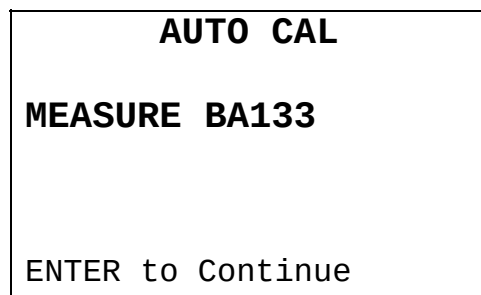


Figure 10-5b Ba133 Calibration Instruction Screen

Place the requested Test Source in the Well Counter and press **ENTER**.

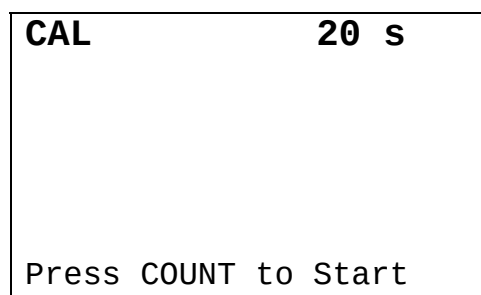


Figure 10-6 Calibration Measurement Screen

The last counting period used for TEST or AUTO CAL is displayed. Use the numeric keypad to enter a different time if desired. The minimum allowed time period is 20 seconds.

Press **COUNT** when the correct time period is displayed.

When **COUNT** is pressed, the following message appears for 3 seconds:

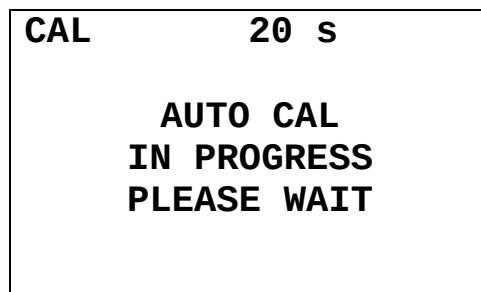


Figure 10-7 Auto Cal in Progress Message

The counting will then begin:

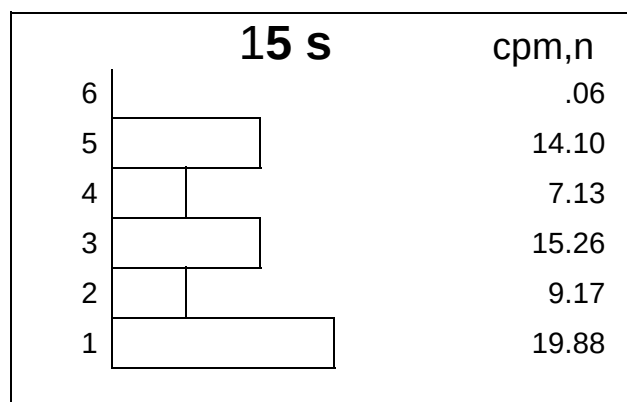


Figure 10-8 Auto Cal Counting Screen

AUTO CAL attempts to bring the energy calibration to within 2% of the ideal value.

If the calibration is already within 2%, it attempts to bring to within 1% of the ideal value.

When this is accomplished, a report is printed.

Energy Deviation: the deviation from the ideal value.

For Cs137:

Ch 1/ (Ch4+Ch5): the ratio of counts in channel 1 to the sum of the counts in channels 4 and 5.

or

For Ba133:

Ch 1/ (Ch3+Ch4): the ratio of counts in channel 1 to the sum of the counts in channels 3 and 4.

Gain Reference: this is related to the High Voltage and has a range of 0 to 4095.

A graphic representation of the net counts in each channel is printed.

The calibration results are also displayed on the screen in case there is no printer.

Calibration Failure

When AUTO CAL cannot bring the energy calibration to within 2% of the ideal value, "AUTO CALIBRATION OUT OF RANGE" is displayed. Make sure that the correct source was used for the calibration and repeat the calibration if necessary.

If the correct source was used, contact Capintec's Authorized Service Center (see CHAPTER 18: CLEANING AND MAINTENANCE, SECTION: SERVICING) for more information.

Calibration Method

Cs137 Test Source:

The calibration is accomplished by adjusting the high voltage until the ratio of the counts in channels 4 and 5 is within the limits corresponding to an energy deviation of the Cs137 energy peak of $\pm 2\%$.

Ba133 Test Source:

The calibration is accomplished by adjusting the high voltage until the ratio of the counts in channels 3 and 4 is within the limits corresponding to an energy deviation of the Ba133 energy peak of $\pm 2\%$.

TEST

The Well Counter Test should be performed every day. It cannot be performed unless Well Counter Background has been measured for the current day.

To perform the Well Counter Test, press the **TEST** key from the Well Counter Measurement Screen.

If Cs137 has been selected as the Test Source, Fig 10-9a will appear.

If Ba133 has been selected as the Test Source, Fig 10-9b will appear.

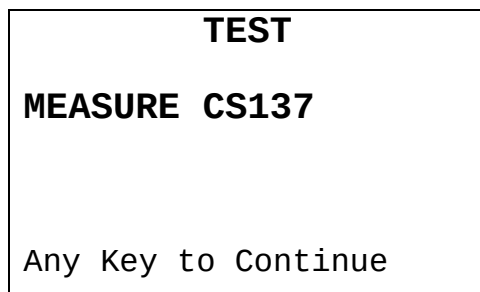


Figure 10-9a Cs137 Well Counter Test Instruction Screen

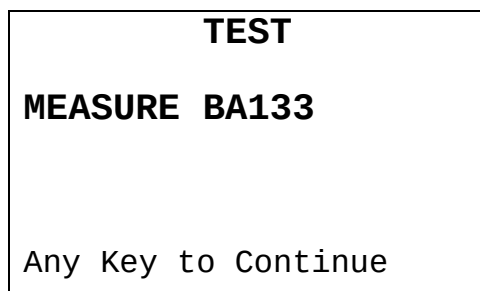


Figure 10-9b Ba133 Well Counter Test Instruction Screen

Place the requested Test Source in the Well Counter and press any key (except **HOME**).

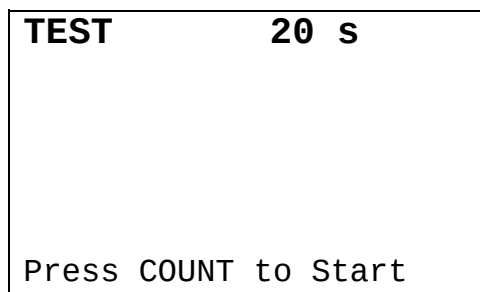


Figure 10-10 Well Counter Test Measurement Screen

The last counting period used for TEST or AUTO CAL is displayed. Use the numeric keypad to enter a different time if desired. The minimum allowed time period is 20 seconds.

Press **COUNT** when the correct time period is displayed.

When the test is complete, a report is printed.

The values given the report and the allowed limits are:

Cs137 Standard:	current activity of the Cs137 Test source
or	
Ba133 Standard:	current activity of the Ba133 Test source

Measured as:	measured activity of the source
Deviation:	deviation of the measured value from the standard value. If the deviation is more than a factor of 2, ERROR is printed (probably used wrong source)
Energy deviation:	deviation from the ideal value. If the deviation is more than 3.0%, performing of Auto Cal is recommended. If it is more than 5%, ERROR will be printed. Confirm the source and perform Auto Cal.
Ch1/(Ch4+Ch5): or Ch1/(Ch3+Ch4):	the ratio measured during AUTO CAL for Cs137 the ratio measured during AUTO CAL for Ba133
Measured as:	the currently measured ratio
Deviation:	the deviation of the measured ratio from the AUTO CAL ratio.
Gain Reference:	this is related to the High Voltage and has a range of 0 to 4095.

A graphic representation of the net counts in each channel is printed.

A list of the background counts in each channel is printed.

The data is also displayed on the screen in case there is no printer.

CHAPTER 11

DIAGNOSTICS

GENERAL

When **DIAGNOSTICS** is selected, the system diagnostic testing will begin. The instrument's memories and the programs are checked (this takes about 1 to 2 minutes) and the results printed and displayed. If any of these tests (RAM, PROM or EEPROM) fail, call the factory.

Press **UTIL** from the Chamber Measurement Screen.

Press **4** to select **DIAGNOSTICS**.

If a printer is part of the system, but is not ready for printing, you will see the display illustrated in Figure 11-1. If you want a printed report, get the printer ready before doing anything else. Press any key (except **HOME**) to continue. If the printer is ready, or if the system does not include a printer, this step will be skipped.

Nuclear data and other system values will be printed. This printout should be kept for future reference.

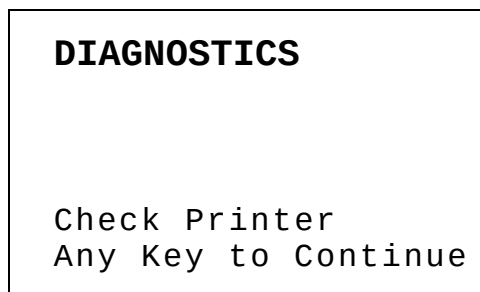


Figure 11-1

Note: The above message "Check Printer" is displayed if the OKI Printer is selected as the system printer. If the SLIP Printer is selected as the system printer, the Message is "Connect Printer". If the ROLL Printer is selected as the system printer, no Message is displayed.

Next, you will see the screen illustrated in Figure 11-2. The PROM test requires about 1-1/2 minutes. Be patient.

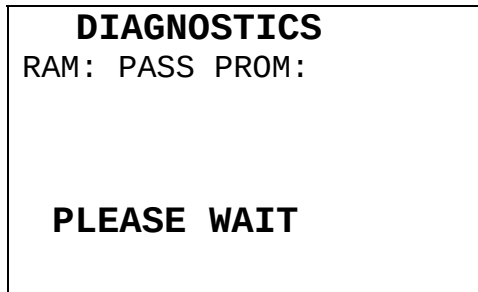


Figure 11-2

The test results will appear on the display similar to that illustrated in Figure 11-3. The test should always indicate PASS for RAM, PROM, and EEPROM. If any of these tests indicate FAIL, copy all of the other data on the display and contact the factory. When you have finished viewing the results, press any key to continue.

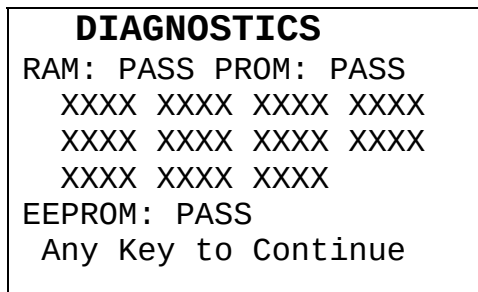


Figure 11-3

DIAGNOSTICS PRINTOUT

An example of the printout is shown on the following pages for the Okidata 320 printer. (The PROM values are just examples).

Note: A U after a Calibration Number indicates that it is a user defined calibration number.

Figure 11-4 Diagnostics Printout on OKIDATA Printer (page 1 of 5)

CRC-15W RADIOISOTOPE DOSE CALIBRATOR

S/N Main Unit: 123456 Rev: 1.00

Chamber : 000000

Printer : 000000

Counter : 000000

Oct 02, 2003 16:03

Capintec, Inc. USA

NUCLIDE DATA:

	Half-Life	Cal #	Correction Factors			Channels	CF
			Syr	Vial	Cap		dpm/cpm
Tc99m	6.007 H	080				1 2	1.400
I 131	8.021 D	151				3	5.300
I 123	13.22 H	277				2	1.500
Xe133	5.243 D	188					
Ga67	3.261 D	100				1 2 3	1.700
Tl201	72.91 H	205				1 2	1.550
In111	2.805 D	303				2 3 4	1.150
Co57	271.7 D	112				2	1.200
Ag110m	249.8 D	554 ÷2					
Am241	432.2 Y	055					
Ar41	1.827 H	468					
As72	26.00 H	795					
As74	17.78 D	304					
As76	26.32 H	110					
Au198	2.696 D	149					
Au199	3.139 D	053					
Ba131	11.80 D	505					
Ba133	10.50 Y	591				1 2 3 4	1.100
Bi207	32.20 Y	846					
Br77	56.00 H	091					
C 11	20.38 M	457					
Ce139	137.6 D	352					
Co55	17.54 H	481					
Co58	70.82 D	389					
Co60	5.271 Y	990				3 4 5 6	3.400
Cr51	27.70 D	100*10				3	36.00
Cs131	9.690 D	148					
Cs132	6.475 D	485					
Cs134	2.065 Y	726					
Cs136	13.10 D	489 ÷2					
Cs137	30.00 Y	220				3 4 5	6.300
Cu64	12.70 H	015					
Cu67	2.575 D	052					
Dy157	8.100 H	424					
F 18	109.7 M	439					
Fe52	8.275 H	374					
Fe59	44.51 D	430					
Ga66	9.400 H	903					
Ga68	68.00 M	416					
Ga72	14.10 H	470 ÷2					
Hf181	42.40 D	387					
Hg197	64.10 H	197					
Hg203	46.60 D	093					
I 124	4.180 D	570					
I 125	59.60 D	319				1	1.300
I 130	12.36 H	984					

Figure 11-4 Diagnostics Printout on OKIDATA Printer (page 2 of 5)

CRC-15W RADIOISOTOPE DOSE CALIBRATOR

S/N Main Unit: 123456 Rev: 1.00
 Chamber : 000000
 Printer : 000000
 Counter : 000000

Oct 02, 2003 16:03

Capintec, Inc. USA

NUCLIDE DATA:

	Half-Life	Cal #	Correction Factors			Channels	CF dpm/cpm
			Syr	Vial	Cap		
In113m	1.658 H	076					
In116m	54.15 M	974					
Ir192	73.83 D	408					
K 42	12.36 H	033					
K 43	22.30 H	430					
Kr79	35.04 H	050					
Kr87	76.30 M	250					
Mn52	5.591 D	676 ±2					
Mn54	312.5 D	309				3 4 5 6	5.700
Mn56	2.577 H	627					
Mo99	65.92 H	165					
N 13	9.965 M	457					
Na22	2.602 Y	957				3 4 5 6	2.300
Na24	14.96 H	658 ±2					
Nd147	10.98 D	213					
Np239	2.355 D	147					
O 15	2.040 M	462					
Pb203	51.88 H	344					
Pb212	10.64 H	101					
Ra226	1600. Y	778					
Rb81	4.580 H	270					
Rb82	1.273 M	504					
Rb84	32.77 D	347					
Sb117	2.800 H	082					
Sb122	2.700 D	146					
Sb124	60.20 D	720					
Sc44	3.927 H	938					
Sc46	83.79 D	822					
Se75	119.8 D	258					
Sn113	115.1 D	180					
Sr85	64.85 D	193					
V 48	15.97 D	569 ±2					
Xe135	9.090 H	085					
Y 86	14.74 H	711 ±2					
Y 88	106.6 D	465 ±2					
Yb169	32.03 D	948					
Zn65	243.9 D	172					
Zn69m	13.76 H	143					
MoCAP	65.92 H	204*10					
MoCAN	65.92 H	246*10					
TcCAPM	6.007 H	042					
TcCAPB	6.007 H	031					

Figure 11-4 Diagnostics Printout on OKIDATA Printer (page 3 of 5)

```
CRC-15W RADIOISOTOPE DOSE CALIBRATOR          Oct 02, 2003 16:04
S/N Main Unit: 123456          Rev: 1.00        Capintec, Inc. USA
Chamber : 000000
Printer  : 000000
Counter  : 000000

NUCLIDE DATA:
      Half-Life  Cal #      Correction Factors      Channels      CF
                        Syr      Vial      Cap                        dpm/cpm

USER NUCLIDES:

USER KEYS:
CHAMBER
  U1: Cs137  U2: Ga67  U3: None  U4: None  U5: None

WELL COUNTER
  U1: None  U2: None  U3: None  U4: None  U5: None
```

Figure 11-4 Diagnostics Printout on OKIDATA Printer (page 4 of 5)

CRC-15W RADIOISOTOPE DOSE CALIBRATOR
S/N Main Unit: 123456 Rev: 1.00
Chamber : 000000
Printer : 000000
Counter : 000000

Oct 02, 2003 16:04
Capintec, Inc. USA

SYSTEM PARAMETERS:

CHAMBER
Response Correction:
0.00 % (Co60 was HIGH)
Saturation: 0.50 %
Nominal Voltage: 155.0 V
Mo / Tc Limit: 0.150 $\mu\text{Ci}/\text{mCi}$

WELL COUNTER
Limits
Background : 3000.0cpm
Wipe : 2000.dpm
Unrestricted : 200.0dpm
Sealed Source: 5.0nCi

Factory Setup
Dead Time: 3.0usec
Calibration Factor: 1.000

TEST SOURCES:

NUCLIDE	S/N	CALIBRATION DATE	CURRENT ACTIVITY
CHAMBER:			
Co57		No Source	
Co60		No Source	
Ba133		No Source	
Cs137		No Source	
Ra226		No Source	

D: Daily C: Constancy Source

WELL COUNTER:
No Source

Figure 11-4 Diagnostics Printout on OKIDATA Printer (page 5 of 5)

CRC-15W RADIOISOTOPE DOSE CALIBRATOR
S/N Main Unit: 123456 Rev: 1.00
Chamber : 000000
Printer : 000000
Counter : 000000

Oct 02, 2003 16:04
Capintec, Inc. USA

PROM VALUES:

0B98	565A	7F50	759E
5FC1	6F2F	EB0E	8745
EB2B	6594	505C	

MEMORY TESTS:

RAM: PASS
PROM: PASS
EEPROM: PASS

CHAPTER 12

CHAMBER MEASUREMENT PROCEDURES

GENERAL

Instructions for measuring a source with the Chamber are given in this section.

The Chamber Measurement Screen is shown below:

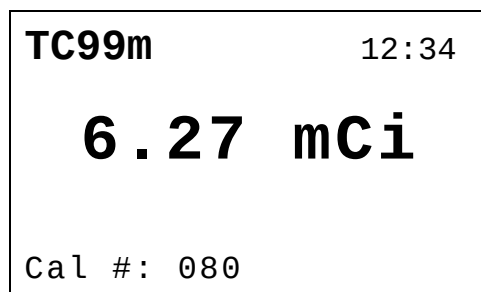


Figure 12-1 Chamber Measurement Screen

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 sample into the Chamber.

Specify Nuclide or enter Calibration Number.

To print a record of the measurement:

Press **ENTER**.

To find out what the activity will be at a different time:

Press **TIME**.

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.

Co57 **Ga67** **Tc99m** **In111** **I123** **I131** **Xe133** **Tl201**

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. (See: CHAPTER 5: SYSTEM INITIALIZATION, SECTION: USER KEY ASSIGNMENT)

NUCL Key:

Press **NUCL**.

SPECIFY NUCLIDE: is displayed.

Input the nuclide name via the number/letter keys (only numbers will appear).

Press **ENTER** when done.

The entire name does not have to be input. If the nuclide is not uniquely specified, a list of possibilities will appear. (If there are more than 10 possibilities, SPECIFY FURTHER will appear.)

Input the number corresponding to the desired nuclide and press **ENTER**.
If **NUCL** was accidentally pressed, press **ENTER** without any input.

Entering Calibration Number

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

Press **CAL#**.

CAL #: is displayed.

Input the desired calibration number and press **ENTER**.

A calibration number may include a multiplication sign (* on the keyboard, displayed as ×) or a division sign (÷). However, the chamber is always direct reading and the multiplication or division sign is only used to be consistent with existing calibration numbers.

If **CAL#** was accidentally pressed, press **HOME** to return to Fig 12-1.

Selecting Sample Container Type

Correction Factors for different container types can be input via Utilities Menu (see CHAPTER 6: CHAMBER INITIALIZATION, SECTION: CORRECTION FACTORS).

The possible sample container types are:

SYRINGE
VIAL
CAPSULE

When a nuclide is selected, the container type is “none” and no Correction Factor is applied to the measurement.

If 1 or more Correction Factors have been entered for the current nuclide, the container type may be changed by using the **LOC** key to scroll through the container types with Correction Factors.

If no Correction Factors have been entered for the nuclide, the **LOC** key is inactive and will beep when pressed.

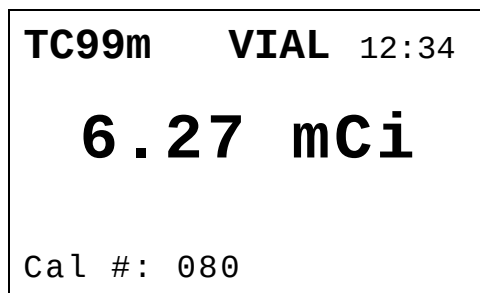


Figure 12-2 Measurement Screen with Container Type Displayed

Selecting Range

The CRC[®]-15W Enhanced is auto ranging over 3 ranges. However, the ranges can be cycled through manually by using the **UP** (⬆) and **DOWN** (⬇) **ARROW** keys. When the unit is first powered on, the display will be in the high activity range (.xx mCi).

To display greater accuracy with the medium activity range (x. µCi), press the **DOWN** **ARROW** (⬇).

For the greatest accuracy, select the low activity range (x.xx µCi) by pressing the **DOWN** **ARROW** (⬇) again.

Pressing the **DOWN** **ARROW** (⬇) a third time will keep the unit in the low activity range (x.xx µCi) but with a longer averaging time.

Pressing the **UP ARROW** (↶) will reverse the process.

When **HOME** is pressed, the display reverts to the power up range (high activity range).

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 printed) along with the measured activity.

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

Press **TIME**.

The calibration number is erased and the current time and date appear in the order: hour, minute, Day, Month, Year. The hour is highlighted.

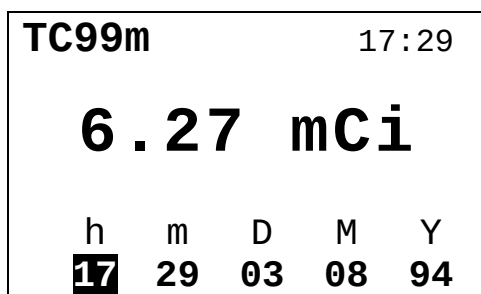


Figure 12-3 Time / Date Input Screen

Use the **ARROW** keys to highlight the field (hour, min, day, month, year) that you want to change, and then use the numeric keypad to change the value of that field.

Press **ENTER** when the desired time and date is displayed.

The activity at the input day and time is displayed.

If only the time was changed, the new time will be shown as in the figure below.

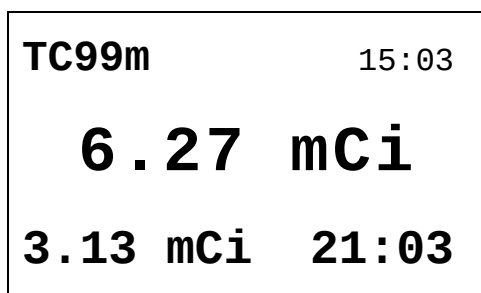


Figure 12-4 Future Activity – Same Day

If the day was changed, the new time and date will be shown:

TC99m	15:03
6.27 mCi	
396.µCi	21:03
DEC 08 1994	

Figure 12-5 Future Activity – Different Day

PRINTING A RECORD OF THE MEASUREMENT

To print a record of the measurement, follow the directions for the selected printer:

OKIDATA Printer

Ticket Chosen:

- If the printer is set up for continuous feed, press **PARK** (on printer)
- Move right hand lever back to single sheet
- Place ticket between 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.
- Press **ENTER** (on keyboard).

Single Line Chosen:

- Verify that the **SEL** light is lit.
- Press **ENTER**.

Roll Printer

- Press **ENTER**.

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.
- Press **ENTER** (on keyboard).

MOLY ASSAY

The CRC®-15W Enhanced 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 Utilities (see CHAPTER 6: CHAMBER INITIALIZATION, SECTION: SELECTING MOLY ASSAY METHOD).

To perform a Moly Assay, press **Mo ASSAY** key while in the Chamber Measurement Screen.

If the assay method has not been uniquely specified, you must choose the method:

SELECT

1. CAPMAC for
Mallinckrodt Gen
2. CAPMAC for
Bristol Myers Gen
3. Capintec Canister

Figure 12-6 Moly Assay Method Selection

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

If only CAPMAC or only CANISTER has been chosen in Utilities, this screen will be skipped.

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.

M099**BKG**

EMPTY
CAPMAC

Press N(6) to Skip
Other Key to Proceed

Figure 12-7 Moly Assay Background Choice

Press **N** if you don't want to measure background with the CAPMAC or Canister. You will go directly to Mo99 assay.

Press any other key (except **HOME**) to begin Mo background measurement (Moly Assay Instruction Screen).

Measuring Mo99 background is very similar to measuring background via **BKG** key or Daily Test.

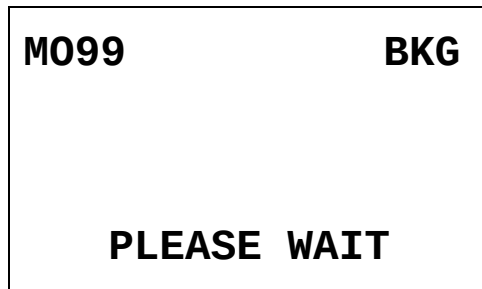


Figure 12-8 Moly Assay Background Wait

When a measurement is ready:

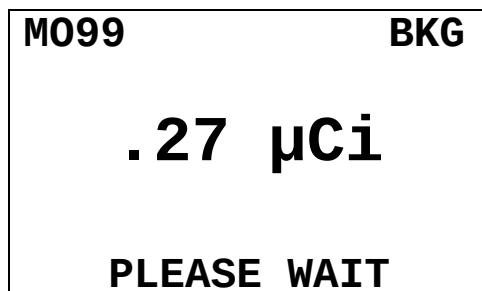


Figure 12-9 Moly Assay Background Measurement Ready

When enough measurements are made, you may accept the measurement and continue:

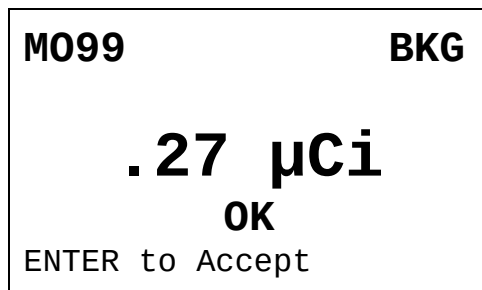


Figure 12-10 Moly Assay Background Measurement Accept

Press **ENTER** to accept measurement and continue to Mo99 Assay.

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

Mo99 Assay

You will now be instructed to measure the eluate in the CAPMAC or CANISTER.

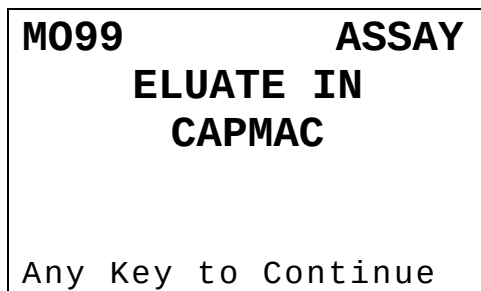


Figure 12-11 Moly Assay Instruction Screen

Press any key (except **HOME**) to begin the measurement.

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

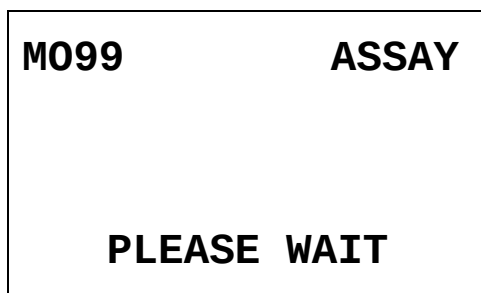


Figure 12-12 Moly Assay Wait

When a measurement is ready:

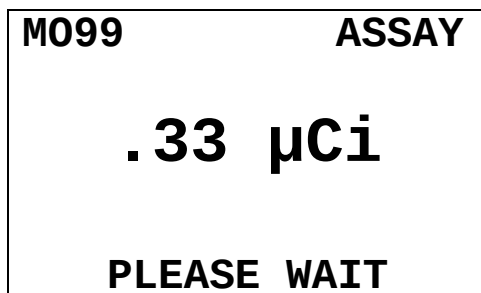


Figure 12-13 Moly Assay Ready Screen

When enough measurements are made, then you may accept the measurement and continue:

M099	ASSAY
.47 μCi	
ENTER to Accept	

Figure 12-14 Moly Assay Accept Screen

Press **ENTER** to accept measurement and continue to Tc99m assay.

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:

TC99m	ASSAY
1.127 Ci	
ENTER to Accept	

Figure 12-15 Tc99m Measurement

Press **ENTER** to accept the measurement.

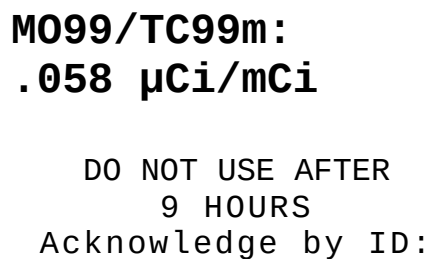
Note: *An error message will appear if the Tc99m activity is too low (below 1mCi)*

Moly Assay Results

The Mo99/Tc99m ratio is calculated and displayed.

The ratio is compared to the allowable value (which can be changed in Utilities) 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 given below:

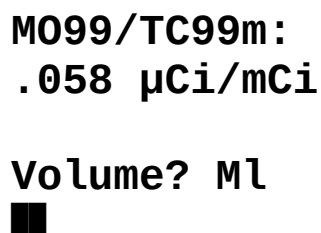


MO99/TC99m:
.058 µCi/mCi

DO NOT USE AFTER
9 HOURS
Acknowledge by ID:

Figure 12-16 Mo99/Tc99m Exceeding Limit

Press **OK** to acknowledge the usage message, erase it. The next screen requests the user to enter the volume of the eluate in ml. This is the screen that will appear if the ratio is within limits and is useable for more than 12 hours.



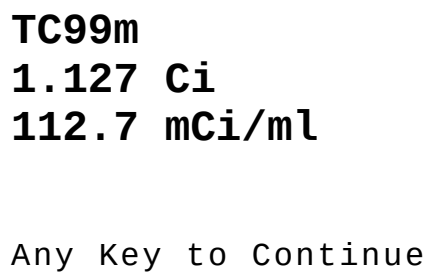
MO99/TC99m:
.058 µCi/mCi

Volume? Ml
■

Figure 12-17 Mo99/Tc99m with Volume Entry

Enter the volume of the elution and press **ENTER**.

The concentration of the elution is calculated and displayed.



TC99m
1.127 Ci
112.7 mCi/ml

Any Key to Continue

Figure 12-18 Elution Concentration

Press any key (except **HOME**) to print a ticket with the details of the assay.

You will then be asked if you want to print again. If **Y** is pressed, another ticket is printed. If **N** is pressed, you will be returned to the Main Measurement Screen.

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 a future time.

Note: A printer is required 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 Co57 pre-set nuclide key or any of the User Keys).

ENTER DOSE	
value	unit
■	mCi
→ to change unit	
ENTER to accept	

Figure 13-1 Dose Entry

Enter the desired dose with the proper unit.

Note: The displayed unit (Ci or Bq) is set outside of the Dose Table function. See CHAPTER 5: SYSTEM INITIALIZATION; SECTION: CHOOSING Ci or Bq.

The Volume Entry screen appears.

ENTER VOLUME	
IN ml	
■	

Figure 13-2 Volume Entry

Enter the volume of the sample that the dose will be drawn from in ml.

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 below.

```

CRC-15W RADIOISOTOPE DOSE CALIBRATOR
S/N Main Unit: 123456      Rev: 1.00
Chamber : 000000
Printer : 000000
Counter : 000000

Oct 02, 2003 14:09
Capintec, Inc. USA

DOSE TABLE

Tc99m
Oct 02, 2003      14:08
Activity: 1.54µCi
Volume: 1.0ml
Dose: .50µCi

TIME    VOL (ml)
14:15   0.32
14:45   0.34
15:15   0.36
15:45   0.38
16:15   0.41
16:45   0.43
17:15   0.46
17:45   0.48
18:15   0.51
18:45   0.54
19:15   0.58
19:45   0.61
20:15   0.65
20:45   0.69
21:15   0.73
21:45   0.77
22:15   0.82
22:45   0.86
23:15   0.91
23:45   0.97
Required volume greater
than existing volume.

```

Figure 13-3 Dose Table Printout

CHAPTER 14

INVENTORY

INVENTORY MENU

Selecting INVENTORY from the Utility Menu brings up the Inventory Menu shown below.

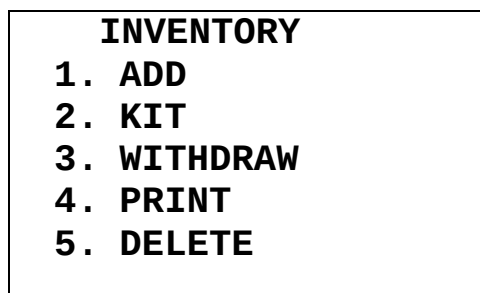


Figure 14-1 Inventory Menu

Adding to the Inventory

To add an item to the inventory, press **1** on the Inventory Menu.

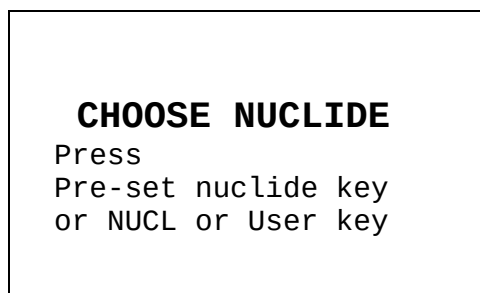


Figure 14-2 Choose Nuclide Screen

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.

Press **UTIL** to exit from the Choose Nuclide Screen and return to the Inventory Menu.

If Tc99m has been selected, the name of the study will then be selected from the following list:

SELECT STUDY	
0. NONE	
1. BONE	5. RENAL
2. LUNG	6. LIVER
3. HIDA	7. BRAIN
4. HEART	8. LYMPH

Figure 14-3 Select Study Screen

Press **0** if plain Tc99m (not a kit) is being added. Otherwise, press the number corresponding to the study for which the kit is intended.

A 2 digit ID may be added to distinguish the item being added from another one with the same nuclide and study.

ENTER ID
0 FOR NONE

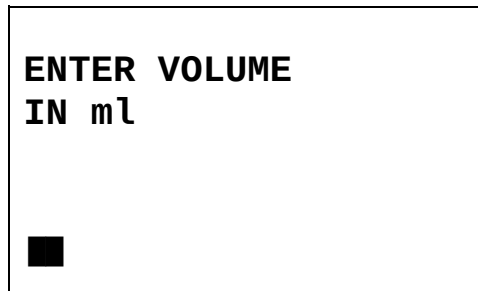
Figure 14-4 Enter ID Screen

A Lot Number of up to 15 characters (digits or letters) may be entered.

ENTER LOT NUMBER

Figure 14-5 Enter Lot Number Screen

The volume in ml (up to 4 digits) is entered next:

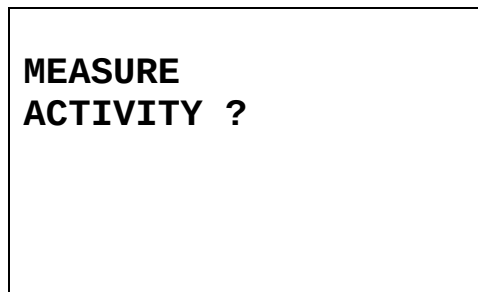


ENTER VOLUME
IN ml

■

Figure 14-6 Enter Volume Screen

The activity may be measured or it may be entered if activity and time of a previous measurement are known.

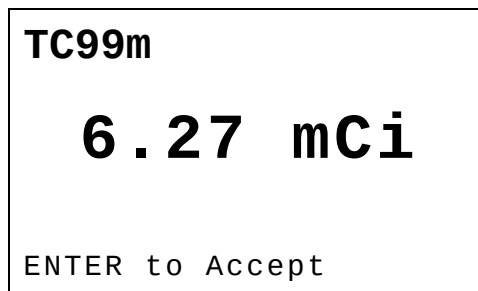


MEASURE
ACTIVITY ?

Figure 14-7 Measure Activity ? Screen

Press **Y** to measure the activity, press **N** to enter the activity and time.

If the activity is to be measured, the measurement screen appears (Tc99m is being measured in the example).



TC99m

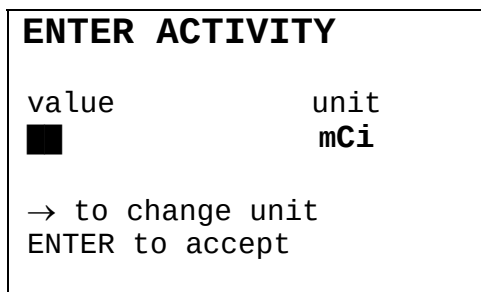
6.27 mCi

ENTER to Accept

Figure 14-8 Inventory Measurement Screen

Press **ENTER** when the activity has stabilized.

If the activity is to be entered, the activity entry screen and then the date/time entry screen will appear.



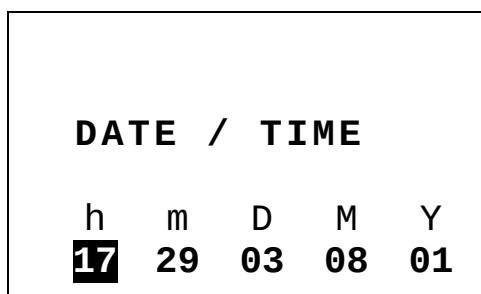
ENTER ACTIVITY

value	unit
■	mCi

→ to change unit
ENTER to accept

Figure 14-9 Inventory Activity Entry Screen

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



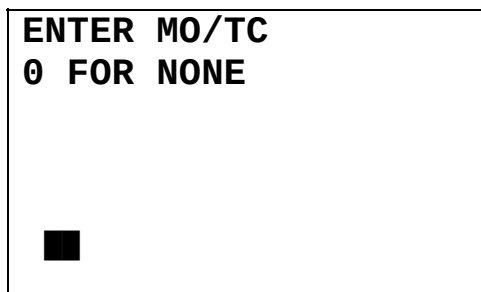
DATE / TIME

h	m	D	M	Y
17	29	03	08	01

Figure 14-10 Inventory Activity Measurement Time / Date Screen

Enter the date / time of the measurement if it is not “now”.

If Tc99m is being added (with or without a study), the Mo to Tc Ratio may be entered.



ENTER MO/TC
0 FOR NONE

■

Figure 14-11 Enter Mo/Tc Screen

Enter the Mo to Tc Ratio. If the value is not known, enter 0.

The entered / measured values will then be displayed for verification. If the values are correct, press **Y** and the item will be stored in inventory. If there is an error, press **N** and the inventory adding procedure will start again from the beginning.

Making a Kit

A kit may be made from plain Tc99m in inventory.
To make a kit, press 2 on the Inventory Menu.

If there is more than one plain Tc99m in the inventory, a list showing the ID number will be displayed. Press the number corresponding to the desired Tc99m.

The details of the selected item will be displayed, showing the current activity, current volume 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 **Y** to use the selection. Press **N** to make another selection (or return to Inventory Menu if there is only one Tc99m in inventory).

The study for which the kit is being made is selected.

SELECT STUDY	
1. BONE	5. RENAL
2. LUNG	6. LIVER
3. HIDA	7. BRAIN
4. HEART	8. LYMPH

Figure 14-12 Select Study for Kit Screen

Enter the optional ID for the kit.

ENTER ID
0 FOR NONE

Figure 14-13 Enter ID for Kit Screen

Enter the optional Lot number for the kit.

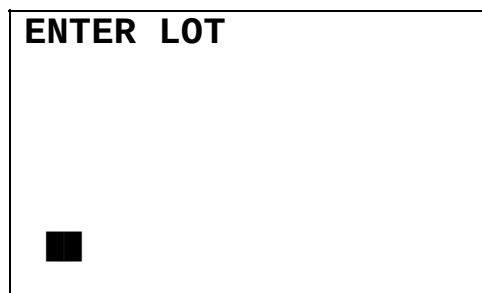


Figure 14-14 Enter Lot Number for Kit Screen

Enter the activity needed to make the kit.

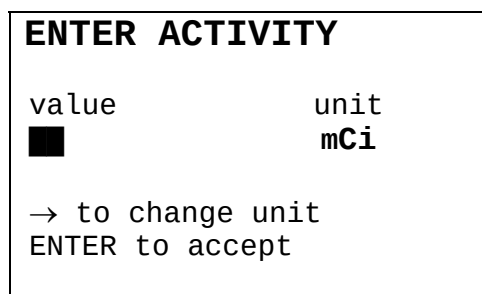


Figure 14-15 Kit Activity Entry Screen

Enter the value of the activity and then press the **RIGHT ARROW** (→). Use the arrow keys to scroll the activity units: μCi , mCi , Ci (or MBq , GBq if using Bq). If the value needs to be changed, press **CE**.

The activity entered and the volume required for that activity will be displayed.

Withdraw the displayed volume and prepare the kit. Press any key to continue. You will be prompted to measure the activity.

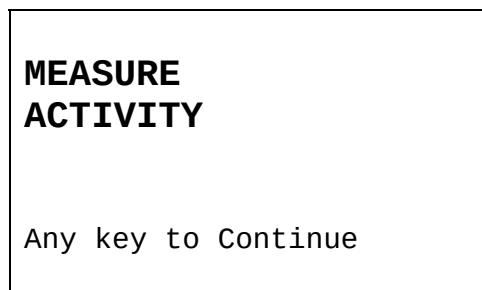


Figure 14-16 Measure Activity Screen

Press any key to continue.

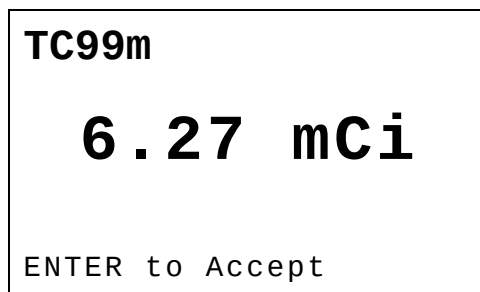


Figure 14-17 Kit Measurement Screen

Press **ENTER** when the measurement stabilizes.

The volume of the kit is then entered.

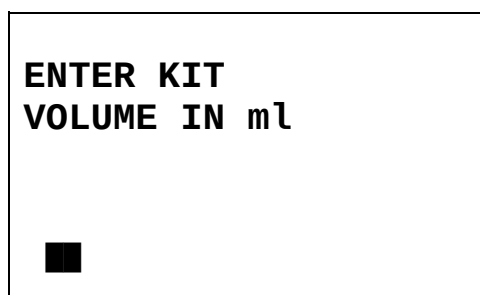


Figure 14-18 Kit Volume Entry Screen

The activity, volume and Mo to Tc ratio (unless 0 was entered) for the original Tc99m will be updated in the inventory and the kit will be added to the inventory.

Withdrawing Activity from an Item in Inventory

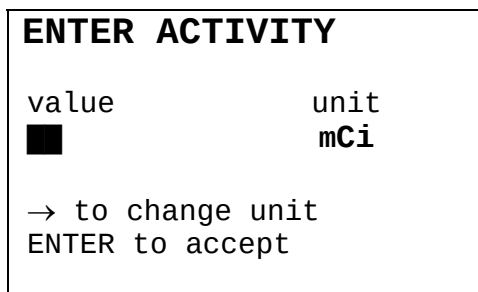
To withdraw activity from an item in inventory to be used for a patient (not for a kit), press **3** on the Inventory Menu.

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 and DOWN arrows to navigate between screens. Press the number in front of the item to select it. Press **UTIL** to return to the Inventory Menu.

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 entered ratio was 0).

Press **Y** to select the item. Press **N** to return to the inventory list and make another selection.

The required activity is then entered.



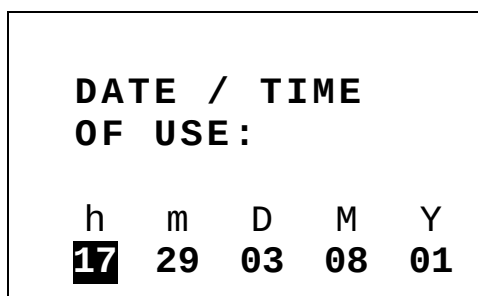
ENTER ACTIVITY

value	unit
■	mCi

→ to change unit
ENTER to accept

Figure 14-19 Required Activity Entry Screen

The time and date when the activity will be used is entered next. The default time / date is “now”.

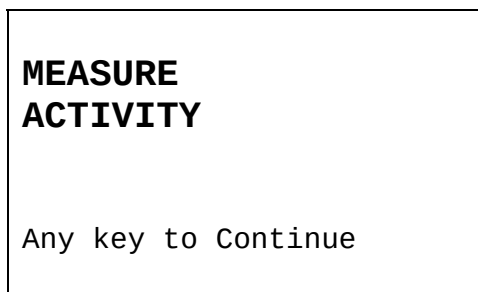


**DATE / TIME
OF USE :**

h	m	D	M	Y
17	29	03	08	01

Figure 14-20 Date / Time of Use Screen

The activity entered and the volume required for that activity will be displayed. If the activity and/or volume is incorrect, press **N** to return to the Required Activity Entry Screen. Press **Y** to continue.

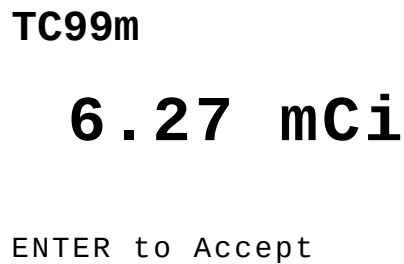


**MEASURE
ACTIVITY**

Any key to Continue

Figure 14-21 Measure Activity Screen

You will be prompted to measure the activity. Withdraw the displayed volume. Press any key to continue.



TC99m

6.27 mCi

ENTER to Accept

Figure 14-22 Withdraw Activity Measurement Screen

The inventory item will be updated with the new volume and activity and Mo to Tc Ratio for Tc99m (unless 0 was entered for the ratio).

Printing the Inventory

To print the inventory, press **4** on the 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 the Inventory

To delete one or more items from the inventory, press **5** on the Inventory Menu.

All the items in the inventory may be deleted, or the inventory may be deleted one item at a time.



DELETE

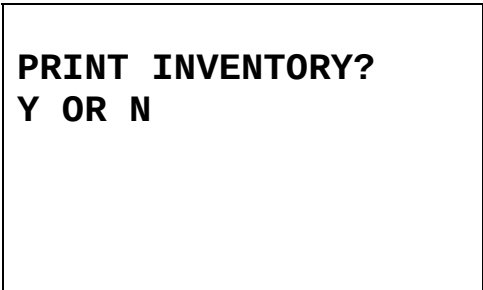
1. ALL

2. SINGLE ITEM

Figure 14-23 Delete Inventory Menu Screen

Deleting All Items in the Inventory

To delete all the items in the inventory, press **1** on the Delete Inventory Menu Screen. You will be asked if you want to print the inventory (so that you know what you are deleting).

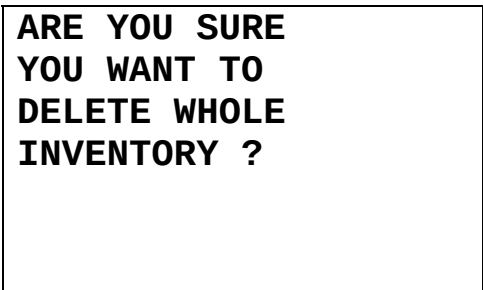


**PRINT INVENTORY?
Y OR N**

Figure 14-24 Print Inventory? Screen

If **Y** is pressed, the inventory will be printed.

You will be asked to confirm the deletion of the whole inventory a second time.



**ARE YOU SURE
YOU WANT TO
DELETE WHOLE
INVENTORY ?**

Figure 14-25 Delete Whole Inventory Confirmation Screen

If **Y** is pressed, all the items in the inventory will be deleted. If **N** is pressed, the Inventory Menu will re-appear and the inventory contents will not be changed.

Deleting Individual Items From The Inventory

To delete individual items from the inventory, press **2** on the Delete Inventory Menu Screen.

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 and DOWN arrows to navigate between screens. Press the number in front of the item to select it for deletion.

When an item is selected for deletion, the details will be displayed, showing current activity, current volume and for Tc99m, the current Mo to Tc Ratio (unless the entered ratio was 0).

Press **Y** to delete the item. Press **N** to keep the item in the inventory.

The inventory list will re-appear (with the previously selected item no longer on the list if deletion was confirmed).

Press **UTIL** when deletion of individual items has been completed. The Inventory Menu will re-appear.

CHAPTER 15

WIPE MEASUREMENT PROCEDURES

GENERAL

Wipe measurements are divided into 4 categories:

- Wipe (work areas)
- Unrestricted
- Sealed Sources
- General

Up to 10 nuclides can be assigned to Wipe and up to 10 nuclides can be assigned to Unrestricted. A different nuclide can be assigned to each Sealed Source location. The general category does not have any nuclides assigned to it. See CHAPTER 7: COUNTER INITIALIZATION, SECTION: NUCLIDES for instructions for assigning nuclides.

When a measurement is completed, the activity is calculated for each assigned nuclide, *as if it were the only nuclide present*. The activity is also calculated for the generic nuclide (see CHAPTER 7: COUNTER INITIALIZATION, SECTION: CONVERSION FACTORS).

A trigger level is assigned to the Wipe category, Unrestricted category and Sealed Sources category (See CHAPTER 7: COUNTER INITIALIZATION, SECTION: TRIGGER LEVELS). The calculated activity is compared to the trigger level for the selected category. If the activity is greater than the trigger level, the activity is listed as *exceeds*.

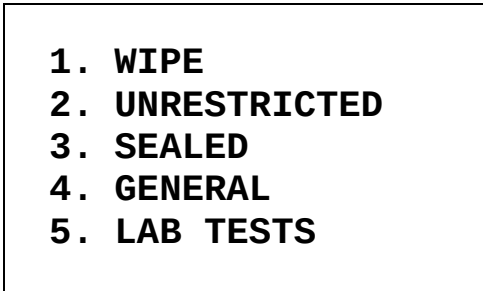
- 
1. **WIPE**
 2. **UNRESTRICTED**
 3. **SEALED**
 4. **GENERAL**
 5. **LAB TESTS**

Figure 15-1 Well Counter Main Menu

MEASUREMENT PROCEDURES

General Wipe Measurement Procedure

To measure a wipe, follow the procedure outlined below:

1. Press **WELL** key to go to the Well Counter Main Menu Screen from the Chamber Measurement Screen.
2. Select the Wipe category (Wipe, Unrestricted, Sealed Source or General)

3. If background has not been measured earlier in the day, the Background Instruction Screen (Fig. 10-1) will appear. You should also measure background whenever appropriate.
4. Any presence of contamination may be confirmed by counting without a sample in the sample chamber.
5. If the Location Number is not correct, enter the correct Location Number.
6. If the counting period is not correct, enter it via the numeric keypad.
7. Place the wipe in the well.
8. Start counting by pressing **COUNT**.
9. The measurement may be terminated by pressing **COUNT**, if so desired.
10. When the measurement has been completed, press **ENTER** key to print the result.
11. **DSPLY** may be pressed to view calculated activities and the Bar Graph.
12. For Wipe and Unrestricted, activity for nuclides assigned to the category may be viewed by selecting each nuclide.
13. Press **UP** Arrow (⬆) to measure the wipe for the next location.
14. Press **DOWN** Arrow (⬇) to measure the wipe for the previous location.
15. Press **COUNT** to re-measure the current wipe.

CAUTION

Whenever the instantaneous counting rate exceeds 60kcps in any 40msec period, COUNTING RATE TOO HIGH will be displayed. When the source is removed you will be returned to Well Counter Measurement Screen.

The Well Counter Main Menu Screen is the HOME position for Well Counter procedures. Whenever **HOME** is pressed from a Well Counter procedure, the system returns to the Well Counter Main Menu Screen. If **HOME** is pressed from the Well Counter Main Menu Screen, the system returns to the Chamber Measurement Screen.

If the background has been measured earlier in the day, the Well Counter Measurement Screen appears:

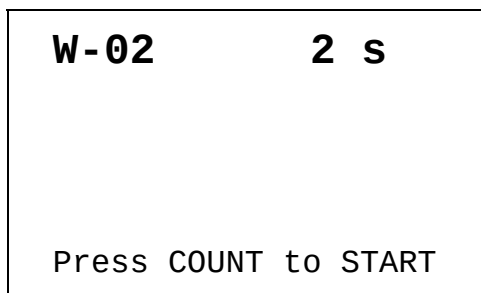


Figure 15-2 Well Counter Measurement Screen

This example is for Wipe, location 2.
Unrestricted is indicated by the letter U.
Sealed Source is indicated by the letter S.
General is indicated by the letter G.

If Sealed Source had been selected, the corresponding nuclide would be displayed under the location.

Location Number

Press **LOC** to change the location number.

The number will be blanked. Enter the correct location number and press **ENTER**.

Entering Counting Period

The last counting period selected is displayed.

Enter the counting period via the numeric keypad and press **ENTER**.

The minimum counting period is 2 seconds for Wipe, General and Background and 60 seconds for Unrestricted and Sealed Source.

The maximum counting period is 9999 seconds.

The counting may be terminated at any time by pressing **COUNT** key.

WIPE or UNRESTRICTED CATEGORIES

Note: *The example below is for Wipe category. Unrestricted is the same except that U is displayed instead of W.*

From the Well Counter Main Menu, press **1** for WIPE or **2** for UNRESTRICTED.

After location and counting time are correct, press **COUNT** to begin the measurement.

When **COUNT** is pressed, the net counting rate per channel will be shown and will be updated every second. If a nuclide has been selected, counts and dpm will be displayed.

A Bar Graph of the net counting rate per channel may also be shown and updated every second. The remaining counting period is shown.

To switch to the Bar Graph, press **DSPLY**.

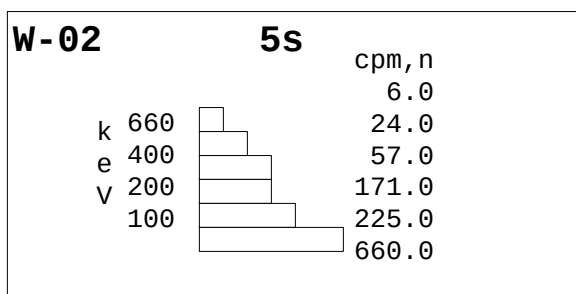


Figure 15-3 Bar Graph Counting Screen

Pressing **DSPLY** toggles between the numeric and graphic counting screens.

To end the measurement before the requested counting period has expired, press **COUNT**.

When the measurement is finished (time is up or **COUNT** key has been pressed during measurement) the counting rate (for all channels) is displayed:

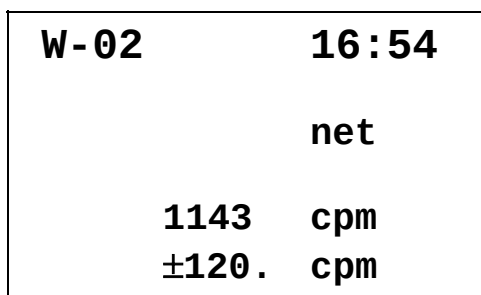


Figure 15-4 Wipe Measurement Results

When **DSPLY** is pressed, a list of any nuclides whose activity exceeds the trigger level for the selected category is displayed. If the list cannot be displayed on one screen, an asterisk (*) appears at the bottom of the screen. Press **DSPLY** again to see the rest of the list.

When **DSPLY** is pressed again, a list of any nuclides whose activity does not exceed the trigger level for the selected category is displayed (OK list). If the list cannot be displayed on one screen, an asterisk (*) appears at the bottom of the screen. Press **DSPLY** again to see the rest of the list.

To view the bar graph, press **DSPLY** from the OK list.

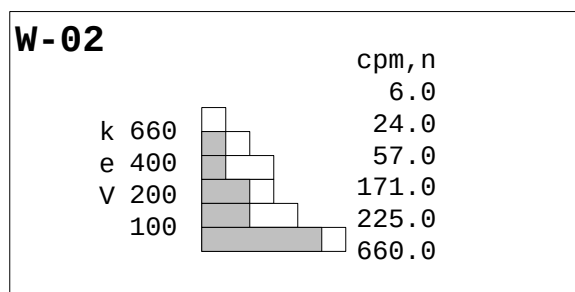


Figure 15-5 Wipe Measurement Results Bar Graph

The net counts are filled in. The channels that are used to calculate the activity of the selected nuclide are solid; the other channels are hatched.

Press **DSPLY** again to return to Well Counter Measurement Result Screen.

Results for Selected Nuclide

Results for one of the nuclides assigned to the category can be viewed. Display the Well Counter Measurement Screen or the Bar Graph.

Select the nuclide via one of the pre-set nuclide keys, one of the user keys or via the **NUCL** key (See CHAPTER 12: GENERAL MEASUREMENT PROCEDURES, SECTION: MEASUREMENT PROCEDURES). The activity for that nuclide will be displayed:

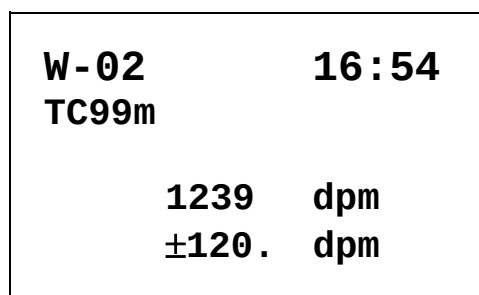


Figure 15-6 Wipe Measurement Results with Selected Nuclide

Note: Only nuclides assigned to the category may be selected.

Counting Rate

To view the counting rate for all the channels, press the **CAL#** key when the Results Screen or Bar Graph Screen is displayed.

Printing

To print a record of the measurement, press **ENTER** when the Results Screen or Bar Graph Screen is displayed. If the Bar Graph Screen is displayed, the Bar Graph will be printed.

Making Another Measurement

To measure the wipe again without changing any parameters, press **COUNT** and the measurement will begin.

To make another measurement with changes in the location number or counting period, press **WELL** key.

To measure the wipe for the next location, press **UP** Arrow (↑).

To measure the wipe for the previous location, press **DOWN** Arrow (↓).

SEALED SOURCE CATEGORY

A wipe is measured as a Sealed Source to detect leakage, for example, from a Co60 teletherapy unit.

Only 1 nuclide can be entered for a specific Sealed Source. See CHAPTER 7: COUNTER INITIALIZATION, SECTION: NUCLIDES for entering the nuclide for a Sealed Source.

From the Well Counter Main Menu, press **3** for SEALED SOURCE.

After location and counting time are correct, press **COUNT** to begin the measurement.

When **COUNT** is pressed, the total counts and the activity (nCi or Bq) will be displayed and updated every second.

A Bar Graph of the net counting rate per channel will be shown and will be updated every second. The remaining counting period is shown.

To switch to the Bar Graph, press **DSPLY**.

To end the measurement before the requested counting period has expired, press **COUNT**.

When the measurement is finished (time is up or the **COUNT** key has been pressed during measurement) the activity of the nuclide selected for the measured Sealed Source will be displayed:

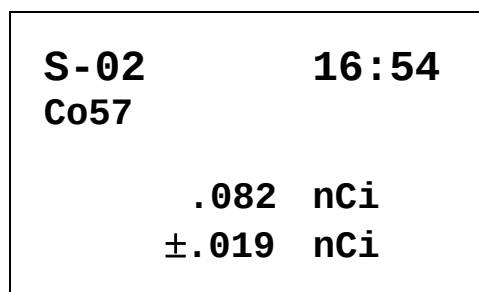


Figure 15-7 Sealed Source Measurement Results

Press **DSPLY** to toggle between Results screen and Bar Graph screen.

To print a record of the measurement, press **ENTER**.

To make another measurement without changing any parameters, press **COUNT** and the measurement will begin.

To make a measurement with changes press **WELL** key.

To measure the next Sealed Source, press **UP** Arrow (↑).

To measure the previous Sealed Source, press **DOWN** Arrow (↓).

GENERAL CATEGORY

A General Measurement is not associated with a particular location. There is no trigger level for General measurements and no assigned nuclides (which means that the nuclide keys are not active). Only counting rate for selected channels is calculated for General Measurements.

The table below gives the correspondence between channels and energy:

Channel	Energy Range in keV
1	15 to 100
2	100 to 200
3	200 to 400
4	400 to 660
5	660 to 800
6	> 800

From the Well Counter Main Menu, press **4** for General.

After location and counting time are correct, press **COUNT** to begin.

The Channel Selection Screen appears:

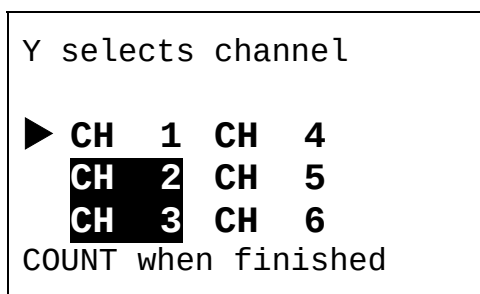


Figure 15-8 Channel Selection

The channels to be used in the calculation of net counting rate must be selected (highlighted). Previously selected channels may be de-selected (highlight removed).

Use the **UP** (⬆) and **DOWN** (⬇) arrows to move the **RIGHT** arrow → so that it points to the channel to be selected (or de-selected) and then press the **Y** key.

When the desired channels are highlighted press **COUNT** to begin the measurement.

When **COUNT** is pressed, the total counts and the counting rate will be displayed and updated every second.

A Bar Graph of the net counting rate per channel will be shown and will be updated every second. The remaining counting period is shown.

To switch to the Bar Graph, press **DSPLY**.

When **COUNT** is pressed, the net counting rate per channel will be shown and will be updated every second. The remaining counting period is shown.

To end the measurement before the requested counting period has expired, press **COUNT**.

When the measurement is finished (time is up or **COUNT** key has been pressed during measurement) the counting rate in the selected channels will be displayed:

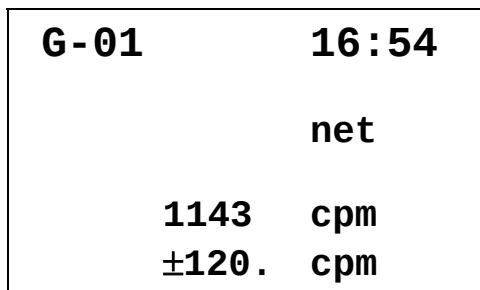


Figure 15-9 General Measurement Results

Press **DSPLY** to toggle between Results screen and Bar Graph screen.

CHAPTER 16

LAB TESTS

GENERAL

This chapter describes the 4 Lab Tests: 2 Urine Tests: Schilling Test and Dicopac® Test and 2 Blood Tests: Plasma Volume and RBC Volume.

The Lab Tests are accessed from the Well Counter Main Menu:

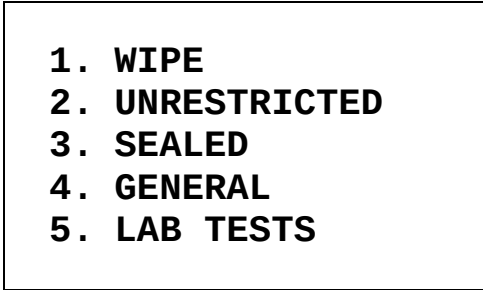
- 
- A rectangular box containing a numbered list of five menu options.
1. WIPE
 2. UNRESTRICTED
 3. SEALED
 4. GENERAL
 5. LAB TESTS

Figure 16-1 Well Counter Main Menu

Press **5** to display the Lab Test Menu:

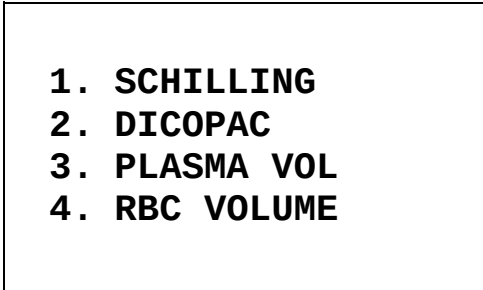
- 
- A rectangular box containing a numbered list of four menu options.
1. SCHILLING
 2. DICOPAC
 3. PLASMA VOL
 4. RBC VOLUME

Figure 16-2 Lab Test Menu

Note: After each measurement for a Lab Test, the final Bar Graph appears and you are asked to accept the measurement: OK Y OR N? Pressing **Y** accepts the measurement. Pressing **N** allows the measurement to be repeated. Pressing **ENTER** prints the Bar Graph.

SCHILLING TEST

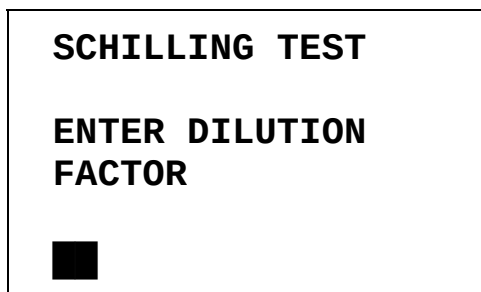
Press **1** to select **SCHILLING** from the Lab Test Menu.

To perform the actual measurements with this protocol the system assumes the following samples have been prepared for counting.

1. Aliquot of urine sample collected over the test period.
2. Co57 standard having the identical volume and geometry as the test urine sample above.

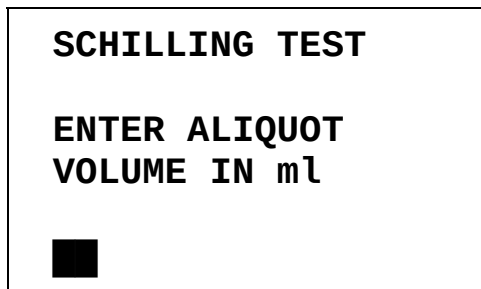
Screens will appear allowing you to enter the following values:

Dilution Factor:	The ratio of the activity of the Co57 capsule to the activity of the Co57 standard. When using a 1% standard, the Dilution Factor equals 100.
Aliquot Volume:	Volume of urine taken from the full urine volume collected.
Urine Volume:	Volume of urine collected over the duration of the test period. If the urine has been diluted to a convenient volume (such as 2000 ml), use this value.



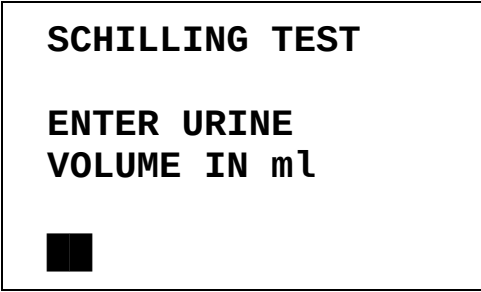
A rectangular screen with a black border. At the top, the text "SCHILLING TEST" is displayed in bold. Below it, "ENTER DILUTION FACTOR" is displayed in bold. At the bottom left, there is a small black square representing a cursor.

Figure 16-3 Schilling Test Dilution Factor



A rectangular screen with a black border. At the top, the text "SCHILLING TEST" is displayed in bold. Below it, "ENTER ALIQUOT VOLUME IN ml" is displayed in bold. At the bottom left, there is a small black square representing a cursor.

Figure 16-4 Schilling Test Aliquot Volume



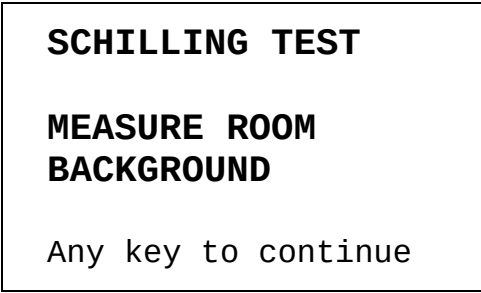
SCHILLING TEST

**ENTER URINE
VOLUME IN ml**

■

Figure 16-5 Schilling Test Urine Volume

When these values have been entered, the test begins by measuring the room background:



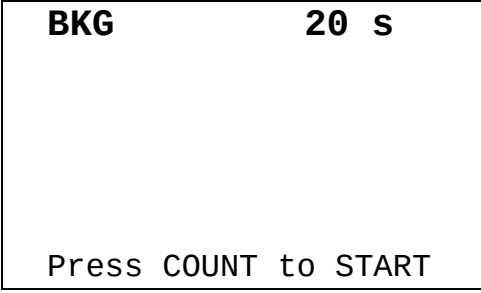
SCHILLING TEST

**MEASURE ROOM
BACKGROUND**

Any key to continue

Figure 16-6 Prompt to Measure Room Background

When a key is pressed, the background measurement screen appears:



BKG **20 s**

Press COUNT to START

Figure 16-7 Measure Schilling Test Background

The counting period can be changed at this time. This will be the counting period for the entire test.

When the counting time is correct, press **COUNT** to begin.

Pressing **START/STOP** (COUNT) at any time during the measurement will abort the measurement and allow you to perform the measurement again.

After the background has been measured, "OK? Y or N" appears at the top of the screen. Press **Y** to accept the measurement, press **N** to repeat the measurement.

A printout of the Bar Graph of the measurement may be obtained by pressing **ENTER**.

You will then be prompted to measure the Standard:

SCHILLING TEST

**MEASURE
STANDARD**

Any key to continue

Figure 16-8 Measure Schilling Test Standard

Place the Co57 standard into the well and press a key to begin counting.

After accepting the Co57 standard measurement, the urine aliquot sample is measured.

SCHILLING TEST

MEASURE SAMPLE

Any key to continue

Figure 16-9 Measure Schilling Test Sample

Place the Urine sample into the well and press a key to begin counting.

After accepting the Urine Sample measurement the Schilling Test Result screens will appear.

DF : 100.0

ALIUQUOT : 2.0 ml

URINE : 2000.0 ml

Any key to continue

Figure 16-10 Schilling Test Result Screen #1

BKG	:	60.53	cpm
STAND	:	535.1	kcpm
URINE	:	6299.	cpm
EXCRETION:			
		11.7%	
Any key to continue			

Figure 16-11 Schilling Test Result Screen #2

When a key is pressed, a report of the test is printed.

The percent excretion is calculated as:

$$\% \text{ excretion} = 100 \times \frac{U - B}{(S - B) \times D} \times \frac{V}{A}$$

where

U = Urine count rate
B = Room Background
V = Urine Volume
S = Standard count rate
D = Dilution factor
A = Aliquot Volume

DICOPAC® TEST

DICOPAC® is a dual isotope kit manufactured by Medi-Physics, Inc. The kit is used to assess vitamin B12 absorption and as an adjunct in the diagnosis of malabsorption due to lack of intrinsic factor. The kit consists of cyanocobalamin Co58 and cyanocobalamin Co57 combined with human intrinsic factor.

Press **2** to select DICOPAC from the Lab Test Menu.

The following items are necessary to perform the DICOPAC® Test:

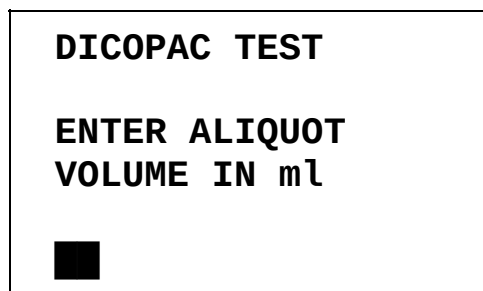
1. Urine collected over the duration of the test period.
2. Aliquot of the urine mentioned above.
3. ml Co57 standard solution diluted to the same volume as the urine sample for number 2 above.
4. ml Co58 standard solution diluted to the same volume as the urine sample for number 2 above.

Prepare the samples to be counted as directed in the DICOPAC® package insert.

Screens will appear allowing you to enter the following values:

Aliquot Volume: Volume of urine taken from the full urine volume collected.

Urine Volume: Volume of urine collected over the duration of the test period. If the urine has been diluted to a convenient volume (such as 2000 ml), use this value.

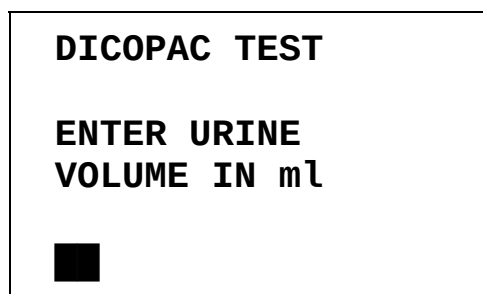


DICOPAC TEST

**ENTER ALIQUOT
VOLUME IN ml**

■

Figure 16-12 Dicopac® Test Aliquot Volume



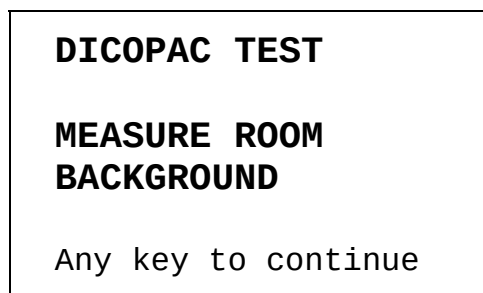
DICOPAC TEST

**ENTER URINE
VOLUME IN ml**

■

Figure 16-13 Dicopac® Test Urine Volume

When these values have been entered, the test begins by measuring the room background:



DICOPAC TEST

**MEASURE ROOM
BACKGROUND**

Any key to continue

Figure 16-14 Prompt to Measure Room Background

When a key is pressed, the Background Measurement screen appears:

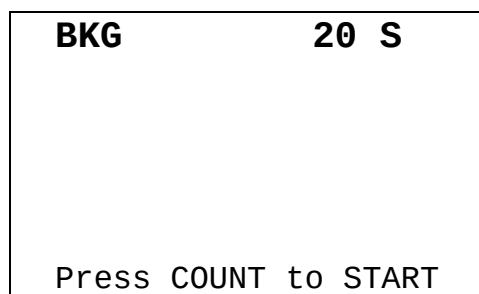


Figure 16-15 Measure Dicopac® Test Background

The counting period can be changed at this time. This will be the counting period for the entire test.

When the counting time is correct, press **COUNT** to begin.

Pressing **START/STOP** (COUNT) at any time during the measurement will abort the measurement and allow you to perform the measurement again.

After the background has been measured, "OK? Y or N" appears at the top of the screen. Press **Y** to accept the measurement, press **N** to repeat the measurement.

You will then be prompted to measure the Co58 Standard:

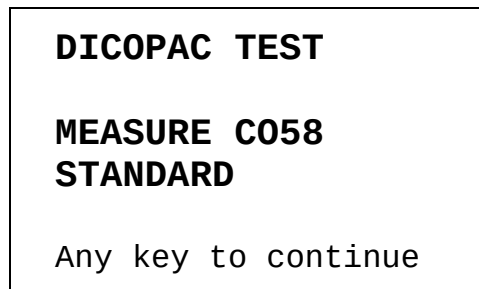


Figure 16-16 Measure Dicopac® Test Co58 Standard

Place the Co58 standard into the well and press the **ENTER** to begin counting.

After accepting the Co58 standard measurement, the Co57 standard is measured:

DICOPAC TEST

**MEASURE C057
STANDARD**

Any key to continue

Figure 16-17 Measure Dicopac® Test Co57 Standard

Place the Co57standard into the well and press the **ENTER** to begin counting.

After accepting the Co57 standard measurement, the urine aliquot sample is measured.

DICOPAC TEST

MEASURE SAMPLE

Any key to continue

Figure 16-18 Measure Dicopac® Test Sample

After the urine sample is counted the Dicopac® Test results screens appear:

ALIQOT : 2.0 ml
URINE : 2000.0 ml

Any key to continue

Figure 16-19 Dicopac® Test Result Screen #1

C058:
STAND : 71.12 kcpm
URINE : 4667. cpm
EXCRETION:
16.4%
Any key to continue

Figure 16-20 Dicopac® Test Result Screen #2

C057:
STAND : 77.50 kcpm
URINE : 5789. cpm
EXCRETION:
18.7%
Any key to continue

Figure 16-21 Dicopac® Test Result Screen #3

C057 / C058:
1.14

Any key to continue

Figure 16-22 Dicopac® Test Result Screen #4

When a key is pressed, a report of the test is printed.

Percent excretion is calculated as:

$$\% \text{ excretion} = 2 \times \frac{U}{S} \times \frac{V}{A}$$

where

U = Net count rate for either Co57 or Co58 as appropriate.

V = Urine volume collected over the duration of the test period.

A = Aliquot volume of urine used in counting.

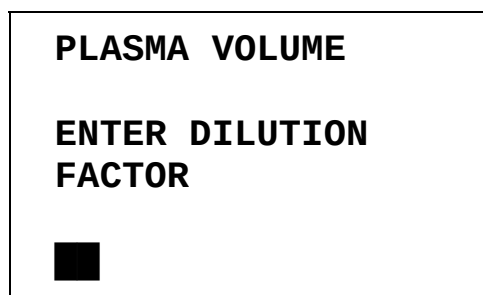
S = Net count rate of the measured standard for Co58 or Co57 as appropriate.

$$\text{and } Co57 / Co58 = \frac{\% \text{ Co57 excretion}}{\% \text{ Co58 excretion}}$$

PLASMA VOLUME (I 125)

Press **3** to select PLASMA VOLUME from the Lab Test Menu.

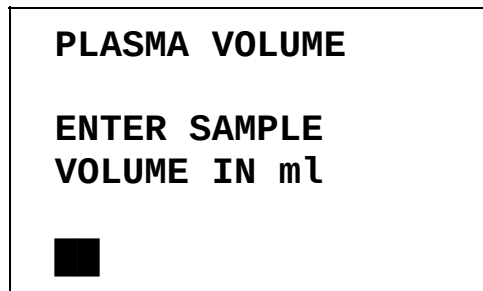
Plasma Volume Data screens will appear:



A rectangular screen with a black border. The text is centered and reads: **PLASMA VOLUME** on the first line, **ENTER DILUTION** on the second line, **FACTOR** on the third line, and a solid black square on the fourth line.

Figure 16-23 Plasma Volume Dilution Factor

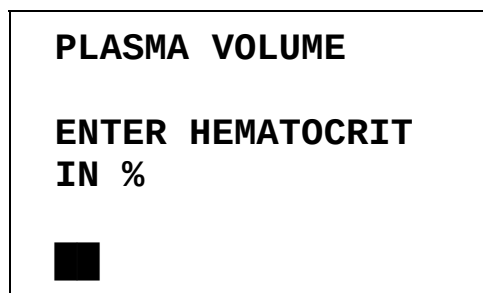
Enter the dilution factor to be used.



A rectangular screen with a black border. The text is centered and reads: **PLASMA VOLUME** on the first line, **ENTER SAMPLE** on the second line, **VOLUME IN ml** on the third line, and a solid black square on the fourth line.

Figure 16-24 Plasma Volume Sample Volume

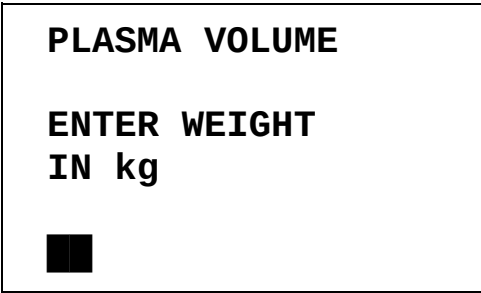
Enter the volume of the sample in ml.



A rectangular screen with a black border. The text is centered and reads: **PLASMA VOLUME** on the first line, **ENTER HEMATOCRIT** on the second line, **IN %** on the third line, and a solid black square on the fourth line.

Figure 16-25 Plasma Volume Hematocrit

Enter the hematocrit determined from a whole blood sample drawn from the patient five to ten minutes post injection.



PLASMA VOLUME

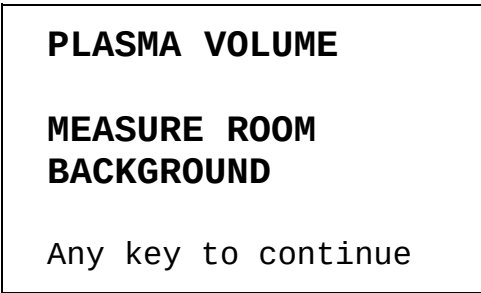
ENTER WEIGHT
IN kg

■

Figure 16-26 Plasma Volume – Patient's Weight

Enter the patient's weight in kg.

When these values have been entered, the test begins by measuring the room background:



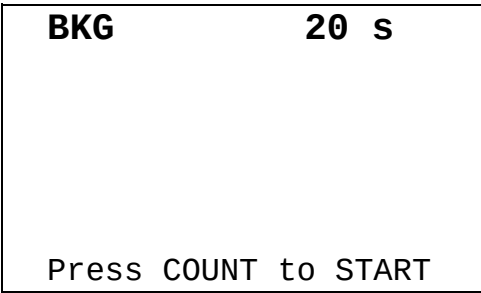
PLASMA VOLUME

MEASURE ROOM
BACKGROUND

Any key to continue

Figure 16-27 Prompt to Measure Room Background

When a key is pressed, the background measurement screen appears:



BKG **20 s**

Press COUNT to START

Figure 16-28 Measure Plasma Volume Background

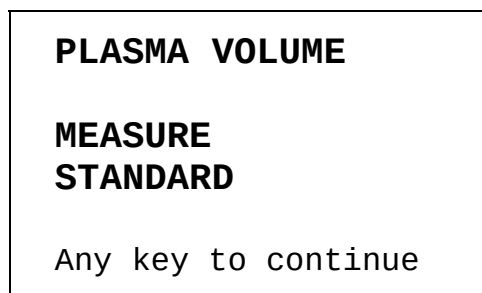
The counting period can be changed at this time. This will be the counting period for the entire test.

When the counting time is correct, press **COUNT** to begin.

Pressing **START/STOP** (COUNT) at any time during the measurement will abort the measurement and allow you to perform the measurement again.

After the background has been measured, "OK? Y or N" appears at the top of the screen. Press **Y** to accept the measurement, press **N** to repeat the measurement.

You will then be prompted to measure the Reference Standard:



A rectangular screen display with a black border. The text is centered and reads: **PLASMA VOLUME** at the top, **MEASURE STANDARD** in the middle, and Any key to continue at the bottom.

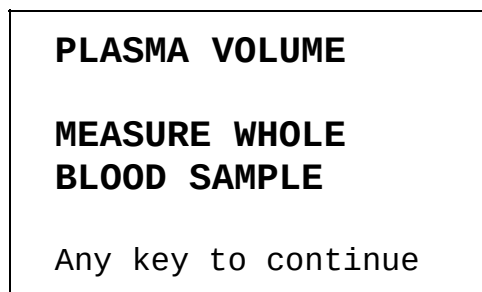
Figure 16-29 Measure Plasma Volume Standard

Place the Reference Standard supplied with the kit into the well and press any key to begin counting.

After accepting the Standard measurement, the two samples are measured:

Whole Blood Sample: Sample of whole blood withdrawn from the patient five to ten minutes post injection.

Plasma Sample: Sample of plasma from the whole blood withdrawn from the patient five to ten minutes post injection.



A rectangular screen display with a black border. The text is centered and reads: **PLASMA VOLUME** at the top, **MEASURE WHOLE BLOOD SAMPLE** in the middle, and Any key to continue at the bottom.

Figure 16-30 Measure Whole Blood Sample

Place the Whole Blood Sample into the well and press any key to begin counting.

After accepting the Whole Blood Sample measurement, the Plasma Sample is measured:

PLASMA VOLUME**MEASURE PLASMA
SAMPLE**

Any key to continue

Figure 16-31 Measure Plasma Sample

Place the Plasma Sample into the well and press any key to begin counting.

After accepting the Plasma Sample measurement, the Plasma Volume Results screens will appear:

BKG : 50.00 cpm
STAND : 535.1 kcpm
URINE : 6299. cpm
PLSMA : 1111. cpm

Any key to continue

Figure 16-32 Plasma Volume Results Screen #1

PLASMA VOLUME**XXXX. ml**
XX. ml/kg

Any key to continue

Figure 16-33 Plasma Volume Results Screen #2

BLOOD VOLUME

XXXX. ml
XX. ml/kg

Any key to continue

Figure 16-34 Plasma Volume Results Screen #3

RBC VOLUME

XXXX. ml
XX. ml/kg

Any key to continue

Figure 16-35 Plasma Volume Results Screen #4

**CALCULATED
HEMATOCRIT**

XX.X %

Any key to continue

Figure 16-36 Plasma Volume Results Screen #5

When a key is pressed, a report of the test is printed.

Results are calculated as follows:

$$\text{Plasma Volume (ml)} = 4000 \times \frac{\text{Net Reference Standard Counts}}{\text{Net Plasma Counts}}$$

$$\text{Whole Blood Volume (ml)} = 4000 \times \frac{\text{Net Reference Standard Counts}}{\text{Net Whole Blood Counts}}$$

$$\text{RBC Volume (ml)} = \text{Blood Volume} - \text{Plasma Volume}$$

$$\text{Calculated Hematocrit} = \frac{\text{Red Cell Volume}}{\text{Whole Blood Volume}}$$

Note: A comparison of the calculated hematocrit with the microhematocrit will give an indication of the accuracy of the procedure and calculations.

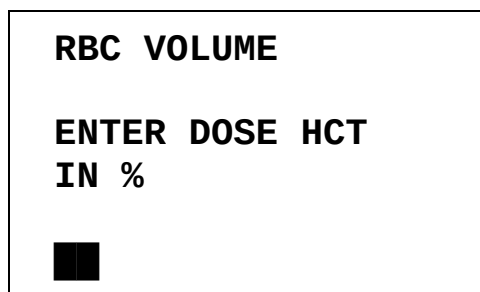
The standard, blood, and plasma counts must be taken under identical sample volume and geometric conditions relative to the detector crystal or else the difference accounted for in the computations by an appropriate correction factor.

RBC VOLUME (Cr51)

This protocol may be used in the determination of red blood cell volume.

Press **4** to select RBC VOLUME from the Lab Test Menu.

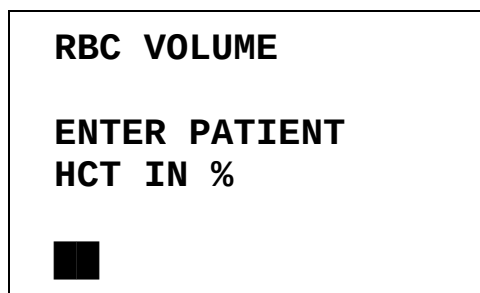
The RBC Volume Data Screens appear:



A rectangular screen with a black border. The text is centered and reads: "RBC VOLUME" on the first line, "ENTER DOSE HCT" on the second line, and "IN %" on the third line. Below the text is a small black square.

Figure 16-37 RBC Volume Dose Hematocrit

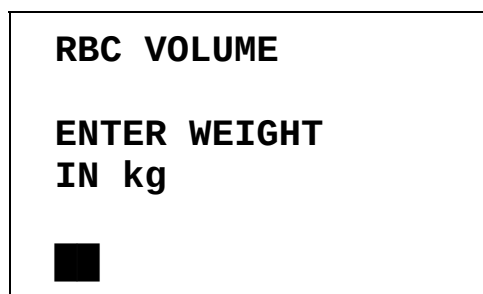
Enter the Dose Hematocrit – Hematocrit of the tagged RBC suspension determined from the remainder of the suspension of the injection into the patient.



A rectangular screen with a black border. The text is centered and reads: "RBC VOLUME" on the first line, "ENTER PATIENT" on the second line, and "HCT IN %" on the third line. Below the text is a small black square.

Figure 16-38 RBC Volume Patient Hematocrit

Enter the Patient Hematocrit – Hematocrit of a blood sample withdrawn from the patient ten to twenty minutes post injection.



RBC VOLUME

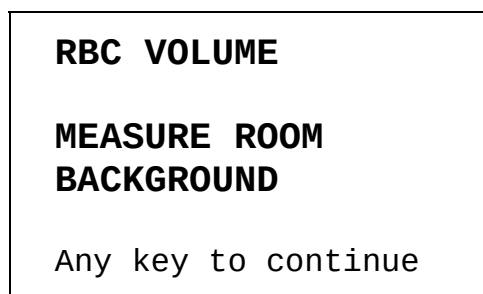
ENTER WEIGHT
IN kg

■

Figure 16-39 RBC Volume – Patient's Weight

Enter the patient's weight in kg.

When these values have been entered, the test begins by measuring the room background:



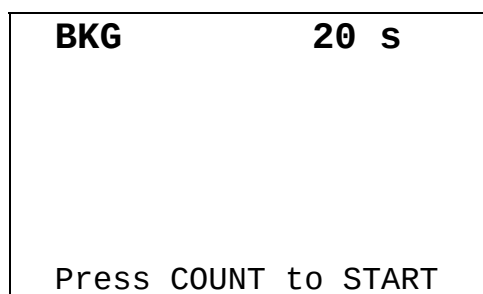
RBC VOLUME

MEASURE ROOM
BACKGROUND

Any key to continue

Figure 16-40 Prompt to Measure Room Background

When a key is pressed, the background measurement screen appears:



BKG **20 s**

Press COUNT to START

Figure 16-41 Measure RBC Volume Background

The counting period can be changed at this time. This will be the counting period for the entire test.

When the counting time is correct, press **COUNT** to begin.

Pressing **START/STOP (COUNT)** at any time during the measurement will abort the measurement and allow you to perform the measurement again.

After the background has been measured, "OK? Y or N" appears at the top of the screen. Press **Y** to accept the measurement, press **N** to repeat the measurement.

You will then be prompted to measure the two Standards:

Whole Blood Standard:	Sample solution made from 1 ml of the tagged RBC suspension diluted with water to 100 ml
Plasma Standard:	Sample solution made from 1 ml of the plasma from the centrifuged tagged RBC suspension diluted with water to 100 ml

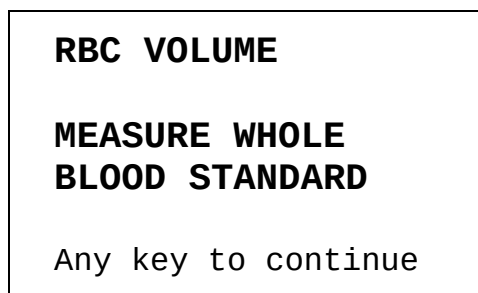


Figure 16-42 Measure RBC Volume Whole Blood Standard

Place the Whole Blood Standard into the well and press any key to begin counting.

After accepting the Whole Blood Standard measurement, the Plasma Standard is measured:

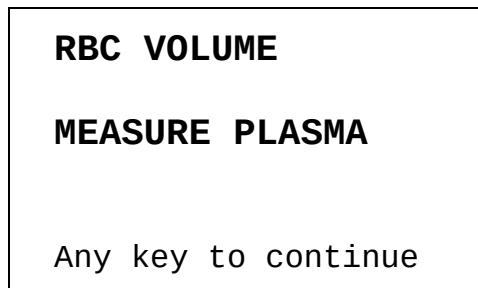


Figure 16-43 Measure RBC Volume Plasma Standard

Place the Plasma Standard into the well and press any key to begin counting.

After accepting the Plasma Standard measurement, the two samples are measured:

Whole Blood Sample:	Sample of blood withdrawn from the patient ten to twenty minutes post injection.
Plasma Sample:	Sample of plasma from the blood withdrawn ten to twenty minutes post injection.

RBC VOLUME

**MEASURE WHOLE
BLOOD SAMPLE**

Any key to continue

Figure 16-44 Measure Whole Blood Sample

Place the Whole Blood Sample into the well and press any key to begin counting.

After accepting the Whole Blood Sample measurement, the Plasma Sample is measured:

RBC VOLUME

**MEASURE PLASMA
SAMPLE**

Any key to continue

Figure 16-45 Measure Plasma Sample

Place the Plasma Sample into the well and press any key to begin counting.

After accepting the Plasma Sample measurement, the RBC Volume Results screens will appear:

BKG : 50.00 cpm
WHOLE BLOOD
STAND: XXXX. cpm
SAMPL: XXXX. cpm

Any key to continue

Figure 16-46 RBC Volume Results Screen #1

BKG : 50.00 cpm
PLASMA
STAND: XXXX. cpm
SAMPL: XXXX. cpm

Any key to continue

Figure 16-47 RBC Volume Results Screen #2

PLASMA VOLUME

XXXX. ml
XX. ml/kg

Any key to continue

Figure 16-48 RBC Volume Results Screen #3

BLOOD VOLUME

XXXX. ml
XX. ml/kg

Any key to continue

Figure 16-49 RBC Volume Results Screen #4

RBC VOLUME

XXXX. ml
XX. ml/kg

Any key to continue

Figure 16-50 RBC Volume Results Screen #5

When any key is pressed, a report of the test is printed.

RBC Volume is calculated as follows:

$$\text{Red Cell Volume (ml)} = 1000 \times \frac{[B - C(1 - A)]E}{D - F(1 - E)}$$

where

A = Hematocrit of Tagged RBC Suspension

B = Net Whole Blood Standard Count

C = Net Plasma Standard Count

D = Net Patient Whole Blood Sample Count

E = Patient Hematocrit

F = Net Patient Plasma Sample Count

$$\text{Whole Blood Volume (ml)} = \frac{\text{Red Cell Volume (ml)}}{\text{Patient Hematocrit}}$$

$$\text{Plasma Volume (ml)} = \text{Whole Blood Volume (ml)} - \text{Red Cell Volume (ml)}$$

CHAPTER 17

CALCULATION UTILITIES

GENERAL

Two calculation utilities are provided with the CRC[®]-15W Enhanced: Conversion between Ci and Bq and Decay Calculation. They are both accessed via the Main Utility Menu

CONVERSION BETWEEN Ci and Bq (Ci ↔ Bq)

An activity is entered in Curies and the value is displayed in Becquerels or an activity is entered in Becquerels and the value is displayed in Curies.

From the Main Utility Menu, press **2** for Ci ↔ Bq.

ENTER ACTIVITY

value	unit
■	μCi

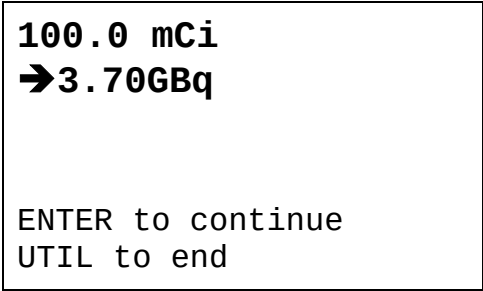
→ to change unit
ENTER to accept

Figure 17-1 Ci ↔ Bq Activity Entry Screen

Enter the value of the activity to be converted and then press the **RIGHT ARROW (→)**. Use the arrow keys to scroll the activity units: μCi, mCi, Ci, MBq or GBq. If the value needs to be changed, press **CE**.

When the value and unit are correct, press **ENTER**.

The result screen will appear (in the example 100 mCi was entered):



```
100.0 mCi  
➔3.70GBq  
  
ENTER to continue  
UTIL to end
```

Figure 17-2 Ci ↔ Bq Result Screen

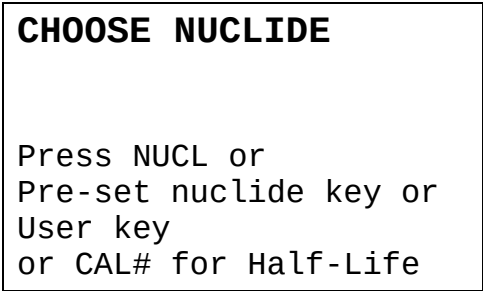
Press **ENTER** to perform another conversion. Press **UTIL** to return to the Main Utility Menu.

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 the Main Utility Menu, press **3** for DECAY CALCULATION.

In the example below, the original activity of Co57 is 100mCi on Jan 1, 1994 and we want to know the activity today (Jan 11 1995).

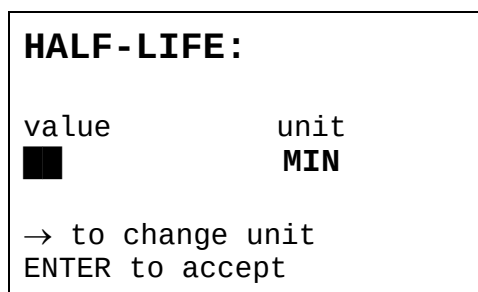


```
CHOOSE NUCLIDE  
  
Press NUCL or  
Pre-set nuclide key or  
User key  
or CAL# for Half-Life
```

Figure 17-3 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.

If you want to perform the decay calculation for a nuclide which is not in memory, press the **CAL#** key.



HALF-LIFE:

value	unit
■	MIN

→ to change unit
ENTER to accept

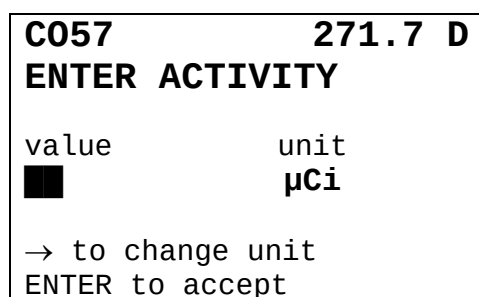
Figure 17-4 Entering Half-Life for Decay Calculation

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

When the value and unit are correct, press **ENTER**.

To exit Decay Calculation, press **UTIL** to return to the Main Utility Screen or **HOME** to return to the Chamber Measurement Screen.

The activity entry screen will now appear with the nuclide name and half-life displayed. In the example below, Co57 was chosen. (If the half-life was entered, the nuclide name will be blank.)



C057 271.7 D

ENTER ACTIVITY

value	unit
■	µCi

→ to change unit
ENTER to accept

Figure 17-5 Decay Calculation Activity Entry Screen

Enter the value of the activity and then press the **RIGHT ARROW (→)**. Use the arrow keys to scroll the activity units: µCi, mCi, MBq or GBq. If the value needs to be changed, press **CE**.

When the value and unit are correct, press **ENTER**.

C057		271.7 D		
FROM :				
h	m	D	M	Y
17	29	11	01	94

Figure 17-6 Decay Calculation Activity Starting Time / Date Screen

The current time / date will appear. If the starting time / date is “now”, press **ENTER**. Otherwise, use the arrow keys to change the date and/or time and press **ENTER**.

C057		271.7 D		
TO :				
h	m	D	M	Y
17	29	11	01	95

Figure 17-7 Decay Calculation Activity Ending Time / Date Screen

The current time / date will appear. If the ending time / date is “now”, press **ENTER**. Otherwise, use the arrow keys to change the date and/or time and press **ENTER**.

The results screen will appear:

C057		271.7 D		
100. mCi			17:29	
JAN 01 1994				
38. mCi			17:29	
JAN 11 1995				

Figure 17-8 Decay Calculation Result Screen

Press any key when finished viewing the results. You will be returned to the Choose Nuclide for Decay Calculation Screen.

CHAPTER 18

CLEANING AND MAINTENANCE

GENERAL

This chapter provides the information necessary for the user to perform the basic maintenance of instrument cleaning, fuse 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.

REFER ALL SERVICING TO A QUALIFIED SERVICE REPRESENTATIVE !

It is recommended that periodic (every three to five years) re-calibration of the CRC®-15W Enhanced be performed by Capintec's Authorized Service Center to guarantee the instrument's high reliability is maintained. Contact Capintec's Authorized Service Center in Pittsburgh for servicing or re-calibration at 1-800-227-6832.

CLEANING INSTRUCTIONS

WARNING !

TO AVOID ELECTRICAL SHOCK OR DAMAGING OF THE CRC®-15W ENHANCED, NEVER GET WATER OR LIQUIDS, INSIDE THE CHAMBER OR DETECTOR HOUSINGS OR THE READOUT ENCLOSURE.

DO NOT USE AN AEROSOL DISPENSER TO SPRAY THE EQUIPMENT WITH ANY CLEANING SOLUTION OR LIQUID.

TO AVOID DAMAGING THE CASE OR DISPLAY SCREEN, DO NOT USE AROMATIC HYDROCARBONS, CHLORINATED SOLVENTS, OR METHANOL-BASED CLEANING SOLUTIONS.

If the CRC®-15W Enhanced Readout, Chamber or Detector requires cleaning, wipe down with a damp cloth, do not use solvents or aerosol cleaners.

For the printer (if included), refer to the printer owner's manual for proper cleaning procedures.

For the Remote Display (if included), refer to the Remote Display owner's manual for proper cleaning procedures.

PREVENTATIVE MAINTENANCE

The Quality Assurance Tests described in CHAPTER 8: ACCEPTANCE & QUALITY ASSURANCE TESTS, should be performed periodically as stated.

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.*

If the unit fails to pass Autocalibration Test or any other test, the user **should not** attempt to perform any adjustments to the system. In this event, please contact Capintec for further assistance.

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 one year limited warranty, under normal conditions of use.

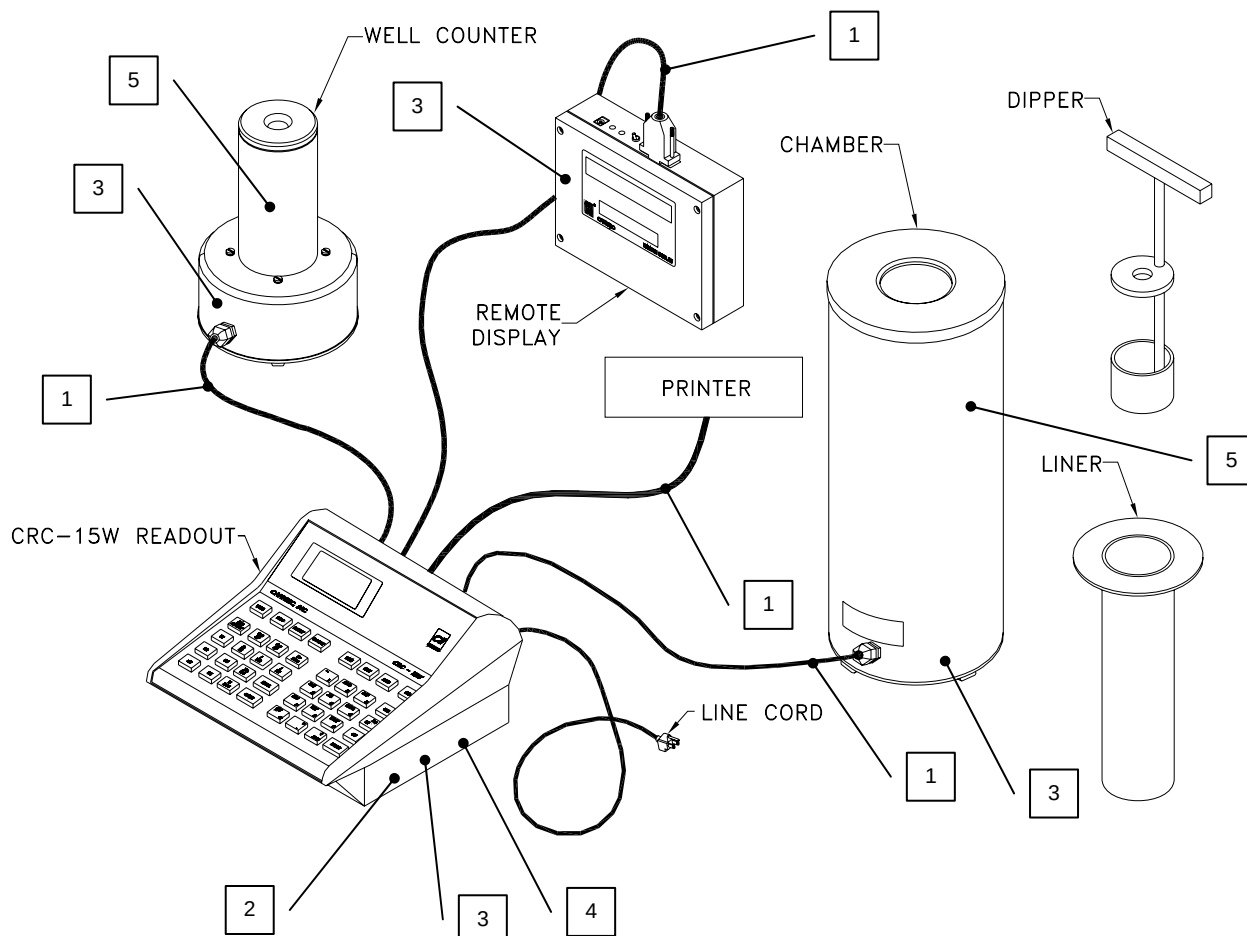
Other than the Readout Unit fuses (see Fuse Servicing in this chapter), there are no user serviceable parts contained in the system.

Every five years, the system should be returned to Capintec's Authorized Service Center for a complete verification.

CAPINTEC, Inc.
620 Alpha Drive
Pittsburgh, PA 15238
Phone (412) 963-1988, 1-800-227-6832
Fax (412) 963-0610

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.



No.	Recycling/Material Code	Important Information
1	External Electrical Cables	
2	Lithium Battery	Contained on the HPC/CPU printed circuit board inside of the readout unit.
3	Printed Circuit Boards	Iometer, HPC/CPU, Power Supply, LCD Controller, Remote Display, HV Power Supply
4	Electrolyte Capacitor	Power Supply Printed Circuit Board
5	Lead	Lead Shielding around Chamber and Well Counter

FUSE SERVICING

Readout Fuses

CAUTION

*For continued protection, replace only with
same type and rating of fuse(s)*

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 F 1.6AH 250 Volts as specified on the label located directly below the power entry module.

To change these fuses:

1. Turn off the CRC®-15W Enhanced 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 18-1 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 F 1.6AH 250 Volt fuse(s).
5. Re-insert the fuse carriers with the arrows pointing up.

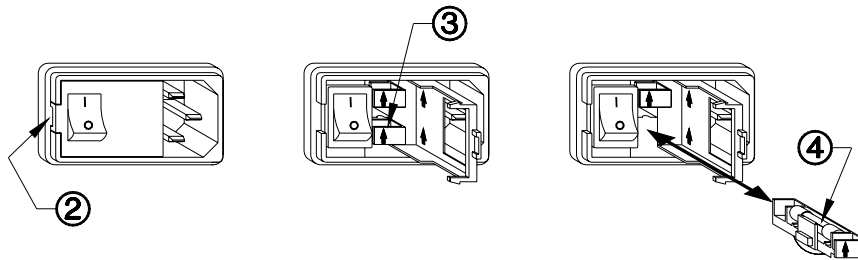


Figure 18-1 Readout Fuse Replacement

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®-15W Enhanced.
8. Verify the CRC®-15W Enhanced System is functioning correctly by performing the Daily Test as specified in CHAPTER 8: 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.

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. See: FUSE SERVICING.

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. See CHAPTER 8: 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 well.

- System may not be in lowest range. Try pressing **SPC**.

Readings appear overly noisy for low activities.

- System may not be in long averaging period. Try pressing **SPC** twice.
- 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. See CHAPTER 9: CHAMBER TESTS, SECTION: BACKGROUND.

Printer prints junk or prints with incorrect spacing.

- Make sure that the Printer Menu Setup is correct. See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: PRINTING.

Print head hangs up when printing tickets.

- 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, add it to the Factory Setup data.
- Make sure that the Printer Menu Setup is correct. See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: PRINTING.

ACCESSORIES AND REPLACEMENT PARTS

The following accessories and replacement parts are available from Capintec. Call Capintec's Authorized Service Center at 1-800-227-6832 for answers to your questions or to place an order.

- CAPMAC Moly Assay Kit (specify generator) CALL
- Dose Calibrator Reference Sources..... CALL
- Shielded products for PET CALL
- Standard Moly Assay Kit 5130-0006
- Calicheck Linearity Test Kit..... 5120-2144
- Ionization Chamber Well Inserts (liners) 7300-2004
- Plastic Sample Holders (dippers) 7300-2005
- Environmental Shield 7300-2450
- Flush Mount Mounting Flange..... 7310-2307
- Shielded Platform with 2mm shielded glass..... 5150-3010
- Shielded Platform with 4mm shielded glass..... 5150-3011
- Dosilift™ remote lowering/raising of syringes or vials 5120-2175
- Remote Display 5130-2082
- RS-232 Port..... 5130-0080
- Okidata 320 Ticket and Report Printer 5110-1150
- Epson Roll Printer 5430-0058
- Epson Ticket Printer 5430-0100
- Printer Ribbons..... CALL
- Multi-part Tickets, Paper, etc..... CALL
- Additional copies of Owner's Manual 9250-0101

Note: *Circuit diagrams, component parts lists, descriptions and calibration instructions are available to appropriately qualified personnel.*

SHIPPING

If for any reason the CRC®-15W Enhanced must be returned to Capintec, the shipping carton must contain the following or equivalent labeling as shown in Figure 18-2 and Figure 18-3. Label stipulating the maximum environmental conditions for safe storage and shipment.

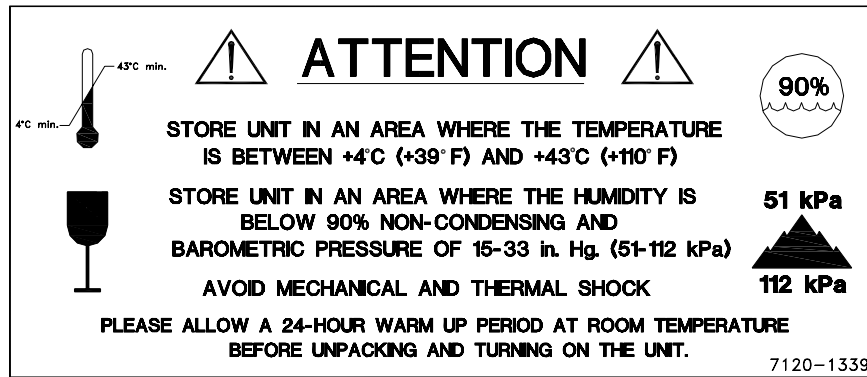


Figure 18-2



Figure 18-3

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.

APPENDIX I

PRINCIPLE OF THE CALIBRATOR

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 nor 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 ν
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 10 MeV, which corresponds to a range of about 10 mg/cm² (8 cm 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 a 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 511 keV 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 which 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

$$E_k \approx \frac{Z^2}{100} \text{ [keV]}$$

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. (See Appendix of this manual for more detailed discussion on Bremsstrahlung.)

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 20 keV 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 100 keV to about 10 MeV in the region of the atomic numbers for detector materials. At 100 keV, the maximum kinetic energy of the scattered electron is about 30 percent of that of the incident photon; at 1 MeV, it is about 80 percent; and at 10 MeV, it is about 98 percent. 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., 1.022 MeV. This process dominates for very high energies, that is, above about 10 MeV. 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.

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:

$$S_i \equiv \frac{\text{Detector Output due to } 3.7 \times 10^{10} \text{ Photons of } E_i}{\text{Detector Output due to one Curie of Co - 60}} \quad (2)$$

The detector response and the sensitivity have the following relation:

$$R_i \equiv \sum_i I_i S_i \quad (3)$$

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 A1-1.

The figure depicts the sensitivity of the ionization chamber as a function of photon energy up to 1.9 MeV. Above a photon energy of 200 keV, the ionization in the chamber is mainly due

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.

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 50 keV 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 13 keV 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 Co-60, 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 A1-1, 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 Appendix I of this manual. Appendix II 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 Xe-133, were of the liquid solution form. Approximately 5 g of radioactive liquid were sealed in borosilicate glass ampoules having a diameter of about 17 mm, a length of 40 mm, and a wall thickness of 0.6 mm. The Xe-133 standard was sealed together with inactive xenon gas in a borosilicate glass ampoule having a volume of about 5 ml, a length of 45 mm, a diameter of 15 mm, and a wall thickness of 1.3 mm.

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 250 keV, 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 70 keV and 250 keV 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 1.2 mm), 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 125-ml size multi-injection dose vials from several sources indicated that the wall thickness varied randomly from 1 to 3 mm 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.

The radioisotopes most sensitive to source configuration and type of container are I-125 and Xe-133. Other radioisotopes that fall into this category are I-123, Y-169, Tl-201, and other radioisotopes that decay with significant low-energy photon emission. It is not unusual to have a required correction factor of 2 if I-125 is measured in a glass vial.

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 Mo-99 breakthrough in Tc-99m. 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.

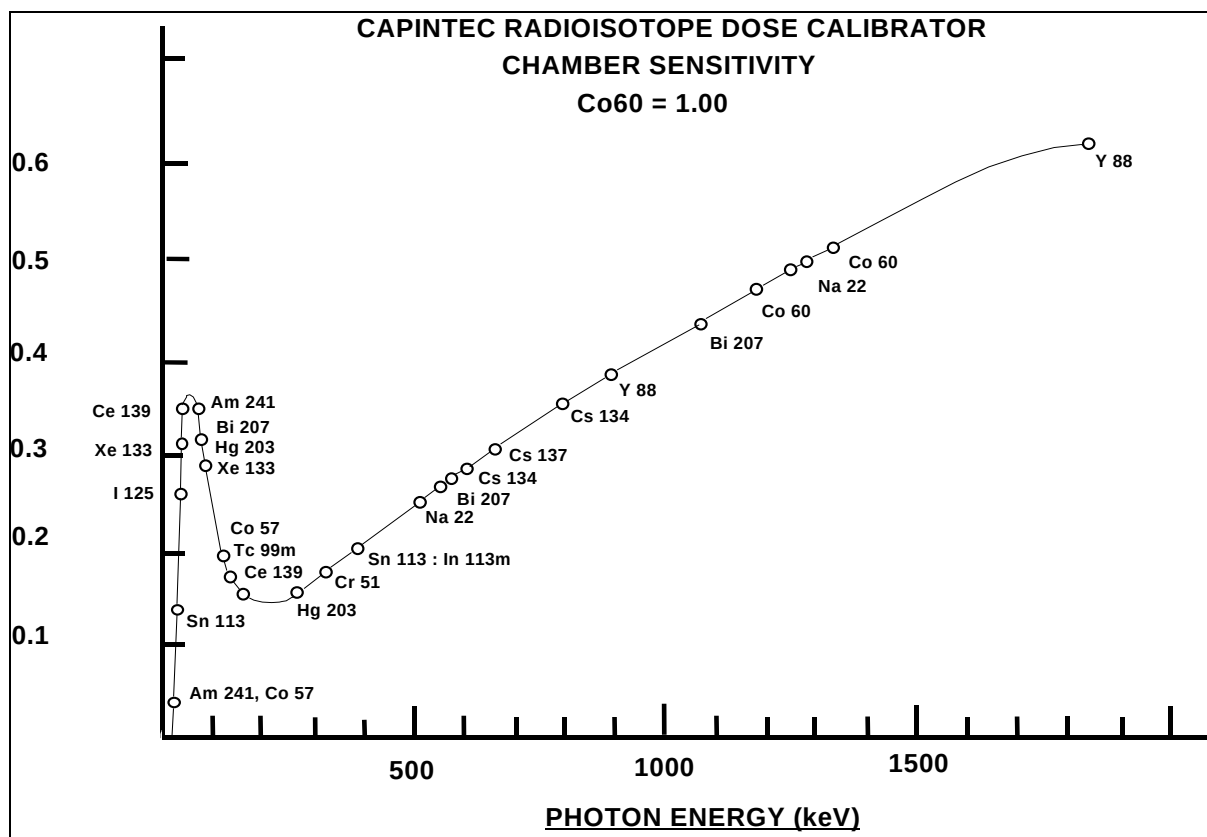


Figure A1-1

APPENDIX II

TABLE OF CALIBRATION SETTING NUMBERS

CALIBRATION SETTING NUMBERS

The Calibration Setting Numbers in Table I are applicable to the Capintec Radioisotope Calibrator only.

The CRC®-15W Enhanced 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 Ra-226 (778) by 2% for each 0.1 mm. of platinum wall thickness. For example, add 10% to the reading for a 0.5 mm. wall platinum needle and add 20% to the reading for a 1.0 mm. wall platinum needle to estimate the true Radium activity.

ABBREVIATIONS USED IN TABLE I

<u>Abbreviation</u>	<u>Meaning</u>	<u>Abbreviation</u>	<u>Meaning</u>
eqb.	equilibrium	D	days
S	seconds	Y	years
H	hours	E	exponential, i.e.,
M	minutes		$3E5 = 3 \times 10^5$

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 0.6 mm. 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 1.2 mm.) 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 I-125 activity is estimated to be about, $\pm 25\%$. This means that you should add 25% to the meter reading if the I-125 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 SRM;s), 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).

NM75 (Nuclear Medicine 75): L.T. Dillman and F.C. Von Der Lage, Radionuclide Decay Schemes and Nuclear Parameters for Use in Radiation-Dose Estimation. NM/MIRD Pamphlet No. 10, 1975.

ORNL76: M.J. Martin Ed., Nuclear Decay Data for Selected Radionuclides. ORNL-5114, Oak Ridge National Laboratory, March 1976.

NDT70: M.J. Martin and P.H. Blichert-Toft. Radioactive Atoms: Auger-Electrons, α -, β A, Vol. 8, Nos.1,2. October, 1970

NDS: Nuclear Data Sheets, Academic Press.

Martin: M. J. Martin. Evaluated Nuclear Data File. Nuclear Data Project. Oak Ridge National Laboratory.

NCRP-58: National Council on Radiation Protection and Measurement., Report No.58 A HANDBOOK OF RADIOACTIVITY MEASUREMENTS PROCEDURE.

NUCLIDES and ISOTOPES: Chart of the nuclides. Fourteenth Edition. General Electric Company Nuclear Energy Operations. Rev. 1989

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. See 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	439			109.71 M 2	ORNL76	
²² Na	Sodium	957		1.7	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	4	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	4	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		1.2	14.29 D 2	NBS76	Estimation use only.
³⁸ Cl	Chlorine	470		2	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		3	12.36 H 1	ORNL76	
⁴³ K	Potassium	430		2	22.3 H 1	ORNL76	
⁴⁴ Sc	Scandium	938			3.927 H 8	ORNL76	

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %		Half-Life (NCRP-58)	Ref.	Comments
⁴⁴ Ti	Titanium	514	2	2	47.3 Y 12	ORNL76	Pure; ⁴⁷ Ca decays to ⁴⁷ Sc. Eqb. in 90 days. Pure; see App. II for non-eqb.
⁴⁶ Sc	Scandium	822			83.79 D 2	ORNL76	
⁴⁷ Ca	Calcium	373			4.536 D 2	ORNL76	
⁴⁷ Sc	Scandium	026 or 618 × 2			3.351 D 2	ORNL76	
⁴⁸ V	Vanadium	569 ÷ 2			15.974 D 3	ORNL76	
⁴⁹ Ca	Calcium	956		2	8.72 M 2	NDT70	
⁵¹ Cr	Chromium	100 × 10		1.25	27.702 D 4	NBS76	
⁵² Mn	Manganese	676 ÷ 2			5.591 D 3	ORNL76	
^{52m} Mn	Manganese	461 ÷ 2			21.1 M 2	ORNL76	
⁵² Fe	Iron	374			8.275 H 8	ORNL76	
⁵⁴ Mn	Manganese	309			312.14 D 5	ORNL76	Decays to ⁵² Mn ^{52m} Mn will contribute to dose.
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	
⁵⁶ Mn	Manganese	627		2	2.577 H 1	ORNL76	
⁵⁷ Co	Cobalt	112		1.9	271.7 D 2	NBS76	
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	
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	333				NM75	Reading gives sum of ⁶² Zn & ⁶² Cu activity in equilibrium sample.
⁶² Cu	Copper						

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 ÷ 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							
	Eqb.	270					NM75	Reading gives act. of ⁸¹ Rb or ^{81m} Kr in equilibrium sample. Eqb. after 2 minutes.
^{81m} Kr	Krypton							
⁸² Br	Bromine	536 ÷ 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 ÷ 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	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	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} Nb	Niobium							
⁹⁷ Nb	Niobium	249				72.1 M 7	ORNL76	
⁹⁷ Zr	Zirconium	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	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		2.1	6.007 H 1	NBS76	
^{99m} Tc	Technetium (in CAP-MAC)	042			2.1	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. 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. Eqb. after 9 hours.
^{103m} Rh	Rhodium							
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 Eqb.	047 or 180 × 2	40	4	462.6 D 4			Reading gives act of ¹⁰⁹ Cd, ^{109m} Ag, or Total Act. in eqb. sample. Eqb. after 6 minutes.
^{109m} Ag	Silver				39.8 S			
¹⁰⁹ Pd	Palladium Eqb.	435 × 10			13.427 H 14 39.8 S			Reading gives act of ¹⁰⁹ Pd, ^{109m} Ag, or Total Act. in eqb. sample. Eqb. after 6 minutes.
^{109m} Ag	Silver							
^{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 Act. in eqb. sample. Eqb. after 15 hours.
^{113m} In	Indium							
^{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	645						Reading gives act. of ^{121m} Te or ¹²¹ Te in eqb. sample. Eqb. in 120 days. See App. II for non-eqb. samples.
	Eqb.							
¹²¹ Te	Tellurium							
^{121m} Te	Tellurium	572						Reading gives sum of ^{121m} Te or ¹²¹ Te in eqb. sample.
	Eqb.							
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 (Eqb. ^{125m} Te)	371	12			2.758 Y 1	NDT70	Reading gives ¹²⁵ Sb Act. in eqb. sample. Eqb. after 1 year.
¹²⁵ Sb	Antimony	364	12				NDT70	Reading gives sum of ¹²⁵ Te and ^{125m} Te in eqb. sample. See App. II for non-eqb. activity.
	Eqb.							
^{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	054						Reading gives act. of ^{129m} Te or total act. in eqb. sample. Eqb. in 10 hours.
	Eqb.							
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	

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %		Published Data %	Half-Life (NCRP-58)	Ref.	Comments
^{129m} Xe	Xenon	362	20	3	8.0 D 2	ORNL76		
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 Eqb.	663				ORNL76		Reading gives sum of ¹³² Te and ¹³² I in eqb. sample.
¹³² I	Iodine							
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. II.
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. II.
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 Eqb.	220		2.0	30.0 Y 2	NBS73		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				2.553 M 1			
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

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %		Published Data %	Half-Life (NCRP-58)	Ref.	Comments	
¹⁴¹ Ce	Cerium	061	5	5		32.50 D 1	ORNL76	Estimation use only. β dominant. Ref: 36.7 & 133.5 keV Reading gives sum of ¹⁴⁴ Ce & ¹⁴⁴ Pr Act. in equilibrium sample. Eqb. after 2 hours.	
¹⁴² Pr	Praseodymium	226 × 10		14		19.13 H 4	ORNL76		
¹⁴⁴ Pr	Praseodymium	137 × 10		5		17.28 M 5	ORNL76		
¹⁴⁴Ce ¹⁴⁴Pr	Cerium Eqb.	387 × 10	5	2.8	285.0 D 1	NBS73			
	Praseodymium								
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. II
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.
¹⁸⁸W ¹⁸⁸Re	Tungsten Eqb.	217 × 10							Reading gives sum of ¹⁸⁸ W & ¹⁸⁸ Re activity in equilibrium sample.
	Rhenium								
^{190m} Os	Osmium	858				9.90 M	NM75		
¹⁹¹ Os	Osmium	250	2	13		15.4 D 2	ORNL76		
¹⁹² Ir	Iridium	408				73.83 D 1	NDS73		
¹⁹⁴ 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	Ref. for 70 & 77 keV.	
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		

Radioisotopes		Calibration Setting Number	Uncertainty Due to Syringe Corr. %		Half-Life (NCRP-58)	Ref.	Comments
²⁰³ Pb	Lead	344	2	2	51.88 H 1	ORNL76	Ref. for 1064, 569.7, 76.7, & 1772 keV.
²⁰⁴ Tl	Thallium	420 × 100		2	3.78 Y 2	NDT70	
²⁰⁷ Bi	Bismuth	846		1.7	32.2 Y 9	NBS73	
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. II.
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.	030 or 146 × 2					Reading gives sum of ²¹² Pb & ²¹² Bi activity in equilibrium sample.
²¹² Bi	Bismuth						
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. See explanation of table entries in appendix I.
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.

APPENDIX III

MULTIPLICATION FACTORS FOR NON-EQUILIBRIUM RADIOISOTOPES

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.

Multiplication factors for Ca47 Activity 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

Multiplication factors for Ni56 Activity 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

Multiplication factors for Zn62 Activity 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

Multiplication factors for Y87 Activity 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

Multiplication factors for Zr95 Activity 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

Multiplication factors for Te121m Activity 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

Multiplication factors for Sb125 Activity 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

Multiplication factors for Te129m Activity 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

Multiplication factors for Te132 Activity 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

Multiplication factors for Xe133m Activity 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

Multiplication factors for Xe135m Activity 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

Multiplication factors for W188 Activity 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

Multiplication factors for Pb212 Activity 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

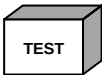
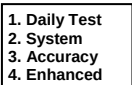
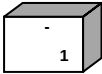
OPERATIONAL SUMMARY

Thank you for choosing CAPINTEC. This “Start-Up” aid is designed to allow you to use the CRC®-15W Enhanced to perform immediate nuclide measurements.

GETTING STARTED with DOSE CALIBRATOR MEASUREMENTS

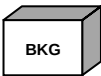
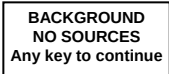
Quality Control & Daily Tests

Prior to making any activity measurements, Daily Tests must be performed.

Press  . You will see this screen:  . Select Daily Test by pressing  . The **Daily Tests** include **Auto Zero**, **Background Adjustment**, **System Test**, **Data Check**, 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®-15W Enhanced. To enter **Reference Source** data, see 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  . You will see the following screen:  . Make sure that no sources are in the vicinity of the well. Press any key, other than the **HOME** key, to begin. At the end of the measuring period, you will see the message “OK - ENTER to accept”. Press the **ENTER** key. The background value will be stored and automatically subtracted from all measurements.

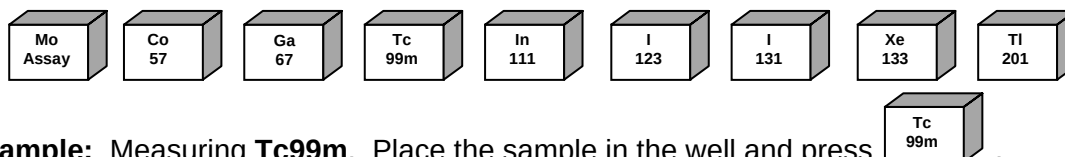
Measuring Nuclide Activity

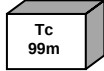
To measure the activity of a sample, simply place the sample into the dipper, lower it into the well, and select the nuclide from the keypad.

Selecting A Nuclide For Measurement

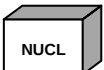
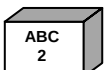
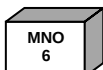
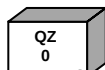
When measuring the activity of a nuclide, you must indicate the nuclide being measured. This can be accomplished in four (4) simple ways:

1. **PRE-SET KEYS:** You can select from 9 pre-defined keys. Each key is labeled to indicate the corresponding nuclide as shown below.



Example: Measuring **Tc99m**. Place the sample in the well and press . The activity for Tc99m is automatically displayed.

2. **USER DEFINED KEYS:** The CAPINTEC CRC®-15W Enhanced has 5 user defined keys. You can assign nuclides to these keys. (See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: USER KEY ASSIGNMENT)
3. **NUCLIDE KEY:** The Nuclide Key allows you to select a nuclide from the list of 85 nuclides that have been stored in the memory. Simply press the **NUCL** key and use the keypad to specify the nuclide. After selecting the values press the **ENTER** key.

Example: Co60 Press . Press    . Press .

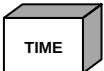
4. **CALIBRATION NUMBERS:** To measure the activity of a nuclide that is not stored in the memory, pre-set keys, or user defined keys, press the **CAL#** key, enter the calibration number for the nuclide, and press the **ENTER** key. The activity can then be measured. Simply place the sample in the well.

Note: Calibration numbers are listed in Appendix II.

Example: Press . Enter the calibration number. Press .

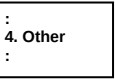
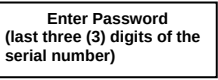
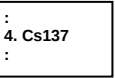
Future Activity

The CRC®-15W Enhanced has a special feature that allows you to automatically determine the activity of a sample at some point in the future.

Example: Press . Enter the new time & date in the 24-hour format. Press . The "FUTURE" activity is displayed.

Enter Test Data (See: CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES)

The Test Data must be entered from the main Utility Menu. To access this menu,

press  to get to the Chamber measurement screen. Press  to display the Utilities Menu. Press , , , , .

The system then displays:

Cs137 Chamber
[Test source data or
message 'no source']

OK? Y or N

Answer **Y** to skip this screen.

The next screen displays:

Cs137 Chamber
[Test source data or
message 'no source']

OK? Y or N

If the Test Source data has been entered in the system, verify that these are the dates from your Cs137 Test Source and press **Y**. Press **N** 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 **Y** to answer yes to "Use Daily?"

The system will display the inserted data. Verify the data and confirm with **Y**. To correct any errors, press **N**.

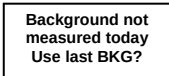
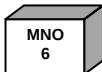
Press . This brings you back to the Main Chamber Screen.

GETTING STARTED with WELL COUNTER MEASUREMENTS

Press  to access the Well Counter.

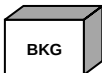
Background Measurement

Before performing the first measurement of each day, you will see the

following screen:  Press  for No.

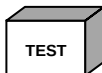
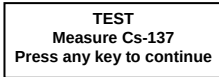
The system will prompt you through a Background measurement. When the Background measurement is complete, you will see the message "ENTER or WELL to SAVE". Pressing **ENTER** will print and store the Background value. Pressing **WELL** only stores the Background value. The Background will be subtracted automatically from all measurements.

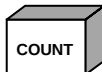
Background adjustment can be performed at any time by pressing the Background

key  .

Daily Test

Prior to carrying out any activity measurements, the Daily Test must be performed on the Well Counter. The test requires a Cs137 Standard Source. The source data must be entered into the system. To enter Test Source data, see the **Enter Test Source** section below.

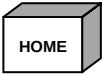
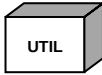
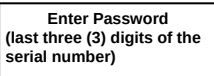
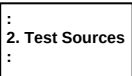
Press  . You will see this screen:  Place the Cs137 Test

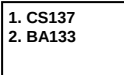
Source into the well and press any key. Press  to start the test.

The test procedure checks the calibration of the counter. If the **Activity Deviation** is greater than **±5%**, check your Test Source dates and re-measure the **Activity Conversion Factor** for the Cs137 Standard Source (see the **Activity Conversion Factor** section below). If the test fails, it will be necessary to perform an **Auto Calibration** (see CHAPTER 10: COUNTER TESTS, SECTION: AUTO CALIBRATION).

Enter Test Source (See CHAPTER 6: CHAMBER INITIALIZATION, SECTION: TEST SOURCES)

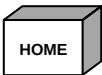
The Test Source must be entered from the Counter Utility Menu. To access this

menu, press  to get to the Counter Measurement Menu. Press  to display the Utilities Menu. Press , , .

The system then displays:  Select the source you wish to use.

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**.

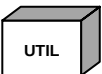
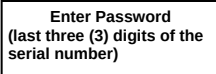
The system will display the inserted data. Verify the data and confirm with **Y**. To correct any errors, press **N**.

Press . This brings you back to the Counter Utility Menu.

Activity Conversion Factor (See CHAPTER 7: COUNTER INITIALIZATION, SECTION: CONVERSION FACTORS)

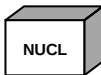
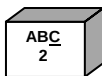
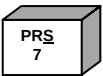
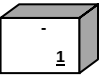
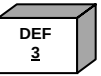
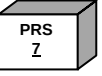
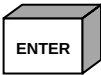
In order to get an activity reading, it is necessary to measure Activity Conversion Factors for the nuclides you use. Get a Standard Source for each nuclide and measure the Conversion Factor in the well.

MEASURE THE ACTIVITY CONVERSION FACTOR (CF): Before measuring CF's, you must be in the Well Counter mode.

Press , , , .

CHOOSE NUCLIDE
Press NUCL or
Pre
-

Is displayed. Select the Isotope you want to measure via the keypad and press **ENTER**.

Example: Cs137 Press . Press , , , , 
Press .

The nuclide you entered will be displayed. Confirm the entry with **Y**. If there is already a CF for this isotope in the system, the values will be displayed. Press **N** to re-measure the CF.

1. Input CF
 2. Measure CF

The system displays . Select **2** for Measure CF. Input the Calibration Date of your Standard Source and press **ENTER**. Input the Calibration Activity of your Standard Source and press **ENTER**.

The system will display the inserted data. Verify the data and confirm with **Y**. To correct any errors, press **N**.

Place the source in the well counter and press any key. Press **COUNT** to start.

After the measurement, the system will ask you to select Channels. Select the Channels that correspond with the main energy peak(s) of the isotope.

CH1: 30-100 keV	CH4: 400-660 keV
CH2: 100-200 keV	CH5: 660-800 keV
CH3: 200-400 keV	CH6: over 800 keV

Press **ENTER** to finish.

The system will display CF and Channel number. Press **Y** to confirm.

Press ENTER to go back to the Well Counter menu.

Selecting a Nuclide for Measurement

You can select a nuclide in three different ways:

- 1. USER DEFINED KEYS:** The CAPINTEC CRC®-15W Enhanced has 5 user defined keys. You can assign nuclides to these keys. (See CHAPTER 5: SYSTEM INITIALIZATION, SECTION: ADDING A NUCLIDE)
- 2. NUCLIDE KEY:** The Nuclide Key allows you to select a nuclide from the list of 85 nuclides that have been stored in the memory. Simply press the **NUCL** key and use the keypad to specify the nuclide. After selecting the values press the **ENTER** key.

Example: Cs137 Press NUCL. Press ABC
2 PRS
7 -
1 DEF
3 PRS
Z

Press ENTER.

- 3. PRE-SET KEYS:** You can select from 8 pre-defined keys. Each key is labeled to indicate the corresponding nuclide as shown below.

Co 57	Ga 67	Tc 99m	In 111	I 123	I 131	Xe 133	Tl 201
----------	----------	-----------	-----------	----------	----------	-----------	-----------

Note: These keys are only valid for Well Counting when Conversion Factors have been measured or entered.

Measuring Nuclide Activity

After specifying the nuclide, to perform an activity measurement, simply place the sample in the counter.

Input the counting period via the numeric keypad and press **COUNT**. Pressing **COUNT** again will terminate the measurement, if so desired.

When the measurement has been completed, press **ENTER** to print the results.

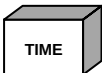
Measurement without Nuclide Selection

The CRC[®]-15W Enhanced allows measurement without any nuclide selected. The system then calculates and displays the results in cpm (or cps) for all the channels.

Press . No nuclide name is displayed. Input the time of count (in seconds). Place the sample in the counter and press **COUNT**.

Future Activity

The CRC[®]-15W Enhanced has a special feature that allows you to automatically determine the activity of a sample at some point in the future.

Example: Press . Enter the new time & date in the 24-hour format.

Press . The "FUTURE" activity is displayed.

For Technical Assistance, contact CAPINTEC Customer Support at 1-800-227-6832.

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NEW PRODUCT WARRANTY

Conditions and Limitations

CAPINTEC warrants our products to be free from defects in material and workmanship for a period of 12 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 be 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.



CAPINTEC, INC.

DECLARATION OF CONFORMITY THE EC DIRECTIVE

We, Capintec, Inc.
540 Alpha Drive
Pittsburgh, PA 15238
Phone: 412-963-1988
Fax: 412-963-0610

declare under our sole responsibility that the product CRC-15W RADIOISOTOPE DOSE CALIBRATOR (including use with Okidata Model 320, 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. EN60601-1
2. IEC60601-1-1
3. EN60601-1-2
4. IEC60601-1-4

The Technical Construction File is maintained at:

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