FLUKE®
Biomedical

Victoreen®

Current Mode Beta Scintillation Detector, Model 943-27

Operator Manual

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Manual No. 943-27-31-1, Rev. 3

Fluke Biomedical
Radiation Management Services

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Section 1
General Information

1.1 General Description

The Victoreen® Model 943-27 Current Mode Beta Scintillation detector is a radiation detection device that detects beta radiation. The detector is housed in a 1.5-inch diameter stainless steel tube. The detector is identified as the Model 943-27 and is manufactured as a P/N 943-27-31 detector assembly. Both identification numbers are used interchangeably throughout this manual. The detector is designed for accident range operation.

The detector operates at a potential of approximately (-) 500 VDC and provides a nominal DC output current of 1×10^{-12} amperes at 1×10^{-3} to 1×10^{-5} uCi/cc. The maximum current output is 1×10^{-4} amperes. The detector consists of a 0.002-inch thick Titanium end window, a calcium fluoride scintillation crystal optically coupled to a quartz light pipe and a photomultiplier tube.

The detector is designed to operate with a Model 943-227-15 Series Digital preamplifier and a Model 960 Digital Process Radiation monitoring system or a Model 942A-200C Series Digital Ratemeter. The Model 943-227-15 Digital Preamplifier is a self-contained electrometer housed in a NEMA 4 enclosure. The preamplifier processes the DC input signal, digitizes the signal, and then transmits the digitized radiation value to the readout device via a RC232C compatible serial data communication. For additional information on the preamplifier and readout device, refer to the applicable product or system level instruction manual.

Interconnection between the detector and preamplifier is accomplished using two (2) six (6) foot coaxial cables. One cable supplies the detector high voltage and the other cable provides the signal output

For additional information on the detector preamplifier or readout device, refer to the instruction manual for the Model 943-227-15 Preamplifier, the Model 942A-200C UDR, or the applicable Model 960 System manual.

1.2 Application

The Model 943-27-31 Detector is used with the Victoreen 942A-200C or Model 960 Digital Process Radiation monitor and the Model 943-227-15 Series Digital preamplifier. The Model 942A-200C or 960 system readouts provide the +15 VDC preamplifier electronics power, (-) 500 VDC detector power and the RS232C serial communications support. The digital preamplifier converts the detector output into a digital signal for processing by the digital readout. Table 1-1 is a list of available configurations and compatible 9XX series equipment. Please contact Fluke Biomedical Radiation Management Services for additional information.

Table 1-1 943-27 Variations and Compatible Equipment

Detector	Preamplifier Variations	Application	Readout
943-27-31 Beta Detector, Current Mode Operation	943-227-15 Digital Preamplifier	Transmission Distances Less than 50 feet	942A-200C Digital Ratemeter or Model 960 Digital Process Control System
	943-227-15VL Digital Preamplifier	Transmission Distances up to 1 mile	942A-200C Digital Ratemeter or Model 960 Digital Process Control System

1.3 Specifications

General specifications for the Model 943-27 Detector are listed below. The 943-27 series products are designed for nuclear applications, and any repairs to it by personnel not qualified to ANSI 45.2.6 1978, Skill Level II may void the nuclear rating.

If a problem develops, the preamplifier may either be returned to the factory for service, or repaired by a qualified technician.

Table 1-2. General Specifications for the 943-27 Detector

Feature:	**Specification:**
Radiation Detected	Beta rays
End Window	Titanium, 1.125 in dia. x 0.0002 in thick, designed to maximize beta transmission and minimize noble gas adsorption
Scintillation Crystal	Calcium Fluoride, CaF_2(Eu) 1.125 in dia. X 0.005 in thick interfaced to 1.125 in dia. x 0.125 in thick quartz light pipe
Detector Housing	Stainless Steel
Detector Constant	1.0×10^{-3} uCi/cc/picoampere, typical, based on calibration method and sampling geometry
Detector Range	1.0×10^{-12} to 1.0 x 10-4 amperes (approximately 1.0×10^{-3} to 1.0×10^{5} uCi/cc, based on calibration method and sampling geometry
Energy Dependence and Efficiency	Dependent on sampling geometry; Refer to Appendix C for applicable isotopic calibration reports
Power Requirements	(-) 500 VDC @ 400 uAmperes
Operating Temperature	0° F to 122 °F (-16 °C to 50 °C)
Relative Humidity	0 – 95 %, non-condensing
Operating Pressure	12 psig max
Dimensions	1.5 in dia. x 9.0 in long (3.8 cm x 22.9 cm)
Weight	3 lbs (1.4 kg)
Preamplifier Interface	High Voltage: Six (6) foot coaxial cable with pre-terminated SHV connector and “Seal Grip”; Signal: Six (6) foot coaxial cable with pre-terminated BNC connector and “Seal Grip”;
Modification Information	None

1.4 Auxiliary Equipment

Model	Description
None	See Table 1-1 for compatible equipment

1.5 Recommended Spare Parts

Table 1-9 Recommended Spare Parts List for the Model 943-27 Detector

Part Number	Description	Used On
	There are no replaceable parts in the 943-27 detector	

1.6 Receiving Inspection

Upon receipt of the unit:

1. Inspect the carton(s) and contents for damage. If damage is evident, file a claim with the carrier and notify the Fluke Biomedical Radiation Management Services Customer Service Department.

Fluke Biomedical
Radiation Management Service
6045 Cochran Road
Cleveland, Ohio 44139
Phone: 440.248.9300
Fax: 440.542.3682

2. Remove the contents from the packing material.
3. Verify that all items listed on the packing list have been received and are in good condition.

NOTE

Management Service Customer Service Department If any of the listed items are missing or damaged, notify the Fluke Biomedical Radiation

1.7 Storage

Storage of Fluke Biomedical instruments must comply with Level B storage requirements as outlined in ANSI N45.2.2 (1972) Section 6.1.2(.2). The storage area shall comply with ANSI N45.2.2 (1972) Section 6.2 Storage Area, Paragraphs 6.2.1 through 6.2.5. Housekeeping shall conform to ANSI N45.2.3 (1972).

Level B components shall be stored within a fire resistant, tear resistant, weather tight enclosure, in a well-ventilated building or equivalent.

Storage of Fluke Biomedical instruments must comply with the following:

1. Inspection and examination of items in storage must be in accordance with ANSI N45.2.2 (1972) Section 6.4.1.
2. Requirements for proper storage must be documented and written procedures or instructions must be established.
3. In the event of fire, post-fire evaluation must be in accordance with ANSI N45.2.2 (1972), Section 6.4.3.
4. Removal of items from storage must be in accordance with ANSI N45.2.2 (1972), Sections 6.5 and 6.6.

Section 2
Theory of Operation

2.1 Functional Description

The detector is comprised of a thin calcium fluoride scintillation disc located behind an ultra-thin (0.0002 in) Titanium end window. The end window permits the penetration of Beta rays as low as 80 Kev. The calcium fluoride disc is optically coupled to the active cathode of a one-inch diameter photomultiplier tube (PMT). A schematic representation of the detector is shown on drawing 943-27-32, located in Appendix A. As shown in the schematic, the cathode of the PMT is tied to a negative high voltage through a ten (10) megohm current limiting resistor, R1. The PMT dynodes are biased by the divider string formed by resistors R2 through R13. The output signal is taken directly from the PMT anode, which is held at a virtual ground potential by the input of the associated integrating electrometer.

2.2 Theory of Operation

Beta particles that have enough energy to penetrate the end window and impinge upon the disc will produce light pulses, proportional to the energy deposited in the disc. The disc is thin so that gamma rays will not have a high incidence of interaction with the disc. This yields a high rejection of gamma rays while still possessing good sensitivity to beta particles.

A photomultiplier tube, optically coupled to the scintillation disc, detects visible light emitted from the disc and converts this light to electrical energy that is proportional to the energy deposited by the beta particle. The electrical charge is sent to an electrometer in an external preamplifier that converts the charge into a digital value for display and processing.

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Section 3
Operation

3.1 Installation

Installation consists of mounting the detector in its associated sampling geometry and making the required electrical connections. Refer to the applicable sampling geometry instruction manual for detector installation instructions.

CAUTION

Remove all power prior to installing the Detector.

Detector Mounting

The detector is designed to be installed within a sampling geometry. The detector is normally part of the process pressure boundary, and is normally installed using to mounting flanges and 2 quad-lobed seal o-rings. The basic mounting procedure is provided below. Refer to the specific sampling geometry installation procedure for further information.

The following materials are normally needed to remove or install the Model 943-27 detector:

O-Ring Lubricant, Dow Corning #55, or equivalent

1ea, 3/16 Hex head bit or T-handle tool

1ea, P/N 943-27-47, Detector Mounting Flange

1ea, P/N 46-103, Quad lobed seal (Detector mounting flange to Adapter flange)

6ea, P/N 5-610, 10-32 x 0.62 Socket head cap screws (varies with application)

6ea, P/N 5-795, #10 split washes, Stn Stl (varies with application)

1ea, P/N 943-27-48, Adaptor Flange

1ea, P/N 46-104, Quad lobed seal (Adapter flange to sampler body)

6ea, P/N 5-1080, 10-32 x 0.88 Socket head cap screws (varies with application)

6ea, P/N 5-795, #10 split washes, Stn Stl (varies with application)

6ea, P/N 5-795, #10 flat washers, Stn Stl (varies with application)

CAUTION

Due to the potential for high activity radioactive gasses in or around the vicinity of the detector, protective Clothing should be worn while installing or removing the detector

Detector Installation

Detector installation includes installing the adaptor flange and quad-lobed seal o-ring, installing the detector mounting flange, detector flange quad-lobed seal o-ring, inserting the detector into the detector mounting tube and securing the detector mounting flange. The high voltage power supply for the detector, if operational, must be turned off by turning the controlling Digital Ratemeter or 960 System power OFF.

Adapter Flange Installation: Lubricate the P/N 46-104 Quad lobed seat, the larger of the 2 seals, with O-ring lubricant, Dow Corning #55, or equivalent. Insert the seal into the groove on the P/N 943-27-48 adaptor flange, the larger of the 2 flanges, with 2 sets of mounting holes. Place the adaptor flange over the mating mounting surface. The quad lobed seal must be located between the adaptor flange and the mating stationery mounting surface. Secure the adaptor flange to the mounting surface using the hardware provided with the sampling geometry. Tighten the nuts securely (50 inch-lbs).

Detector Installation: Locate the P/N 943-27-47 detector-mounting flange, the smaller of the 2 flanges, with 1 set of mounting holes. From the bottom of the detector, the end with the titanium window, slide the detector flange over the body of the detector, up to the cables at the opposite end of the detector. The groove cut into the flange must face the bottom of the detector. Lubricate the P/N 46-103 Quad lobed seat, the smaller of the 2 seals, with O-ring lubricant, Dow Corning #55, or equivalent. Slide the quad lobed seal over the body of the detector, up to the detector flange. Insert the seal into the groove on the P/N 943-27-47 detector flange. The quad lobed seal must face the bottom, or sensitive end of the detector to permit sealing to the adaptor flange.

Install the Model 943-27 detector, with detector flange and quad lobed seal, into the hole in the adaptor flange and into the detector housing. Insert the detector into the detector housing until the sensitive end of the detector rests on the support ring on the bottom of the detector tube. Use care to not damage the thin, beta sensitive end window on the detector.

Detector Flange Installation: Slide the detector mounting flange and quad lobed seal down the body of the detector until it stops on the detector adaptor flange. Install the 6, 10-32 x 0.62 inch long, stainless steel, Socket head cap screws and lock washers into the holes provided in the detector flange. Line up the holes in the detector flange with the threaded holes in the adaptor flange. Screw the cap screws into the threaded mounting holes in the adaptor flange. Tighten the nuts securely (50 inch-lbs).

This completes the detector installation. The sampling geometry may now be pressure tested. The maximum pressure for the system is 12 psig.

Detector Removal:

CAUTION

Due to the potential for high activity radioactive gasses in or around the vicinity of the detector, protective Clothing should be worn while installing or removing the detector.

WARNING

The sampling geometry is an accident range noble gas monitor, and radioactive gasses may be present within the sampling volume. The local plant Health Physicist should be consulted prior to removing the Detector or opening the Grab sample valve.

Detector removal is the opposite of the typical detector installation described above. If the detector has not been replaced for over 18 months, the 46-103 Quad lobed seal should be inspected for wear or damage. If the seal is worn, it should be replaced at this time. When replacing the seal, the new seal should be lubricated with O-ring lubricant, Dow Corning #55, or equivalent. If the detector adaptor flange has not been replaced for over 6 years, the 46-104 Quad lobed adaptor flange seal should be inspected for wear or damage. If the seal is worn, it should be replaced at this time. When replacing the seal, the new seal should be lubricated with O-ring lubricant, Dow Corning #55, or equivalent

CAUTION

Remove all power prior to connecting field wiring.

Electrical Interface

Electrical connections from the detector include a high voltage and a signal coaxial cable, with pre-terminated connectors. The connectors are designed for termination within the associated preamplifier.

The detector high voltage and signal cables enter the preamplifier through “Seal Grip” type penetrations on the enclosure body. The “Seal Grips” contain a rubber gland that is intended to grip the coaxial cables to prevent moisture entry into the enclosure. The “Seal Grips” are an integral part of the detector cables. The “Seal Grip” enclosure nut is removed from the fitting. The insulating washer stays with the fitting. The detector signal and high voltage cables, with connectors and “Seal Grip” fitting nuts are then inserted into the holes preamplifier enclosure. The “Seal Grip: end fittings are then re-installed securely against the wall of the enclosure.

The detector Signal (BNC) and High Voltage (SHV) cables are then terminated on the bulkhead connectors located on the enclosure inner panel.

NOTE

The electrometer circuitry in the preamplifier is highly sensitive to moisture and physical damage. Use extreme care when the preamplifier case is opened as the high impedance electrometer circuitry is easily damaged. Do not leave the preamplifier enclosure in the open position for any extended period of time.

3.2 Set-up

Once the detector is installed and electrically connected to the preamplifier, the detector must be calibrated. This includes exposing the detector to a series of standard radioactive sources and adjusting the high voltage supplied by the readout device to obtain the same output current (adjusted for radioactive decay) that was obtained during the factory calibration. This data is provided on the Calibration Data sheet provided with the detector. To place the system in operation, the following steps should be performed:

NOTE

Ensure you have read and fully understand Section 1, 2 and 3 prior to continuing.

1. Adjust the High Voltage. Refer to the applicable preamplifier and readout/controller device manual prior to powering up the controller and adjusting the high voltage.

3.3 Operation

Once the detector/preamplifier/readout devices have been installed and the high voltage has been adjusted, operation of the Model 943-27 Current Mode Beta Scintillation Detector is automatic.

Operation of the 943-27 Detector is controlled by the Model 943-227-17 Digital Preamplifier and the Model 942A-200C Digital Ratemeter or Model 960 Digital Process Radiation monitoring system. Once the power to the controlling device is turned on, detector operation begins. No operator interaction is required.

An operational check source is normally provided with the sampling geometry. The check source is actuated from the controlling device and is used to verify operation of the detector by producing an upscale reading on the controlling device.

Normal Operation

If the measured radiation field is within the range of the detector during power-up, the uCi/cc value will be displayed on the controller. The digital display will update once per second.

Alarms

The radiation alarms are initiated by the applicable controller. Refer to the applicable controller manual.

Section 4
Maintenance, Calibration and Troubleshooting

4.1 Maintenance

The 943-27-15 Detector is designed to operate for extended periods of time with no scheduled maintenance required. Operation may be verified by periodically actuating the check source (provided with the detector and sampling assembly) and observing the response of the unit. If the response varies by more than 50% of the normal value, further troubleshooting may be required. If a problem develops, troubleshoot the unit per Section 4.3 and the drawings in Appendix B.

Periodically, approximately every 18 months, it is suggested that the detector be re-calibrated.

4.2 Calibration

Electronic Adjustments

There are no user adjustments available on the 943-27 Detector. The detector high voltage is determined during calibration and is provided by the associated readout/controller.

Point source Calibration

WARNING

The calibration procedures require the use of high activity beta emitting button sources. These sources are intended solely to provide a beta radiation field. They should be used only by persons who have been trained in the appropriate safety procedures to be followed in the presence of beta radiation and the proper interpretation of the data. Notify the plant Health Physicist prior to the use of these sources.

SPECIAL NOTE

Due to the activity of these sources, possession of these sources requires a USNRC Byproduct Material License or Agreement State License, as defined in Title 10 of the Code of Federal Regulations.

Source and Source Holder Description

WARNING

USE PRECAUTIONS FOR HANDLING RADIOACTIVE MATERIAL SOURCES

WARNING

HANDLE WITH CAUTION

WARNING

"HIGH BETA RADIATION FIELDS"
Handle the sources with caution.
Direct the open end of the source holder away from personnel.
DO NOT Look at the Open Source.
Wear safety glasses.
DO NOT touch the source window.
DO NOT remove the large end of the holder. It contains the source.

Table 4-1. Current Mode Beta Detector Calibration Source Set

Part Number:	Isotope:	Activity, microCuries
844-130-1-12	^{90}Sr	200
844-130-1-13	^{137}Cs	200
844-130-1-14	^{36}Cl	200

Refer to figure 4-1 for a pictorial view of the source holder assembly. The source holder consists of the following components:

Shielding: The source is housed in an Aluminum cylinder, 2.5-inch diameter x 4.5-inch length. The source is sealed in one end of the cylinder. Refer to drawing844-131-1-TAB, included in Appendix A.

CAUTION

The activity of the sources are a nominal 200 microCuries. The cesium source holder has no lead shielding and readings on the surface of the holder are approximately 25 mR/hr (0.25 mGy/hr). Consult the local Health Physicist for precautions that must be followed when handling the sources.

Source: The activity is deposited on a 40 mm diameter Whatman #1 qualitative filter paper that is bonded to a 0.51 mm thick stainless steel disc. The disc is sealed with a 2-mil Kapton window and sealed into an aluminum mount. The overall dimensions on the source disc are 3.2 mm in height and 47 mm in diameter**.**

Calibration: To calibrate the detector, the small end cap on the source holder is removed, exposing the internal radioactive source.

WARNING

"HIGH BETA RADIATION FIELDS"
Handle the sources with caution.
Direct the open end of the source holder away from personnel.
DO NOT Look at the Open Source.
Wear safety glasses.
DO NOT touch the source window.

Follow the following precautions when handling the source holder:

1. Remember that high Beta radiation fields exist when the end cap is removed
2. Direct the open end of the source holder away from people.
3. Do not look directly into the end of the open source holder.
4. Wear safety glasses when using the source.
5. Do Not Touch the source window. The thin window is easily punctured, directly exposing the source material.
6. The U.S. Nuclear Regulatory Commission requires a leak test of the source every six (6) months.
7. The large end cap of the holder contains the radioactive source capsule. DO NOT REMOVE.

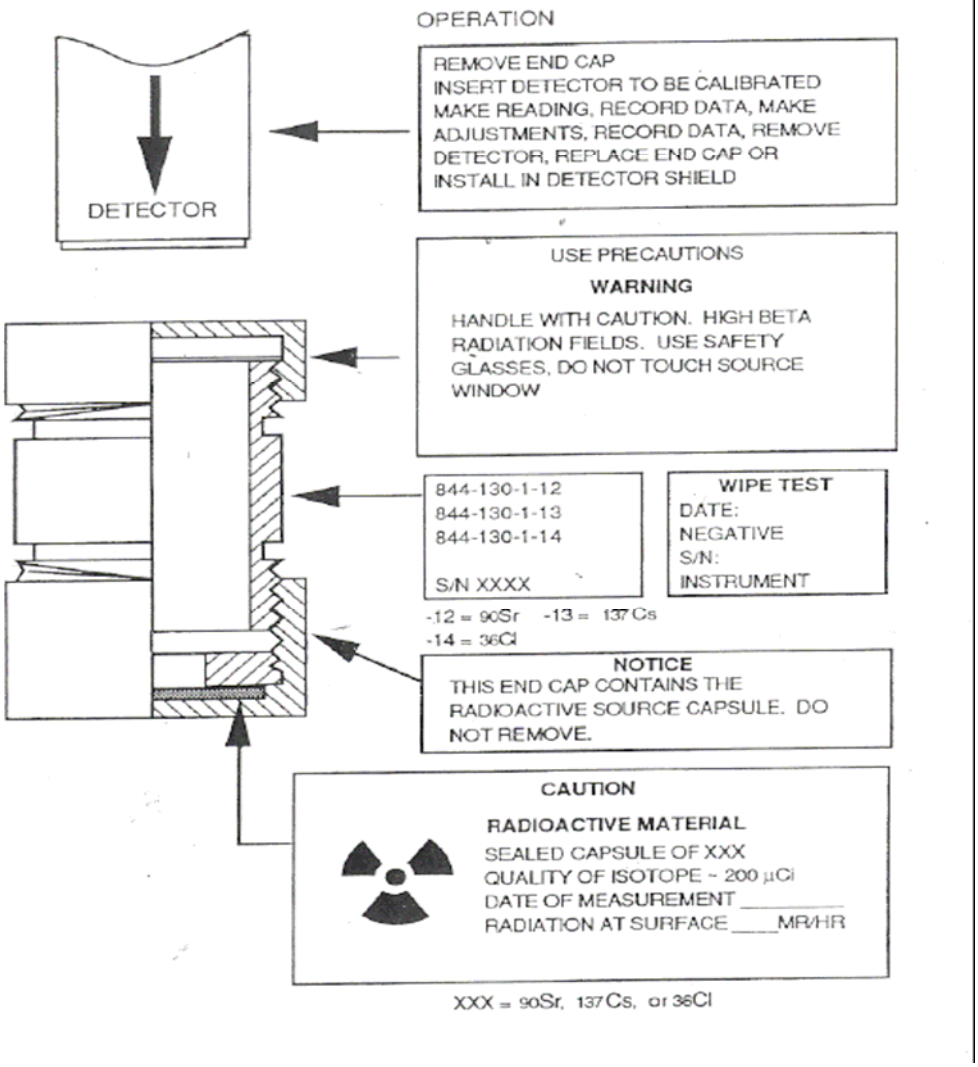

Figure 4-1 Source Holder Assembly and Operation

Source Wipe Test

Due to the amount of activity in each source, the Current Mode Beta source set requires a USNRC or Agreement State Byproduct Material license. To guard against leaks of radioactive material, or possible contamination, the regulatory agency generally requires a wipe test be performed at an interval not to exceed six (6) months for each source.

WARNING

The wipe test of the source is made with the end cap removed. Any part of the body in front of the open source may be exposed to high radiation fields. Do not test quickly to minimize exposure. Direct the open end away from personnel and wear safety glasses.

The activity is covered with a 2 mil Kapton window and is sealed into the aluminum mount. DO NOT TOUCH the source window with anything, including the wipes.

Wipe Test Procedure:

1. Procure a long handled Q-tip type cotton swab and moisten it with alcohol.
2. Remove the small end cap. Direct the open end away from any personnel.

WARNING

Do not swab the source window. It is a 2-mil Kapton window that may easily be broken.

3. Holding the swab, quickly swab the internal surface of the cylinder.
4. Replace the small end cap. Return the holder to storage.
5. Measure the swab using a detector capable of detecting 0.005 microCuries or less and record the data.
6. If more than 0.005 microCuries of activity is detected, notify the cognizant plant Radiation Safety Officer or Health Physicist.

Source Holder Data Sheet:
The following summarizes the data provided with the source holders:

CURRENT MODE BETA SOURCE SET

P/N 844-130-1-12	^{90}Sr
P/N 844-130-1-13	^{137}Cs
P/N 844-130-1-14	^{36}Cl

USE PRECAUTIONS FOR HANDLING SOURCES
RADIOACTIVE MATERIAL

WARNING: HANDLE WITH CAUTION

HIGH BETA RADIATION FIELDS EXIST WHEN END CAP IS REMOVED
DIRECT THE OPEN SOURCE AWAY FROM PEOPLE
WEAR SAFETY GLASSES WHEN USING THE SOURCES
DO NOT TOUCH THE SOURCE WINDOW – THE THIN WINDOW WILL PUNCTURE EASILY
U. S. NUCLEAR REGULATORY COMMISSION REQUIRES SIX MONTH LEAK TESTING

NOTICE: THE LARGE END CAP CONTAINS THE RADIOACTIVE SOURCE CAPSULE
DO NOT REMOVE

PART NUMBER	SERIAL NUMBER, FLUKE	SERIAL NUMBER, MANUFACTURER	RADIOACTIVE MATERIAL	ACTIVITY, microcuries	DATE OF MEASUREMENT
844-130-1-12	XXXX	XXXX	^{90}Sr	200	XX/XX/XX
844-130-1-13	XXXX	XXXX	^{137}Cs	200	XX/XX/XX
844-130-1-14	XXXX	XXXX	^{36}Cl	200	XX/XX/XX

Detector Calibration Procedure

The following procedure is recommended to assure an accurate calibration of the Model 943-27 Current Mode Beta scintillation detector.

Equipment Required:

1. Detector to be calibrated
2. Electronics to be used with the detector
3. Calibration sources P/N 844-130-1-12, 844-1-130-1-13 and 844-130-1-14.
4. Data Sheet: The data sheets are used to delineate the minimum recording requirements. The baseline calibration data is supplied at the time of installation. Record all identification information on the data sheet prior to doing any measurements. The expected calibration values must be corrected for decay prior to doing the calibration. Refer to the calibration procedures in Appendix B for sample data sheets.

Detector Leakage:

1. With the detector connected to the readout device, apply power and allow a 15-minute warm-up.
2. Record the readout with no radiation sources present. The maximum background current is approximately 4.0×10^{-11} amps.
3. Expose the window of the detector directly to light. Read detector leakage. There should be little difference between this and the previous reading. If there is a significant increase in readings, the detector window has a light leak and must be repaired before proceeding.

Calibration Source Measurements, General:

1. Remove the detector from the sampling geometry and note the background radiation reading. In a normal background environment, the background should be less than 4.0×10^{-11} amperes. If the background is greater than this, the detector should be replaced. Record the ambient background radiation value.

WARNING

The following procedure exposes the operator to beta radiation. Safety glasses must be worn and the amount of "line of sight" exposure time must be minimized.

2. Remove the source holder end cap. This is the smaller of the two end caps.
3. Insert the detector into the P/N 844-211-1-13, ^{137}Cs reference source.
4. With the source in place, allow approximately two minutes for the reading to stabilize. Record the reading displayed on the readout device. The reading should yield a net value, within +/- 2%, of the decay corrected, background subtracted target value provided on the original calibration data sheet. If the reading is not within +/- 2%, the high voltage may be increased or decreased as necessary. Once +/-2% agreement is reached, NO FURTHER ADJUSTMENTS of the high voltage are permitted.
5. Remove the detector from the source holder and re-install the end cap.
6. Re-run the background measurement. The background should remain less than 4.0×10^{-11} amperes
7. Repeat steps 2 through 5 using the remaining two sources. The reading should yield a net value, within +/- 6%, of the decay corrected, background subtracted target value provided on the original calibration data sheet.

Calibration Source Measurements, using Model 960 Digital Radiation Monitoring System:

1. Select the Display Option on the 960 front panel keypad that converts the display units to raw output from the detector (in amperes).
2. Remove the detector from the sampler.
3. Decay to the present day the "net current" value printed on the calibration data sheet, under the heading of customer sources, for the Cesium-137 source.

WARNING

The following procedure exposes the operator to beta radiation. Safety glasses must be worn and the amount of "line of sight" exposure time must be minimized.

4. Remove the cap marked "Removing this cap will expose user to beta radiation".
5. Place the Cesium-137 source assembly on the ground with the open side up.
6. Insert the detector into the source assembly.

7. Wait a minimum of 1 minute, and then observe the 960 display. Compare the value displayed to the calculated value in step 3 above. The observed value must be within +/- 2% of the calculated value.
8. If the value is within the required tolerance, proceed to step 10.
9. If the value is not within the required tolerance, adjust the scaler high voltage (96SF, R8) until the observed value falls within the required tolerance. If the observed value is too low, increase the high voltage. If the observed value is too high, decrease the high voltage.

NOTE

DO NOT adjust the high voltage after this point

10. Remove the detector from the source holder and lay it on the ground. Replace the end cap on the source holder.
11. Wait 5 minutes, and then observe the 960 display. The displayed value is the background current for this detector. The value must be less than 4.0×10^{-11} amperes. If greater than 4.0×10^{-11} amperes, the det4ector should be returned for repair or replacement.
12. Decay to the present day the “net current” value printed on the calibration data sheet, under the heading of customer sources, for the Strontium-90 source.
13. Remove the cap from the Strontium-90 source holder. Place the source holder on the ground. Insert the detector into the holder.
14. Wait a minimum of 1 minute, and then observe the 960 display. Compare the value displayed to the calculated value in step 12 above. The observed value must be within +/-6% of the calculated value.
15. Remove the detector from the source holder and lay it on the ground. Replace the end cap on the source holder.
16. Decay to the present day the “net current” value printed on the calibration data sheet, under the heading of customer sources, for the Chlorine-36 source.
17. Remove the cap from the Chlorine-36 source holder. Place the source holder on the ground. Insert the detector into the holder.
18. Wait a minimum of 1 minute, and then observe the 960 display. Compare the value displayed to the calculated value in step 16 above. The observed value must be within +/-6% of the calculated value.
19. Remove the detector from the source holder and lay it on the ground. Replace the end cap on the source holder.
20. If all 4 values fall within the required tolerances, the detector is calibrated. Record the values obtained as well as the detector high voltage. The high voltage may be measured at the 1000:1 test jack on the 960 front panel.
21. If any of the 4 values does not fall within the required tolerances, return the detector for repair or replacement.
22. Re-install the detector into the sampler.
23. This concludes the field detector calibration procedure.

4.3 Troubleshooting

WARNING

Extreme care must be used when troubleshooting a system that has power applied. All standard troubleshooting precautions apply.

WARNING

Once a problem has been located, remove all power before continuing with the repair.

CAUTION

Personnel performing the troubleshooting/repair must be qualified to ANSI 45.2.6, 1978, Skill Level II.

Personnel performing the following procedure must be familiar with the operation of the monitoring system and the location of each piece of equipment used in the system.

If a problem develops, verify that the voltages at connection point inputs and outputs are present and that all wiring is secure. Refer to Appendix B and C for drawings and parts lists. If a PROM requires replacement, specify the board revision level when ordering the part.

Troubleshooting / Adjustments

Troubleshooting includes a verification of detector response by actuating the radioactive check source and verification of the high voltage value. The check source is actuated from the associated readout/controller. The high voltage may be measured at the connection point in the digital preamplifier enclosure.

Specialized test equipment and firmware are required to adjust the auto-zero and PGA subsystems in the electrometer. If the test equipment and firmware is not available, the unit should be returned to Fluke Biomedical RMS for re-alignment.

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Appendix A
Connector Designations

A.1 CONNECTOR DESIGNATIONS, 943-27

Table A-1 Field Electrical Connections, 943-27

	943-27	
Cable	**Description**	**Connects To 943-227-15 or 943-227-15VL**
HV	High Voltage, 6 Ft Coaxial Cable with SHV Connector	HV
SIG	Signal, 6 Ft Coaxial Cable with BNC Connector	SIG

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Appendix B
Applicable Drawings

B.1 Applicable Drawings, 943-27

Drawing No.	**Description**
GEL-943-27	Dimensional Drawing
943-27-31	Detector Assembly
943-27-32	Detector Socket Assembly
844-130-1-TAB	Source Holder Assembly

B.2 Related Manuals (Not Supplied with this document)

SXXXXXX-1	Applicable 960 Series system Manual
942A-200C-M1	Digital Ratemeter
943-227-15-1	Digital Preamplifier Manual

B.3 Related Calibration Reports (Not supplied with this document)

The available detector calibration procedures and primary isotopic calibration reports applicable to the detector are listed below. The calibration reports each describe a different sampling geometry. Copies of these procedures are available from Fluke Biomedical RMS Customer Service Department at (440) 498-2564.

Reference Procedures:

Document Number:	Description:
CAL- BETA2	943-27-31 Beta Scintillation Detector Factory Calibration Procedure, 300cc and other
CAL- BETA3	943-27-31 Beta Scintillation Detector Factory Calibration Procedure, 11cc only

Reference Primary Calibration Reports (not included in this manual):

958.316	Primary Isotopic Calibration for 300cc Offline Gas monitor with 943-27 Current Mode Beta Scintillation Detector
958.323	Linearity Test Report, Current Mode Beta Scintillation Detector
958.350	Primary Isotopic Calibration for 11cc Offline Gas monitor with 943-27 Current Mode Beta Scintillation Detector
958.401	Primary Isotopic Calibration an In-line Accident Range Noble Gas Monitor with 943-27 Current Mode Beta Scintillation Detector
958.405	Primary Isotopic Calibration for Model 940-513, 11cc Offline Sampler with 943-27 Current Mode Beta Scintillation Detector
958.407	Primary Isotopic Calibration for Model 940-483EH with 943-27 Current Mode Beta Scintillation Detector

Appendix C
Bill of Materials

C.1 Bill of Materials, 943-27

Part Number	Description
943-27-31	Detector Assembly
943-27-32	Socket Assembly
844-130-1-TAB	Source Holder Assembly

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Appendix D
Cable Termination Instructions

D.1 Cable Termination Instructions

The cables provided with the Model 943-27 Detector are factory pre-terminated.

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Appendix E
Modification Sheets, Engineering Instructions

E.1 Modification Sheets, Engineering Instructions

P/N	Description
943-27	None

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