

**FLUKE®**

**Biomedical**

# **Victoreen® 190N**

**Portable Neutron Survey Meter**

## **Operators Manual**

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# Section 1

## Introduction

### 1.1 Product Description

The Model 190N is a portable neutron survey meter in the classical Anderson and Braun design (Snoopy). This survey meter provides mRem rate and dose measurements by combining a moderator / attenuator probe with all of the features of the Model 190, a “smart” digital survey instrument.

The 190N is lighter in weight than previous designs and ergonomically designed to be easier to carry and use.

The probe can also be attached to a Model 190AC or the Model 190F Frisker. Both of which can be AC powered, for continual area monitoring. The Frisker version also includes a metal stand for the 190F.

### 1.2 Specifications

|   |  |
|---|--|
| <b>General</b>                                  | The Model 190N is comprised of a neutron moderator / attenuator containing a BF <sub>3</sub> proportional counter and a Model 190. A handle and a carrying strap are attached to the moderator. The Model 190 serves as the readout. It is attached to the moderator as well and can be placed on either side of the handle. It is also completely removable. A special probe adapter in the Model 190 is cabled to a preamplifier in a housing on the moderator which is coupled directly to the BF <sub>3</sub> tube inside. |
| <b>Readout</b>                                  | The Model 190N uses the standard Model 190 as the readout. See the Model 190 manual for a full description of the audio and visual display features  |
| <b>Alarm</b>                                    | Audio and visual alarms can be programmed into the Model 190N via the Model 190-1A Infrared Communicator   |
| <b>Logging of Data</b>                          | The 190-1A communicator interfaced to a personal computer can be used to set up data logging   |
| <b>Detector Assembly, Model RP-N</b>            | The detector assembly is a polyethylene cylinder 9.5 inches long by 8.5 inches in diameter (24.1 x 21.6 cm) containing a BF <sub>3</sub> proportional counter and neutron energy compensating materials. This arrangement is based upon the standard reliable Anderson and Braun design for neutron energy response. The handle is padded for ease of gripping. An adjustable shoulder strap is provided   |
| <b>BF<sub>3</sub> Operating Characteristics</b> | The BF <sub>3</sub> proportional counter nominally operates at 1150 V<br>Active Length: 2 inches ( 5.08 cm)<br>Fill Gas: Enriched BF <sub>3</sub> , 96% Boron 10<br>Gas Pressure: 20 cm Hg.<br>Resolving Time: 1 microsecond<br>Plateau Slope: 2% per 100 V<br>Tube Life Expectancy: Greater than 10 <sup>10</sup> counts  |
| <b>Neutron Energy Response</b>                  | The energy range is thermal ( 0.025 eV ) to 15 MeV.  |

Accuracy: Within  $\pm 10\%$  of theoretical ICRP dose rate.  
Recommended Response Time: 24 seconds

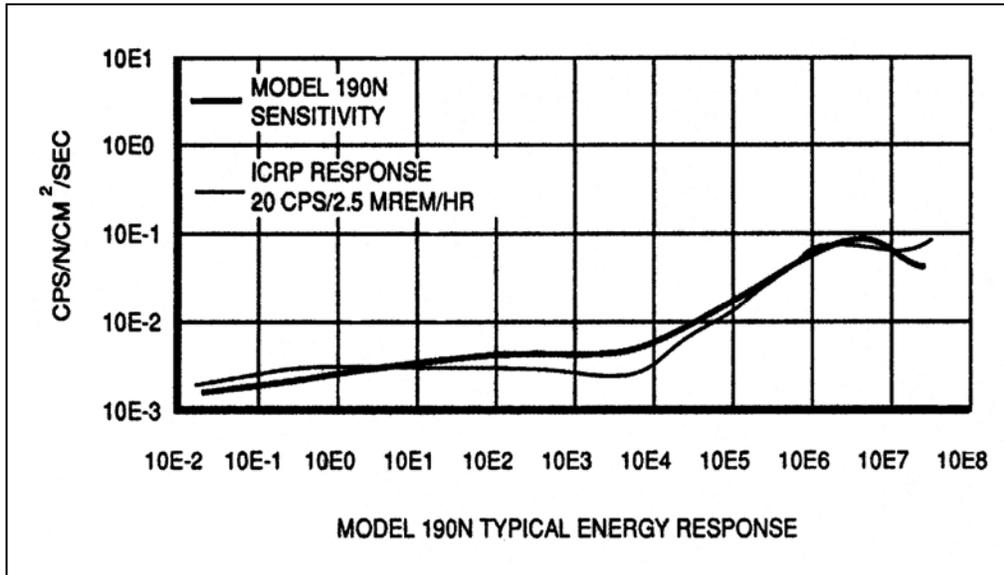


Figure 1-1. Neutron Energy Response

**Typical Neutron Sensitivity** Nominal 2000 counts per mRem

|                                    |   |
|------------------------------------|---|
| <b>Range Rate:</b>                 | 0 $\mu$ Rem/h to 75 Rem/h<br>0 $\mu$ Sv/R to .75 Sv/h<br>0 CPM to $2.5 \times 10^6$ CPM<br>0 CPS to 41,660 CPS  |
| Integrate:                         | 0 $\mu$ Rem to 1000 Rem<br>0 $\mu$ Sv to 10 Sv,<br>0 to $10^9$ Counts   |
| <b>Gamma Sensitivity/Rejection</b> | No response in $^{137}\text{Cs}$ gamma radiation in fields up to 500 R/h  |
| <b>Accuracy</b>                    | 10% of the theoretical ICRP dose rate   |
| <b>Dimensions</b>                  | Overall Diameter: 12.50 in (31.75 cm)<br>Overall Length: 10.25 in (26 cm)   |
| <b>Flexibility</b>                 | The Model 190 is detachable from the detector assembly for remote readings.<br>It can be held, or can be mounted on either side of the cylinder for convenient carrying |
| <b>Miscellaneous</b>               | Detector Assembly cable length: 4.5 ft (1.3 m). An optional 30 ft (9.14 m) cable is available   |
| <b>Weight</b>                      | 21 lbs (9.52 kg) (total Model 190 + Detector assembly)  |
| <b>Directionality</b>              | Less than 20% in three orthogonal directions  |
| <b>Power Requirements</b>          | Four 9 V alkaline batteries supplied, 100 hours operation   |

|                                |   |
|--------------------------------|---|
| <b>Calibration</b>             | Model 190N is calibrated against a NIST traceable “Tissue Equivalent Proportional Counter” and uses Radium/Beryllium neutrons at a distance of 100 cm |
| <b>Temperature Range</b>       | The Model 190’s operating range is 14°F to 104°F (-10°C to + 40°C). The detector assembly operating range is –112°F to 176°F (-80°C to + 80°C)        |
| <b>Relative Humidity Range</b> | 0 to 95% non-condensing   |

## 1.3 Applications

Possible applications for the 190N are:

1. Surveys
2. Area Monitoring

## 1.4 Batteries

See Model 190 manual for battery replacement.

## 1.5 Routine Cleaning

**CAUTION**

Do not immerse the Model 190N. The unit is not waterproof. Liquid could damage the circuits. The unit should be kept clean and free from dirt and contamination. The unit may be cleaned by wiping with a damp cloth using any commercially available cleaning or decontaminating agent.

## 1.6 Receiving Inspection

Upon receipt of the package:

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 Service at 440.248.9300.
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**

If any of the listed items are missing or damaged, notify Fluke Biomedical at 440.248.9300.

## 1.7 Storage

Store in an environment free of corrosive materials, fluctuations in temperature and humidity, or vibration and shock.

## 1.8 Battery Installation/Replacement

Four 9 V alkaline batteries are supplied with the Model 190. The battery compartment is located on the back of the instrument. The compartment will hold up to four batteries. All four batteries must be in place for proper operation and to avoid damage to the instrument. Use the following procedure to install/replace the batteries:



CAUTION

To prevent battery leads from shorting on the battery compartment's conductive coating, ensure that all four batteries are installed at all times.



CAUTION

Unit power must be left ON and batteries replaced one at a time to prevent data loss when the log mode is activated and logged data is to be retrieved.

1. Loosen the two quarter turn fasteners securing the battery compartment cover to the back panel.
2. Remove the battery compartment cover to gain access to the batteries.
3. Replace the batteries one at a time, observing proper polarity.
4. Replace the battery compartment cover, securing it with the two quarter turn fasteners.

WARNING

The unit may make beeping sounds while inserting the batteries.



WARNING

Extreme caution should be used when connecting the probe to the meter. Improper connection may result in injury, damage to the instrument, or damage to the probe.



WARNING

An electrical shock hazard exists between the high voltage supply and ground.



CAUTION

To prevent battery leads from shorting on the battery compartment's conductive coating, ensure that all four batteries are INSTALLED at all times.



CAUTION

Unit power must be left ON and batteries replaced one at a time to prevent data loss when the log modes activated and logged data is to be retrieved.

CAUTION

The equipment described in this manual is intended to be used for the detection and measurement of ionizing radiation. It should be used only by persons who have been trained in the proper interpretation of its readings and the appropriate safety procedures to be followed in the presence of radiation. Although the equipment described in this manual is designed and manufactured in compliance with all applicable safety standards, certain hazards are inherent in the use of electronic and radiometric equipment.

NOTE

In the case of an Electro Static Discharge (ESD) power down of the Model 190N, it is necessary to reset the unit by cycling the power (turning the unit off and then on). After reset, the unit will power up in its normal operating mode

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## Section 2

# Operation



WARNING

An electrical shock hazard exists between the high voltage supply and ground.

## 2.1 Operation

The 190 can operate in Rate Mode and display in CPM and mRem /hr units. In Integrate mode the 190 can display in Counts or mRem. Comparable SI units are also provided. The “Mode” button is used to toggle among allowable display units.

While surveying, should a neutron flux above nominal be observed, the operator can detach the probe from the Model 190 readout and move away from the area by the length of the cable. A standard and two longer length cables are available.

In addition to being a survey meter, the probe can be used as a area monitor by purchasing a Model 190AC which is an AC powered version of the Model 190. This eliminates the dependence on batteries.

### 2.1.1 Time constants

The Model 190 has the capability of acquiring and displaying data with either 24, 12, 6, or 3 second time constants. The time constant is adjustable by momentarily pressing the “Response Time” button. It is recommended to use the largest time constant in the lowest rate mode.

### 2.1.2 Integrate / Rate Mode

Normally surveys are taken in the rate mode, however, the Model 190 can switch between the rate and integrate mode with the push of the “Rate/Integ” button. The integration starts upon instrument turn on, and both the integration time and the integrated value are displayed. Should a reset of the integration be desired, it can be accomplished by holding down the “Resp Time” button for longer than 3 seconds. The integration will reset and re-start upon let up of the button. Please see the Model 190 manual for a more detailed discussion.

## 2.2 Operational Checks

The Model 190 self checks upon turn on.

## **2.3 Calibration**

The 190N is calibrated against a Tissue Equivalent Proportional Counter using Radium / Beryllium neutrons at a distance of 100 cm.

The lower discriminator threshold is set at about 1 MeV.

The calibration provides the factor in converting from counts ( CPM ) to Dose Equivalent (mRem/hr). A quality factor of 8 is assumed for this calculation. A Model 190-1A communicator, a personal computer, and the appropriate software, would give the user the ability to re-calibrate the Model 190, including entering a new Quality Factor.

## Section 3 Troubleshooting



WARNING

An electrical shock hazard exists between the high voltage supply and ground.

### 3.1 Troubleshooting

Refer to the Table 3-1 for symptom/cause/corrective action.

Table 3-1. Troubleshooting Table

| Symptom  | Probable Cause   | Corrective Action   |
|--|--|---|
| The words "No Detector" is displayed on the Model 190. | Probe Adapter Module not plugged in.<br>Probe Adapter Module female plug not correctly aligned with the pins in the 190. | Make Sure The Unit is Off During The Corrective Action. Either plug in the module or remove, check the pins, and carefully re-plug.<br>If required, straighten the pins with a small screwdriver. |

NOTE

Refer to the Model 190 Manual for other symptoms, error messages, probable causes and corrective actions.

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## Section 4

# Service Information



WARNING

An electrical shock hazard exists between the high voltage supply and ground.

### 4.1 General

The 190N contains 4 functional elements:

1. Model 190 Survey Meter
2. Probe Adapter Module / Preamplifier Assembly
3. Moderator Assembly
4. BF<sub>3</sub> Tube

See the Model 190 manual for all items pertaining to the Model 190. The detector assembly is composed of a polyethylene cylinder, other neutron moderating and absorbing materials, and a BF<sub>3</sub> tube. The Probe adapter module on the Model 190, the cable, and the preamplifier in the moderator housing couple, shape, and discriminate the pulses from the BF<sub>3</sub> tube to the Model 190.

### 4.2 Circuit Description

Refer to the basic Model 190 manual, part number 190001, for all items pertaining to the Model 190.

The 190PA Probe Adapter/Preamp consists of two circuit boards that are interconnected with a shielded multi-wire cable. Sheets 1 & 2 of the circuit diagram 190123 shows both of these circuits. In sheet 1, the first amplifier stage is a charge sensitive amplifier that integrates the radiation produced detector pulse on capacitor C5. Resistor R5 discharges C5 exponentially. The second amplifier stage shapes the pulse into approximately 1 microsecond in width.

In sheet two of the circuit diagram, the preamplifier pulse is capacitor coupled to a comparator circuit that has an amplitude discrimination level of about 80 millivolts. The 93C46 device is an EEPROM that is used for storage of calibration factors, probe ID and other similar data specific to the operation of the system.

The Model 190 provides high voltage, typically 1100 V, for operation of the detector. Additional filtering of the high voltage is provided by R1, R2, C2, C3, and C4 as shown in sheet 1 of 190123.

### 4.3 Calibration and Adjustments

There are no calibrations or adjustments to be made to the detector assembly. For calibrations and adjustments to the Model 190, see the Model 190 manual.

## **4.4 Replaceable Parts**

| <b><u>Item</u></b>     | <b><u>Part Number</u></b> |
|------------------------|---------------------------|
| Model 190              | 190                       |
| RP-N                   | RP-N                      |
| Probe Adapter / Preamp | 190PA                     |
| Adjustable Strap       | 91-5                      |
| BF <sub>3</sub> Tube   | 35-190                    |
| 190N Manual            | 190N-1                    |
| 190 Manual             | 190001                    |

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