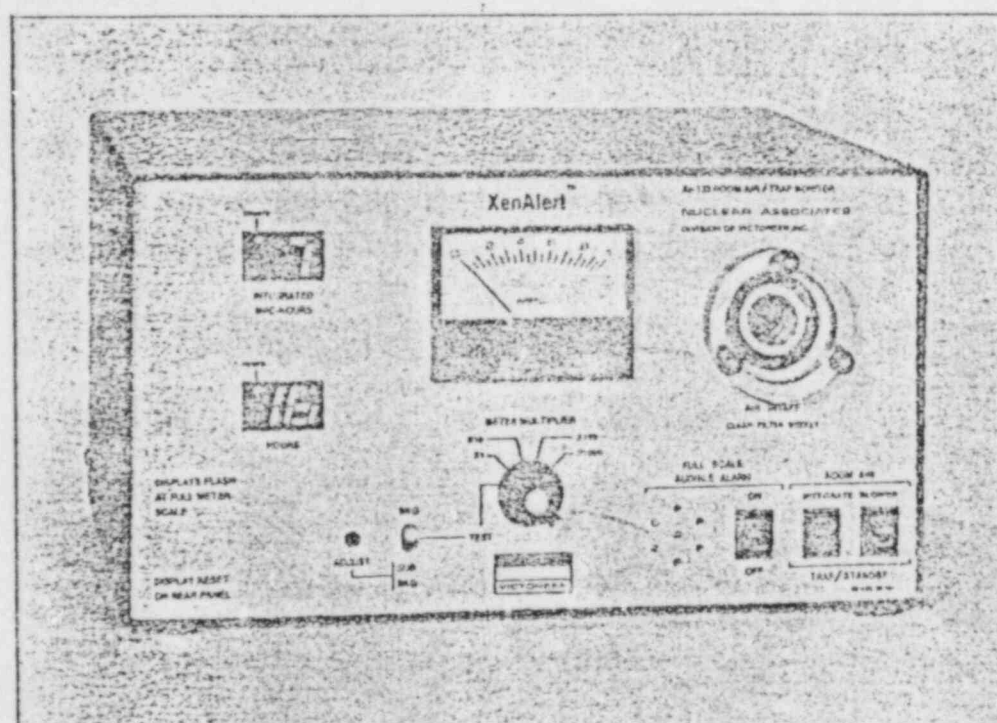


# XenAlert™ \*

## Xenon Room Air and Trap Monitor

Model 36-751



\*Patent Pending



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### I. INTRODUCTION

The XenAlert Monitor is designed to measure and integrate the concentration of xenon-133 in room air. Its wide range also permits measurement of the xenon-133 concentration in the exhaust air of xenon gas traps. This serves as an indicator of the effectiveness of the trap's filter cartridges.

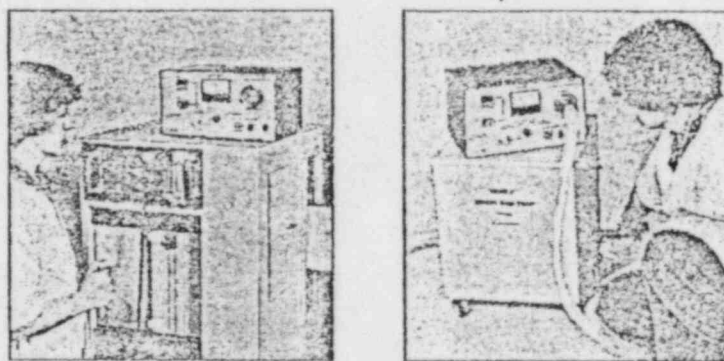
#### Room Air Monitoring

The Code of Federal Regulations (10 CFR 20.103) limits the quantity of xenon-133 that an individual may inhale, in any calendar quarter, to that which would result from inhaling a uniform concentration of  $10^{-5}$   $\mu\text{Ci/ml}$  for 40 hours per week for 13 weeks. This quantity is called the Maximum Permissible Concentration (MPC). If the concentration is expressed in units of MPC, then the integrated concentration is in units of MPC-Hours. The average value of this concentration should not exceed 40 MPC-Hours per week.

The XenAlert indicates the xenon-133 concentration in MPC units ( $1 \text{ MPC} = 10^{-5} \mu\text{Ci/ml}$ ) on an analog meter. At the same time, it integrates the concentration and displays it as MPC-Hours. Also displayed are the total number of hours over which the integration has taken place.

To comply with the Code, your XenAlert MPC-Hours must be less than 520 for any consecutive 13-week period. MPC-Hours should be recorded and examined on a weekly basis (see Appendix A). An MPC-Hours reading of less than 40 per week indicates that your accumulation rate (if it remains constant) is below that which would result in a total of 520 MPC-Hours for the 13-week period ( $40 \times 13 = 520$ ). While a reading greater than 40 during any week does not mean that you have exceeded the limit, it does indicate that you should investigate the source and exercise stricter adherence to safety procedures in the department.

The XenAlert provides a means of checking the concentration of xenon-133 according to the Code of Federal Regulations. Whenever there is the possibility of exposure to xenon-133, a XenAlert should be operating close by. If more than one person normally works with xenon-133, an individual log of the XenAlert MPC-Hours information may be kept (see Appendix A).



Left: "XenAlert" monitors room air during ventilation study. Right: Gas trap output is displayed in MPC units.

### Gas Trap Monitoring

The performance of charcoal filter cartridges used in all xenon gas traps may degrade with use. Therefore, it is desirable to measure the xenon-133 concentration in the effluent air directly at the trap's exhaust port. This measurement allows the user to determine trap performance and assess its effect on the xenon-133 concentration in the total room air volume. The XenAlert can be used to determine the activity in the trap effluent; see page 7 and Appendix B.

## II. DESCRIPTION

The XenAlert's detector is a large-area, thin-window GM tube, mounted in a chamber through which air is constantly circulated by a blower. The monitor is calibrated to display the count rate in MPC units and the total accumulated counts in MPC-Hours. The counting chamber is shielded by  $3/8$ " of lead to minimize the effect of background radiation on the count rate. In addition, a background-subtract circuit is provided to subtract the background count rate for both the MPC meter and the integrated MPC-Hours readings.

A visual alarm (both digital registers flash once per second) is activated when the meter reaches full scale on any range or when the MPC-HOURS reach 80. An audible alarm (intermittent tone), selected by a front-panel switch, goes on when a full-scale meter reading is reached on any range. A constant tone is produced when the MPC-HOURS register reaches 80. When the instrument is not in use, a standby circuit retains the MPC-HOURS reading in memory and suspends further integration until both the INTEGRATE and BLOWER switches are returned to ON or ROOM AIR. A reset button returns both the MPC-HOURS and HOURS readouts to zero.

The AIR INTAKE has a particulate-matter filter and a fitting for attaching a hose when checking a gas trap. The trap's exhaust is monitored (without adding to the integrated MPC-HOURS reading) by placing both the INTEGRATE and BLOWER switches in the TRAP/STANDBY position.

### III. OPERATING CONTROLS AND INDICATORS

INTEGRATE. This switch controls the integration of MPC-HOURS. It is ON when monitoring room air and OFF during gas trap monitoring or standby.

BLOWER. This switch turns the blower on. The blower must be ON when monitoring room air in order to move air past the detector. It is interlocked to the INTEGRATE switch and must be on for integration of MPC-HOURS to take place. It is placed in the OFF position when doing gas trap monitoring or during standby. It should be turned on for 5 minutes after gas trap monitoring, but before turning the integrator on, in order to blow the xenon out of the instrument.

FULL-SCALE AUDIBLE ALARM ON/OFF. A front-panel switch gives the user the choice of whether or not the alarm will sound when the analog meter reaches full scale on any range.

METER MULTIPLIER. Determines the meter scale factors and allows the user to select the appropriate range. Generally, the lower ranges (X1 and X10) are used for room air monitoring while the higher ranges (X100 and X1000) are used for gas trap monitoring.

TEST: Allows the user to observe and adjust the background reading. When the associated toggle switch is placed in the BKG position, the meter displays the background count rate. In the SUB BKG position, a screw-driver adjustment is used to enter the background count rate. In normal operation, only the net count rate from xenon-133 is displayed on the analog meter or integrated in MPC-Hours.

AIR INTAKE: A 1" I.D. hose (model #36-754) may be attached for gas trap monitoring. Three thumbscrews permit access to a coarse, reusable filter which should be cleaned or replaced weekly. Air leaves the instrument through a rear exit port.



COUNT INDICATOR. Light-emitting diode (LED), located in the upper left corner of the MPC-HOURS digital register, will flash for alternate detector pulses.

POWER INDICATOR. A single LED, located in the upper left corner of the HOURS digital register, flashes once per second when the XenAlert is integrating MPC-HOURS and recording total HOURS. The LED remains lit when the XenAlert is not integrating or recording HOURS (such as in STANDBY or when making gas trap measurements). If the indicator does not light at all, the XenAlert is not receiving power and should be checked immediately.

RESET: This button, located at the rear of the instrument, resets the MPC-HOURS and HOURS display to zero.

Note: When MPC-HOURS reaches 80, the alarm sounds continuously and is stopped only by pushing the reset button.

#### IV. SPECIFICATIONS

Detector: Pancake, thin-window GM tube.

Accuracy:  $\pm 20\%$  at full scale.

Reproducibility:  $\pm 5\%$ .

Counting Chamber: Shielded with 9.5 mm (3/8") lead.

Air Exchange System: Axial blower exchanges air more than 3 times per minute.

Air Intake Port: 2.5 cm (1") O.D. front-panel port with particulate-matter filter.

MPC Analog Meter: Ranges are 1, 10, 100, 1000 MPC, full scale.

Calibration Factors (full scale):  $X1 = 10^{-5} \mu\text{Ci/ml}$ .  
 $X10 = 10^{-4} \mu\text{Ci/ml}$ .  $X100 = 10^{-3} \mu\text{Ci/ml}$ .  $X1000 = 10^{-2} \mu\text{Ci/ml}$ .

Time Constants: 40 sec on X1, 4 sec on X10, 0.4 sec on X100, and 0.04 sec on X1000.

MPC-HOURS Register: 0-99; alarms at 80. Two-digit light-emitting diode (LED).

Hours Register: 0-80; 2-digit LED.

Visual Alarm: MPC-HOURS and HOURS registers flash once per second at full scale on all ranges or when MPC-HOURS reaches 80.

Audible Alarm: User-selectable. Intermittent tone will alarm at full-scale meter readings on all ranges.

Emergency Audible Alarm: Continuous tone on reaching 80 MPC-Hours. Integration and data accumulation continue to 99.

Background Subtract Circuit: Activated by moving range switch to TEST. Allows meter display of background count rate or internal subtracted background count rate. Enables user to adjust subtracted background.

Reset Function: Rear-panel pushbutton resets MPC-HOURS and HOURS to zero.

Standby Function: Switch suspends data integration when xenon studies are not in progress. Accumulated data remains in memory.

Power: 115V, 60 Hz, 25W (230V, 50 Hz on special order).

Accessories Supplied: Screwdriver. - Instruction Manual.

Chart Recorder Output: 1 mA, 100-ohm load miniature phone jack, accepts Switchcraft 750 plug.

## V. SET-UP AND OPERATION

### ROOM AIR MONITORING

1. To protect the plastic air inlet tube from shipping damage, the XenAlert comes with this short tube packed separately. Remove the 3 black thumbscrews from the air inlet, and place the porous air filter in the air inlet recess. Install the plastic flange so that its flat side is against the porous filter and the air inlet tube faces out.
2. Plug unit into 115V AC line. Turn INTEGRATE and BLOWER switches on, that is, to the "Room Air" position.
3. Place METER MULTIPLIER switch on TEST. To adjust background, place toggle switch in BKG position. Wait 4 minutes, and record the background reading as it appears on the meter. Place the toggle switch in SUB BKG position. Using the supplied screwdriver, turn the ADJUST screw until the meter reads the same as it did in the BKG position.  
Note: Background radiation may affect your xenon-133 measurements and may change from time to time due to the presence of other isotopes in the room or in the patient being imaged. Check the background-subtract circuit periodically and adjust it as necessary. The background should never exceed 0.5 MPC.
4. Place the METER MULTIPLIER switch in the X1 position. The meter should read between zero and 0.1 MPC. The background has been subtracted from both the meter and digital readouts.
5. Place a radioactive source, such as Model 62-103 Cs-137 Check Source, on top of the instrument, directly over the label which reads: "Place Check Source Here." Be sure the printed side of the source faces up. The meter should read approximately 2 MPC with this particular source. Check the instrument at least weekly to make sure it is still operational.
6. Press the RESET button on rear of instrument. MPC-HOURS and HOURS should read zero.
7. Place AUDIBLE ALARM switch in ON position, if desired.
8. The XenAlert is now ready to monitor and integrate the xenon-133 concentration in room air. Place the unit as close as possible to where you will be working with xenon.
9. At the end of the working day, place the instrument on standby by turning the INTEGRATE and BLOWER switches to TRAP/STANDBY. Record the readings in your logbook (Appendix A)

10. At the start of each week, or at 80 MPC-HOURS (whichever occurs first), reset the XenAlert to zero.

Note: Do NOT unplug the XenAlert from its power source. Accumulated data is LOST when power is removed.

#### GAS TRAP MONITORING

1. To measure the concentration in the effluent from a gas trap, place one end of a 1" I.D. hose on the XenAlert's air intake and the other end over the gas trap exhaust port. Gas trap measurements should be made while xenon is being trapped, such as during the washout phase of a ventilation study.
2. Place the INTEGRATE and BLOWER switches on TRAP/STANDBY.
3. Place the METER MULTIPLIER switch on X1000. Proceed with the washout procedure and observe the MPC meter reading. If it reads less than 100 MPC, place the switch on X100.
4. Determine the activity (A) in the trap effluent by using the formula:  
$$A = \text{MPC} \times 10^{-5} \times V \times T$$

where A = effluent activity in  $\mu\text{Ci}$ .  
MPC = reading from analog meter.  
 $10^{-5} = 1 \text{ MPC in } \mu\text{Ci/ml}$ .  
V = trap flow velocity in ml/minute.  
T = washout time in minutes.
5. Remove the gas trap hose connection.
6. Turn on the BLOWER until the MPC meter reads zero, which indicates that all the xenon from the trap is out of the XenAlert. This should take about 5 minutes.
7. Return the INTEGRATE switch to ON or ROOM AIR in order to continue monitoring room air.
8. Record the results (see Appendix B).

The graph on page 11 shows the total amount of xenon-133 that could escape from all sources and the total air flow volume that would be necessary to keep the average concentration for 40 HOURS below  $10^{-6} \mu\text{Ci/ml}$  or 0.1 MPC. Integrated over a 40-HOUR week, this would be equivalent to 4 MPC-HOURS. For example, if 34 mCi escaped during the course of a week, and the air flow volume of the room was 500 cubic feet per minute, the average concentration would be  $10^{-6} \mu\text{Ci/ml}$  or 0.1 MPC, which would correspond to 4 MPC-HOURS.

#### MAINTENANCE

Particulate-Matter Filter (36-753): It should be replaced or cleaned with soap and water once a week to prevent it from becoming clogged. Three front-panel thumbscrews permit access to the filter.

APPENDIX A

XENALERT ROOM AIR LOG

Week of \_\_\_\_\_

Day	No. of Studies	No. of mCi		MPC HRS	HRS
1.			Start		
			Finish		
			Difference		
2.			Start		
			Finish		
			Difference		
3.			Start		
			Finish		
			Difference		
4.			Start		
			Finish		
			Difference		
5.			Start		
			Finish		
			Difference		
6.			Start		
			Finish		
			Difference		
7.			Start		
			Finish		
			Difference		

ML10



**SAMPLE**

APPENDIX A

XENALERT ROOM AIR LOG

Week of Nov. 13, 1978

Day	No. of Studies	No. of mCi		MPC HRS	HRS
1. Mon. 11/13	3	30	Start	0	0
			Finish	3	8
			Difference	3	8
2. Tues. 11/14	2	20	Start	3	8
			Finish	5	16
			Difference	2	8
3. Wed. 11/15	5	50	Start	5	16
			Finish	15	24
			Difference	10	8
4. Thurs. 11/16	1	15	Start	15	24
			Finish	16	35
			Difference	1	11
5. Fri. 11/17	2	25	Start	16	35
			Finish	25	45
			Difference	9	10
6. Sat. 11/18	-	-	Start		
			Finish		
			Difference		
7. Sun. 11/19	1	10	Start	25	45
			Finish	26	46
			Difference	1	1

## XENON GAS TRAP MONITORING LOG

$$A = \text{MPC} \times 10^{-5} \times V \times T$$

[illegible]

**SAMPLE**

APPENDIX B

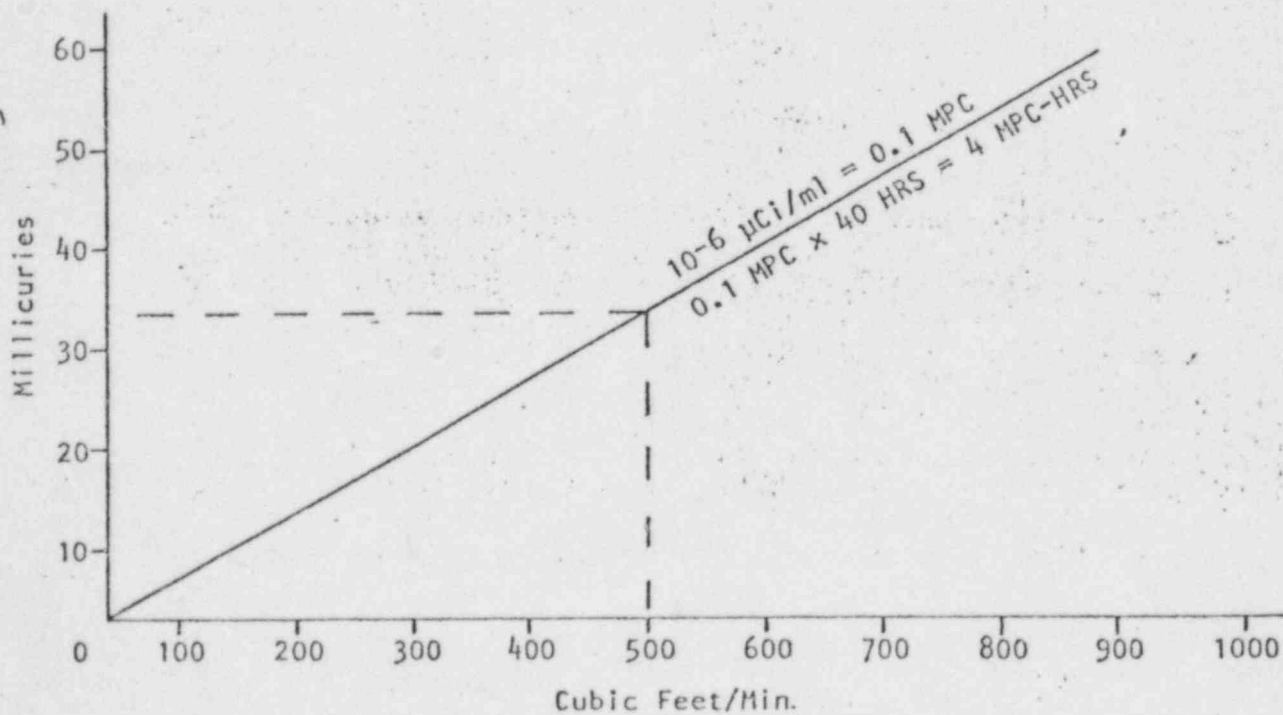
XENON GAS TRAP MONITORING LOG

$$A = \text{MPC} \times 10^{-5} \times V \times T$$

Date	MPC ( $10^{-5}$ $\mu\text{Ci}/\text{ml}$ )	V (ml/min)	T (min)	A ( $\mu\text{Ci}$ )
11/11/78	500	5000	5	125
11/18/78	400	5000	5	100

APPENDIX C

ACTIVITY-AIR FLOW VOLUME



(over)

#### WARNING

THIS INSTRUMENT CONTAINS CMOS INTEGRATED CIRCUITS. NO SERVICE SHOULD EVER BE ATTEMPTED UNLESS BY A COMPETENT TECHNICIAN THOROUGHLY FAMILIAR WITH THESE DEVICES. STATIC CHARGES NORMALLY PRESENT IN A DRY ATMOSPHERE OR LEAKAGE CURRENT IN SOLDERING IRONS OR OTHER NON-GROUNDED TOOLS CAN INSTANTLY DESTROY CMOS INTEGRATED DEVICES. IF THIS DEVICE HAS I.C. SOCKETS, DO NOT EVEN ATTEMPT TO REMOVE OR REPLACE THEM WITHOUT OBSERVING ANTI-STATIC AND LEAKAGE CURRENT PRECAUTIONS.

#### WARRANTY

This instrument and its accessories, excluding those accessories listed below, is warranted by VICTOREEN, INC., against defects in materials and workmanship for a period of one year from the date of original shipment. During the warranty period, VICTOREEN will repair or, at its option, replace, at no charge, an instrument containing such defect, provided that it is returned, transportation prepaid, to the VICTOREEN repair facility listed below. Instruments repaired in warranty will be returned transportation prepaid.

In addition, the calibration of each instrument is warranted to be within its specified accuracy at the time of shipment. If an error in this initial calibration is discovered, the instrument will be recalibrated at no charge, provided it is returned as described above. This does not apply to any calibration deviation that may result from normal use.

THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS, WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THIS EXPRESS WARRANTY EXCLUDES COVERAGE OF AND DOES NOT PROVIDE RELIEF FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE, INCLUDING BUT NOT LIMITED TO LOSS OF USE, LOSS OF SALES OR INCONVENIENCE. THE EXCLUSIVE REMEDY OF THE PURCHASER IS LIMITED TO REPAIR, RECALIBRATION OR REPLACEMENT OF THE INSTRUMENT AT VICTOREEN'S OPTION.

This warranty does not apply if the product, as determined by VICTOREEN, is defective because of normal wear or accident or misuse, or as a result of service or modification by other than an authorized VICTOREEN repair facility. This warranty is void if the unit is subjected to temperatures above 55°C.

This warranty specifically excludes the following items which are covered by their original manufacturers' warranty: Photomultiplier, geiger and proportional tubes, crystal and other solid state detectors, batteries and major ancillary items of instrument systems, such as, but not limited to, recorders and pumps.

#### NON-WARRANTY SERVICE

If repairs or replacement not covered by this warranty are required, a repair estimate will be submitted for approval before proceeding with the repair or replacement.

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FOR REPAIR SERVICE, RETURN THE PRODUCT, PREPAID, TO:

RMI, DIVISION OF VICTOREEN, INC.  
596 SHERWOOD AVENUE  
SATELLITE BEACH, FL. 32937