PORTABLE TRITIUM MONITORS
MODULAR OR FIXED ARCHITECTURE TRITIUM MONITORS
SINGLE OR MULTI RANGE TRITIUM MONITORS
NUCLEAR POWER PLANT MONITORS
ULTRA HIGH SENSITIVITY WIDE RANGE MONITORS
SURFACE CONTAMINATION MONITORS
TRITIUM IN AIR SAMPLE COLLECTOR
NOBLE GAS BETA/GAMMA MONITORS
HEAVY WATER LEAK DETECTOR
ENVIRONMENTAL GAMMA MONITORS
REMOTE MONITORING SOFTWARE
TESTING & CALIBRATION EQUIPMENT
MAINTENANCE REPAIR PARTS

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WHERE MONITORS ARE NEEDED

Tritium, and the need for its measurement or monitoring, is found in several broad areas including:

- Nuclear Fusion Research Laboratories.
- Nuclear Fission Research Laboratories.
- Heavy-Water Nuclear Reactor Plants.
- Manufacturing Facilities for self-powered lights.
- Radiopharmaceutical Laboratories (with C14 and other radioisotopes).
- Hospitals and Universities.
OVERHOFF TECHNOLOGY CORPORATION

TRITIUM MONITORS

For the past 27 years, Overhoff Technology Corporation (OTC) has offered the world’s largest selection of monitors for the detection of airborne tritium. This catalog will help you select the right monitor for your specific application.

OTC has gained an outstanding reputation for monitors that excel in performance and are reasonably priced. OTC’s experience in producing hundreds of different types of monitors for different users allows you to benefit from the company’s design expertise and economical production methods.

In contrast to competitors who offer two or three models of monitors, OTC offers more than a dozen basic instruments for both fixed and portable use. In addition, each basic instrument is available with numerous features and options to precisely meet your facilities specific requirements.

SUPERIOR PERFORMANCE

OTC tritium monitors feature long life, accurate performance and heightened sensitivity. Engineered to satisfy strict military standards, OTC monitors adhere to the same stringent quality guidelines when manufactured for industrial applications.

There is an OTC tritium monitor for every conceivable sensitivity. OTC builds process instrumentation to measure from highest level (pure tritium) to the lowest level ($10^{-8}$ Ci/m$^3$ or even $10^{-9}$ Ci/m$^3$). In most cases, OTC monitors are the only instruments capable of meeting these requirements. They are uniquely designed to be insensitive to radon background radiation, which would otherwise falsify the essential tritium measurement.

OTC monitors feature very low drift and noise characteristics, they are able to maintain stable calibration indefinitely. In addition, OTC tritium monitors maintain their measurement accuracy under harsh, industrial environmental conditions not just in laboratory conditions! A wide variety of optional design features and capabilities are available with OTC tritium monitors, including:

Prevention of tritium oxide (HTO) contamination (plate-out).

Discrimination against airborne radioisotopes, including reactor-generated gases.

Capability for measuring other radioisotopes such as Carbon 14, Argon 14, Xenon 133, etc.

Configurations to separately identify elemental tritium, the oxides of tritium, as well as total tritium.
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Our basic models include monitors for fixed and portable uses. Some portables can be used temporarily for fixed applications.

Fixed Monitors are grouped according to whether they use:

• Linear or Proportional Chamber Technology
• Single or Multiple Ionization Chambers
• Single or Multiple Range Ionization Chambers

OPTIONS:

Options include an extensive array of additions to the basic monitor:

Logarithmic Outputs
Digital Chart Recorders
Totalizers
Special Relay Interfaces
RS-232 and RS-485 Outputs
OverView Remote Monitoring System
Sampling Systems, Pumps, Flow Meters, Filters
Radio Links
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PORTABLE TRITIUM MONITORS
PORTABLE TRITIUM SURVEY MONITORS

MODEL 200SB
(DUAL 200 cc CHAMBERS, MDA 10μCi/m³)

Economy model with medium sensitivity for general purpose survey duty. Combines good gamma compensation with very fast measurement response. Fast warm up and complete temperature stability, and wide range makes it particularly useful as an emergency monitor in nuclear power plants and in similar applications.

MODEL 400SBDγC
(QUAD 200 cc CHAMBERS, MDA 2 μCi/m³)

Low cost instrument with sensitivity to 2μCi/m³, quadruple 200 cc ionization chambers for complete gamma compensation even in substantial non uniform gamma fields. Fast warm up, temperature stable drift free performance of measurement of tritium in the presence of other radioactive gases. Particularly useful for low level area portable monitoring. Applications in nuclear power plants and processing facilities.

MODEL SP1400DD
(DUAL 1400 cm³ CHAMBERS, MDA 1 μCi/m³)

Sensitivity to 1 μCi/m³, dual 1400 cc ionization chambers for tritium specific measurements in the presence of other radioactive (noble) gases. Automatic Zero for temporary use in fixed locations. Applications include portable area monitoring in processing facilities, power plants, fusion research facilities or wherever ultra high sensitivity portable tritium monitors are required.
The Overhoff Technology Corporation 200SB portable tritium survey monitor is a low cost light weight survey meter. The front panel features only three controls, an ON - OFF - SAMPLE switch and the switch for setting the alarm level. Zero adjustment is unnecessary, the 200SB shows no zero drift over a temperature range of 0°C to +50°C. A large pump and fast electronics are combined to give this instrument fast overall response.

**SENSITIVITY, RANGE, SPEED OF RESPONSE**

This instrument is useful where measurement sensitivities of the order of 10 μCi/m³ (1 MPCA) is sufficient, and where wide range, and fast response are needed.

This low cost portable model has a 4 1/2 digit LCD display for readings from 0 to 19,999 MPCA.

**CONVENIENT FOR USE**

The instrument needs no zero adjustment. It is ready for use by merely selecting the desired alarm level and activating the instrument power.

The initial power surge transient will disappear in a minute, the readings will then be accurate.

**GAMMA COMPENSATION**

The use of twin, side by side, or coaxial ionization chambers provides good gamma compensation in moderate background gamma radiation fields.

**FAST RESPONSE**

The use of a large pump, 3 liters a minute, together with fast electronics yields an overall measurement time constant of under 5 seconds.

**HTO DISCRIMINATION**

An HTO discriminating version is available. By addition of an external desiccant column, this survey instrument will specifically measure HTO in the presence of HT, or other radioactive gases.
MODEL 200SB

PERFORMANCE SPECIFICATIONS

**MEASUREMENT RANGE**: 10 – 199,999 μCi/m³, basic sensitivity of the order of 10 μCi/m³

**DISPLAY**: 0 – 19,999 digits, LCD panel meter

**GAMMA COMPENSATION**: two chambers in a side by side arrangement

**RESPONSE RATE**: 5 seconds to reach 90 % of final reading,

**NOISE LEVEL**: +10 μCi/m³, 1 S.D. (3 second electronic time constant)

**ZERO STABILITY**: after 1 minutes (or less) warm up, the zero drift to less than 10 μCi/m³

**ALARM (ACOUSTIC)**: 1. nine position stepped attenuator set point for signal of 20 – 10,000 μCi/m³, steady tone
2. low flow produces a steady tone

**ALARM (VISUAL)**: signal level: red LED
low flow: yellow LED
low battery: red LED

**DUST FILTER**: in line disposable cartridge Pall No. 12082

**SAMPLING SYSTEM**: 2 hose barb ports are located on the front panel

**IONIZATION CHAMBER VOLUME**: effective volume: 200 cm³
port to port volume: 220 cm³

**PUMP**: Special high volume internal pump for a flow rate from 2-3 LPM

**POWER**: two “D” size batteries alkaline, carbon-zinc or NiCd,

**ENVIRONMENTAL**: 0° C to +50° C, 0 - 98 % RH

**CASE**: light weight aluminum

**SIZE AND WEIGHT**: 7.6“ L, 5.2“ W, 4.4“ H excluding handle, 5 lbs (2.3 kg)

**ACCESSORIES**: sniffer hose

**OPTIONAL EQUIPMENT**: transit case
jack for external power supply

NOBLE GAS OR HTO SPECIFIC
MODEL 200SB-HTO

A special version of the basic 200SB instrument with six hose connections is available for specific HTO measurement in the presence of HT or other radioactive gases as well as external and internal gamma fields.
## Parts List for Model 200SB Tritium Monitor

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<tr>
<td>1</td>
<td>230-4-2</td>
<td>Hose Barb, Sample-Out</td>
</tr>
<tr>
<td>1</td>
<td>DMO-742</td>
<td>Digital Panel Meter</td>
</tr>
<tr>
<td>2</td>
<td>B16</td>
<td>Battery Holder</td>
</tr>
<tr>
<td>2</td>
<td>B1-XC</td>
<td>Battery Cap</td>
</tr>
<tr>
<td>2</td>
<td>EN95</td>
<td>Batteries, D-Size Alkaline, Primary Power</td>
</tr>
<tr>
<td>4</td>
<td>415</td>
<td>Batteries, 45V Polarizing</td>
</tr>
<tr>
<td>1</td>
<td>12082</td>
<td>In Line Dust Filter, Pack of 3</td>
</tr>
<tr>
<td>1</td>
<td>CLIC-51</td>
<td>Dust Filter Clip</td>
</tr>
<tr>
<td>1</td>
<td>PSF-100A-0.5</td>
<td>Pressure Switch</td>
</tr>
<tr>
<td>1</td>
<td>MSR320</td>
<td>Alarm Speaker</td>
</tr>
<tr>
<td>2</td>
<td>20-3320</td>
<td>Control Knob, Cap and Skirt</td>
</tr>
<tr>
<td>1</td>
<td>KU402B1/8</td>
<td>Zero Knob</td>
</tr>
</tbody>
</table>
Model 400SBD\(\gamma C\)

HIGH PERFORMANCE TRITIUM IN AIR PORTABLE SURVEY MONITOR

SENSITIVITY

The 400SBD\(\gamma C\) is useful for measurements as low as 2 \(\mu\text{Ci}/\text{m}^3\). The new OTC electrometer, which measures to below \(10^{-10}\) amperes combines low noise and high zero stability. Unlike other instruments, the 400 series instruments no longer require a front panel manual zero control. Thermally induced zero shifts of the electrometer and associated electronics have been eliminated.

RADON INTERFERENCE, NOISE RESPONSE

For an unambiguous measurement of very low tritium a monitor must be able to ignore response to ambient radon. The 400SB series incorporates this capability and therefore produces accurate, fast and drift free measurements to nearly \(+1\ \mu\text{Ci}/\text{m}^3\).

TOTAL GAMMA COMPENSATION

Cruciform ionization chamber geometry provides nearly perfect gamma compensation regardless of photon energy, flux gradient or flux direction. Gamma compensation of the 400 series instruments is typically three orders of magnitude better than instruments using nested or side by side ionization chambers.

FAST RESPONSE

Its exceptionally rapid response is uniquely due to its ability to ignore radon. The electronic time constant is only 10 seconds, the pneumatic time constant of about 12 seconds, for an overall time constant of only 15 seconds. Meter readings will reach 90 % of final value within 30 seconds to a step response of aspirated tritium.

FAST WARM UP, NO ZERO DRIFT

After applying power, the initial transient “warm up” drift effects take less than a minute. Long term drifts have been eliminated, manual zero adjustments are no longer required.

HTO DISCRIMINATION

(MODEL 400SBD\(\gamma C-HTO\))

By addition of a desiccant column, this survey instrument will specifically measure HTO in the presence of other radioactive gases as well as background gamma. The desiccant can be regenerated repeatedly for reuse.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Sensitivity</td>
<td>to 2.0(\mu\text{Ci}/\text{m}^3)</td>
</tr>
<tr>
<td>Fast Response</td>
<td>10 second time constant</td>
</tr>
<tr>
<td>Gamma Compensated</td>
<td>virtually no offset in 10 mR/h fields</td>
</tr>
<tr>
<td>No Response To Radon</td>
<td>ensures complete zero stability</td>
</tr>
<tr>
<td>No Zero Drift</td>
<td>long term zero stability to better than 1(\mu\text{Ci}/\text{m}^3)</td>
</tr>
<tr>
<td>Rapid Warm Up</td>
<td>less than 30 second warm-up</td>
</tr>
</tbody>
</table>

The Overhoff Technology Corporation Model 400SBD\(\gamma C\) portable tritium monitor is an instrument with unequalled performance in sensitivity, stability, speed of response and gamma compensation.
MODEL 400SBDγC

PERFORMANCE SPECIFICATIONS

MEASUREMENT RANGE 1 – 19,999 μCi/m³, basic sensitivity of the order of 1 μCi/m³

DISPLAY 0 – 19,999 digits, LCD panel meter

ACCURACY, SPAN ±10 % of reading, ±1 μCi /m³, whichever is greater

NOISE LEVEL ±1 μCi/m³, 1 S.D. (10 second electronic time constant)

ZERO STABILITY ±1 μCi /m³ long term

GAMMA COMPENSATION Four chambers in a cruciform pattern to reduce errors due to external gamma radiation.

ALPHA PULSE SUPPRESSION a circuit provides recognition and cancellation of undesirable noise spikes attributed to airborne radon

RESPONSE RATE 30 seconds to reach 90% of final reading

ALARM (ACOUSTIC) 1. Ten position stepped attenuator set point for signal alarm 2 - 1,000 μCi/m³, steady tone. An OFF position is included. 2. Low flow produces an intermittent tone 3. Mute switch silences audible tone

ALARM (VISUAL) signal level: red LED low flow: yellow LED, flashing low battery: red LED

EXTERNAL CONNECTIONS mini DIN plug for output signal, and for alarms

IONIZATION effective volume: 400 cm³

CHAMBER VOLUME port to port volume: 440 cm³

DUST FILTER HEPA, in-line disposable cartridge, Pall P/N 12082

PUMP internal rotary vane pump

FLOW RATE nominally 1.5 - 2 LPM

ENVIRONMENTAL 0° C to +50° C, 0 - 95 % relative humidity

BATTERIES two “D” size batteries alkaline external jack for supplementary power input

POWER CONVERTER 100-240 VAC, 50/60 Hz, .25 A to 3.3 Vdc @ 1.2 A 5.5 mm O.D. x 2.1 mm I.D. Plug, center pin is positive

CASE lightweight aluminum

SIZE AND WEIGHT 7.6” [193mm] L x 5.2” [132mm] W x 6.9” [175mm] H excluding handle, 6.5 lbs (3 kg)

OPTIONAL EQUIPMENT • transit case • RS232 Serial Data output

NOBLE GAS DISCRIMINATION: MODEL 400SBDγC -HTO ONLY

A special version of the basic 400 series instrument is for measurement of tritium (oxide) in the presence of radioactive noble gases. By addition of a desiccant cartridge, this instrument will respond solely to HTO, ignoring all other airborne radio nuclides and gamma fields.
## PARTS LIST FOR MODEL 400SB\(\gamma\)C TRITIUM MONITOR

<table>
<thead>
<tr>
<th>Qty Req’d</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50084</td>
<td>Pump (replaces 50030 and G02/CDC/3)</td>
</tr>
<tr>
<td>4</td>
<td>1020686</td>
<td>Ionization Chamber</td>
</tr>
<tr>
<td>1</td>
<td>PSF-100A-0.5</td>
<td>Pressure Switch</td>
</tr>
<tr>
<td>1 to 5</td>
<td>22BH-4-2</td>
<td>Hose Barb, Sample-In</td>
</tr>
<tr>
<td>1</td>
<td>230-4-2</td>
<td>Hose Barb, Sample-Out</td>
</tr>
<tr>
<td>1</td>
<td>CLIC-51</td>
<td>Holder for Dust Filter (12082)</td>
</tr>
<tr>
<td>1</td>
<td>DMO-41</td>
<td>LCD Panel Meter (oldest S/N)</td>
</tr>
<tr>
<td>1</td>
<td>DMO-41DC</td>
<td>LCD Panel Meter (intermediate S/N)</td>
</tr>
<tr>
<td>1</td>
<td>DMO-742W</td>
<td>LCD Panel Meter (newest S/N)</td>
</tr>
<tr>
<td>2</td>
<td>20-3320</td>
<td>Control Knob including Cap and Skirt</td>
</tr>
<tr>
<td>1</td>
<td>KU402B1/8</td>
<td>Zero Knob</td>
</tr>
<tr>
<td>2</td>
<td>B16</td>
<td>Battery Holder</td>
</tr>
<tr>
<td>2</td>
<td>B1-XC</td>
<td>Battery Cap</td>
</tr>
<tr>
<td>1</td>
<td>MSR320</td>
<td>Alarm Speaker</td>
</tr>
<tr>
<td>1</td>
<td>PSA05R-033</td>
<td>AC Adapter</td>
</tr>
<tr>
<td>1</td>
<td>RPS-R</td>
<td>AC Plug for Adapter</td>
</tr>
<tr>
<td>1</td>
<td>CP-004A-ND</td>
<td>Plug for DC Power</td>
</tr>
<tr>
<td>1</td>
<td>163-5004</td>
<td>Jack for DC Power</td>
</tr>
<tr>
<td>2</td>
<td>EN95</td>
<td>Batteries, D-Size Alkaline, Primary Power</td>
</tr>
<tr>
<td>4</td>
<td>415</td>
<td>Batteries, 45V Polarizing</td>
</tr>
</tbody>
</table>
The Overhoff Model 2x200-LD Tritium Leak Detector has the unique ability to monitor for tritium compounds and elemental tritium in real time while providing gamma compensation. The two measurement channels, T2 and T2O/HTO, are selected with a front panel toggle switch and appear on a single digital display.

The required radiological protection for tritium compounds is much higher than that for elemental tritium. Elemental tritium will combine readily with oxygen to form tritium oxide and also will replace hydrogen atoms in compounds. Therefore the presence of elemental tritium in the working environment is an indication of a current leak in the system or container. Knowing this, the user of the Model 2x200-LD can rapidly locate the point of release and more efficiently secure the source of leakage.

SENSITIVITY

The sensitivity of the 2x200-LD is better than 5 μCi/m³ (0.5 DAC) for T2O. The sensitivity to T2 is better than 0.05% of the T2 DAC stated in 10CFR835.

RADON INTERFERENCE, NOISE RESPONSE

Unambiguous measurement of very low tritium levels requires a monitor that can ignore ambient radon. The Model 2x200-LD incorporates a radon suppression circuit and therefore produces accurate and drift-free readings.

GAMMA COMPENSATION

The instrument has active gamma compensation with 2x2 ionization chamber geometry.

FAST RESPONSE

Exceptionally rapid response is due to its unique ability to ignore radon. The instrument has an electronic time constant of only 10 seconds, a pneumatic time constant of about 12 seconds, for an overall time constant of only 15 seconds. Meter readings will reach 90% of final value within 30 seconds to a step response of aspirated tritium.

FAST WARM UP, NO ZERO DRIFT

After applying power, the initial transient “warm-up” drift effects take less than a minute. Long term drifts have been eliminated and manual zero adjustments are no longer required.

DESICCANT COLUMN

A desiccant column traps the tritium oxide in the sample. The indicating type desiccant changes color from blue to pink when it is exhausted. Regeneration will restore the drying capacity.

The Model 2x200-LD can be configured as a "sniffer" to provide real-time indication of the T2 and T2O concentrations which allow the user to quickly identify the source of leakage of tritium from containers.
# MODEL 2x200-LD
## PORTABLE TRITIUM IN AIR LEAK DETECTOR

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MEASUREMENT RANGE</strong></td>
<td>1 – 19,999 μCi/m³, basic sensitivity of the order of 5 μCi/m³</td>
</tr>
<tr>
<td><strong>DISPLAY</strong></td>
<td>0 – 19,999 digits, LCD panel meter</td>
</tr>
<tr>
<td><strong>T2 AND T2O MODES</strong></td>
<td>Two channel measurement, switch selectable</td>
</tr>
<tr>
<td><strong>ACCURACY, SPAN</strong></td>
<td>±10 % of reading, ±2 μCi/m³, whichever is greater</td>
</tr>
<tr>
<td><strong>NOISE LEVEL</strong></td>
<td>±2 μCi/m³ (10 second electronic time constant)</td>
</tr>
<tr>
<td><strong>ZERO STABILITY</strong></td>
<td>±2 μCi/m³ long term</td>
</tr>
<tr>
<td><strong>GAMMA COMPENSATION</strong></td>
<td>Chambers in a side by side pattern reduce errors due to external gamma radiation.</td>
</tr>
<tr>
<td><strong>ALPHA PULSE SUPPRESSION</strong></td>
<td>A circuit provides recognition and cancellation of undesirable noise spikes attributed to airborne radon.</td>
</tr>
<tr>
<td><strong>RESPONSE RATE</strong></td>
<td>30 seconds to reach 90% of final reading</td>
</tr>
<tr>
<td><strong>ALARM (ACOUSTIC)</strong></td>
<td>1. Ten position stepped attenuator set point for signal alarm</td>
</tr>
<tr>
<td></td>
<td>2. 2-1,000 μCi/m³, steady tone. An OFF position is included.</td>
</tr>
<tr>
<td></td>
<td>3. Low flow produces an intermittent tone</td>
</tr>
<tr>
<td></td>
<td>4. Mute switch silences audible tone</td>
</tr>
<tr>
<td><strong>ALARM (VISUAL)</strong></td>
<td><strong>Signal level:</strong> red LED</td>
</tr>
<tr>
<td></td>
<td><strong>Low flow:</strong> yellow LED, flashing</td>
</tr>
<tr>
<td></td>
<td><strong>Low battery:</strong> red LED</td>
</tr>
<tr>
<td><strong>EXTERNAL CONNECTIONS</strong></td>
<td>Mini DIN plug for output signal, and for alarms</td>
</tr>
<tr>
<td><strong>IONIZATION</strong></td>
<td>Effective volume: 200 cm³</td>
</tr>
<tr>
<td><strong>CHAMBER VOLUME</strong></td>
<td>Port to port volume: 660 cm³</td>
</tr>
<tr>
<td><strong>DUST FILTER</strong></td>
<td>HEPA, in-line disposable cartridge, Pall P/N 12082</td>
</tr>
<tr>
<td><strong>PUMP</strong></td>
<td>Internal rotary vane pump</td>
</tr>
<tr>
<td><strong>FLOW RATE</strong></td>
<td>Nominally 1.5 - 2 LPM</td>
</tr>
<tr>
<td><strong>ENVIRONMENTAL</strong></td>
<td>0°C to +50°C, 0 - 95 % relative humidity</td>
</tr>
<tr>
<td><strong>BATTERIES</strong></td>
<td>Two “D” size NiMH batteries</td>
</tr>
<tr>
<td></td>
<td>External jack for supplementary power input and charging</td>
</tr>
<tr>
<td><strong>POWER CONVERTER</strong></td>
<td>100-240 VAC, 50/60 Hz, .25 A to 3.3 Vdc @ 1.2 A</td>
</tr>
<tr>
<td></td>
<td>5.5 mm O.D. x 2.1 mm I.D. Plug, center pin is positive</td>
</tr>
<tr>
<td><strong>SIZE AND WEIGHT</strong></td>
<td>7.6” [193mm] L x 5.2” [132mm] W x 6.9” [175mm] H excluding handle, 6.5 lbs (3 kg)</td>
</tr>
<tr>
<td><strong>DESICCANT COLUMN</strong></td>
<td>Clear polycarbonate cartridge of indicating desiccant</td>
</tr>
</tbody>
</table>
## MODEL 2x200-LD
PORTABLE TRITIUM IN AIR LEAK DETECTOR

### PART LISTS

<table>
<thead>
<tr>
<th>Qty Req’d</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50084</td>
<td>Pump</td>
</tr>
<tr>
<td>4</td>
<td>1020686</td>
<td>Ionization Chamber</td>
</tr>
<tr>
<td>1</td>
<td>PSF-100A-0.5</td>
<td>Pressure Switch</td>
</tr>
<tr>
<td>2</td>
<td>22BH-4-2</td>
<td>Hose Barb, Sample-In</td>
</tr>
<tr>
<td>1</td>
<td>230-4-2</td>
<td>Hose Barb, Sample-Out</td>
</tr>
<tr>
<td>1</td>
<td>12082</td>
<td>In-Line Dust Filter (Pack of 3)</td>
</tr>
<tr>
<td>1</td>
<td>CLIC-51</td>
<td>Holder for Dust Filter No. 12082</td>
</tr>
<tr>
<td>1</td>
<td>DMO-742W</td>
<td>LCD Panel Meter</td>
</tr>
<tr>
<td>2</td>
<td>20-3320</td>
<td>Control Knob including Cap and Skirt</td>
</tr>
<tr>
<td>1</td>
<td>KU402B1/8</td>
<td>Zero Knob</td>
</tr>
<tr>
<td>2</td>
<td>B16</td>
<td>Battery Holder</td>
</tr>
<tr>
<td>2</td>
<td>B1-XC</td>
<td>Battery Cap</td>
</tr>
<tr>
<td>1</td>
<td>MSR320</td>
<td>Alarm Speaker</td>
</tr>
<tr>
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<td>PSA05R-033</td>
<td>AC Adapter</td>
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<td>RPS-R</td>
<td>AC Plug for Adapter</td>
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<tr>
<td>1</td>
<td>CP-004A-ND</td>
<td>Plug for DC Power</td>
</tr>
<tr>
<td>1</td>
<td>163-5004</td>
<td>Jack for DC Power</td>
</tr>
<tr>
<td>2</td>
<td>GP450DHC</td>
<td>D-Size NiMH Batteries, Primary Power</td>
</tr>
<tr>
<td>4</td>
<td>415</td>
<td>Batteries, 45V Polarizing</td>
</tr>
<tr>
<td>2</td>
<td>26930</td>
<td>Indicating Desiccant Column</td>
</tr>
<tr>
<td>1</td>
<td>23005</td>
<td>5 lb Jar of Indicating Desiccant</td>
</tr>
</tbody>
</table>
The Model 400AC portable tritium monitor is based on our popular Model 400 platform and is a small, high sensitivity, hand held, battery (rechargeable) operated, fully gamma-compensated survey meter with RS232 serial data output and user recalibration features.

**ADDITIONAL FEATURES OF THE MODEL 400AC**

(Not available on the Model 400SBDyC)

- Disable Gamma Compensation
- Rechargeable Batteries and Rechargeable Battery Capacity Monitor
- Power Supply and High Bias Voltage Failure Monitors
- Manual and **Automatic Calibration**
  - a) Calibration with Tritium Gas
  - b) Calibration with a Gamma Source
    (Using Gamma-Tritium Equivalence Ratio)
- Improved Gamma Compensation and Noise Immunity
- Constant Air Flow Control
- 50% Fewer High Bias Voltage Batteries

**SENSITIVITY**

The 400AC is useful for measurements as low as 2 \( \mu \text{Ci/m}^3 \). The Overhoff electrometer, which measures to below \( 10^{-16} \) amperes, combines low noise and high zero stability.

**RADON INTERFERENCE, NOISE RESPONSE**

For an unambiguous measurement of very low tritium a monitor must be able to ignore response to ambient radon. The 400AC incorporates this capability and therefore produces accurate, fast and drift free measurements to nearly \( \pm 1 \mu \text{Ci/m}^3 \).

**TOTAL GAMMA COMPENSATION**

Cruciform ionization chamber geometry provides nearly perfect gamma compensation regardless of photon energy, flux gradient or flux direction. Gamma compensation of the 400AC is typically three orders of magnitude better than instruments using nested or side by side ionization chambers.

Gamma compensation can be disabled in cases when not required.

**FAST RESPONSE**

Its exceptionally rapid response is primarily due to its ability to ignore radon. The electronic time constant is only 10 seconds, the pneumatic time constant of about 12 seconds, for an overall time constant of only 15 seconds. Meter readings will reach 90% of final value within 30 seconds to a step response of aspirated tritium.

**FAST WARM UP, NO ZERO DRIFT**

After applying power, the initial transient “warm up” drift effects take less than a minute. Long term drifts have been eliminated and manual zero adjustments are no longer required.

**AUTOMATIC CALIBRATION**

The 400AC features the ability to perform a fully automatic gamma calibration by using the provided calibration software. Calibration is started with a single mouse click and requires no intervention. Calibration consists of 3 stages, taking 2 minutes each, for a total of 6 minutes. During the calibration the compensation ionization chambers are disabled automatically. Upon completion a printed calibration report is generated automatically.

The Overhoff Technology Model 400AC portable tritium monitor is an instrument with unequaled performance in sensitivity, stability, speed of response and gamma compensation.
MODEL 400AC
PORTABLE TRITIUM IN AIR MONITOR

MEASUREMENT RANGE  1 – 19,999 μCi/m³, basic sensitivity of the order of 2 μCi/m³
DISPLAY  0 – 19,999 digits, LCD panel meter
ACCURACY, SPAN  ±10 % of reading, ±2 μCi/m³, whichever is greater
NOISE LEVEL  ±1 μCi/m³, 1 S.D. (10 second electronic time constant)
ZERO STABILITY  after 30 seconds (or less) warm up, zero drift less than ±1 μCi/m³
GAMMA COMPENSATION  chambers in a side by side pattern reduce errors due to external gamma radiation.
ALPHA PULSE SUPPRESSION  a circuit provides recognition and cancellation of undesirable noise spikes attributed to airborne radon
RESPONSE RATE  30 seconds to reach 90% of final reading
ALARM (ACOUSTIC)  1. Ten position stepped attenuator set point for signal alarm
  2 - 1,000 μCi/m³, steady tone. OFF position is included.
  2. Low flow produces an intermittent tone
  3. Mute switch silences audible tone
ALARM (VISUAL)  signal level: red LED
  low flow: yellow LED, flashing
  low battery: red LED
EXTERNAL CONNECTIONS  RS232 serial data output for tritium measurement, level alarm status and calibration
IONIZATION  effective volume: 400 cm³
CHAMBER VOLUME  port to port volume: 440 cm³
DUST FILTER  external in-line disposable cartridge type
PUMP  internal rotary vane pump
FLOW RATE  nominally 1.5 - 2 LPM
ENVIRONMENTAL  0° C to +40° C, 20 - 90 % relative humidity non-condensing
BATTERIES  two “D” size NiMH batteries
  external jack for supplementary power input and charging
POWER CONVERTER  100-240 VAC, 50/60 Hz, 25 A to 3.3 Vdc @ 1.2 A
  5.5 mm O.D. x 2.1 mm I.D. Plug, center pin is positive
SIZE AND WEIGHT  7.6” [193mm] L x 5.2” [132mm] W x 6.9” [175mm] H excluding handle, 6.5 lbs (3 kg)
CALIBRATION  Automatic Calibration using pc-based software (included)
  Manual Calibration by adjusting a calibration potentiometer
# MODEL 400AC
PORTABLE TRITIUM IN AIR MONITOR

## PART LISTS

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<thead>
<tr>
<th>Qty Req’d</th>
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<td>1</td>
<td>50084</td>
<td>Pump</td>
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<td>Ionization Chamber</td>
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<td>GP450DHC</td>
<td>Batteries, D-Size NiMH, Primary Power</td>
</tr>
<tr>
<td>2</td>
<td>415</td>
<td>Batteries, 45V, Polarizing</td>
</tr>
<tr>
<td>1</td>
<td>J2-400AC</td>
<td>RS232 Cable</td>
</tr>
</tbody>
</table>
ULTRA SENSITIVE PORTABLE TRITIUM MONITORS

MODELS

SP1400DD

ULTRA HIGH SENSITIVITY, FAST RESPONSE TO 1.0μCi/m3.

True, unambiguous measurement to low levels combined with a fast response (10 sec. electronic time constant), not matched by any other portable tritium survey monitor.

INSTANTANEOUS WARM UP

The instrument will generally settle to 1.0uCi/m³ within one minute after application of power.

NO LONG TERM DRIFT

The instrument is free from long term drift by using a highly stable electrometer design.

SMALL IONIZATION CHAMBERS, EFFECTIVE GAMMA COMPENSATION

Dual 1400 cc ionization chambers keep the overall instrument size and weight to a manageable size.

HEAVY DUTY PUMP

A generously sized pump provides up to 4 volume changes per minute to ensure a fast overall measurement response.

DIGITAL DISPLAY

The SP1400 series uses a 4-1/2 digit LCD display.
ULTRA SENSITIVE PORTABLE TRITIUM MONITORS

TRULY PORTABLE

A shoulder strap frees both hands for directing the sniffer hose when the instrument is used for leak detection, or similar purposes.

DISPOSABLE IN LINE FILTER

A small throw away cartridge filter fits directly onto the plastic sniffer hose, ensuring that the ionization chambers are protected against debris and dust.

SUPPLIED COMPLETE WITH WALL CHARGER

A wall charger for NiMH batteries maintains full battery charge under all instrument operating conditions.

SEMI PERMANENT AREA/STACK MONITOR

The sensitivity of the SP1400 exceeds that of most "fixed" monitors, it can therefore be used for similar duty. The internal pump has been rated for 2000 hours MTBF. Model SP1400 can be used for area monitoring for several months at a time.

REMOTE FACILITIES

A multi pin connector on the front plate of the instrument has been provided for the connection to remote meter displays, alarms and chart recorders.

COVER WITH CARRYING HANDLE

A matching cover which attaches with two draw latches serves to stow the carrying strap, the sniffer hose and spare dust filters.
## PORTABLE TRITIUM MONITOR

### SP 1400DD

#### TECHNICAL SPECIFICATIONS, micro Curie units of measure

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Single Range 0 - 19,999 ( \mu \text{Ci/m}^3 )</td>
</tr>
<tr>
<td>Display</td>
<td>4 1/2 digit LCD display in steps of 1( \mu \text{Ci/m}^3 )</td>
</tr>
<tr>
<td>Stability</td>
<td>0.5 ( \mu \text{Ci/m}^3 ) long term, for temperatures 0° C to 40° C</td>
</tr>
<tr>
<td>Alarm (acoustic)</td>
<td>set point adjustment with a ten position attenuator RESET/ON/OFF toggle switch</td>
</tr>
<tr>
<td>Interface</td>
<td>connector for remote display or chart recorder, alarm output</td>
</tr>
<tr>
<td>Power</td>
<td>6 D size batteries, NiMH, furnished with a detachable wall charger</td>
</tr>
<tr>
<td>Ionization Chambers</td>
<td>dual chambers, one chamber used for gamma compensation, volume 1400 cm(^3) each, deep drawn aluminum</td>
</tr>
<tr>
<td>Pump</td>
<td>brushless dc miniature pump for 4 to 6 volume changes per minute, ON - OFF switch</td>
</tr>
<tr>
<td>Size</td>
<td>front panel approximately 5” x 13”, depth 12” including carrying handle</td>
</tr>
<tr>
<td>Weight</td>
<td>16 lbs</td>
</tr>
<tr>
<td>Accessories</td>
<td>carrying strap; sniffer hose; dust filter; wall charger</td>
</tr>
</tbody>
</table>
## TECHNICAL SPECIFICATIONS, mega Becquerel units of measure

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>Single Range 0.01 - 199.99MBq/m³</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>4 1/2 digit LCD display in steps of 0.01MBq/m³</td>
</tr>
<tr>
<td><strong>Stability</strong></td>
<td>0.5 μCi/m³ long term, for temperatures 0°C to 40°C</td>
</tr>
<tr>
<td><strong>Alarm (acoustic)</strong></td>
<td>Set point adjustment with a ten position attenuator</td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>Connector for remote display or chart recorder, alarm output</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>6 D size batteries, NiMH, furnished with a detachable wall charger</td>
</tr>
<tr>
<td><strong>Ionization Chambers</strong></td>
<td>Dual chambers, one chamber used for gamma compensation, volume 1400 cm³ each, deep drawn aluminum</td>
</tr>
<tr>
<td><strong>Pump</strong></td>
<td>Brushless dc miniature pump for 4 to 6 volume changes per minute, ON - OFF switch</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>Front panel approximately 5” x 13”, depth 12” including carrying handle</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>16 lbs</td>
</tr>
<tr>
<td><strong>Accessories</strong></td>
<td>Carrying strap; sniffer hose; dust filter; wall charger</td>
</tr>
</tbody>
</table>
## Parts List for Model SP1400DD Tritium Monitor

<table>
<thead>
<tr>
<th>Qty Req'd</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BP06CNNNF28VC3</td>
<td>Pump</td>
</tr>
<tr>
<td>1</td>
<td>DMO-742</td>
<td>Panel Meter</td>
</tr>
<tr>
<td>1</td>
<td>FW7304/10</td>
<td>Battery Charger</td>
</tr>
<tr>
<td>1</td>
<td>1020421</td>
<td>Battery Cover Gasket</td>
</tr>
<tr>
<td>1</td>
<td>1020415-M</td>
<td>Ionization Chamber Measurement side</td>
</tr>
<tr>
<td>1</td>
<td>TCCM773</td>
<td>Shoulder Strap</td>
</tr>
<tr>
<td>1</td>
<td>MS3116F14-15P</td>
<td>remote output connector plug</td>
</tr>
<tr>
<td>1</td>
<td>1020423</td>
<td>calibration control cover</td>
</tr>
<tr>
<td>1</td>
<td>12082</td>
<td>Dust Filter (3 ea. per pkg)</td>
</tr>
<tr>
<td>1</td>
<td>GP450-DHC</td>
<td>Primary Battery (6 ea. per pkg)</td>
</tr>
<tr>
<td>1</td>
<td>415</td>
<td>Polarizing Battery (4 ea. per pkg)</td>
</tr>
<tr>
<td>1</td>
<td>5233K53</td>
<td>Sniffer Hose, 10 ft</td>
</tr>
<tr>
<td>1</td>
<td>1020216-1T</td>
<td>Calibration Resistor Low Range</td>
</tr>
</tbody>
</table>

### Consumables
- Pump
- Panel Meter
- Battery Charger
- Battery Cover Gasket
- Ionization Chamber Measurement side
- Shoulder Strap
- remote output connector plug
- calibration control cover
- Dust Filter (3 ea. per pkg)
- Primary Battery (6 ea. per pkg)
- Polarizing Battery (4 ea. per pkg)
- Sniffer Hose, 10 ft
- Calibration Resistor Low Range
300/400 UNITS - FIXED CONFIGURATION
300/400 SERIES - FIXED CONFIGURATION

FAMILY TREE

The 300 and 400 series instruments can be supplied with special ionization chambers so that measurements as low as $10^{-7}$ Ci/m$^3$, or as high as pure tritium can be reached.

This section covers specific models with a fixed configuration. These models have established designs made for specific applications. Options are available to suit different requirements for range of measurement, alarms and outputs.

See Section 3 for 300 and 400 series modular construction instruments. These monitors have more choices for options, such as ionization chambers, displays, alarms and outputs.

The 300 and 400 series monitors are classified into four basic groups:

311 series - single range ionization chamber, with single chamber
321 series - single range ionization chamber, with dual chambers
411 series - multirange ionization chamber, with single chamber
421 series - multirange ionization chamber, with dual chambers

300 SERIES MONITORS
(Single range ionization chambers)

The 300 series monitors use “single” range ionization chambers.

The standard versions use a 4½ digit panel meter, the tritium monitor can measure over a 4 plus decade range of measurement 1 - 19,999.

Special versions use higher digit count displays, and the tritium monitor can measure as high as 5 decades of measurement 1 - 99,999.

400 SERIES MONITORS
(Automatically switched, multi-ranging ionization chambers)

The 400 series monitors use multiranging ionization chambers for a wider range of measurement. Seven decades of measurement are feasible for some ionization chamber configurations.
SPECIFIC MODELS

Each of the following models can include a variety of individual features and options described in the following pages.

SINGLE IONIZATION CHAMBER DESIGNS

MODEL 311

All Model 311 instruments use single ionization chambers and single “range” electrometers.

MODEL 411

Similar to the 311 series, the 411 instruments have a single ionization chamber. However, a wider range of measurement is afforded through the use of automatic, range-switching electrometer amplifiers (i.e. multirange ionization chambers).

DUAL IONIZATION CHAMBER DESIGNS

MODELS 321/421 (STANDARD)

These models feature dual ionization chambers for tritium specific or oxide of tritium specific measurements, and simultaneously, for the suppression of response to environmental gamma fields.

MODELS 321/421 NPPM (NUCLEAR POWER PLANT MONITOR)

An industrial version of the standard 321/421 tritium monitor configured for the special environmental conditions in heavy water CANDU nuclear power plants. Designed to measure HTO (or total T) in the presence of other radioactive gases. Available with contamination (plate-out) proof ionization chambers.

MODEL 357RM GENERAL PURPOSE ROOM AIR MONITOR

A low cost, table top monitor with single range ionization chambers, alpha (radon) pulse rejection, analog panel meter and dual 2L chambers with resolution to 1 μCi/m³.

MODEL 347 ROOM AIR MONITOR WITH BETTER SENSITIVITY

Using quadruple ionization chambers for optimum gamma compensation. Model 347 features highest sensitivity to tritium. Noise level and stability are ±0.5 μCi/m³.

COMMON FEATURES

The ionization chambers are normally furnished as separately or remote mounted, CODE ICR. Upon special request, chambers can be mounted inside the main electronics cabinet, use CODE ICR.

MEASUREMENT, RANGES AND SENSITIVITY

Using linear ionization chambers, OTC tritium monitors have been designed and built for measurement sensitivities from 0.1 μCi/m³ (1 s.d.) to pure tritium. As can be expected, chamber size and configuration is related to sensitivity.
ALARMS, MEASUREMENT

Single or two independent alarms with visual and acoustic signals. Front panel mounted potentiometers or thumb switches are used to adjust the level set point. 400 series multiranging instruments are further equipped with range selector switches so that alarm setting can be made over the entire range of measurement.

DISPLAYS

A variety of digital displays are available. Use CODE DDxx depending on the number of digits required.

300 series single range instruments are often equipped with 4 1/2 digit (0-19,999) digital panel meters, or with a 5 decade analog logarithmic output signals.

The 400 series employ moving decimal points on the panel meter and may include additional range indicating lights to identify the measurement decade in operation. Logarithmic analog outputs for 400 series instruments have scales of up to seven decades. Range switching is automatic and is not visible to the instrument operator.

OPTIONS

All electronic, pneumatic or mechanical options and features, as listed are available as far as applicable, for all 300 and 400 series. However, the 357 and 347 models are only available with a reduced set of special options.

REAR PANEL INTERFACE

All 300 and 400 series instruments have rear panel connections suitable for remote display, control or computer interface.

These include, as a minimum,

Analog signal (0 - 10 V)
Alarm functions, including remote acknowledge
Supply voltages
Range information (400 series)

Additional rear panel signals which are associated with special features.
MODEL 347
LOW COST MONITOR FOR ULTRA SENSITIVE DETECTION OF AIRBORNE RADIOACTIVE GASES QUADRUPLE IONIZATION CHAMBERS FOR BEST GAMMA COMPENSATION

A low cost very high sensitivity general purpose monitor for reliable measurements to as low as 0.5 μCi/m³ in the presence of significant external gamma fields.

OTC Model 347 tritium monitor will not respond to ambient radon, this instrument is fast, accurate and has long term zero stability.

This monitor is a simplified, lower cost, version of the 300 series instruments, but with a restricted number of available optional features.

The quadruple chambers are Kanne type arranged in a cruciform pattern.

A separately mounted pump system with HEPA and ULPA filters assures a sample free of particulates.

OPTIONAL EQUIPMENT AVAILABLE
Remote Alarm Units
Remote Meter Displays
Tritium Gas Calibrator
Calibration Resistor
4-20 mA Output
Logarithmic Output
RS232 Output
TECHNICAL SPECIFICATIONS

MEASUREMENT
Tritium in Air Concentration

RANGES
single, 0.1 to 1999.9 μCi/m³

DISPLAY
Digital Meter, 4½” digit LED

ACCURACY
±10 % of reading, ±1 μCi/m³, whichever is greater

STABILITY AND DRIFT LONG TERM
±1 μCi/m³, ambient temperature

NOISE
<1 μCi/m³, 2 sigma, with 30 second time constant

GAMMA COMPENSATION
second ionization chamber pair of equal volumes, mounted in cruciform pattern, serves to cancel effects of external gamma fields

RESPONSE RATE ELECTRONIC
two linear time constants, 30 seconds for <80 μCi/m³
3 seconds for >80 μCi/m³

WARM-UP TIME
less than 5 minutes required for high voltage power supplies to stabilize

ALARM SYSTEM
single alarm, with set point adjustable from 1 to 1000 μCi/m³

IONIZATION CHAMBER VOLUME
measuring: 2900 cm³
total wetted: 4000 cm³

ENVIRONMENTAL
Storage Temperature: -40° C to +60° C
Operating Temperature: 0° C to +50° C
Humidity: 0 to 95 % RH non-condensing

PHYSICAL CABINET
Bench top, frame constructed of aluminum extrusions, front and rear panel

POWER
115 VAC or 240 VAC 50/60 Hz

DIMENSIONS
8.8” [223mm] H x 19.0” [483mm] W x 16.0” [406mm] D

WEIGHT
45 lbs [20.4 kg]

FLOWMETER
0 - 10 LPM adjustable rotameter

DUST FILTER and PUMP
separately mounted

POWER
115 VAC or 240 VAC 50/60 Hz

DIMENSIONS
7.0” [178mm] H x 17.0” [432mm] W x 16.0” [406mm] D

WEIGHT
20 lbs [9.1 kg]
### PARTS LIST FOR MODEL 347 TRITIUM MONITOR

<table>
<thead>
<tr>
<th>Qty Req’d</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCO-201-E1 or VCO301-P2</td>
<td>120VAC Pump or 240VAC Pump</td>
</tr>
<tr>
<td>1</td>
<td>803562</td>
<td>HEPA Filter Cartridge (pack of three)</td>
</tr>
<tr>
<td>1</td>
<td>CWFG01PLV</td>
<td>Ultra Pure Filter Element</td>
</tr>
<tr>
<td>1</td>
<td>2-231-S604-70</td>
<td>O-Ring for Filter Cover (pack of ten)</td>
</tr>
<tr>
<td>1</td>
<td>2-036-S613-60</td>
<td>O-Ring for Filter Housing (pack of ten)</td>
</tr>
<tr>
<td>1</td>
<td>RMA-21-SSV</td>
<td>Flow Meter</td>
</tr>
<tr>
<td>1</td>
<td>AP-141-12-1 or AP-141-12-2</td>
<td>Digital Panel Meter, 120VAC or 240VAC</td>
</tr>
<tr>
<td>1</td>
<td>A41-43-36</td>
<td>Mains Transformer</td>
</tr>
<tr>
<td>1</td>
<td>100251-ASSY</td>
<td>Main PCB Assembly for Model 347</td>
</tr>
<tr>
<td>1</td>
<td>100511-347</td>
<td>4-20mA Output &amp; Logarithmic Converter Board</td>
</tr>
<tr>
<td>1</td>
<td>100512-347</td>
<td>RS232 Output Board</td>
</tr>
<tr>
<td>1</td>
<td>KL-701</td>
<td>Knob Lock for Compensation Control</td>
</tr>
<tr>
<td>1</td>
<td>MS91528-1N2B</td>
<td>Knob for Compensation Control</td>
</tr>
<tr>
<td>1</td>
<td>MDL–1/4</td>
<td>Fuse, 1/4 Amp (pack of 5)</td>
</tr>
<tr>
<td>1</td>
<td>17501</td>
<td>AC Power Cord (USA and Canada)</td>
</tr>
</tbody>
</table>
MODEL 357RM

LOW COST MONITOR FOR DETECTION AND MEASUREMENT OF AIR BORNE TRITIUM

The model 357 tritium monitor is stable to 1 μCi/m³. (1 S.D.)

Only OTC tritium monitors are designed and built to distinguish tritium against natural radon background. Instruments that do not have this feature will exhibit a noisy zero response even if the electronics is claimed to be stable.

With radon rejection, the Model 357 ignores radon and is, therefore, fast, sensitive and accurate. Once adjusted, it is long-term zero stable and, due to special electrometer design, its span calibration is permanently stable.

These monitors are simplified versions of OTC 300 series monitors which have been in continuous service for twenty years. They come in rack mount configuration and are also suited for table top use.

The only maintenance required for Model 357 is periodic service of the pump and replacement of the dust filter.

The sensitivity and noise level of Model 357 is superior to current competitive instrumentation by an order of magnitude.

OPTIONAL EQUIPMENT AVAILABLE

- Remote Alarm Units
- Remote Meter Displays
- Tritium Gas Calibrator
- Calibration Resistor
- RS232 Output
- Logarithmic Output
- 4-20mA Output
- Plate-Out proof wire grid chamber
## TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th><strong>MEASUREMENT</strong></th>
<th>Tritium in Air Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RANGE</strong></td>
<td>1 – 19,999 µCi/m³</td>
</tr>
<tr>
<td><strong>DISPLAY</strong></td>
<td>Digital Meter, 4½” digit LED</td>
</tr>
<tr>
<td><strong>ACCURACY</strong></td>
<td>±10 % of reading, ±1 µCi/m³, whichever is greater</td>
</tr>
<tr>
<td><strong>STABILITY AND DRIFT LONG TERM</strong></td>
<td>±1 µCi/m³, ambient temperature</td>
</tr>
<tr>
<td><strong>NOISE</strong></td>
<td>±1 µCi/m³, 2 sigma, with 20 second time constant</td>
</tr>
<tr>
<td><strong>GAMMA COMPENSATION</strong></td>
<td>second ionization chamber of equal volume, coaxially mounted, serves to cancel effects of external gamma fields</td>
</tr>
<tr>
<td><strong>RESPONSE RATE ELECTRONICS</strong></td>
<td>two linear time constants 20 seconds for measurements below approximately 80 µCi/m³ 3 seconds for measurements above 80 µCi/m³</td>
</tr>
<tr>
<td><strong>ALARM SYSTEM</strong></td>
<td>single alarm, with set point adjustable from 1 to 1,000 µCi/m³</td>
</tr>
<tr>
<td><strong>INDICATORS</strong></td>
<td>acoustic signaler, red LED</td>
</tr>
<tr>
<td><strong>IONIZATION CHAMBER VOLUME</strong></td>
<td>measuring: 1,600 cm³ total wetted: 2,000 cm³</td>
</tr>
<tr>
<td><strong>ION TRAP</strong></td>
<td>Kanne Type, coaxial integral</td>
</tr>
<tr>
<td><strong>PORTS</strong></td>
<td>hose barb fittings for 3/16” I.D. vinyl tubing</td>
</tr>
<tr>
<td><strong>FLOWMETER</strong></td>
<td>0-10 LPM adjustable rotameter</td>
</tr>
<tr>
<td><strong>DUST FILTER AND PUMP</strong></td>
<td>High efficiency respirator type cartridge. Long life continuous duty oscillating piston positive displacement pump</td>
</tr>
<tr>
<td><strong>ENVIRONMENTAL</strong></td>
<td>Storage Temperature: -40° C to +60° C  Operating Temperature: 0° C to +50° C  Humidity: 0 to 95 % RH non-condensing</td>
</tr>
<tr>
<td><strong>POWER</strong></td>
<td>115 VAC or 240VAC, 50/60 Hz</td>
</tr>
<tr>
<td><strong>PHYSICAL CABINET</strong></td>
<td>19” rack mount, frame constructed of aluminum extrusions, front and rear panel are 1/8” thick aluminum. Covers are aluminum sheet.</td>
</tr>
<tr>
<td><strong>DIMENSIONS</strong></td>
<td>8.8” [223mm] H x 19.0” [483mm] W x 16.0” [406mm] D</td>
</tr>
<tr>
<td><strong>WEIGHT</strong></td>
<td>40 lbs. [18.2Kg]</td>
</tr>
<tr>
<td><strong>OPTIONS</strong></td>
<td>Plate-out proof chamber design  Choice of one additional output; RS232 Serial Data, 4-20mA or logarithmic Output</td>
</tr>
</tbody>
</table>
## PARTS LIST FOR MODEL 357 TRITIUM MONITOR

<table>
<thead>
<tr>
<th>Qty Req’d</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCO-201-E1</td>
<td>120VAC Pump</td>
</tr>
<tr>
<td></td>
<td>VCO301-P2</td>
<td>240VAC Pump</td>
</tr>
<tr>
<td>1</td>
<td>803562</td>
<td>HEPA Filter Cartridge (pack of three)</td>
</tr>
<tr>
<td>1</td>
<td>2-231-S604-70</td>
<td>O-Ring for Filter Cover (pack of ten)</td>
</tr>
<tr>
<td>1</td>
<td>2-036-S613-60</td>
<td>O-Ring for Filter Housing (pack of ten)</td>
</tr>
<tr>
<td>1</td>
<td>VFA-24-SSV</td>
<td>Flow Meter</td>
</tr>
<tr>
<td>1</td>
<td>AP-141-12-1</td>
<td>Digital Panel Meter, 120VAC</td>
</tr>
<tr>
<td></td>
<td>AP-141-12-2</td>
<td>Digital Panel Meter, 240VAC</td>
</tr>
<tr>
<td>1</td>
<td>A41-43-36</td>
<td>Mains Transformer</td>
</tr>
<tr>
<td>1</td>
<td>A14-2.5-36</td>
<td>Transformer for High Voltage Power Supply</td>
</tr>
<tr>
<td>1</td>
<td>100251-ASSY</td>
<td>Main PCB Assembly for Model 357</td>
</tr>
<tr>
<td>1</td>
<td>100511-Model 357</td>
<td>4-20mA Output &amp; Logarithmic Converter Board</td>
</tr>
<tr>
<td>1</td>
<td>100512-357</td>
<td>RS-232 Output Board</td>
</tr>
<tr>
<td>1</td>
<td>KL-701</td>
<td>Knob Lock for Compensation Control</td>
</tr>
<tr>
<td>1</td>
<td>MS91528-1N2B</td>
<td>Knob for Compensation Control</td>
</tr>
<tr>
<td>1</td>
<td>MDL-1</td>
<td>Fuse, 1 Amp (pack of 5)</td>
</tr>
<tr>
<td>1</td>
<td>17501</td>
<td>AC Power Cord</td>
</tr>
<tr>
<td>1</td>
<td>1020934</td>
<td>Ionization Chamber Assembly for Model 357</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td>Dual Solid Wall Electrodes</td>
</tr>
<tr>
<td>1</td>
<td>1020974</td>
<td>Ionization Chamber Assembly for Model 357</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td>Wire Grid Measure Side and Solid Wall Compensation Side</td>
</tr>
<tr>
<td>1</td>
<td>1021101</td>
<td>Ionization Chamber Assembly for Model 357</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dual Wire Grid Electrodes</td>
</tr>
</tbody>
</table>
MODEL 357BW
TRITIUM MONITOR

The model 357BW is a single range, ionization chamber monitor for the measurement of tritium. It is contained in a NEMA 12 enclosure and is suitable for permanent installation and for continuous duty.

It is suited for the monitoring of rooms, glove boxes, fume hoods, exhaust stacks and systems, as well as process piping when supplied with external dedicated ionization chambers.

The enclosure has a hinged door with a tempered glass window. The enclosure is double-hinged so that it can be opened for servicing the various components inside. The audible alarm and a pushbutton for muting the audible alarm are located on the top of the enclosure. The sample inlet and exhaust fittings are located on top of the enclosure. Connector receptacles are mounted on the top of the enclosure for AC power entry and remote output.

Major distinguishing features include the following:

- Display/Control Unit installed in a Wall Mount NEMA 12 enclosure.
- Available with Dual or Quadruple ionization chambers
- Single measurement range over four plus decades.
- Plate out proof ionization chambers eliminate "background" zero drift
MODEL 357BW
TRITIUM MONITOR

PERFORMANCE SPECIFICATIONS

MEASUREMENT

Range          single, 1 – 10,000 μCi/m³
Display        4 digit panel meter, LED
Accuracy       ±5 % of reading, ±1μCi/m³ whichever is greater
Reproducibility ±5 % over the entire measurement range
Zero Drift     ±1 μCi/m³ long term, over the entire temperature range
Temperature Coefficient Less than ±0.3%/°C, total accumulated error ≤±10% relative to 20°C reading
Response Time  two linear electronic time constants, 20 seconds for measurements below approximately 80μCi/m³, 3 seconds for measurements above 80μCi/m³
Background Subtraction second pair of ionization chambers of equal volume, mounted in a cruciform arrangement, serves to cancel effects of external gamma fields
Warm Up Time   less than five minutes
Over Range Indication All segments on digital panel meter display will flash when the measurement has exceeded 10,000 μCi/m³

ALARM SYSTEMS

High Level Alarm a single set point alarm system is adjustable with digital thumb switches over the entire measurement range
Indicator      Audible and Visual flashing red LED.
Mode Switch    A toggle switch is used to select the operating mode, Latching or Non Latching with a momentary Reset position
Malfunction Alarm Audible and Visual steady amber LED indicates when either one of two conditions occur, A failure of any one of the internal D.C. power supplies or malfunction of the electrometer
Low Flow Alarm  Audible and Visual steady amber LED indicates when the sample flow rate has dropped to below 2 LPM
Acknowledge push button silences the audible indicator for all of the above alarms
MODEL 357BW TRITIUM MONITOR, continued

IONIZATION CHAMBER INTERNALLY MOUNTED

Ionization Chamber measuring: 1800 cm$^3$
total wetted: 4000 cm$^3$

Electrode Wire grid, contamination resistant

Gaskets Silicone rubber

Pressure 0.1 to 2 atmospheres

Ports 1/4” stainless steel Swagelok

Material of chamber: stainless steel
Construction electrometer housing: aluminum

SAMPLE FLOW SYSTEM INTERNALLY MOUNTED

Flow Meter 0-10 LPM adjustable rotameter

Dust Filter and high efficiency 99.99% at 0.1 microns, respirator type Electrostatic Filter

Pump long life continuous duty oscillating piston positive displacement pump. Medo VCO201 E1

ENVIRONMENTAL

Temperature -40° C to +65° C storage
0° C to +55° C operating

Humidity 0 - 95 % RH

Air Conditioning Ventilation or air conditioning is not required.

PHYSICAL, MAIN CABINET NEMA 12 rated

Size 24.0” [610mm] wide x 24.0” [620mm] high x 19.0” [483mm] deep

Power 120 VAC ±10%, 60 Hz, 1A, 1 PH

Fuse 1 A slow blow fuse

Weight 160 pounds [73 kg]
MODEL 357BWC
CART MOUNTED SEMI-PORTABLE TRITIUM MONITOR

The Model 357BWC is a single range, ionization chamber monitor for the measurement of tritium. It is contained on a mobile stainless steel cart and is suitable for moving to multiple sampling points and for continuous duty. The display/control unit is enclosed in a NEMA 12 enclosure on top the cart. It is suited for the monitoring of rooms, glove boxes, fume hoods, exhaust stacks and systems, as well as process piping. The NEMA enclosure has a hinged door with a tempered glass window and is double hinged so that it can be opened for servicing the various components inside.

Major distinguishing features include the following:

- 1-10,000 μCi/m³
- Quad 2L Ionization Chambers (gamma compensation)
- Contamination/Plate-out Proof Design (wire grids)
- Alpha Pulse Suppression (radon compensation)
- Dual Desiccant Dryer Cartridges (noble gas compensation)
- Heavy duty pump, HEPA filter and Flow Meter
MODEL 357BWC
CART MOUNTED TRITIUM MONITOR

PERFORMANCE SPECIFICATIONS

MEASUREMENT

Range single, 1 – 19,999 $\mu$Ci/m$^3$
Display 4½ digit panel meter
Accuracy ±5 % of reading, ±1$\mu$Ci/m$^3$ whichever is greater
Stability and Drift ±1 $\mu$Ci/m$^3$ long term (thirty days), ambient temperature conditions
Noise ±1 $\mu$Ci/m$^3$, 1 sigma, with alpha suppression in use
Response Rate two linear electronic time constants approximately 20 seconds for signals up to about 80 $\mu$Ci/m$^3$
approximately 3 seconds for signals above 80 $\mu$Ci/m$^3$
Offset Compensation Manual compensation control provided to offset the effects of gamma radiation and/or tritium build-up
Warm Up Time less than five minutes

ALARM SYSTEMS

High Level Alarm A single set point alarm system is adjustable with digital thumb switches over a 1 to 10,000 $\mu$Ci/m$^3$ range
Indicator Audible and Visual flashing red LED
Mode Switch A toggle switch is used to select the operating mode, Latching or Non Latching with a momentary Reset position
Malfunction Alarm Audible and Visual steady amber LED indicates when either one of two conditions occur, A failure of any one of the internal D.C. power supplies or malfunction of the electrometer
Low Flow Alarm Audible and Visual steady amber LED indicates when the sample flow rate has dropped to below 1 LPM
Acknowledge Push Button Silences the audible indicator for all of the above alarms
IONIZATION CHAMBER

Measuring volume  1800 cm³
Total wetted volume  4,000 cm³
Electrodes    Wire Grid, contamination resistant
Gaskets    Silicone rubber
Pressure    0.1 to 2 atmospheres
Ports    1/4” Stainless Steel Gyrolok
Material of Construction  Stainless Steel
Electrometer Housing  Aluminum

SAMPLE FLOW SYSTEM

Pump    115Vac, 50/60 Hz, diaphragm type
Thomas 107CAB11
Flow Rate    6 LPM Maximum, 5 LPM recommended
Flow Meter    1-10 LPM, Dwyer RMA-21-SSV
Dust Filter    HEPA respirator type Scott 803562-01
Maximum Pressure    103kPa (1 atmosphere)
Connections    1/4” stainless steel gyrolok tube fittings
Tubing    316L Stainless Steel, 1/4” OD
Low Flow Sensor    Differential pressure switch, Dwyer Model 1823-2
adjusted to trip <1 LPM.
Pump Control    ON/OFF circuit breaker power to pump
Sampling Modes    Sample Mode; the sample stream passes through the both the upstream and downstream ionization chambers and exits through the sample outlet hose.
By-Pass Mode    Manually operated valves change the flow path to exclude the ionization chambers and the desiccant column.
Inlet Temperature    Thermometer -20°C to +120°C Range
Moisture Trap    Parker Type S1P with visible coalescing element
ENVIRONMENTAL

Temperature: 5°C to +50°C Operating
Humidity: 0 – 95% RH
Air Conditioning: Ventilation or air conditioning is not required.

PHYSICAL, MAIN CABINET

Mounting: The system is mounted on a heavy-duty cart of stainless steel construction with low friction casters (two swivel types at one end and two straight types at the other). The swivel casters have locking mechanisms.
Size: 24” [610mm] Wide x 41.02” [1042mm] Long x 36” [914mm] Height to top shelf of cart with a 53” [1346mm] Overall Height
Enclosure: NEMA 12 Rating
Weight: 288 lbs [131kg]
Inlet/Outlet Hoses: Sample inlet and outlet hoses are braided stainless steel construction with quick connect couplers at each end. Length is 42” [1.07 meters]
MODEL ASU-4
AIR SAMPLING UNIT

The Air Sampling Unit (ASU) is intended for simultaneous air sampling from 4 different locations. A portion of the sampled air is routed to a Tritium Monitor. Air can be sampled from a location up to 60m away. The ASU is a wall mount NEMA 12 enclosure. The enclosure has a hinged door that is furnished with a tempered glass window providing a view to the inside of the enclosure in order to visually check the air flow rate setting and signal lights. The enclosure is a double-hinged design, so that it can be opened for service.

Features include the following:

Components Installed in a Rugged, Wall Mount Industrial NEMA 12 Enclosure

Auto and Local Control Modes

Programmable Logic Controllers

Programmable Display with a Color LCD Screen

Flow Meters and Filters
## MODEL ASU-4
**AIR SAMPLING UNIT**

### TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Flow Rate</td>
<td>3-25 LPM, Nominal Setting 10 LPM</td>
</tr>
<tr>
<td>Operational Temperature Range</td>
<td>10º to 40ºC</td>
</tr>
<tr>
<td>Operating Principle</td>
<td>Air sample is pulled by a pump from 4 different locations into a manifold and then sent out through the exhaust line, which is sampled by a tritium monitor. Each flow rate from 4 inlet lines is adjusted by air flow meter. There is a separate purge air inlet.</td>
</tr>
<tr>
<td>Air Mixing Manifold</td>
<td>Built from aluminum bar stock with 5 inlets and one outlet. Inlets are for 4 sample lines and one purge line. The outlet is connected to the pump inlet.</td>
</tr>
<tr>
<td>Flow Meter</td>
<td>Polycarbonate body flow meter, with stainless steel valve, adjustable range from 1 to 25 LPM.</td>
</tr>
<tr>
<td>Filters</td>
<td>Respirator cartridge type HEPA filter for all four sample inlets and one purge inlet. Connection fittings are 1/4” SS Swagelok fittings.</td>
</tr>
<tr>
<td>Enclosure</td>
<td>NEMA 12 rated, 24” [600mm] wide x 18.8” [478mm] high x 22.56” [573mm] deep</td>
</tr>
<tr>
<td>Differential Pressure Switch</td>
<td>Diaphragm pressure switch used to detect low flow. Set point is ~ 5 LPM</td>
</tr>
<tr>
<td>Programmable Logic Controller (PLC)</td>
<td>Panasonic PLC with relay outputs, powered by a 24VDC power supply for. PLC also has RS232 serial data output for future expansion to include remote capability.</td>
</tr>
<tr>
<td>Pump</td>
<td>Thomas reciprocating piston pump, model 2688CE44, 470W, 115VAC, 60Hz</td>
</tr>
<tr>
<td>Solenoid Valves</td>
<td>Brass body, nitrile rubber seals</td>
</tr>
<tr>
<td>Weight</td>
<td>130 lb [59 Kg]</td>
</tr>
</tbody>
</table>
NUCLEAR POWER PLANT TRITIUM MONITOR MODEL 321/421 NPPM

This tritium monitor is a version of the OTC standard 321/421 series, configured for the special environmental conditions associated with nuclear power plants, especially those of the CANDU type. This monitor can be used for other applications where tritium specific measurements in the presence of other radionuclides are required.

Major distinguishing features include the following:

- Measures tritium or tritium oxide specifically
- Immune to other radioisotopes, including reactor gases as well as radon
- Gamma compensated dual chamber design
- Plate out proof ionization chambers eliminate “background” zero drift
- Drift free “zero”
- Rugged industrial enclosure
- Unaffected by variations in temperature or humidity

A variety of alarms and controls are available. Optional Remote Displays and Sampling Units can be built to suit different applications.

SENSITIVITY - NOISE LEVELS

The Model 421 NPPM has been designed to exhibit sensitivities commensurate with safety requirements associated with worker exposure in power plants. Sensitivity limits induced by background noise levels with instruments incorporating 2 liter ionization chambers approach 0.3 μCi/m³.

RANGE

The Model 421 NPPM is dual range, extending measurement to up to 6 plus decades.

MAINTENANCE

Except for routine attention the sample line dust filters and preventive maintenance to the sampling pump, the instrument will provide decades of trouble free service.

SUPERVISORY SIGNALS

Computer compatible outputs are provided to signal operational failure including loss of sample flow, pump failure, electrical failure including that of the electronics, and failure of the ionization chambers.
NUCLEAR POWER PLANT TRITIUM MONITOR,
MODEL 421 NPPM VERSION

MEASUREMENT

Range, typical two, automatically switch
0.1 – 10,000 μCi/m³ low range
1.00 – 200.00 mCi/m³ high range
other ranges available

Display 4 1/2 digital panel meter

Accuracy ± 2 % of reading, ± L.S.D., whichever is greater

Stability and Drift ±1.0 μCi/m³ long term (thirty days), ambient temperature conditions

Noise ±1.5 μCi/m³, 1 sigma, with alpha suppression in use

Response Rate three linear electronic time constants

- approximately 40 seconds for signals up to about 80 μCi/m³
- approximately 10 seconds for signals from 80 to 10,000 μCi/m³
- approximately 3 seconds for signals above 1.00 mCi/m³

Warm Up Time less than ten minutes

ALARM SYSTEMS

High Level

Low Range Level alarm with 4-digit thumb wheel potentiometer preset from 1 – 9,999 μCi/m³. High Range Level alarm with 3-digit thumb wheel potentiometer preset from 2 – 200 mCi/m³. Toggle switch selector for High or Low Range Level Set Points. An Alarm condition activates a visual (red LED) an acoustic indicator and fail-safe relay closure. Toggle switch selector for latching or non-latching modes and reset. Acknowledge push button to silence acoustic indicator after alarm is tripped.

Malfunction

Failure of any one three conditions will activate a non-latching visual indicator and fail-safe relay closure. One, a dc power supply monitor verifies all internal dc supplies are within specification. Two, verifies that the electrometer cable is connected. Three, sample flow monitored by a delta pressure switch.
NUCLEAR POWER PLANT TRITIUM MONITOR, MODEL 421 NPPM VERSION, continued

IONIZATION CHAMBER
INTERNALLY MOUNTED

- Measuring volume: 1,200 cm$^3$ each
- Total wetted volume: 2,000 cm$^3$ each
- Electrodes: Wire Grid, contamination resistant
- Pressure: 0.1 to 2 atmospheres
- Ports: 1/4” stainless steel Swagelok

SAMPLE FLOW SYSTEM
INTERNALLY MOUNTED

- Pump: diaphragm type 115/230 VAC 50/60 Hz
- Flow Rate: 14 LPM maximum @ 0 psia
- Flow meter: 0 - 10 LPM adjustable
- Dust Filter: HEPA respirator type
- Connection: 1/4” stainless steel Swagelok tube fittings
- Low Flow Sensor: Differential pressure switch

ENVIRONMENTAL

- Temperature: -40° C to +65° C storage, 0° C to +55° C operating
- Humidity: 0 - 95 % RH
- Air Conditioning: Ventilation or air conditioning is not required.

PHYSICAL, MAIN CABINET

- Size: 29.37” [747mm] High x 23.63”[600mm] Wide x 18.62” [473mm] Deep wall mounted NEMA 12 painted steel enclosure with key lockable door
- Power: 115/230 VAC, 50/60 Hz, 50 W including pump and up to 4 remote indicators
- Weight: 186 lbs [84kg]
RECYCLING DRYER UNIT

Desiccant: dual copper tube coaxial columns containing desiccant agent. Columns are equipped with internal heaters for the regeneration of the desiccant

Cycling System

Motor driven cam timer controls solenoid valves and the heaters for sequential operation of each column

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>In use</td>
<td>1. heat column</td>
</tr>
<tr>
<td>In use</td>
<td>2. purge vapor</td>
</tr>
<tr>
<td>In use</td>
<td>3. cool column</td>
</tr>
</tbody>
</table>

The sequence of events takes six hours for completion, whereupon the sequence recommences for the opposite column.

VISUAL INDICATORS

Status Indicator: Rotary pointer knob indicates different states of the sample/regenerate process for both desiccant columns

Low Flow: indicates when purge pump flow is <2 LPM

Power: 115/230 V, 50/60 Hz, 1500 Watts

Circuit Protection: Circuit breaker/power ON/OFF switch

Physical Size: 30” [762mm] W x 46.75” [1187.5mm] H x 13.5” [343mm]D wall mounted painted steel enclosure

Weight: 245 lbs [111 kg]
TRITIUM SAMPLING UNIT (OPTIONAL)

- **Pump**: 115/230 VAC, 50/60 Hz
- **Flow Rate**: 89 LPM Maximum at 0 psia
- **Flow Meter**: 10-100 LPM
- **Dust Filter**: HEPA respirator type
- **Pressure**: 0.1 – 2 atmospheres
- **Connections**: 1/4” stainless steel Swagelok tube fittings
- **Low Flow Sensor**: differential pressure switch
- **Vacuum Sensor**: vacuum switch

**CONTROLS**

- **Power Control**: Pushbutton switch for power
- **Pump Control**: Maintained pushbutton switch for power to pump
- **Sample Control**: maintained pushbutton switch for MAIN/REMOTE control
- **Valve Selection**: controlled by a rotary switch

**VISUAL INDICATORS**

- **Manifold Low Flow**: red LED, “on” when purge pump flow fails or falls below 2 LPM.
- **Connections**: 1/4” stainless steel Swagelok tube fittings

**ENVIRONMENTAL**

- **Temperature**: -40° C to +65° C Storage
  0° C to +50° C Operating
- **Humidity**: 0 – 95 % RH
- **Air Conditioning**: Ventilation or air conditioning is not required.

**PHYSICAL**

- **Physical Size**: 23.62” [600mm] Wide x 25.75” [654mm] High x 15.16” [385mm] Deep NEMA 12 Enclosure
- **Power**: 120VAC, 60Hz, 1Ph, 15A
- **Weight**: 101 lbs [46 kg]
REMOTE DISPLAY / CONTROL UNIT (OPTIONAL)

Power Control  ON/OFF toggle switch for power to unit
Pump Control  ON/OFF maintained pushbutton switch for power to pump
Sample Control  MAIN/REMOTE maintained pushbutton switch for control unit selection
Valve Selection  Valve selection controlled by PLC touch screen

VISUAL INDICATORS

PLC Touch Screen  Displays Tritium Concentration
Power  120VAC, 60Hz, 1Ph, 2A

ENVIRONMENTAL

Temperature  -40° C to +65° C Storage
             0° C to +50° C Operating
Humidity  0 – 95 % RH
Air Conditioning  not required.

PHYSICAL

Physical Size  23.62” [600mm] Wide x 25.75” [654mm] High x 15.16” [385mm] Deep Excluding Hardware
NEMA Rating  NEMA 12
Power  120VAC, 60Hz, 1Ph, 2A
Weight  66 lbs [30 kg]
300/400 UNITS - MODULAR CONFIGURATION
300/400 UNITS - MODULAR CONFIGURATION
TRITIUM MONITORS

ESSENTIAL CHARACTERISTICS, FEATURES AND OPTIONS

These are line powered tritium monitors for continuous unattended operation. They can be configured to serve a variety of purposes, including environmental surveillance in rooms, stacks or power plants, as well as glove boxes and process piping in tritium handling facilities.

FOREWORD

The 300/400 series tritium monitors are a family of instruments that share a common basic ionization chamber and electronics design philosophy.

Any specific model, to suit different applications, can be configured from a large selection of options.

All line powered tritium monitors for installation are grouped into the 300 and 400 series of instruments, and are categorized into four basic according to whether they use single or dual ionization chambers, or if automatic range switching for wide range of measurement has been incorporated.

Complexity, hence cost, is related to the number and nature of the associated ionization chambers, and the number of measurement ranges over which the instrument will function.

MODELS AVAILABLE: (but not limited to)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>311</td>
<td>single range, with single ionization chamber</td>
</tr>
<tr>
<td>321</td>
<td>single range, with dual ionization chamber</td>
</tr>
<tr>
<td>411</td>
<td>multi-range, with single ionization chamber</td>
</tr>
<tr>
<td>421</td>
<td>multi-range, with dual ionization chamber</td>
</tr>
</tbody>
</table>

MODEL 311
(SINGLE CHAMBER, SINGLE RANGE)

Highest sensitivity of 1 μCi/m³, with single ionization chambers from 10 cc to 2 liters. Four decade measurement range, with general application for glove box monitoring, process monitoring, chromatography and similar applications.

HIGHER SENSITIVITY

Increased sensitivity to 0.1 μCi/m³ is attained through ionization chambers with larger volumes.
MODEL 411  
(SINGLE CHAMBER, MULTIRANGE)

Multirange version of Model 311, for wider measurement ranges up to 7 decades.

TRITIUM SPECIFIC IONIZATION CHAMBER RESPONSE

Monitors made to respond only to tritium, or tritium oxide, even in the presence of competing radioactive airborne agents. The 321 and 421 series instruments use balanced ionization chambers, which, together with specialized sample preparation systems are immune to competing radiogases, responding only to tritium or its oxide.

SENSITIVITY

Depending on chamber size, 300/400 tritium monitors will measure tritium from $10^{-7}$ μCi/cc to pure tritium.

SENSITIVITY AND RANGE OF MEASUREMENT, 300 SERIES

Single range monitors, the 300 series instruments, can be configured to measure over 3 to 5 decades selected anywhere between $10^{-7}$ μCi/cc to pure tritium.

SENSITIVITY AND RANGE OF MEASUREMENT, 400 SERIES

Multi-range monitors, the 400 series instruments, will measure over much wider ranges, covering up to as much as seven decades of displayed measurement.

A wide range of measurement places extreme demands on ionization chamber design with regard to contamination effects of tritium oxide. Proper design ensures linearity over the full range and minimum offset at the low end of the measurement range. Wider measurement ranges, such as 7 decades may use switched ionization chambers, using one ionization chamber only for low signal levels, and a second chamber only for high values.

There are special designs for ionization chambers which resist plate out.

KEY PERFORMANCE CHARACTERISTICS OF OTC TRITIUM MONITORS

OTC devotes a very significant portion of its budget to ongoing research and development to continuously improve instrument performance, to reduce costs, and improve the quality and maintainability.
GAMMA RESPONSE

The 311 and 411 series of tritium monitors employ single ionization chambers, which respond not only to tritium but will also respond to external gamma and X-ray fields. Typically, a flux of 1 mR/hr will produce instrument response equivalent to about 90 $\mu$Ci/m$^3$. Lead shielding can be supplied to mitigate gamma sensitivity.

In contrast, the 321 and 421 series of tritium monitors feature dual ionization chambers, the two chambers being of identical geometry and are used to cancel gamma response. Instruments with four ionization chambers are specified for optimum gamma suppression under challenging field gradient and energy conditions.

MEASUREMENT DISPLAY

All fixed 300/400 series instruments use 3½, 4½, even 3¾ or 5 full displays. Selection depends on the range and units of measure each particular application.

STABILITY AND NOISE LEVEL

The measurement sensitivity is specified in terms of stability and noise level under fully operational conditions, and not just to the electronic system performance alone.

For example, an instrument designed to measure to one micro Curie per cubic meter will exhibit a noise level and stability of better than 1 $\mu$Ci/m$^3$ for one standard deviation. Normally, the stability of the electronic circuitry itself is better by an order of magnitude.

OTC tritium monitors feature long term zero stability under all environmental conditions.

OTC pioneered proprietary methods to eliminate tritium monitor sensitivity to environmental effects including the disintegration of ambient radon, and of natural terrestrial and cosmic radiation.

SPAN ACCURACY AND LINEARITY

All OTC tritium monitors are calibrated to high levels of accuracy. OTC tritium monitors can be factory adjusted to a precision of as high as 5% in terms of equivalent electrical signal, or better than 15% when using certified tritium gas.

Measurement errors at low signal levels arise from tritium plate out, foreign radioactive material such as radon or cosmic radiation. At high levels, measurement errors are attributed to recombination effects which can be eliminated, or greatly mitigated by careful ionization chamber design.
RESPONSE RATE

The measurement signal level and the rate (time constant) are inherently interrelated. High measurement levels demand fast response, whereas low measurement levels demand long time constants, in order to smooth out noise and to provide a stable display. To accommodate this contradictory requirement, three distinct time constants have been incorporated into the instruments.

3 second for measurement above 1000 mCi/m³

5 to 10 second time constant for measurement of 80 - 1000 mCi/m³

20 seconds or more for measurement below 80 mCi/m³

Time constants usually switch automatically, although manual switching as well as different break points can be incorporated as requested.

COMMON FEATURES

All 300 and 400 series instruments are equipped with a number of basic common features.

ICI/ICR Internal/Remote Ionization Chambers

The ionization chambers are normally furnished as separately or remote mounted, CODE ICR. Upon special request, chambers can be mounted inside the main electronics cabinet, use CODE ICR.

Measurement, Ranges and Sensitivity

A configuration with dual 8 liter chambers features a 0.1 μCi/m³ (1 s.d.) sensitivity.

Alarms, Measurement

Single or two independent alarms with visual and acoustic signals. Front panel mounted potentiometers are used to adjust the level set point. 400 series multiranging instruments are further equipped with range selector switches so that alarm setting can be made over the entire range of measurement.
**Digital Displays**

A variety of digital displays are available.

DD3.5  3½ Digit Display, max reading is 1999
DD3.75  3¾ Digit Display, max reading is 3999
DD4  4 Digit Display, Programmable, max reading is 9999
DD4.5  4½ Digit Display, max reading is 19999
DD5  5 Digit Display, Programmable, max reading is 99999

Use CODE DDxx depending on the number of digits required.

300 series single range instruments are typically equipped with 4½ digit panel meters, and with 5 decade analog logarithmic output signals.

400 series employ moving decimal points on the panel meter and may include additional range indicating lights to identify the measurement decade in operation. Logarithmic analog outputs for 400 series instruments have scales of up to seven decades. Range switching is automatic and is not visible to the instrument operator.

**Electrical Interfaces**

All 300 and 400 series instruments have rear panel connections suitable for remote display, control or computer interface.

These include, as a minimum,

- Analog signal (0 - 10 V)
- Alarm functions, including remote acknowledge
- Supply voltage
- Range information (400 series)

**ELECTRONIC AND PNEUMATIC OPTIONS**

The standard 300/400 series instruments can be furnished with a variety of electronic options. A master “mother” board has room for several discretionary “plug-in” cards whose output interface connections protrude through the rear of the cabinet. OTC offers a number of standards as well as custom designed interface cards.

**APS  Alpha Pulse Suppression**

Noise free measurements of airborne tritium is only possible by suppressing response to alpha decay due to environmental radon. With circuitry which inhibits instrument response to radon and large cosmic ray pulses, measurement sensitivities as low as 0.1 μCi/m³ can be attained.
LOG  Logarithmic Converters

Circuits to convert instrument output signals to a logarithmic form for the purpose of logarithmic meter displays or for chart recorders with logarithmic scales. Useful for signal compression when used with 4-20 ma or digital interfaces.

TZ  Totalizer

An 8 digit LCD display for time integrated activity rate of tritium. Very useful for the determination of inventory passage through stacks or hoods. A battery ensures retention of data during periods of line power loss.

PFA  Pump and Flowmeter Assembly

A complete assembly consisting of HEPA filter, pump and adjustable flowmeter.

SFM  System Failure Monitor

This supervisory circuit detects and signals failure of all d.c. power supplies, and verifies the integrity of the ionization chamber/electrometer.

FFA  Low Flow Failure Alarm

Loss of flow sample stream switches are available on request.

CR  Chart Recorder

An electronic chart recorder can be linked with the instrument to store data. The recorder has color LCD touch screen, removable memory card and RS-232 output.

ALX  Customer selected Alarm Output Configuration

Special alarm configurations are available to fit into all 300/400 series instruments. Consult the factory for available options.

GP  Gold Plated Measurement Chamber

Gold Plating of Measurement Chamber to Help Reduce Plate-Out

MP  Mirror Polished Measurement Chamber

Mirror Polishing of Measurement Chamber to Help Reduce Plate-Out
RDU  Remote Display Unit

Such options are designed to suit particular customer requirements and can include a variety of annunciators, visual and acoustic. Consult the factory for details.

RS-232/RS-485/Ethernet Computer Interfaces

All conventional computer interfaces are available on plug in cards.

HTL  Helium Leak Test Certificate

Certification that the ionization chambers have passed leak tests performed with a helium mass spectrometer.

CALR  Calibration Resistors

Ultra high meg ohm resistors, certified to about 2% precision for use for electrical calibration (or verification) of the tritium monitors response.

CALG  Calibration Gas

NIST traceable tritium gas calibrators. Gas is contained in a “lecture” bottle, the calibrator is supplied with all necessary components, including the regulator, gages, and valves.

E-I  Voltage To Current Converter

The 0 to 10 volt measurement signal can be converted to a standard 4 to 20 ma current signal.

400 series (multiranging) instruments can be equipped with a 4 to 20 ma signal which covers the entire range of operations.

Although not absolutely required, for better measurement resolution it is suggested that the 4 to 20 ma converter be preceded by a logarithmic conversion.
IONIZATION CHAMBERS

There are many different designs of ionization chambers for the measurement of airborne tritium and other radioactive gases.

OTC has designed and built many different ionization chambers, of different sizes and configurations, each of which was optimized for some specific purpose. OTC ionization chambers have been used not only for room air monitoring, but for glove boxes, process piping, gas chromatographs, and for challenging environments such as nuclear power plants. OTC ionization chambers span all sensitivities, from $10^{-7}$ Ci/m$^3$ to pure tritium. They can be used to selectively measure tritium, or only its oxide, even in the presence of other radioactive gases. OTC ionization chambers are designed for easy assembly and maintenance.

IONIZATION CHAMBERS

An ionization chamber is an electrically closed vessel containing an internal electrode. An electric field is applied between the wall of the chamber and the electrode, so that the ionization produced by radiation is collected in the form of a current. In a linear ionization chamber, the current is proportional to the internal radioactivity, and is essentially independent of the chamber’s electric field potential.

INTERCHANGEABILITY

All OTC ionization chambers have been designed so that the electrometer preamplifiers are located in a cavity in the mounting flange. Measurement (tritium) calibration is located directly at the ionization chamber-electrometer module so that, in general, any ionization chamber-electrometer module will function in combination with any main electronics cabinet, and still maintain instrument calibration. It is therefore possible to use one or several different ionization chamber-electrometer modules with any given main electronics system.

NON SPECIFIC RESPONSE

Ionization chambers respond not only to the airborne isotope inside the chamber, but will also respond to ionization produced inside the chamber by external gamma, X-rays and cosmic ray fields.
**GAMMA COMPENSATION**

To overcome undesirable effects due to external gamma fields, OTC tritium monitors can be supplied with compensating ionization chambers. Here, a second ionization chamber of identical dimensions is used to cancel the effects of external radiation upon the measuring ionization chamber. Additional gamma radiation suppression by means of lead shielding can be supplied.

**LINEARITY**

OTC ionization chambers are designed to be highly linear. At high radiation activity levels, it becomes increasingly probable that an ion and an electron will recombine, will be lost and not form part of the ion current collected by the electrode. Special electrode and chamber designs help to reduce this effect.

**KANNE DESIGN**

Most OTC ionization chambers utilize the Kanne configuration, where the ionization chamber is surrounded by a closely spaced second chamber. The volume between the two surfaces serves as an ionization trap. To prevent build-up of debris in the ionization trap, or within the active volume of the ionization chamber, it is normal to use a high efficiency dust filter ahead of the ionization trap.

**CONFIGURATION**

Design of every ionization chamber system has been optimized both for performance as well as for economy. Low level ionization chambers are at least 2 liters in overall volume, are often lead shielded and in a gamma compensation (dual) configuration. High level ionization chambers are generally small and employ closely spaced large diameter electrode configurations to minimize nonlinearities. Glove box ionization chambers employ perforated walls for direct intrusion into the glove box, thereby eliminating the need for pumps and plumbing.
CONSTRUCTION AND MATERIALS

Most OTC ionization chambers are secured to a massive flat “baseplate” which serves not only as a mounting structure, but which also houses the electrometer. Calibration of the entire system is rendered directly at the electrometer via trimmer potentiometers accessible in the side of the ionization chamber mounting flange. This permits interchange of ionization chamber modules without loss of instrument calibration. Dual ionization chambers consist of an identical pair of chambers, mounted on either side of the baseplate which houses the electrometer.

Stainless steel or aluminum is commonly selected, although copper and brass can also be used. Insulators generally are chosen to be inert to radiation, but the insulator for the ionization collecting electrode is almost always (except for ultra high levels) chosen to be fabricated from PTFE. All commonly used inch or metric fittings and hose barbs can be supplied.

CHAMBER MODELS

SOME AVAILABLE CONFIGURATIONS

2 Liter Ionization Chamber (2LS)

Single or dual, mounted onto 7” square baseplate. Total wetted volume is 2,000 cc with an active internal volume of 1,600 cc, and volume of about 400 cc in the ionization trap. Supplied with two Swagelok or hose barb fittings.

OTHER STANDARD SIZES

Ionization Chambers with volumes of 500 cc, 200 cc, or 20 cc

Single or dual, mounted onto 7” square baseplate. These chambers are generally used for process monitoring and are sometimes built with matching gamma compensation chambers. Supplied with two Swagelok fittings.
Perforated Wall Ionization Chambers (2LPW, 200PW)

Available in a nominal 2 liter and a 200 cc configuration, these ionization chambers have perforated walls, allowing free passage of the surrounding atmosphere. Pumps are obviously no longer required for these ionization chambers.

Suitable for area monitoring, these chambers should be covered with light tissue to act as a dust filter when they are exposed to particulate laden air.

8 LITER IONIZATION CHAMBER

Dual or quadruple ionization chambers for ultra low level tritium specific monitoring. Measurement as low as $10^{-7}$ Ci/m$^3$ can be made with these large ionization chambers. Mounted onto a 12” square baseplate, total wetted volume is 11,240 cc with an active internal volume of 6,500 cc. Supplied with two Swagelok hose barb fittings.
IONIZATION CHAMBERS FOR TRITIUM SPECIFIC MEASUREMENTS

Specific tritium only measurements are made possible through the use of drying systems or permeation tubes which segregate tritium oxide from all other radioisotopes. Use of such separation methods permit measurement of tritium in any of its forms, that is, HT, HTO, or total tritium.

CRUCIFORM CHAMBERS FOR COMPLETE GAMMA COMPENSATION

Response to external gamma fields with high gradients is almost totally eliminated through the use of four identical ionization chambers nested in a cruciform pattern. Two chambers are used for measurement, the other two, diagonally opposite, are used for gamma compensation.

MORE IONIZATION CHAMBER OPTIONS
TRITIUM SPECIFIC MEASUREMENTS CRUCIFORM CHAMBERS

PLATE-OUT PROOF CHAMBERS

Contamination from plate-out HTO is reduced by use of a specially designed ionization chamber which replaces the regular inner chamber in a standard Kanne design. Tests have shown that an improvement of up to three orders of magnitude is reached using this design.

PURGING IONIZATION CHAMBERS

Traces of HTO that have caused plate-out inside ionization chambers can often be removed by purging the ionization chambers with low
SPECIFYING IONIZATION CHAMBERS

OTC manufactures a wide variety of single, dual or multiple ionization chambers in sizes from 10 cc to 8 liters.

Ionization chambers are available in versions with wire grids (for low plate-out), perforated walls, or as otherwise required.

<table>
<thead>
<tr>
<th>MODELS</th>
<th>IDENTIFICATION CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>dual ionization chambers for tritium specific measurement in the presence of other radioactive gases</td>
<td>HTO</td>
</tr>
<tr>
<td>20 cc single ionization chamber</td>
<td>20 CCS</td>
</tr>
<tr>
<td>200 cc single ionization chamber</td>
<td>200 CCS</td>
</tr>
<tr>
<td>500 cc single ionization chamber</td>
<td>500 CCS</td>
</tr>
<tr>
<td>2 liter single ionization chamber</td>
<td>2 LS</td>
</tr>
<tr>
<td>2 liter dual ionization chamber</td>
<td>2 LD</td>
</tr>
<tr>
<td>2 liter quad ionization chamber</td>
<td>2 LQ</td>
</tr>
<tr>
<td>8 liter single ionization chamber</td>
<td>8 LS</td>
</tr>
<tr>
<td>8 liter dual ionization chamber</td>
<td>8 LD</td>
</tr>
<tr>
<td>remote location of chamber</td>
<td>ICR</td>
</tr>
<tr>
<td>perforated wall</td>
<td>PW</td>
</tr>
<tr>
<td>wire grid</td>
<td>WG</td>
</tr>
</tbody>
</table>

Materials of construction of ionization chambers and attached base plates are listed:

- aluminum                                     AL
- brass                                        BR
- stainless steel                               SS

SPECIAL IONIZATION CHAMBER OPTIONS

For most applications, standard single or dual 2 liter ionization chambers are used. Many other special ionization chamber configurations are available. Consult the factory for details and prices.
PASSIVE SAMPLERS
TRITIUM AND CARBON 14 IN AIR SAMPLE COLLECTING SYSTEM

A COMPLETELY SELF CONTAINED PASSIVE SAMPLE COLLECTOR FOR AIRBORNE RADIOACTIVE MATERIAL

TRITIUM IN AIR SAMPLE COLLECTING SYSTEM FOR MEASUREMENT TO 10^-9 Ci/m^3 OR LOWER

The TASC is a small self-contained unit which serves to collect samples from stacks, hoods, room air, the outside environment or other areas.

METHOD OF OPERATION AND USE

The radioactive material is continuously collected and concentrated in small vials. The amount trapped increases linearly with elapsed time. At regular intervals, the contents are assayed using (liquid) scintillation counters.

Knowing the collector flow rate, and the results of the scintillation assay, it is easy to deduce the average sample activity over the period of time over which the sample was collected.

RADIOISOTOPES, TRITIUM, CARBON 14 OR OTHER

Separate HT and HTO collectors are provided for discriminating tritium measurement. The HTO (T2O) is directly trapped in a double set of vials, while the HT fraction of airborne tritium is trapped in a second set of vials by converting the HT (T2) into the oxide by means of a small low temperature catalytic oxidizer.

Cascaded triple vials are provided to ensure virtually 100% collection efficiency.

Other isotopes that can be collected include Carbon 14, where the radioisotope, in the form of 14 CO2, is collected by using specific chemical reagents.

DESCRIPTION

The self-contained instrument consists of a pump and flow regulator to draw a constant sample (air) stream into a set of vials which collect the radioactive material.

Two sets of vials are used to ensure that whatever may be missed by one vial is virtually certain to be trapped by a second and third.

One set of vials is used to collect tritium oxide, the air stream exiting from this set is passed through a small low temperature catalytic oxidizer and the resultant oxides are then trapped in the second set of vials.

A timer is mounted on the front panel of the instrument, as well as visual indicators to signal failure of sample flow. A rotameter and a low flow switch monitor the sampling flow rate.

FOR NRC, EPA & DOE COMPLIANCE REQUIREMENTS

The TASC uses well proven techniques of passively collecting very low level radioactive samples by continued trapping in vials containing liquid or granular agents.

Government regulations impose very strict requirements on minimum detectable activity levels. Passive samplers, although they do not provide real time data, provide a low cost highly effective method of measuring to extremely low levels, thereby ensuring compliance.
**TASC TECHNICAL SPECIFICATION**

**SENSITIVITY**
For Tritium: Better than $10^{-9}$ Ci/m$^3$
For Carbon 14: Better than $1 \times 10^{-11}$ Ci/m$^3$

The detection limit depends on the collection time for any given sample flow rate

**FLOW RATE**
Standard Rotamerter (0 - 250 cc/min)
or
Optional Electronic Mass Flow Meter (10 to 500 ml/min)

**PUMP**
Oscillating piston high reliability pump

**FLOW FAILURE**
$\Delta P$ sensor, relay and pilot light

**SAMPLING VIALS**
20 cc vial, or other as requested

**OXIDIZER**
Heated platinum palladium cartridge

**ELAPSED TIME**
Electronic timer

**ENCLOSURE COOLING**
Long life fan

**ENVIRONMENTAL**
5 - 50° C, 0 - 99 % R.H.

**Quantity Discounts Available On Orders of 5 Units or More**
ULTRA LOW LEVEL MONITORS
ULTRA LOW LEVEL MONITOR

PURPOSE

This wide range tritium monitoring station is designed to meet monitoring requirements established by NESHAP and EPA 40CFR or for DOE establishments for the determination of ultra low levels of airborne tritium.

SENSITIVITY AND RANGE

Limits of resolution attained by this instrument is $10^{-9} \text{ Ci/m}^3$ or even lower. Using linear as well as proportional chamber technology, the upper limit of useful measurement can be extended to $10 \text{ Ci/m}^3$ or higher.

DISCRIMINATION

Separate measurements for the elemental as well as the oxide forms of tritium are provided. The instrument discriminates against all other airborne radioactive materials.

COMPUTER DATA ACQUISITION AND DISPLAY

A user friendly icon based P.C. system is used for the retention and display of all measurement, supervisory and alarm status information.

METHOD

Two high level linear ionization chambers and two low level proportional counters are used to span the total range of measurement. One pair of high and low level units are used to measure total tritium concentration and the other pair is used to measure the elemental form only. An automatically regenerating drying systems is used for separation of the chemical forms.

MODEL 93 -WR - T - HTO

SEPARATE SAMPLE LINES FOR ELEMENTAL AND OXIDE FORMS, ULTRA HIGH SENSITIVITY TO $10^{-9} \text{ Ci/m}^3$, WIDE RANGE TO 10 Ci/m³ STATION BY USING BOTH PROPORTIONAL COUNTERS AND LINEAR IONIZATION CHAMBERS
TECHNICAL SPECIFICATIONS SHORT FORM

Range
0 - 10 Ci/m³

Sensitivity
1 x 10⁻⁹ Ci/m³

Display
19” color video terminal showing all current and trend data for measurements, and supervisory information.

Accuracy
±10 %, and/or 10⁻⁹ Ci/m³

Response Rate
Varies with measurement level, up to 30 minutes at very low levels to 1 second at the upper end of the range

Alarms
Set point alarms for each channel, supervisory alarms for sample flow counter for flow failure

High/Low Change Over
Automatic changeover to prevent contamination of the low level measurement system

Volumes of Chambers
Linear: 2 liters nominal
Proportional: 4 liters nominal

Counter Gas Flow
Adjustable from 0.1 lpm to 1 lpm

Enclosure
Standard 19” relay rack NEMA 12 enclosure, 72” high
LOW LEVEL MONITORS, 300/400 SERIES

MEASURE TO $10^{-7}$ Ci/m$^3$

- IMMUNE TO OTHER RADIOISOTOPES, AND EXTERNAL GAMMA RADIATION.
- ELEMENTAL OR OXIDE SPECIFIC TRITIUM MEASUREMENT.
- ULTRA LOW LEVEL REAL TIME MEASUREMENTS

These monitors with linear ionization chambers offer real time rapid determinations of tritium in its elemental or in its oxide form, even in the presence of competing radioactive gases.

MODEL 321/421 - HTO - ES
This low level tritium monitor responds only to the oxide of tritium.

MODEL 321/421 - T - ES
A catalytic oxidizer converts all elemental tritium into the oxide form, this tritium monitor will measure total tritium, or the oxide only, when the catalytic oxidizer is bypassed.

MODEL 321/421 - HT-HTO-ES
Provides simultaneous measurement of both the elemental as well as the oxide forms of tritium.

MODEL 321 ES
This monitor using a single range electrometer with a digital display, will measure from 0.1 to 1999.9 $\mu$Ci/m$^3$.

MODELS AVAILABLE:

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>321/421 ES</td>
<td>Extra Sensitive</td>
</tr>
<tr>
<td>321/421 HTO-ES</td>
<td>Extra Sensitive, Oxide Only</td>
</tr>
<tr>
<td>321/421 HT-HTO-ES</td>
<td>Extra Sensitive, Elemental and Oxide</td>
</tr>
<tr>
<td>321/421 T-ES</td>
<td>Extra Sensitive, Total Tritium</td>
</tr>
</tbody>
</table>

MODEL 421 ES
Employing automatic range switched electrometers, the upper range of the basic tritium monitor can be extended several decades for measurements up to 200 mCi/m$^3$

DISCRIMINATION AGAINST OTHER RADIOGASES AND EXTERNAL GAMMA FIELDS

Out of a sample stream carrying the tritium and other radioactive gases, the tritium oxide is separated by use of a semipermeable membrane which collects only the tritium oxide and prevents passage of other gases.

FLOW SYSTEM

The permeated tritium oxide is carried into the ionization chamber by air that has been cleaned by a high efficiency purification system.

Dual ionization chambers are employed for compensation of external gamma fields. The purified carrier air first flows through the compensating ionization chamber, then through the permeation column where it picks up the tritium, and finally passes through the measuring ionization chamber.

AIR PURIFICATION SYSTEM

An automatically regenerating dryer system removes all moisture from the incoming air. This dried air stream is passed through an activated carbon bed for further gas purification, eliminating organic vapors. A HEPA filter follows, to ensure that no particulates can enter the ionization chambers.
DISCRIMINATES AGAINST OTHER RADIOISOTOPES

Model 593 is sensitive only to tritium. A semipermeable membrane is used to isolate tritium oxide for passage into the instrument measuring system. All other sample constituents, including pollutants, radioisotopes, aerosols or particulates are removed and eliminated from the measurement.

FAST RESPONSE THROUGH DEDICATED ELECTRONIC SIGNAL PROCESSING

Simultaneous pulse rise and pulse duration signal processing is used to select only those pulses which correspond to tritium beta decay.

This method of pulse selection, described by a number of authors dating back to the 1960's, brings orders of magnitude increase in speed of response, as well as in inherent sensitivity.

MEASURES HTO OR TOTAL TRITIUM

A catalytic oxidizer can be provided so that either total tritium, or just the oxide form, can be measured at any time.

COMPENSATED FOR EXTERNAL GAMMA FIELDS

Gamma compensation is required to be able to measure to ultra low levels. Model 593 uses not only electronic signal processing to distinguish tritium signals (from background) but also uses dual counters to ensure that the effects of moderate external gamma fields are still further reduced.

Lead shielding around the counter tubes is used to reduce background gamma, thereby improving the statistical signal to noise ratio to enhance sensitivity.

FULLY AUTOMATIC OPERATION, CONVENIENT DISPLAY AND CONTROLS

Except for routine replacement of the counting gas cylinders, the operation of the instrument is fully automatic and requires no operator attention.

The instrument features a large digital panel meter for measurement display, as well as alarm functions for measurement levels, loss of sample flow, depletion of counting gas or of electronics failure.

MODEL 593

Specifically designed to measure ultra low levels of tritium for compliance with 10CFR61 regulations, Model 593 measures to levels of

\[ 3 \times 10^{-9} \text{ Ci/m}^3 \]

\[ 100 \text{ Bq/m}^3 \]

PRINCIPLE OF OPERATION

Model 593 utilizes a pair of balanced proportional counters. The counting gas first passes through the gamma compensation counter, then traverses finally through the second proportional counter.
TECHNICAL SPECIFICATIONS

The Model 593 employs two balanced proportional gas flow counter tubes together with a diffusion permeation system for rapid ultra low level tritium specific measurements. The following specifications apply to the standard unit. Consult the factory for variations.

MEASUREMENT

RANGE 0 to 2 MBq/m³ (0 to 50 μCi/m³)

DISPLAY 4 1/2 digit panel meter, in steps of 100 Bq/m³

RESOLUTION and NOISE LEVEL 100 Bq/m³, 1 S.D. (1σ)

TIME BASE, MEASUREMENT 10 minutes, pulses are accumulated (measurement repetition rate) over a 10 minute period.

TIME BASE, BACKGROUND 100 minutes (or 10 minutes) pulses from the background compensation counter are averaged over a period as long as 100 minutes to enhance signal stability.

MEASUREMENT INTERFACE OUTPUTS
i) 0 - 10 V, linear
ii) logarithmic, 1 volt/decade
iii) E to I, 4 - 20 mA, logarithmic 2 mA/decade
iv) RS - 232

OPTIONAL DISPLAY FEATURES
i) chart recorder, logarithmic scale
ii) totalizer integrates measurement

ELECTRIC FUNCTIONS

ALARMS, MEASUREMENT Single alarm point, logarithmic scale

ALARMS, SUPERVISORY i) sample flow failure
ii) counting gas pressure loss
iii) electronics failure

ALARM INTERFACE i) fail safe relay closures
ii) RS - 232

PNEUMATIC SYSTEM

PROPORTIONAL COUNTERS Dual copper clad acrylic counter tubes, 2 liter active volume, 2.5 liter wetted volume, 0.001 inch tungsten collector anode

COUNTER GAS P - 10 or “MAGIC” gas for high performance
Flow rate 250 cc/min, typical

TRITIUM COLLECTION transfer via a polysulfone semipermeable diffusion membrane

SAMPLE FLOW SYSTEM Oscillating piston pump, flow rate 5 lpm typical

FLOW METERS front panel rotameters and LED failure displays for counter gas and sampling system

ENCLOSURE 19” relay rack, 48” high, 24” deep approx, indoor use only

WEIGHT less than 200 lbs

POWER 115/230V 50/60 Hz, 100 W max.

ENVIRONMENTAL temperature 10° C to 30° C
humidity 0 - 95 % R.H.
SURFACE CONTAMINATION MONITORS
THE FERRET FAMILY

RADIOACTIVE SURFACE CONTAMINATION THE FERRET FINDS IT
...even Tritium and Carbon 14 in 60 seconds or less
When time is money - use the low cost easy to use
FERRET Surface Contamination Monitor

HIGH SENSITIVITY FAST RESPONSE.
The FERRET will, within seconds, detect and
determine radioactive surface contamination to a
fraction of regulatory requirements for permissible
amounts.

WHAT ARE THE FERRETS?
The Ferrets are self contained ultra sensitive
proportional counters for Tritium, Carbon 14 and
all other alpha, beta and gamma emitters

WHAT DISTINGUISHES THE FERRETS FROM
EACH OTHER?
There are two FERRETS, both of which was
designed for specific applications.

FEATURES:

• The FLAT FERRET for the accurate
  measurement of all flat surfaces
• SPEEDY FERRET. An a.c. powered counter
  for the rapid assay of wipes and swipes.

BENEFITS:

• The FERRETS are your low cost solution to
  rapid, accurate and sensitive determination or
  assay of radioactive surface contamination.
• The FLAT FERRETS are used to screen
  suspected surface areas, only those that
  show evidence of contamination will then
  require closer inspection.
• The SPEEDY FERRET is used to assay
  wipes and swipes for removable
  contamination well beyond regulatory
  requirements.
THE FLAT FERRET, MODEL FF-27

OPEN WINDOW GAS PROPORTIONAL COUNTER

AND NOW...
MODEL FF-27 FOR REJECTION OF OTHER NUCLIDES AND INTEGRATION CAPABILITIES

FEATURES:
● PORTABLE
● SENSITIVE
● LOW GAS CONSUMPTION
● BUILT IN AUDIO
● AUTO GAS SHUTOFF

DESCRIPTION:
The FF-27 Tritium Contamination Monitors are portable gas flow proportional counters sensitive to betas of H-3. The windowless probes slide over flat surfaces on poly tape which gives repeatable spacing from surface as well as easy scratch-free movement. The poly tape is easily cleaned but may also be replaced if contaminated. P-10 counting gas utilized in the FF-27 probes is non-combustible and can be used in any environment.

Gas use is minimized by careful design of chamber and by auto shut-off of gas flow when “trigger” on probe handle is released. Typical counting efficiency is 70% of all Tritium betas escaping the surface being monitored as compared with results obtained using an internal hemispherical 2 pi counter. Gas flow is normally set at 800 cc/min, giving a one hour use for lecture bottle or, of course, proportionally longer within larger cylinder. (See option below) Probe may also be used to monitor hands, clothing and equipment with included Model H face plate. Two lecture cylinders of P-10 gas are included with instrument.

The electronics include OTC stabilized high voltage bias supply, preamp, pulse shaper and pulse to analog converter. Circuit design minimizes recovery time of detector and allows linear response at higher count rates than previously possible. A piezo electric speaker with volume control and 3-1/2” meter provide audible as well as visual readout.
SPECIFICATIONS

Ranges:
500; 5,000; 50k; 500k cts/min (FF-27M) or
0-10; 100; 1,000; 10,000 cts/sec (FF-27S)

Flowmeter: 10-1000 cc/min. Needle valve control.

Background:
Typically less than 800 cts/min for (FF-27M) or 15 cts/sec for (FF-27S)

Controls:
Open range switch, battery check, flow gas control, sound volume control.
Hidden high voltage bias supply for detector: Input sensitivity high voltage control.

Calibration:
4 range pots and 1 overall control. Internal.

Detection Area:
FF-27S (or M) With clothing mask attached 0.5cm x 14cm.
Mask removed 4.6cm x 21.6cm.

Sensitivity:
At 100 Bq/100 cm², 35 cts/sec above background for FF-27.

Battery:
2 nine volt "transistor" batteries Eveready 1222 or equivalent, 300 hour normal operating life.

Weight:
Probe FF-27: 0.57 Kg (1lb. 4 oz.)
Electronics Package: 2.6 Kg (5lbs. 12oz.) plus
P-10 gas container: 0.6 Kg (2lbs. 6 oz.)

Shipping Weight:
15 lbs.

Option:
SPEEDY FERRET, MODEL SF-TF-6
FOR WIPE AND SWIPE ASSAY

FEATURES:
- WINDOWLESS
- WIPE
- COUNTER
- PORTABLE

FOR:
- TRITIUM
- CARBON 14
- SULPHUR 35
- ETC.

SYSTEM INCLUDES:
- PRS-5 SCALER
- PRE-AMP
- STB-TF-6 DRAWER, SHIELD, DETECTOR

SPECIFICATIONS:
- Ideal for wipe test counting of flow energy beta emitters
- 1-1/8" diameter low background gas flow detector probe with drawer and 1 inch lead shield
- Background: typically < 10 cpm
- Connects directly - no changes or adapters needed
- Low gas usage
- O-ring gas seal
- Uses P-10 (90% argon 10% methane) or similar counting gas
- Includes 3 feet RG 58 cable
- MHV terminated
- Includes 6 feet of 1/4" gas supply tubing
ENVIRONMENTAL GAMMA MONITORS
MODEL HPIC

ENVIRONMENTAL GAMMA MONITORS

ULTRA SENSITIVE, WIDE RANGE, VERSATILE

Designed around Overhoff Technology Corporation (OTC) proprietary electrometers, these high pressure ionization chamber gamma monitors are far more sensitive, yet physically much smaller than other competing instruments.

SENSITIVITY

The OTC HPIC gamma monitors will detect changes of less than 1% of ambient terrestrial and cosmic radiation, over a wide temperature range. The standard sensitivity version measures as low as 10 μR/h [0.1 μSv/h]. Also available is a high sensitivity version that can measure as low as 1 μR/h [0.01 μSv/h] with better stability.

RANGES

The auto-ranging electronics has a measurement range up to 4,000 mR/h [40 mSv/h] on the standard version. The high sensitivity version is limited to a measurement range up to 400 mR/h [4 mSv/h].

SIZE

The tripod mounted sensor is compact, measuring 7” [178mm] diameter x 14” [356mm] long, excluding power supply module. The total package weighs only 18 lbs [8.2 kg].

ENVIRONMENTAL

The sensor package is waterproof and operates from 0° C to +50° C without drift in zero and change in span sensitivity. The sensor is rugged and will withstand moderate shock.

REMOTE CAPABILITY

The HPIC can be operated in remote locations without AC line power for up to 24 hours when using a power supply module that is equipped with internal batteries. Additional power supply modules are available as an accessory. Continuous operation is possible by using fully charged modules, rotated on a daily basis. Data can be stored at the site of the HPIC on compact flash memory cards or transmitted in real-time via RF link.
MEASUREMENT, STANDARD SENSITIVITY VERSION

MEASUREMENT RANGE 0-4.0 R/h [0-40 mSv/h]
RESOLUTION AND ACCURACY (SPAN) 10 μR/h [0.1 μSv/h]
STABILITY AND DRIFT better than ±10 μR/h (±0.1 μSv/h)
DISPLAY Monochrome graphic LCD with backlight

MEASUREMENT, HIGH SENSITIVITY VERSION

MEASUREMENT RANGE 0-400 mR/h [0-4 mSv/h]
RESOLUTION AND ACCURACY (SPAN) 1 μR/h [0.01 μSv/h]
STABILITY AND DRIFT better than ±3 μR/h (±0.03 μSv/h)
DISPLAY Monochrome graphic LCD with backlight

DATA ACQUISITION

COMMUNICATION LINK RS232 Serial Transmission
SOFTWARE Terminal Emulation Program

POWER

HPIC POWER Li-Ion rechargeable battery pack, operates for 8 hrs (full charge). Recharges in 4 hours at 7.5V, 1A

POWER SUPPLY MODULE Input: 100-240VAC, 50-60Hz
Output: 7.5VDC, 3A max
Internal NiMH battery, 6 cells, 9.5Ah
HPIC will operate for 24 hrs at full charge recharges in 8 hrs

ENVIRONMENTAL

TEMPERATURE, HUMIDITY 0° C to +50° C, 99% RH
ENCLOSURE RATING IP64, sealed against dust and water spray

DIMENSIONS AND WEIGHTS

SENSOR TUBE 5” [127mm] Diameter x 12.6” [320mm] Long
SENSOR FRONT PANEL 6.6” [168mm] Diameter x 0.5” [12mm] Thick
TRIPOD MOUNTING PLATE 25” [635mm] L x 7” [178mm] W x 0.5” [12mm] Thick
WEIGHT 12.5 lbs [5.7 kg]
TRIPOD, adjustable height 38” to 63” [96.6cm to 160cm] 9 lbs [4.1 kg]
POWER SUPPLY MODULE 4.8” [122mm] H x 6.3” [160mm] W x 9.4” [239mm] L
5.5 lbs. [2.5 kg]

OPTIONS: Choose one of the following,

RADIO NETWORK 1500ft [450M] up to 20miles [32.2km]
LOCAL DATA STORAGE Data recording media; CF card, data capacity; 512M
MODEL 903

REACTOR GAS MONITOR FOR BETA AND GAMMA RADIATION

FOR DOSE RATE ASSESSMENT OF RADIOACTIVE GASES

Specifically designed to measure the total energy absorption per unit volume due to both beta and gamma components of radioactive gases typically found in association with nuclear power plant reactors. Mixture of gases typically include $^{85}$Kr, $^{41}$Ar, and others. The instrument is designed specifically to measure ENERGY ABSORPTION PER UNIT VOLUME PER UNIT TIME, and can be calibrated in terms of MeV·Bq/m$^3$ or MeV·Ci/m$^3$.

This measurement is noted to be closely related to dose rate, which is ENERGY ABSORPTION PER UNIT MASS PER UNIT TIME, rather than volume. The two rates are indirectly related to each other.

INSTRUMENT CONFIGURATION

A volume of radioactive gas, as contained in a shielded chamber, is faced by a scintillation photo-multiplier detector.

The signal output of the scintillation system is processed by analog circuitry to produce an output which is accurately proportional to the beta/gamma energy per unit time.

ENERGY

The instrument response is proportional over a wide range of energies. The degree to which the proportionality is accurate is a function of the energy spectrum of the radiogases as compared to the effective size of the scintillation detector. The OTC scintillator system is configured to be accurate over the range of energies typically associated with reactor gases.

PRINCIPLES OF RADIATION ABSORPTION

A scintillator is a material which converts particle or photon energy into scintillation of light. The scintillation is converted into an electric signal and subsequently amplified by a photomultiplier tube.

If the scintillator photo pulses are to be accurately proportional to the incident energy, the scintillator has itself to be energy independent, at least over the range of energy of interest. To accomplish this, it is required to simply make the scintillator physically large and use as dense a material as possible.
GAMMA RAY INTERACTIONS

Of the various ways gamma rays can interact with matter (the scintillator) only three interaction mechanisms have any real significance.

They are:

1. Photoelectric absorption.
2. Compton scattering, and
3. Pair production. It is to be noted that photoelectric absorption predominates for low energy gamma rays (up to several hundred keV), pair production predominates for high energy gamma rays (above 5-10 MeV). Compton scattering is the most probable process over the range of energies between these extremes.

To be specific, the photoelectric process involves the generation of an Auger electron of very short range, thus even small scintillators will suffice.

Reactor gases, mainly Krypton, Xenon and Argon, all have energies below 1.3 MeV, therefore, the pair production process is not of importance. Thus, the major key to scintillator size is the absorption process associated with Compton scattering. Full discussion of all the possible interactions associated with Compton scattering has no place in this description, but can be found in many texts on radiation detection and measurement. It is sufficient to say that to ensure even (flat) energy response, the detector should be sufficiently large, so that the recovery of all secondary gamma radiation produced through Compton scattering be as complete as possible. This simply means making the scintillator out of a dense a material as possible, and to make it physically as large as suitable.

SHIELDING

If the instrument is to be located where gamma background is present, then shielding of the instrument is required to ensure that the external background does not add an unwanted contribution to the measurement.

ELECTRONICS

With a sufficiently large and dense scintillator, the output current of the photomultiplier tube is accurately proportional to the total energy of the incident beta and gamma radiation. The associated electronics is quite simple, a very stable high voltage power supply is required since the amplification factor of the PM tube is related to the power of the number of dynode amplifier stages (typically 10 - 14) inside the tube.

The current signal amplifier stages consist of linear d.c. amplifiers, which may be followed by a logarithmic converter, E to I converter, RS - 232 or any similar desired output.
MODEL 903

REACTOR GAS MONITOR FOR BETA AND GAMMA RADIATION

ABRIDGED TECHNICAL SPECIFICATION

RADIATION DETECTED Reactor gases, beta and gamma radiation
ISOTOPES Krypton, Xenon, Argon and others
ENERGY RANGE 80 Kev to 1.5 Mev
ACCURACY Beta: essentially 100 %
MAXIMUM RANGE OF MEASUREMENT \(0 - 2 \times 10^{10} \text{ MeV} \text{Bq/m}^3\)
(other ranges available on request)
SCALE 6 decades over any user selected range
SENSITIVITY, STABILITY \(\pm 1 \times 10^4 \text{ MeV} \text{Bq/m}^3\),
other sensitivity requirements are met by altering the desired range
SAMPLING VOLUME 1 liter, nominal, sampling volume can be removed for inspection
PHOTOMULTIPLIER TUBE 10 - 14 stage, CsSb photocathode for ultra stable again
SCINTILLATOR Sodium Iodide, Bismuth Germanate, Calcium Tungstate or other
SHIELDING The sampling volume is surrounded by lead shielding of 100 mm (4") thickness to eliminate gamma background
DISPLAY Digital, or analog, as customer specified
SIGNAL OUTPUTS linear, 0 - 10 V, or as option
1. logarithmic
2. 4 - 20 ma
3. RS 232, RS485, or ethernet
ENVIRONMENTAL temperature: 0 - 50° C
humidity: 0 - 99 % R.H.
CHECK SOURCE optional, Kr 85 micro bead, remotely controlled
ALARM FUNCTIONS 1. single set point signal alarm, 10 turn potentiometer adjustable over the full measurement scale
2. loss of high voltage malfunction alarm
3. sample flow malfunction alarm
PUMP and FLOW METER Rotameter with needle valve, oscillating piston, or vane pump
POWER 120/240 V, 50/60 Hz
HEAVY WATER LEAK DETECTOR
MODEL 1925
HEAVY WATER LEAK DETECTOR (HWLD)

LOW LEVEL REAL TIME TRITIUM-IN-WATER MONITOR

This monitor has been designed for real time low-level detection of tritium in water in the industrial environment of nuclear power plants. Low MDA, reliability, ruggedness and simplicity of operation is what sets this monitor apart from laboratory type of the equipment. The primary purpose of the Model 1925 is to detect the leak of heavy water in nuclear power plants that utilize CANDU reactors; however, it can be used for other purposes such as monitoring changes in tritium content of ground water, rivers, lakes or ocean currents.

MINIMUM DETECTABLE ACTIVITY (MDA)

The unit detects tritium decay with Photo Multiplier Tubes (PMT) working in coincidence mode. Use of highly effective PMTs, specially designed sampling cell to minimize cosmic radiation and Cherenkov effects and 1" lead shielding provide for low background noise of only one count per second with a counting efficiency of 30%. MDA is 3.7kBq/L.

RESPONSE TIME

The unit is equipped with up to 6 inputs for sampling 6 individual lines. The response time from when sample enters the system until the unit starts to respond is 3 minutes and in 9 minutes the full value of tritium concentration in the sample is displayed on the screen. Each sample line is sampled for 10 minutes so that the effect of residual activity from the previous line is minimized.

REMOTE MONITORING AND ALARMING

The instrument is equipped with 4-20mA output for remote monitoring as well as with 2 alarm outputs and malfunction outputs in the form of dry, fail-safe, relay contacts. Alarms are adjustable and by default are set at 100kBq/L (Hi Alarm) and 110kBq/L (Hi-Hi Alarm).
DATA RECORDING

The instrument is equipped with Serial Data Recorder that utilizes Microdrive® card to store up to five years worth of readings in daily files. This information is in text format that is easily extractable to Excel for analysis and graphic presentation.

PRESSURE REGULATING EQUIPMENT

Pressure of input sample streams can be up to 103 kPa. This pressure is immediately reduced to 2-3 psi via Pressure Regulating Valves (PRV). Each PRV is associated with Pressure Relieve Valve set to open at 100 kPa, therefore, the pressure in the system can never be more than 100 kPa, which makes it safe to handle. This also makes the instrument Class 6 Nuclear Device.

FULLY INTEGRATED PACKAGE

Model 1925 is a completely self-contained instrument for real time observation of tritium concentration in water. The instrument is mounted inside of the 200cm tall steel enclosure with reinforced anchoring feet and locked access.

Liquid scintillator is connected to the unit externally and it is stored inside of the polyurethane drum of 23 liters. This quantity of liquid scintillator is sufficient for 60 days of continuous, 24/7 operation.

The main subassemblies are:
1. Sample water input lines
2. External cooling loop input/output lines
3. Internal cooling loop complete with chiller, chiller pump and plumbing
4. PRV and RV system with manifolds
5. Water purification system (oil-in-water and micron filter)
6. Sample water pump
7. Detection module
8. Data acquisition electronics module
9. System control module
10. Waste water output line, RV output line and sample bypass output lines

COOLING SYSTEM

In order to have maximum efficiency of the liquid scintillator, solution that is tested inside of the sample cell is kept between 12°C and 20°C. This is achieved by internal cooling loop system, which is a closed loop cooling system with its own pump and chiller unit. If the unit operates in extreme temperatures (more than 45°C) external cooling loop is provided, where user shall provide chilled water from its own source.
PLC CONTROL

Sampling of input lines and control of alarms and pumps is done by PLC unit placed inside of the System Control Module. There is an alarm provided in case of PLC failure as well as manual override so that the operation can be continued manually until PLC is replaced. Manual operation is a backup system; the unit normally operates in automatic mode.

ROUTINE MAINTENANCE

Scheduled maintenance of consumables is required. Liquid scintillator needs to be replenished every 2 months and sample water filters need to be replaced. Also, periodic check of the efficiency and background is recommended if there is a possibility of increased background contamination and due to standard lifecycle of electronics components.

ANNUAL INSPECTION AND SERVICE

It is recommended that the instrument be inspected and serviced on an annual basis to ensure continuing trouble free operation. All components of the instrument should be inspected and instrument re-calibrated.

REPAIR

Equipment failures of a minor nature can be repaired under local supervision by the operator of the equipment. When necessary, the manufacturer (Overhoff Technology Corporation (OTC)) can dispatch service personnel for quick remediate action.

DOCUMENTATION

All OTC equipment is accompanied by complete documentation, which includes the following:

1. User and Maintenance Manual that contains:
   a. Theory of operation
   b. Installation instructions
   c. Operation instructions
   d. Calibration procedure
   e. Suggested maintenance
   f. Repair instructions
   g. Drawings, diagrams and schematics

Training will be provided by the manufacturer, free of charge. Assistance with commissioning is also available by the manufacturer (OTC).
**MODEL 1925 TECHNICAL SPECIFICATION**

**MEASUREMENT RANGE:** 3.7kBq/L – 130kBq/L  
**RESOLUTION (SENSITIVITY):** 1.0kBq/L  
**MINIMUM DETECTABLE LIMIT:** 3.7kBq/L at confidence level of 95%  
**DISPLAY:** 6–Digit Vacuum Fluorescent Display  
**RESPONSE RATE:** 3 min beginning of the response, 9 min full value displayed  
**MEASUREMENT METHOD:** Liquid Scintillation Counting  
**DETECTOR:** Dual PMT coincidence counter surrounded by multi-element shielding  
**SIGNAL PROCESSING:** Electronic signal processing of coincident pulses for tritium specific wave shapes (height and duration)  
**MEASUREMENT ALARM SET POINT:** Can be manually adjusted  
**DATA RECORDING:** Serial Data Recorded with Microdrive® card  
**SAMPLING/MIXING SYSTEM:** Dual head, low flow rate pump. Liquid scintillator and sample mixed at the sample cell.  
**SAMPLE CELL:** Stainless steel cell, volume 5cc with fused silica windows and Viton O-rings for sealing.  
**WASTE MANAGEMENT:** Waste water output lines with Swagelok® fittings are provided, user to provide waste collection system.  
**TEMPERATURE:** 0°C to 50°C  
**HUMIDITY:** 0 to 95 % R. H.  
**SEISMIC:** Withstands modest shock  
**ELECTRICAL:** Power 110/230VAC, 5A  
**MECHANICAL:** Self contained, mounted on a steel frame with lifting eyes for easy transport.  
**DIMENSIONS:** 31.5in x 23.6in x 84.0in  
(800mm x 600mm x 2133mm)  
**WEIGHT:** 1100 lb (500 kg)
### PARTS LIST FOR MODEL 1925 HEAVY WATER LEAK DETECTOR

<table>
<thead>
<tr>
<th>Qty Req’d</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 each</td>
<td>614C359C2</td>
<td>Photo Multiplier Tube Ass’y</td>
</tr>
<tr>
<td>2 each</td>
<td>608F6370C2</td>
<td>Pre-Amplifier PCB Ass’y</td>
</tr>
<tr>
<td>1 each</td>
<td>609F6075C2</td>
<td>Comparator PCB Ass’y</td>
</tr>
<tr>
<td>1 each</td>
<td>614D6360C2</td>
<td>Display PCB Ass’y</td>
</tr>
<tr>
<td>1 each</td>
<td>686B6295C2</td>
<td>Alarm/Relay PCB Ass’y</td>
</tr>
<tr>
<td>2 kits</td>
<td>565C6289C2</td>
<td>Pump Kit</td>
</tr>
<tr>
<td>2 each</td>
<td>564F6852C2</td>
<td>Viton O-ring</td>
</tr>
<tr>
<td>2 each</td>
<td>564E6851C2</td>
<td>Viton O-ring</td>
</tr>
<tr>
<td>1 each</td>
<td>544E6165C2</td>
<td>Relief Valve</td>
</tr>
<tr>
<td>1 each</td>
<td>545A6259C2</td>
<td>3 way Solenoid Valve</td>
</tr>
<tr>
<td>1 each</td>
<td>601B533C2</td>
<td>Level Switch</td>
</tr>
<tr>
<td>1 each</td>
<td>601c6534C2</td>
<td>Level Switch</td>
</tr>
<tr>
<td>1 each</td>
<td>584A6217C2</td>
<td>Filter Cartridge</td>
</tr>
<tr>
<td>1 each</td>
<td>601D6535C2</td>
<td>Dual Pressure Switch</td>
</tr>
<tr>
<td>2 each</td>
<td>611C7017C2</td>
<td>Rtd, 3 Wire Class</td>
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<tr>
<td>2 each</td>
<td>584C6373C2</td>
<td>Filter Element</td>
</tr>
<tr>
<td>10 each</td>
<td>653D6010C2</td>
<td>Armature Brush</td>
</tr>
<tr>
<td>10 each</td>
<td>817D7186C2</td>
<td>Eprom</td>
</tr>
<tr>
<td>1 each</td>
<td>160F6019C2</td>
<td>Spray Can with Touch up paint</td>
</tr>
</tbody>
</table>
OVERHOFF OVERVIEW

SOFTWARE AND HARDWARE FOR ALL YOUR REMOTE MONITORING NEEDS

Inside your facility you need real-time monitoring for:
• differential pressure on containment boxes and rooms
• linear feet per minute air velocity on open front hoods
• gamma and neutron radiation levels
• airborne radioactivity levels
• stationary contamination monitor alarms
• temperature and humidity in the facility
• status of security doors

At the perimeter of your facility you need real-time monitoring for:
• gamma and neutron radiation levels
• airborne radioactivity levels
• temperature and humidity
• barometric pressure
• wind speed and direction
• status of security gates

Overhoff Technology provides state-of-the-art radiation monitoring instruments for real-time monitoring. Along with our ability to network your legacy and newer instruments, we can provide you with the best and most comprehensive remote monitoring system possible. We can provide networking for any instrument with a communication port. If your instruments do not have communication ports we can add serial ports (RS232, RS485, USB) or Ethernet ports to those instruments. Tracking and trending of your data along with predictive analysis with Overhoff OverView ensures that your radiation monitoring program remains in high gear.
CALIBRATION EQUIPMENT & TESTING

CALG  Gas Calibrator

The Gas Calibrator is supplied with all needed components to accurately calibrate your OTC Tritium Monitors, including the regulator, gages, valves and a lecture bottle containing <1mCi of NIST traceable tritium gas.

CALL  Calibration Gas, Certified <1mCi Lecture Bottle

The Lecture Bottle contains <1mCi of NIST traceable tritium gas. This tritium gas is used in conjunction with the Gas Calibrator listed above.

CALR  Calibration Resistors

Ultra high meg ohm resistors, certified to about 1% precision, used for electrical calibration (or verification) of the tritium monitors response.

CALB  Recommended Yearly Calibrations

Calibration (or verification) of tritium monitors should be performed at yearly intervals, or as otherwise specified. The object is to make sure that the instrument displays readings which correctly corresponds to the activity of the tritium laden gas stream passing through the ionization chamber.

TRN  Training Sessions

Training Sessions can be conducted at Overhoff Technology for all Tritium Monitors built by Overhoff.

Training Course Descriptions:

- Theory of Measurement for Tritium Monitors
- Operation and Maintenance of the Tritium Monitor
- Troubleshooting and Repair of the Tritium Monitor
- Calibration of the Tritium Monitor
## Tritium Gas Standard

<table>
<thead>
<tr>
<th>Cylinder Type</th>
<th>Lecture Bottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material of Construction</td>
<td>Steel</td>
</tr>
<tr>
<td>Dimensions</td>
<td>50mm diameter x 310mm long</td>
</tr>
<tr>
<td>Volume</td>
<td>0.4 Liters</td>
</tr>
<tr>
<td>Maximum Pressure</td>
<td>1800 psi</td>
</tr>
<tr>
<td>Carrier Gas</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>Maximum Radioactivity</td>
<td>1 milli Curie</td>
</tr>
<tr>
<td>Valve Material</td>
<td>Brass</td>
</tr>
<tr>
<td>Connection Fitting</td>
<td>CGA-180</td>
</tr>
</tbody>
</table>

The lecture bottle is a secondary standard that is made by diluting gas from a primary standard with a tritium concentration traceable to NIST.

Nominal available concentrations:
- 50 μCi per liter
- 20 μCi per liter
- 7 μCi per liter

Note: check for availability when ordering.

Regulations require our customers to furnish a copy of their license for radioactive materials permitting them to possess H3 gas. Amount of radioactive material is an exempt quantity and shall not exceed 1 mCi.
MAINTENANCE AND REPAIR
OF TRITIUM MONITORS
HEPA FILTERS AND HOUSINGS

Entry of dust particulates is prevented by attaching a good quality particulate filter ahead of the instrument sampling inlet. OTC Tritium Monitors are never to be operated without a dust filter in the sample stream.

It is IMPERATIVE that the sample stream be free from dust, dirt or moisture. Not only will the instrument show erratic behavior, but it may cease to function entirely.

OTHER PARTS AVAILABLE BUT NOT LIMITED TO

Ionization Chamber/Electrometer Module
Main/Amplifier PC Board Assembly
Logarithmic Amplifier
RS-232 and RS-485 Output Boards
Digital Panel Meter
Power Supply Assembly
Pumps
Transformers
Desiccant Cartridges and Media
Various Control Knobs and Switches
Carrying Cases
Sniffer Hoses

(Call Factory for Assistance)
APPENDIX
THE NATURE OF TRITIUM

The third isotope of hydrogen, called tritium, is an artificially created substance which is very weakly radioactive. Upon radioactive decay, it emits a beta particle with a maximum energy of about 18 kev. The half life of tritium is somewhat over 12 years, which makes it a relatively long lived radioactive material.

Since it is chemically indistinguishable from hydrogen, tritium is readily absorbed by the body and can be hazardous to human health. Because it is readily absorbed by the human body, it is used (along with Carbon 14) as a radioactive tracer in the pharmaceutical industry.

THE PHOENIX REACTION

Tritium fuses with deuterium (hydrogen 2) under conditions of high pressure and temperature, releasing enormous quantities of energy. Called the Phoenix reaction, this is the basis of mankind’s future source of energy, as well as being one of today’s major methods of destruction.

Tritium is an unwanted phenomenon in heavy-water moderated nuclear power plants. It is the result of neutron capture by the D2O itself, and becomes a hazard when -- after a number of years of operation -- the concentration of DTO becomes significant.

TRITIUM DETECTION METHODS

The quantity or activity of tritium is determined by measuring the energy released as it decays. At very high levels, it is possible to use calorimetric methods, measuring the heat generated as the tritium decays. More usually, however, measurement methods involve the detection of the beta particles (electrons) that are created during decay.

1. GAS PROPORTIONAL COUNTERS

If tritium is in gaseous form, rather than liquid, and the application is to detect individual decay events, then proportional counters are used.

Basically, a proportional counter is a device that uses a process known as gas multiplication to linearly amplify the charge generated by a nuclear event. When used for the detection of tritium, the purpose of the proportional counter is to amplify the very weak beta energy to a level where it can be further processed, pulse by pulse, by conventional electronic means. OTC Proportional counters selectively measure tritium in concentrations below $10^{-3} \mu$Ci/m$^3$.

2. LINEAR IONIZATION CHAMBERS

If tritium is contained in a volume under an electric field, the electric charges that are generated by a radioactive decay can be collected in the form of an averaged electric current. Although tritium is a very weak radioisotope, it is feasible to use ionization chambers for measurements as low as a few hundred Bequerels per cubic meter ($10^{-7}$ to $10^{-9}$ Ci/m$^3$). The sensitivity of measurement attainable by the use of ionization chambers depends on several factors, including the size of the chambers and the quality of the electrometer ionization current amplifier.
3. DISTINGUISHING BETWEEN CHEMICAL FORMS OF TRITIUM

Tritium may be present in elemental form such as HT, DT or T₂, or it may be found in its oxide form HTO, DTO or T₂O. Since the liquid form is chemically identical to ordinary water, it is easily retained by the body. In its gaseous form, it is almost entirely expelled by the lungs and is not absorbed. Therefore, the oxide form is much more dangerous as a biological hazard.

Consequently, it is important to be able to determine the presence of only the oxide fraction of tritium or to be able to measure the relative quantity of the oxide and the elemental forms. To measure tritium oxide only, the following method can be used. A desiccant system, using drier columns, is interposed between two ionization chambers of identical volume. The ionization chambers are polarized with opposite voltages, so that the net ionization current collected from both ionization chambers will then represent the contributions of ionization current due only to tritium oxide. It is to be noted that this method applies also for true tritium oxide measurements, even when other gaseous radionuclides are present in the sample stream.

To measure the tritium fraction due to elemental tritium only a similar method can be used by first oxidizing the elemental tritium by means of small catalytic converter.

4. DISTINGUISHING TRITIUM IN THE PRESENCE OF OTHER RADIOISOTOPES

General environmental air monitoring. The planet we inhabit is naturally radioactive. When measuring tritium in the air we breathe, it is necessary to distinguish it from other radioactive factors such as naturally occurring radon and background gamma radiation from terrestrial or cosmic origin. This is accomplished by using radon alpha pulse suppression and by the use of dual ionization chambers as described above.

5. CONTAMINATION (PLATE-OUT) PROOF IONIZATION CHAMBERS

The inner shell of the standard Kanne design is replaced by a thin wire cage. The wire cage serves as the repelling electrode of the ionization chamber, effectively shielding all ionizations or electrons that may emerge from the interior solid wall of the chamber assembly. Since the actual surface area of the wire cage is very small, memory effects due to absorbed HTO are reduced by two to three orders of magnitude over conventional ionization chambers.

6. ULTRA LOW-LEVEL MEASUREMENT CHAMBERS

Large (40 liter) ionization chambers are used for measurements as low as 10⁻⁸ Ci/m³. These 40-liter chambers are used in conjunction with air purification systems and permeation tubes. Further details are provided in the sections describing Models 321/421 HT - HTO - T - ES monitors.
APPLICATIONS THAT AFFECT CONFIGURATIONS OF TRITIUM MONITORS

Different applications require different system configurations. The level of tritium activity usually determines the configuration required.

A. PROCESS PIPING (HIGH CONCENTRATIONS)

Linearity, accuracy of measurement, and vacuum integrity of the ionization chambers are paramount for the measurement of high tritium concentrations. The design of the ionization chamber is crucial to ensure freedom from saturation effects, and it must be leak tight. The possibility of radiological damage to the ionization chamber structural components must also be taken into account.

High levels of tritium oxide tend to produce semi-permanent deposits on the insides of the ionization chambers, which create false signals. By incorporating specially designed contamination (plate-out) proof ionization chambers this problem is solved.

B. ENVIRONMENTAL MONITORING, GLOVE BOX, HOOD, STACK AND DUCT MONITORS (INTERMEDIATE CONCENTRATIONS)

Facilities that routinely process or handle significant quantities of tritium use monitors to control human exposure, and to ensure a minimum discharge of tritium into the environment. These types of applications require that the tritium monitors be capable of measuring intermediate levels of concentration. Such instruments need to measure as low as 0.1 μCi/m³, or more.

For these applications, the monitors must be capable of distinguishing tritium in the presence of natural background, including radon and external low-level gamma fields. This requires special methods to render the monitor immune to radon. Lead shielding can be used to reduce the response to external gamma fields. Dual ionization chambers are used to overcome the effects of external gamma fields.

Nuclear Power Plants or Fusion Research Facilities. Atmospheres surrounding nuclear reactors are bombarded with a wide variety of highly energetic nuclear radiation. The air itself becomes radioactive, and the “reactor gases” will also produce signals in the devices detecting tritium in the air. By using ionization chambers (or proportional counters) to isolate the measurement of tritium, the effects of the other radiogases are eliminated. Discriminating Tritium Monitors are ideal for this purpose.

Portable monitors. The above comments apply equally well to small battery powered instruments used for radiological health and safety. In general, the sensitivity of portable monitors should be low enough to measure fractions of allowed limits of concentration for a “working” environment.

Portable instruments are sometimes subjected to rapid changes of temperature. Special engineering is required to maintain measurement accuracy and avoid temperature induced zero drifts.
C. ULTRA LOW-LEVEL TRITIUM MONITORING

As government regulations become ever more arduous, monitors must be engineered to provide increased sensitivity. Current regulations in the US imply measurements as low as 10^-9 Ci/m^3. To measure to these levels, samples of the atmosphere are “bubbled” through liquid traps on a continuous basis. At periodic intervals (typically one week), the “enriched” liquid is analyzed for tritium content.

OTC constructs real time tritium monitors that are capable of reaching these low levels. A level of 10^-9 Ci/m^3 indicates a tritium disintegration rate of 37 events per second, per cubic meter. At that level, proportional counters or linear ionization chambers can be used to provide accurate measurements. In each case, special sample handling is required, otherwise the tritium measurement will be critically impaired by the presence of foreign radioactive or pseudo radioactive contaminants.

OTC also produces passive tritium collectors for low-cost monitoring of low-level tritium or Carbon 14. These collectors use conventional “bubblers” or chemically specific agents for the accumulation of the radioactive material.

==========

Overhoff Technology Corporation (OTC) builds an unlimited variety of tritium monitors for all types of applications. If you do not find a monitor in this catalog to meet your requirements, OTC can custom-build monitors according to your exact specifications.

Quantity Discounts Available On Orders of 5 Units or More
OVERHOFF TECHNOLOGY SALES REPRESENTATIVES

Revised 02/10

If your area is not listed or if you would like to become a representative please email us or call 1 513 248 2400.

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  - Buenos Aires - Argentina
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  - Tel: +54 11 4958 2801
  - Fax: +54 11 4958 3115
  - Email: hchester@nuclearlab.com
  - Website: www.nuclearlab.com

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  - P.O. Box 3103
  - Nunawading VIC 3131
  - Australia
  - Contact: Michael Bernardo
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  - Fax: +61 3 9877 8272
  - Email: Michael_Bernardo@australian-radiation-services.com.au
  - Website: www.australian-radiation-services.com.au

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  - Woodbridge, Ontario L4L 7A2
  - Canada
  - Contact: Ernie Franzese
  - Tel: +1 905 856 5950
  - Fax: +1 905 851 7473
  - Email: rmsys@rogers.com
  - Website: www.radiation-measurement-systems.com

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  - Fax: +86 021 6652 8796
  - Email: yfzhang@chnflying.com
  - Website: www.chnflying.com

- **Riguang Medical**
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  - Website: www.pbcasia.com.cn

If your area is not listed or if you would like to become a representative please email us or call 1 513 248 2400.
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