**MIRION TECHNOLOGIES**

**Sensing Systems Division**

# Fission Counter Chamber
# Dual-Range

**1.4 to 1.4 x $10^5$ nv Counter Range**
**6 x $10^5$ to 1.4 x $10^{10}$ nv Chamber Range**
**300°F (150°C) Operation**
**0.7 cps/nv Counter Sensitivity**
**1.4 x $10^{-13}$ A/nv Chamber Sensitivity**
**Meets MIL-S-901 & MIL-STD-167 (Type 1)**

## Tube Number: WL-6376A

**Application**

The WL-6376A fission chamber is designed to detect thermal neutrons in the range of 1.4 to 1.4 x $10^5$ neutrons/cm2/second when operated as a counter and in the range of 6 x $10^5$ to 1.4 x $10^{10}$ neutrons/cm2/second when operated as a chamber. The detector is extremely rugged in construction, meeting MIL-S-901 for shock and MIL-STD-167 (Type 1) for vibration, and may be operated in any position at temperatures up to 300°F (150°C).

The WL-6376A is constructed of aluminum, with high purity alumina ceramic insulators throughout, including those used in the type HN connector. In typical operation as a fission counter the WL-6376A has a thermal neutron sensitivity of approximately 0.7 counts/neutron/$cm^2$ throughout a wide range of applied voltage. When connected for service as an ionization chamber, the thermal neutron sensitivity is approximately 1.4 x $10^{-13}$ amperes/neutron/$cm^2$/second with a gamma sensitivity of approximately 4.2 x $10^{-11}$ amperes/R/hour.

**Mechanical**

| | |
|---|---|
| Diameter | (50.8 mm) 2.00 Inches |
| Overall Length | (292 mm) 11.5 Inches |
| Approximate Sensitive Length | (152) 6 Inches |
| Net Weight | (794 grams) 1.75 Pounds |
| Shipping Weight | (5.4 kg) 12 Pounds |

Materials

| | |
|---|---|
| Outer Case | Aluminum |
| Electrodes | Aluminum |
| Insulation | $A1_20_3$ |
| Sensitive Material: | |
| Amount of U235 in U308 | >90 % |
| Thickness | 2.0 mg/cm2 |
| Gas Fill | Ar-N |
| Gas Pressure | 76 cm-Hg |

**Impedance**

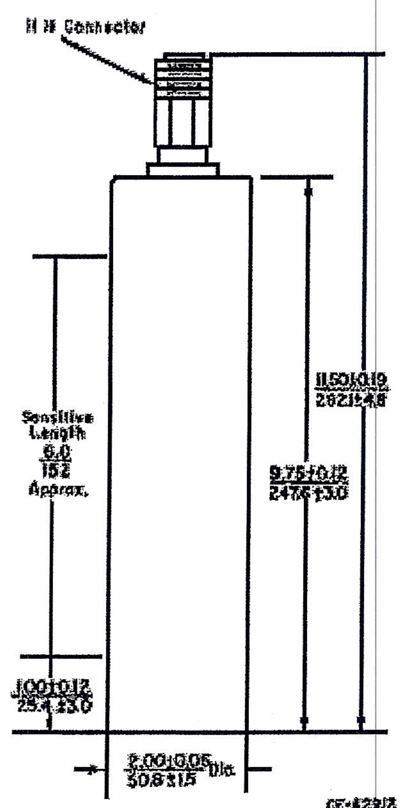
| | |
|---|---|
| Resistance (minimum) (At Max. Temp.) | $10^{-9}$ Ohms |
| Capacitance | 150 pF |

**Maximum Ratings**

| | |
|---|---|
| Voltage between Electrodes | 1000 Volts |
| Temperature | (150°C) 300 °F |
| External Pressure (Note 1) | (7.0 kg/$cm^2$)100 psig |
| Thermal Neutron Flux | 3 x $10^{10}$ nv |

**Typical Operation as a Counter (at approx. 25°C)**

| | |
|---|---|
| Operating Voltage | 300 Volts |
| Operating Voltage Plateau | 200-800 Volts |
| Thermal Neutron Flux Range | 1.4 to 1.4 x $10^5$ Volts |
| Sensitivity (Note 2) | 0.7 nv |
| Output Pulse Characteristics: | |
| Amplitude (unloaded) | 2 x $10^{-4}$ Volts |
| Inherent Rise Time (average) | 2 x $10^{-7}$ Seconds |



**Typical Operation as a Chamber (at approx. 25°C)**

| | |
|---|---|
| Operating Voltage (Note 3) | 300-1000 Volts |
| Thermal Neutron Flux Range (Note 4) 6 x10'5 | to $1.4 \times 10^{10}$ Nv |
| Thermal Neutron Sensitivity | $1.4 \times 10^{-13}$ A/nv |
| Gamma Sensitivity | $4.2 \times 10^{-11}$A/R/Hr |
| Alpha Background Current | $1.6 \times 10^{-8}$A |

**Notes**

1. The pressurizing atmosphere must be dry and non-corrosive.
2. The sensitivity given is with the alpha background counting rate of the naturally radioactive uranium adjusted to 5 counts/second. By varying the pulse height selector on the associated circuitry, or by use of high resolution circuitry, other sensitivities are available.
3. The minimum voltage required for saturation is dependent upon the incident neutron flux level.
4. The lower limit of operating range is determined by an inherent alpha background current.





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# Uncompensated Ionization Chambers
## 3" Diameter – Guard Ring

| Tube Type | Maximum Temp. °F | Sensitivity A/nv |
|---|---|---|
| → WL-6937A | 300 | $7.6 \times 10^{-14}$ |
| WL-7606 | 575 | $7.6 \times 10^{-14}$ |
| WL-8075 | 300 | $7.6 \times 10^{-14}$ |
| WL-23272 | 300 | $3.3 \times 10^{-13}$ |

**Application**

This group of uncompensated ionization chambers is designed to operate in a thermal neutron to gamma flux ration of $10^4$ nv to 1 R/hr or greater. These chambers feature guard-ring construction to minimize the effect of interelectrode leakage currents. They are extremely rugged and may be operated in any position up to their rated temperature. The materials used in construction of the detector, including those of the type HN connectors, have been selected for low activation properties. This reduces the magnitude and duration of activation currents and facilitates handling after exposure to high neutron fluxes.

| **Mechanical** | Units | ↓ WL-6937A | WL-7606 | WL-8075 | WL-23272 |
|---|---|---|---|---|---|
| O.D., Nominal | Inches | 3.00 | 3.00 | 3.00 | 3.00 |
| Length, Nominal | Inches | 13.62 | 13.62 | 13.62 | 21.50 |
| Sensitive Length, Nominal | Inches | 7.0 | 7.0 | 7.0 | 14.0 |
| Net Weight | Pounds | 2.5 | 2.5 | 2.5 | 3.75 |
| Shipping Weight | Pounds | 10.0 | 10.0 | 10.0 | 11.5 |
| **Materials** | | | | | |
| Outer Case | - | Aluminum | Aluminum | Aluminum | Aluminum |
| Electrodes | - | Aluminum | Aluminum | Aluminum | Aluminum |
| Insulation | - | $Al_2O_3$ | $Al_2O_3$ | $Al_2O_3$ | $Al_2O_3$ |
| Neutron Sensitive Material: | | | | | |
| Content | - | Boron ($B^{10}$) | Boron ($B^{10}$) | Boron ($B^{10}$) | $B^{10}F_3$ |
| Thickness | $mg/cm^2$ | 0.8 | 0.8 | 0.8 | - |
| Gas Fill | - | Ar-$N_2$ | Ar-$N_2$ | Ar-$N_2$ | $B^{10}F_3$ |
| **Impedance** | | | | | |
| Resistance, Minimum: | | | | | |
| Signal Electrode to Case | Ohms | $10^{11}$ | $10^{11}$ | $10^{11}$ | $10^{11}$ |
| H.V. Electrode to Case | Ohms | $10^{11}$ | $10^{11}$ | $10^{11}$ | $10^{11}$ |
| Capacitance (Note 1): | | | | | |
| Signal Electrode to Case | pF | 170 | 170 | 170 | 180 |
| H.V. Electrode to Case | pF | 250 | 250 | 250 | 275 |
| **Maximum Ratings** | | | | | |
| Voltage Between Electrodes: | Volts d.c. | 1500 | 1500 | 1500 | 2500 |
| Temperature | °F | 300 | 575 | 300 | 300 |
| External Pressure (Note 2) | PSI | 180 | 180 | 180 | 180 |
| Thermal Neutron Flux | nv | $2.5 \times 10^{11}$ | $2.5 \times 10^{11}$ | $2.5 \times 10^{11}$ | $2.5 \times 10^{11}$ |
| Gamma Flux | R/hr | $10^7$ | $10^7$ | $10^7$ | $10^7$ |
| **Typical Operation** | | | | | |
| Operating Voltage (Note 3) | Volts d.c. | 200-1000 | 200-1000 | 200-1000 | 200-2000 |
| Saturation Characteristics | - | See Fig. 6 | See Fig. 6 | See Fig. 6 | See Fig. 5 |
| Thermal Neutron Flux: | | | | | |
| Lower Limit | nv | $2.5 \times 10^2$ | $2.5 \times 10^2$ | $2.5 \times 10^2$ | $3.0 \times 10^1$ |
| Upper Limit | nv | $5.0 \times 10^{10}$ | $5.0 \times 10^{10}$ | $5.0 \times 10^{10}$ | $5.0 \times 10^9$ |
| Thermal Neutron Sensitivity: | | | | | |
| Reactor (Note 4) | A/nv | $4.4 \times 10^{-14}$ | $4.4 \times 10^{-14}$ | $4.4 \times 10^{-14}$ | - |
| Source Box (Note 5) | A/nv | $7.6 \times 10^{-14}$ | $7.6 \times 10^{-14}$ | $7.6 \times 10^{-14}$ | $3.3 \times 10^{-13}$ |
| Gamma Sensitivity: (Note 6) | A/R/hr | ↑ $4.0 \times 10^{-11}$ | $4.0 \times 10^{-11}$ | $4.0 \times 10^{-11}$ | $1.3 \times 10^{-10}$ |

**Notes**

1. Capacitance is measured between an electrode and case with all other electrodes grounded to the case.
2. The pressurizing atmosphere must be dry and non-corrosive.
3. The saturation voltage varies with current level. See saturation characteristics for proper operating voltage.
4. The reactor sensitivity was determined experimentally, however perturbation effects may alter the effective neutron sensitivity.
5. The Thermal Neutron Sensitivity is determined in a Pu-Be source box. Reactor environments often produce significant flux perturbation which may alter the effective neutron sensitivity.
6. The gamma sensitivity is determined in a $Co^{60}$ flux.

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Uncompensated Ionization Chambers
3" Diameter – Guard Ring
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| Tube Type | Maximum Temp. °F | Sensitivity A/nv |
|---|---|---|
| WL-6937A | 300 | $7.6 \times 10^{-14}$ |
| WL-7606 | 575 | $7.6 \times 10^{-14}$ |
| WL-8075 | 300 | $7.6 \times 10^{-14}$ |
| WL-23272 | 300 | $3.3 \times 10^{-13}$ |

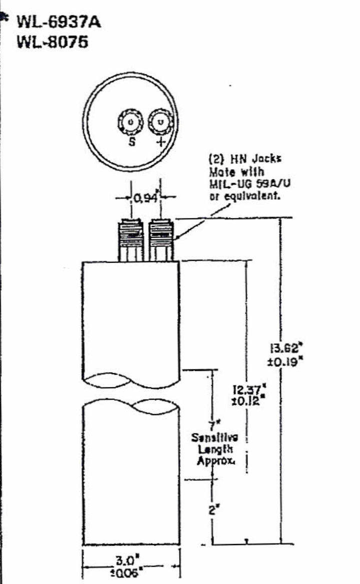


FIGURE 1

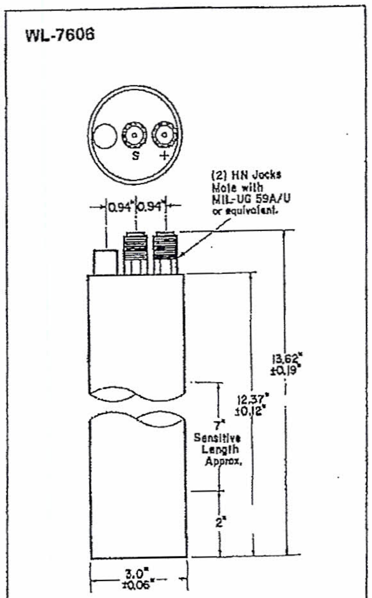


FIGURE 2

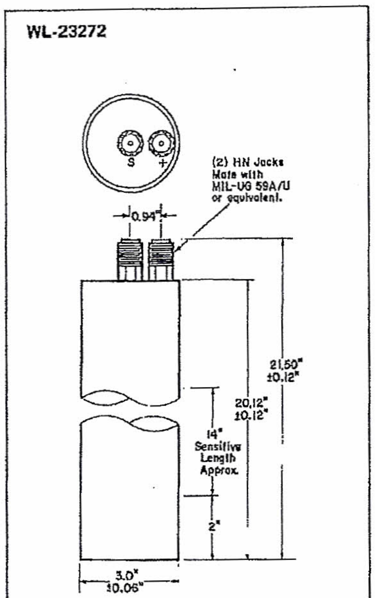


FIGURE 3

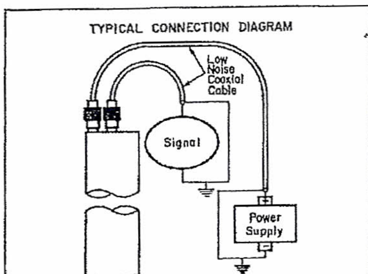


FIGURE 4

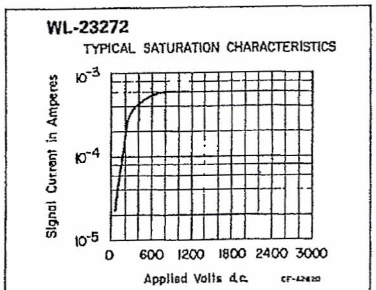


FIGURE 5

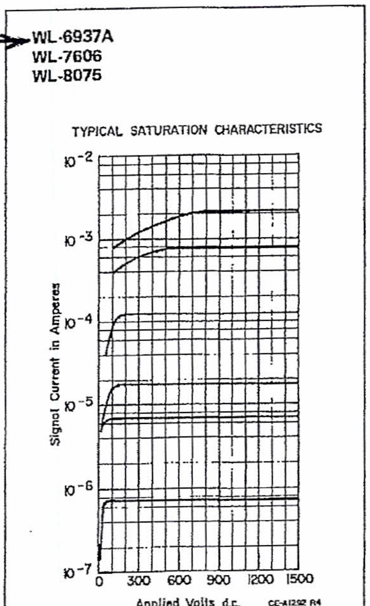


FIGURE 6

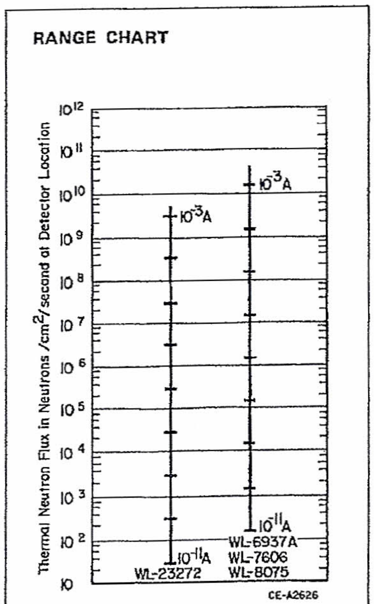


FIGURE 7

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**MIRION TECHNOLOGIES**

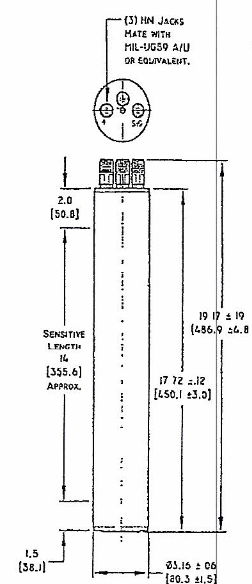
Sensor and Control Division

# Compensated Ionization Chamber

# WL-23084

## APPLICATION

The WL-23084 Compensated Ion Chamber is designed to operate in a thermal neutron to gamma flux ratio of 500 nv to 1 R/hr with 95% compensation. This chamber employs guard-ring construction to minimize the effect of inter-electrode leakage current, permitting operation from 230 nv to a maximum of $5 \times 10^{10}$ nv. The chamber materials, including those of the type HN connectors, have been selected for their low activation properties. The use of such materials reduces the magnitude and duration of the activation currents and facilitates handling of the chamber after it has been exposed to high neutron fluences. This chamber is extremely rugged and may be operated in any position up to the rated temperature; however, operation in an end-on flux will shift the chamber's compensation characteristic and may alter its effective neutron sensitivity.




## MECHANICAL

| | |
|---|---|
| Outside Diameter (nominal) | 3.16 Inches (79.4 mm) |
| Length (nominal) | 19.17 Inches (486.9mm) |
| Sensitive Length (nominal) | 14.0 Inches (355 cm) |
| Net Weight | 5.7 Pounds (2.6 kg) |
| Shipping Weight | 19.0 Pounds (9.6 kg) |

## MATERIALS

| | |
|---|---|
| Outer Case | Aluminum |
| Electrodes | Magnesium and Aluminum |
| • Insulation | Alumina Ceramic |
| Neutron Sensitive Material Content | B-10 Enriched Boron |
| Thickness (Approx.) | 0.8 $mg/cm^2$ |
| Gas Filling | Nitrogen (with Helium Trace) |

## IMPEDANCE

Resistance, minimum (Note 1)

| | |
|---|---|
| H.V Electrode to Case | $10^{12}$ Ohms |
| Signal Electrode to Case | $10^{13}$ Ohms |
| Compensating Electrode to Case | $10^{12}$ Ohms |

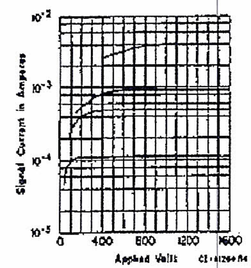
| | |
|---|---|
| Approximate Capacitance (Note 2) | 290 pF |
| Signal to Case H.V. to Case | 330 pF |
| Compensating Electrode to Case | 182 pF |

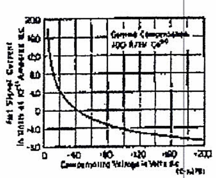
## MAXIMUM RATINGS

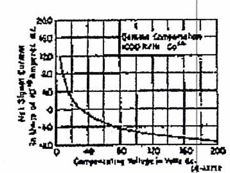
| | |
|---|---|
| Voltage between Electrodes | 1500 Volts DC |
| Temperature | 400°F(205°C) |
| Thermal Neutron Flux | $5 \times 10^{11}$ nv |
| External Pressure (Note 3) | 180 psig (12 $kg/cm^2$) |

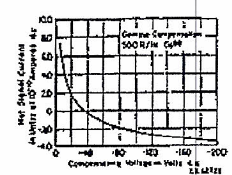
**TYPICAL OPERATION**

| | |
|---|---|
| Operating Voltage | 300 to 1500 Volts DC |
| Compensating Voltage | -10 to -80 Volts DC |
| Saturation Characteristics (Note 4) | See Figure 1 |
| Thermal Neutron Flux Range | 1.3 x $10^3$ to 5.0 x $10^{10}$ nv |
| Thermal Neutron Sensitivity | |
| Source Box (Note 5) | 7.6 x $10^{"14}$ A/nv |
| Reactor (Note 6) | 4.4 X $10^{\sim 14}$ A/nv |
| Gamma Sensitivity (Note 7) | |
| Total Compensation | 0 A/R/hr |
| Uncompensated | 2.3 x $10^{"11}$ A/R/Hr |









**NOTES**

1. The detector is not designed for immersion in water. High humidity environments may degrade performance.

2. Capacitance is measured between an electrode and case with all other electrodes grounded to the case.

3. The pressurizing atmosphere must be dry and non-corrosive.

4. Saturation voltage varies with current level. See saturation characteristics for proper operating voltage.

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5. Thermal neutron sensitivity is evaluated using an AmBe source. Reactor environments often produce significant flux perturbation which may alter the effective sensitivity.

6. The reactor sensitivity was determined experimentally. However, perturbation effects and reactor spectrum may alter the effective neutron sensitivity.

7. The gamma response is determined using a $Co^{60}$ source.