

# IONIZATION CHAMBERS



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# 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<sup>3</sup> 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

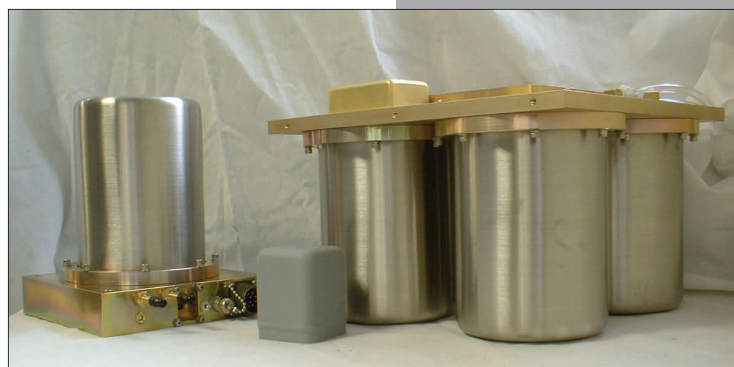
An ionization chamber is an electrically closed vessel containing an internal electrode. An electric field is applied between the wall of the chamber and the electrode, so that the ionization produced by radiation is collected in the form of a current. In a linear ionization chamber, the current is proportional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

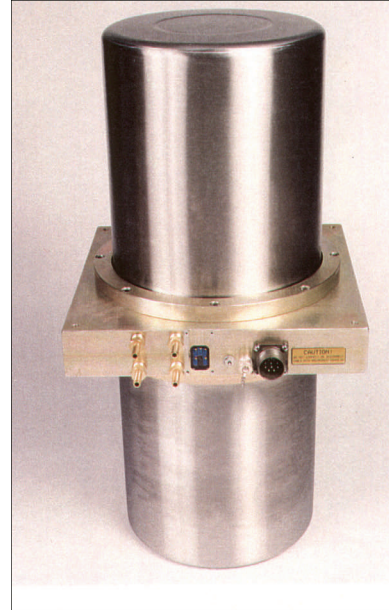
OTC ionization chambers are designed to be highly linear. At high radiation activity levels, it becomes increasingly probable that an ion and an electron will recombine, will be lost and not form part of the ion current collected by the electrode. Special electrode and chamber designs help to reduce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

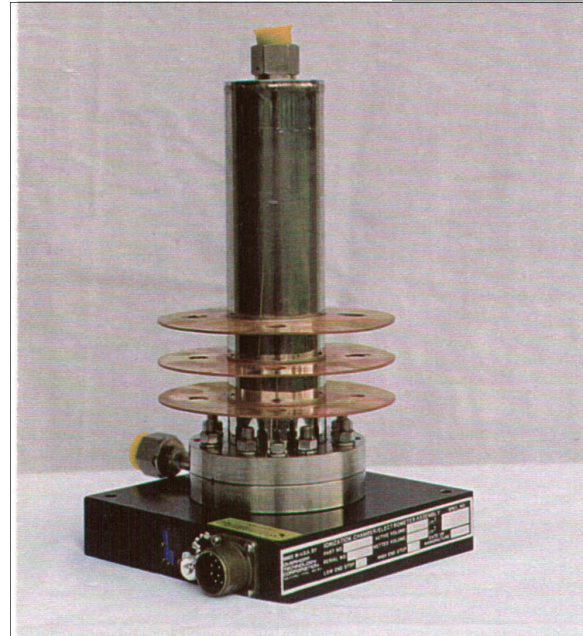
Design of every ionization chamber system has been optimized both for performance as well as for economy. Low level ionization chambers are at least 2 liters in overall volume, are often lead shielded and in a gamma compensation (dual) configuration. High level ionization chambers are generally small 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.

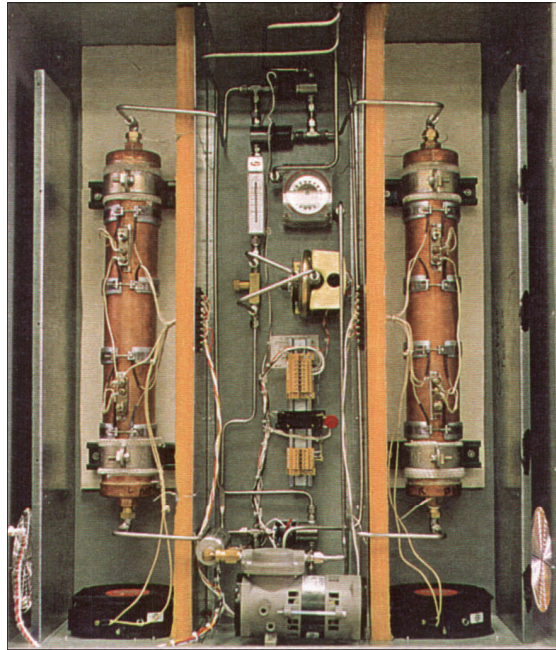
**8 LITER IONIZATION CHAMBER**

Dual or quadruple ionization chambers for ultra low level tritium specific monitoring. Measurement as low as  $10^{-7}$  Ci/m<sup>3</sup> 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.

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

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.



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