



Pressurization System



IsoVac Report R-4130

HOW THE RADIFLO® PROCESS WORKS

The technical description of the fully automated Radiflo Leak Detection Process is provided below to assist in understanding how it is applied to evaluation of the hermeticity of sealed devices. The simplest application of the process is to 'non-organic' devices that have an internal cavity.

The equipment consists of two basic systems: (a) A pressurization system which contains a very dilute mixture of Krypton85 gas in Nitrogen; and (b) a scintillation crystal detection system that is used to measure each device after pressurization to detect and separate out any leaking devices.

Step 1 - Devices are placed in metal baskets or fixtures, and the baskets placed inside of a pressurization tank, the tank lid closed and locked and the console cover closed.



Loading parts into vertical pressurization tank



Parts placed in horizontal pressurization tank

The chamber configuration of 'Horizontal' or 'Vertical' is chosen to assist in handling of devices. Many devices are conveniently handled in baskets, (in bulk), some may require custom trays to prevent the leads on electronic devices from being damaged from handling, and others are handled in 'tubes' or 'sticks', from fabrication through testing.

Step 2 - The pressurization system is programmed for the pre-calculated pressure and time required to achieve the desired leak rate sensitivity, following the Radiflo equation.



Operator Control Panel



Pressure Setting



Bomb-Time Setting

Step 3 - The machine is started and the air is evacuated from within the pressurization tank, the Kr85/N₂ mixture is transferred into the tank to the programmed pressure, and the machine then stands for the preset time interval.

Step 4 - The Kr85/N₂ mixture is then fully recovered back into a lead shielded storage tank and the tank is backfilled with air.

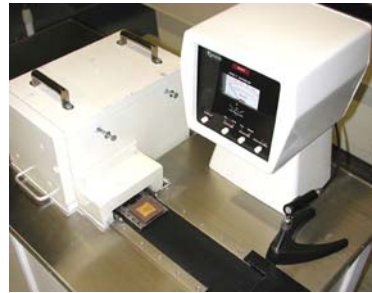
Step 5 - The devices are removed from the tank and taken to a counting station where they are measured for Kr85 gas that may have leaked into a device through a defective hermetic seal.



Manual Counting Station



Testing Relays



Conveyor-belt counting station

The technical theory of the test:

- Krypton85 gas is a radioactive inert noble gas that emits very weak gamma rays and beta particles.
- The detectability of the Kr85 gas is millions of times greater than the detection of helium in a mass spectrometer leak test. Thus short pressurization times and greater accuracy. The measurement of Kr85 in a reject device is reading as few as 1 Kr85 molecule in >1 billion molecules of air in the part.
- The gamma rays from Kr85 gas trapped within a leaker, will penetrate the walls of normal devices, and are easily detected by the scintillation crystal at the counting stations, giving an audible signal, a meter deflection, and a red light indication. This measurement only requires less than 100 milliseconds, and is achieved either manually by an operator or automatically at rates of 1 part per second.
- The "absolute" leak rate of the device is calculated by simple formula based on the concentration of Kr85/N₂ tracer gas used, the bombing time & pressure, and the measured reading on the device. The counting station reading is an exact measurement of the number of Kr85 molecules that are inside the device at the time it is removed from the Radiflo.

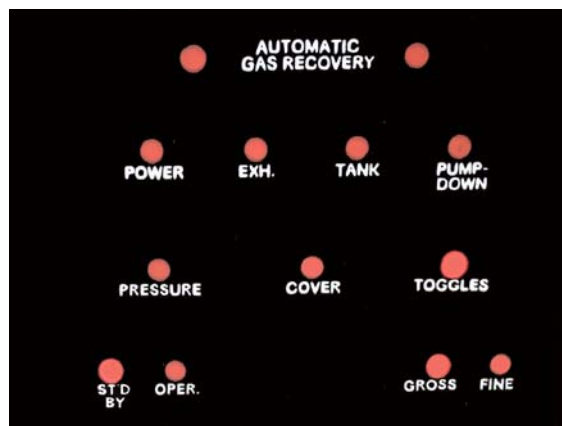
- [The Kr85 tracer gas is measured inside the device through the walls of the device, and not required to be measured coming back out of the device, (as in the helium test).]
- Parts are easily reworked and re-tested by just pre-reading the device and then running another standard Radiflo test.

Special Techniques:

- The Radiflo process performs both a Gross leak test, and a Fine leak test. They can be run separately, or in a single test, covering a large gross leak through 10^{-8} atm cc/sec. Higher sensitivities are easily achieved beyond 10^{-11} atm cc/sec, by just extending the pressurization time.
- Kr85 tracer gas has extremely low solubility in surface materials, and is not hindered by fingerprints, labels, etc. Plastic devices are commonly leak tested in the Radiflo process.
- Devices with absolutely no internal cavity, ("Zero-Cavity" devices), are Radiflo tested using a patented method of adding a few milligrams of steam-activated charcoal to the inside of the device, and then pressurizing with Kr85 gas. The charcoal has a unique ability to "Getter" and hold the Kr85 for lengthy periods of time, thus assuring the detection of the non-hermetic device.

Safety Considerations:

- The Radiflo equipment is designed with endless safety features built in to protect the operators from any exposures.
- Numerous 'interlocks' monitor all stages of the equipment and assure that it is operated carefully and safely. Any of these interlocks prevent the equipment from being put into operation until the interlock is taken care of.



These verify "Power", "Exhaust System", "Tank Lid Lock", "Proper Pump-down", "Pressure-Limits", "Cover-Closure", "Toggle Switches are Off", "Automatic Gas Recovery",

- The pressure tanks in the Radiflo are built and tested to satisfy all safety codes.
- The Radiflo Equipment has always been accepted by all U.S. States, and foreign countries.
- Krypton85 gas is considered to be a 'non-biological health hazard', is not absorbed by the body tissue, and is classified as a weak radiation emitter.
- Tens of thousands of operators and technicians have worked with Kr85 in leak testing over the past 49 years, without ever having any overexposures or health concerns.