

# Safety Of Radioactive Electron Capture Detectors (ECDs)

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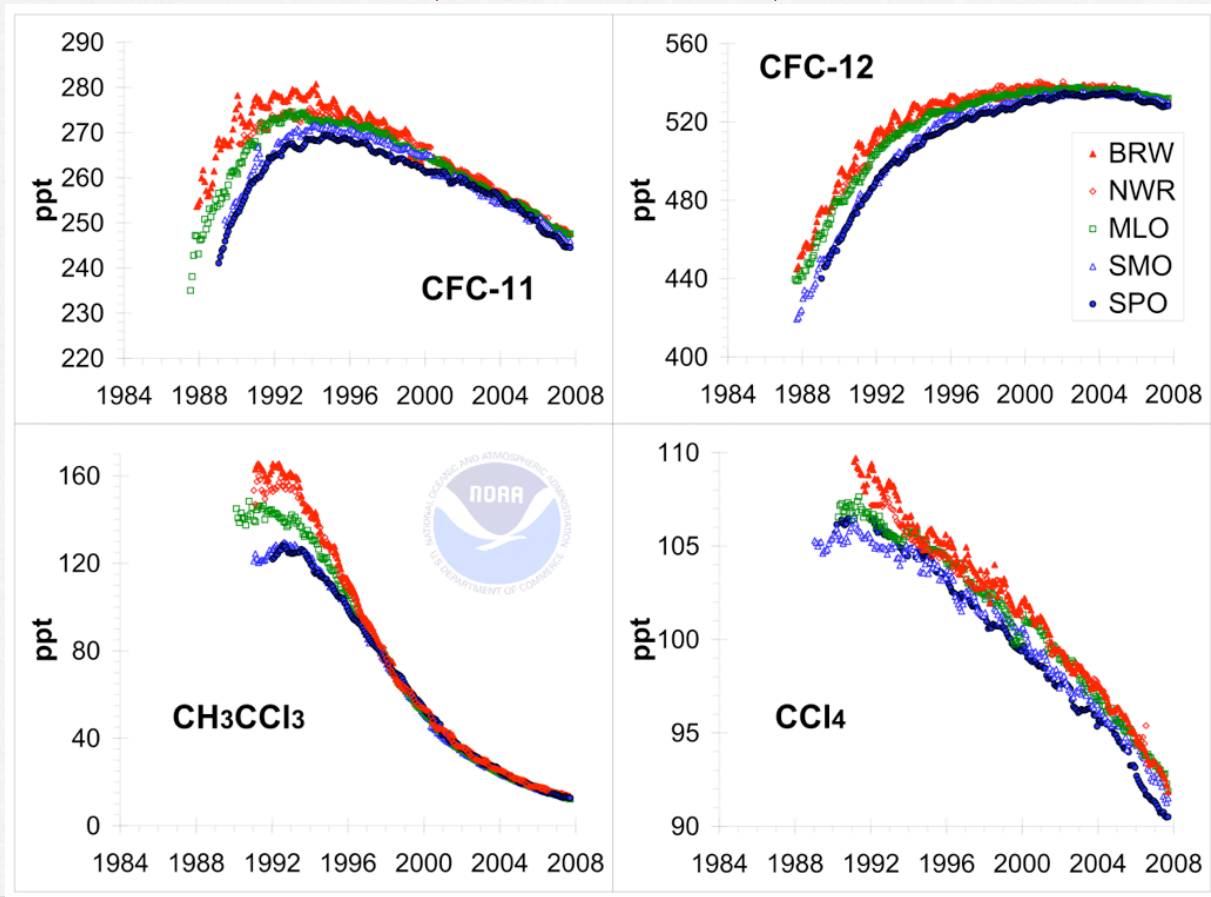
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## Why do we use ECDs?

*Answer: NOAA has reporting responsibility to Congress for the U.S. Clean Air Act for compounds regulated by the Montreal Protocol (and it works).*





# Radiation 101

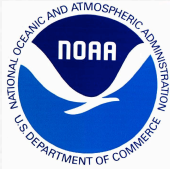


- Radioactive radiation is everywhere. Colorado has one of the highest backgrounds in the USA, >120 millirems per year (mrems/yr), because of our uranium mines, granite rocks, and high altitude enhancement of cosmic rays.
- We get an additional 40 mrems/yr from food and 200 mrems/yr from radon in air. Medical exposure is another 40-70 mrems/yr. *US average total yearly exposure is about 360 mrems/yr, but Colorado is 420 mrems/yr.* An opened 15 mCi ECD source yields 6 mrems/yr if you are 6 inches away from it. A sealed source yields  $\mu$ mrems/yr.
- OSHA threshold = 100mrems/hr, serious blood problems occur >10,000 mrems/hr, with serious injury or death at >450000 mrems/hr.



# Electron Capture Detectors (ECDs)

- Are in one the most commonly used analytical instrument, the Electron Capture Detector Gas Chromatograph (ECD-GC); **NOAA/ESRL has over 140 ECDs.**
- ECD uses Nickel-63 isotope on a platinum foil, emits high velocity electrons.
- Half Life of Nickel-63 = 92-101 years
- Radiation depends on manufacturer, 5-15 millicuries



## Units of radioactivity: Source and Human Exposure Terms

- Source:  $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$  or electrons emitted per second.
- Smoke detector has a strength of 1 microcurie.
- ECDs (5-20 millicuries) are 5,000-20,000 times more radioactive than a smoke detector. But, it is sealed, but never open an ECD.
- Human exposure: 1 smoke detector exposure for a year is 0.008 mrems where rem = roentgen equivalent for man and roentgen = ergs (energy) of x-ray radiation per gram of tissue. ECDs are wiped tested for leaking radiation once every 6 months; if it passes the wipe test, the ECD has a leak of less < 0.005 microcurie. *So, 1 ECD exposure for a year is 200 times safer than the total source of a smoke detector.*



# Major Types of radioactive radiation

- Alpha (fast moving Helium nucleus, 2 protons/ 2 neutrons), exposure can be serious because of mass (4 amu), stopped by single sheet of paper. Twenty times more dangerous for human exposure.
- Beta (fast moving electrons with 0 amu), **ECD radioactivity with 67 keV energy is converted into harmless thermal electron by 10-16 inches of air or one sheet of aluminum foil.**
- Gamma (high frequency radiation), X-rays, most serious, stopped by thick lead sheets.



# How does the ECD work in a GC?

What is a Gas Chromatograph?  
Separation and Detection (Electron Capture Detector, ECD) of Unknowns (one channel)

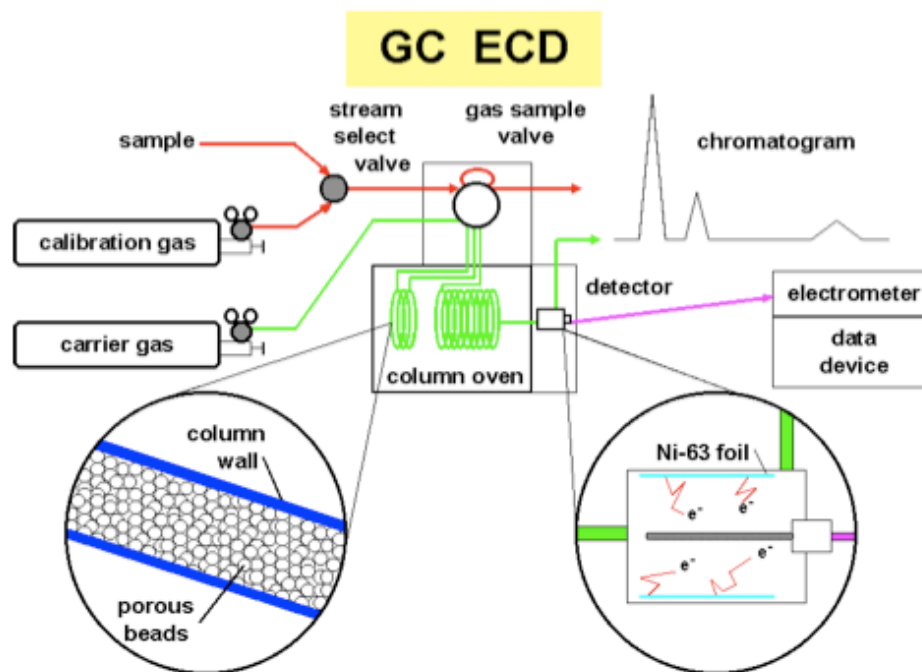


Diagram courtesy of Thayne Thompson

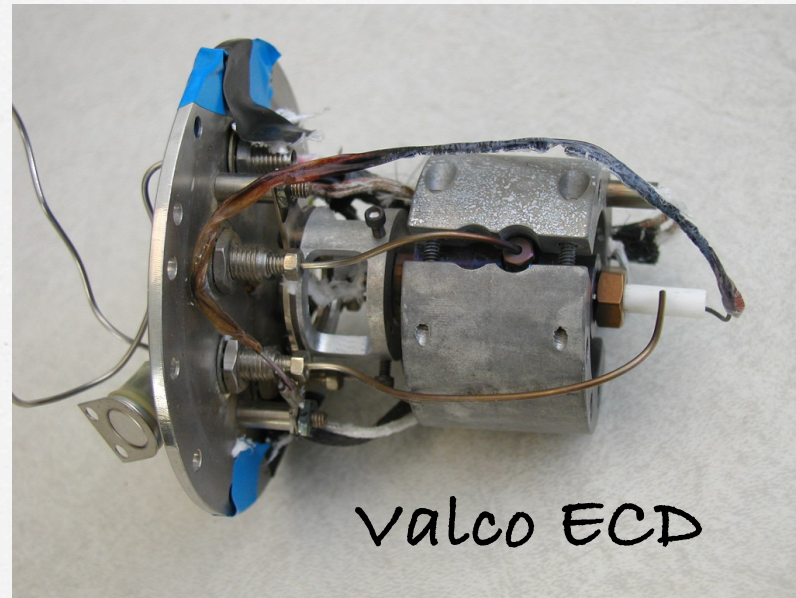


## Typical ECD cells (~1" diameter, 1" long)

Shimadzu ECD



Valco ECD



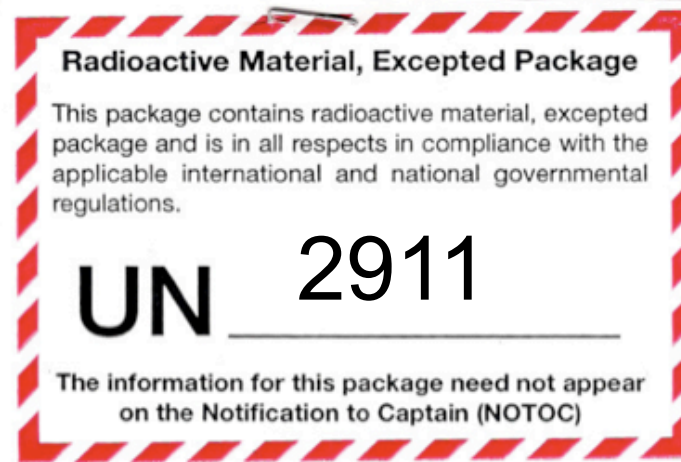
Station staff: *Wipe tests must be done every 6 months on working ECDs. Wipe tests are done before shipping and after shipment to final destination.* The test sheets should be wiped on the exhaust port on the outside of the can or ECD. Unused ECDs are stored in a locked cabinet in David Skaggs Research Center in Boulder, CO.





# New Air Freight Shipping Labels Required for the Outside of the Box

New shipping labels for ECDs are required by US Department of Transportation (US DOT) and other international organizations. Use UN 2911 for ECDs. Contact Jim Elkins for stickers.





## Summary

- ❑ *ECDs are sealed radioactive sources with little or no danger to you and the public. They are wipe tested for radioactivity twice a year, before shipment, and after arrival.*
- ❑ *If in doubt on any radioactive issue, contact your Radiation Safety Official (NOAA/Rhonda Carpenter, 303 497-3912).*
- ❑ *Never ever throw a radioactive source away in the trash, contact your RSO immediately for proper disposal.*
- ❑ *If an ECD cell is breached (smashed by heavy object), then don't touch it and tape off area. Call your RSO immediately. Never open the sealed source up, it is dangerous.*
- ❑ *New shipping label is required for air freight, contact the NOAA Certified Hazardous Material Traffic Manager (George Angel, 303 497-3670).*