GEIGER COUNTERS AND RADIATION DETECTORS FOR HOME USE

A Geiger counter detects radiation and is suited to finding radioactive contamination; a dosimeter adds up the total dose a person receives. A home device can show that radiation is present, but it does not replace official fallout maps and instructions, which are what tell you when to shelter, leave, or return.

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WARNING

A detector does not change what to do after a nuclear explosion. Get inside, stay inside, and stay tuned. Leave your shelter when officials say it is safe or tell you to evacuate, not because of a reading on a home device.

WHAT A GEIGER COUNTER MEASURES

CDC calls Geiger counters the most commonly used portable radiation detection instruments. A Geiger counter is a gas-filled tube with electrodes that registers radiation passing through it.

CDC lists the Geiger-Mueller counter as a portable detector used to find contamination on a person or object. It can also measure the radiation level in the air around you, but CDC says it is "better suited for measuring radioactivity," and that pressurized ionization chambers give a more accurate measurement of ambient radiation levels.

So a Geiger counter answers "is there radioactive material here?" well. It is less precise at answering "how much dose am I getting in this room?"

SURVEY METERS AND DOSIMETERS: THE DIFFERENCE

Responders use several kinds of instruments. FEMA's nuclear detonation planning guidance describes them (FEMA, Appendix 2.1):

- **Handheld survey meters.** A broad category that includes Geiger-Mueller detectors, ion chambers, and scintillator meters, typically used to monitor contamination or radiation. FEMA notes that occasional users "may find using these devices confusing because many display several orders of

magnitude on the scale," and that reading them correctly requires knowing which probe is attached and how to change and multiply the scale.

- **Personal dosimeters.** CDC defines a dosimeter as a small portable instrument for measuring and recording the total accumulated dose of ionizing radiation a person receives. FEMA notes that passive badge dosimeters only record accumulated exposure and do not warn you in real time.
- **Electronic and alarming dosimeters.** These display dose and dose rate and sound an alarm when a set limit is crossed. CDC says alarming dosimeters are used by first responders and safety officers.
- **Personal radiation detectors.** FEMA describes these as very sensitive devices built to find low levels of radiation. Its caution is worth knowing: "Due to their sensitivity, these devices often saturate at relatively low radiation levels," and FEMA says they cannot be used in the higher-radiation response zones.

The practical point: a survey meter tells you the rate right now, and a dosimeter tells you the total over time. They answer different questions.

RADIATION UNITS, EXPLAINED

Readings come in several units, and US and international units differ by a factor of 100. These are CDC's and EPA's definitions and conversions.

Dose rate (how much radiation per hour, the number a meter shows for the air around you). CDC: ambient levels are reported in gray per hour (Gy/h) or sievert per hour (Sv/h); in the US, roentgen per hour (R/h) or rem per hour (rem/h). Multiply an international reading by 100 to get US units, so 1 Sv/h = 100 rem/h. Smaller versions you will see on consumer devices include microsieverts per hour (μSv/h), microroentgen per hour (μR/h), and millirem per hour (mrem/h).

Dose (the total absorbed by the body). CDC gives these conversions:

UNIT	EQUALS
1 sievert (Sv)	100 rem
1 rem	10 millisieverts (mSv)
1 gray (Gy)	100 rad
1 rad	10 milligray (mGy)

EPA gives the same: 1 Sv = 100 rem and 1 Gy = 100 rad. CDC says the gray measures the amount of energy absorbed in a material; EPA lists the sievert and rem as units of effective dose.

Radioactivity (how much radioactive material). CDC: measured in becquerels (Bq) or, in the US, curies (Ci); 1 Ci = 37 billion Bq.

> ■ **TIP**
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> When you write down a reading, write the unit with it. A reading of "10" means very different things in μSv/h, mR/h, and mrem/h.

WHAT A HOME DETECTOR CAN TELL YOU

- **That radiation is present, and roughly where.** Holding a Geiger counter near clothing or an object can show whether contamination is there, which is the job CDC says these instruments are suited for.
- **That a reading is above your normal background.** Radiation is always present. EPA says background radiation is present on Earth at all times, from radon, cosmic radiation, and minerals in soil and water. A detector at home will never read zero. Take readings in your home now so you know what normal looks like on your device.
- **A trend over time.** FEMA's guidance says radioactive decay causes the fallout hot zone to begin shrinking within 24 hours. Readings that fall over hours match that.

WHAT IT CANNOT TELL YOU

- **Whether your route out is safe.** FEMA says accurate fallout distribution and dose rate estimates are critical so that evacuees do not evacuate through locations with higher dose rates. A reading inside your house says nothing about the roads miles away. Officials build that picture from responder measurements, plume models, and observations.
- **Whether low readings far from the blast are a health threat.** FEMA notes that a ground-level detonation can produce elevated but low radiation levels that common responder instruments easily detect very far from ground zero, and that this low-level radiation "is not an immediate health concern" even though it may cause public concern. A detector that chirps more than usual is not, on its own, a reason to leave shelter.
- **Readings above its range.** As FEMA notes for sensitive detectors, a device can saturate. Check your device's stated range in its manual.
- **Whether your food or water is safe.** That takes laboratory instruments. CDC notes lab equipment is used to detect radioactivity in environmental or clinical samples. Follow CDC's guidance on sealed food and bottled water in the shelter in place guide.

Seeing fallout is not a measurement either. FEMA says visible particles may not show on rough or dirty surfaces, so their presence or absence cannot be used to directly estimate radiation dose rates.

WHY OFFICIAL INSTRUCTIONS COME FIRST

Official guidance is built around the information a single detector cannot give you. CDC says staying tuned is how you get updates about evacuation, shelters, and when it is safe to go outside. FEMA says response zones should be set by measured radiation levels, and that measurements improve the models officials use as they come in (FEMA).

CDC also points out that detection equipment must be maintained to work properly, and that radiation safety professionals can help with using instruments and interpreting readings. If you own a detector, read the manual, learn its units and range, keep spare batteries, and treat it as a supplement to your radio, not a replacement.

NEXT STEPS

- Keep a radio before a detector: Emergency radio and alerts
- Understand why levels fall quickly: How fallout works
- What to keep in your shelter: Fallout shelter kit

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COMPILED FROM THESE SOURCES

1. CDC, How to Measure Radiation and Radioactivity
2. CDC, Radiation Dictionary
3. EPA, Radiation Terms and Units
4. EPA, Radiation Sources and Doses
5. FEMA, Planning Guidance for Response to a Nuclear Detonation, Third Edition (2022)
6. CDC, What to Do: Stay Tuned

Every safety claim on this sheet links to its primary source.