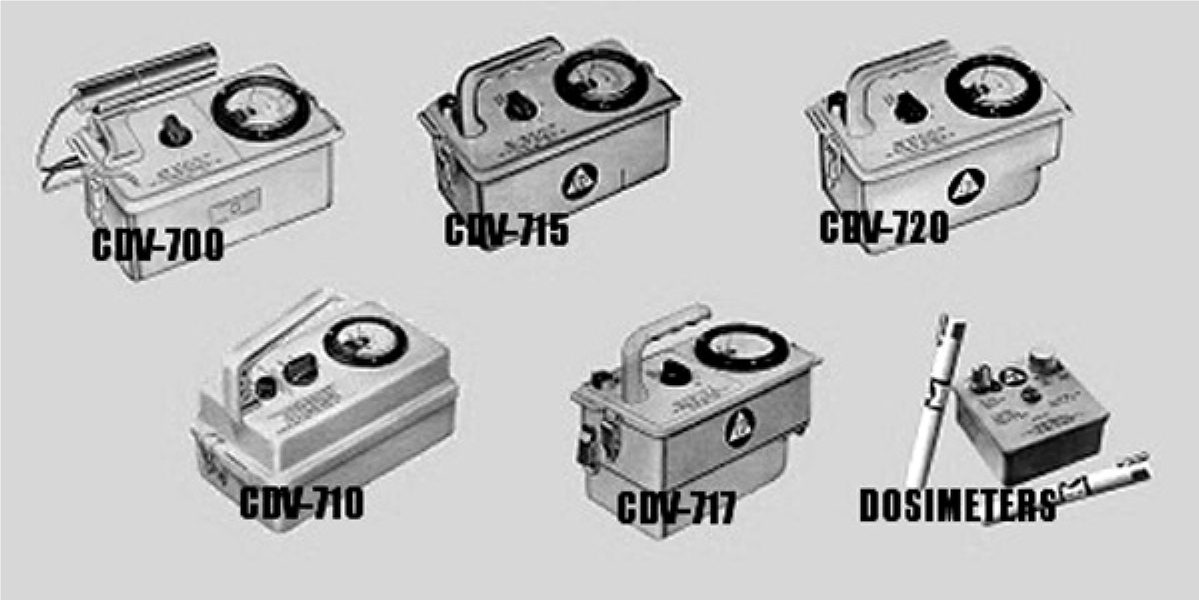
Civil Defense Radiation Detection Survey Meters, Geiger Counters and Dosimeters FAQ



Cold War Relics or Tomorrow's Family Life-Savers?!?

Q: What is the Purpose of This FAQ?

A Advice on, the inexpensive FEMA surplus Civil Defense radiation survey meters, geiger counters and dosimeters available on the market

Secondly, we inquired specifically how best to go about evaluating and testing surplus or auction acquired Civil Defense meters to assure one was confidently in possession of a reliable and accurate unit. This is essential because most of the available Civil Defense meters have usually arrived in the marketplace via a FEMA auction as part of a larger lot where any particular meter's previous history of maintenence, repairs, calibration, and past storage conditions is largely obscured.

Q: Who Needs Radiation Detection Instruments?

A: The reasons for acquiring a radiation detecting survey meter, geiger counter and/or dosimeter are as varied as are peoples concerns for the future and the safety of their families in this ever changing world. Radiation threats are unique in that you can't see, smell, taste, hear or feel them, until it's already done its damage and you are suffering the effects. Without a radiation detector you would have to depend solely on the limited resources of the authorities to monitor your location, then determine your risk level, decide the best protective action and then to 'get the word out'.

Exclusively depending on others to monitor, evaluate, warn and advise you, in a rapidly developing nuclear emergency crisis, would surely not be anywhere near as quick in revealing your current risk as when you are capable of taking your own independent radiation readings. Also, where authorities are warning of radiation fallout not yet arrived, but anticipated to be heading your way, with a radiation meter you'll be able to confirm that the suggested protective action is in fact reducing your exposure and not inadvertently increasing it. (Safe avenues of evacuation and/or designated safe areas can potentially shift as quickly as the wind!)

The specific causes of potential life-threatening nuclear radiation emergencies include...

- Nuclear power plant accidents here or abroad (Three Mile Island, Chernobyl)
- Nuclear materials processing plant accidents (Tokaimura, Japan)
- Nuclear waste (radioactive waste from hospitals, spent fuel and radioactive waste from nuclear power plants, radioactive contaminated materials, etc.) storage or processing facilities mishaps
- Nuclear waste transport truck or train accidents
- Accidents involving non-waste, but normal daily nuclear materials transport (trucks, planes, trains, couriers) One out every 50 HazMat shipments contain radioactive materials. Approximately three million packages of radioactive material are shipped in the United States each year.
- Improper storage of radioactive materials (non-waste) at any point during their normal material life cycle. (Power plants, Medical, Industrial, Academic, etc.)
- Lost or stolen radioactive sources (Over the last 50 years, incidents of lost and stolen *licensed* radioactive devices occur at the rate of once every other day.
- Nuclear terrorism here via...
  - *** An attack on, or sabotage of, a nuclear power plant.
  - Or, a real terrorist atomic bomb detonated here.
  - Or, much more likely, conventional explosives used to disperse radioactive materials to effectively contaminate an area and much within in it.
- Limited nuclear war overseas with the fallout carried here by the wind
- Nuclear War involving a direct attack upon the USA.

Regarding radioactive fallout and minimizing the effects on your family with the use of a radiation meter, Cresson H. Kearny, the author of Nuclear War Survival Skills, Original Edition Published September, 1979, by Oak Ridge National Laboratory, a Facility of the U.S. Department of Energy (Updated and Expanded 1987 Edition) states in Chapter 10 - Fallout Radiation Meters:

A survivor in a shelter that does not have a dependable meter to measure fallout radiation or that has one but lacks someone who knows how to use it will face a prolonged nightmare of uncertainties. Human beings cannot feel, smell, taste, hear, or see fallout radiation.

Which parts of the shelter give the best protection? How large is the radiation dose being received by each person? When is it safe to leave the shelter for a few minutes? When can one leave for an hour's walk to get desperately needed water? As the fallout continues to decay, how long can one safely work each day outside the shelter? When can the shelter be left for good? Only an accurate, dependable fallout meter will enable survivors to answer these life-or-death questions.

With a reliable dose rate meter you can quite quickly determine how great the radiation dangers are in different places, and then promptly act to reduce your exposure to these unseen, unfelt dangers. For example, if you go outside an excellent fallout shelter and learn by reading your dose rate meter that you are being exposed to 30 R/hr, you know that if you stay there for one hour you will receive a dose of 30 R. But if you go back inside your excellent shelter after 2 minutes, then while outside you will have received a dose of only 1 R.

Bottom Line: Having on-hand an inexpensive radiation detecting meter in this day and age is cheap family insurance and, like major medical insurance, we can also hope & pray never to have to use it! Also, like any real insurance, it'll be near impossible to get it after the fact!

Q: What's the Difference Between *Alpha*, *Beta* and *Gamma* Radiation?

A: Everything in nature would prefer to be in a relaxed, or stable state. Unstable atoms undergo nuclear processes that cause them to become more stable. One such process involves emitting excess energy from the nucleus. This process is called radioactivity or radioactive decay. "Radiation" and "radioactivity" are often confused, the proper relationship is that "radioactive atoms emit radiation."

The three main types of nuclear radiation emitted from radioactive atoms are:

- **Alpha**: These are actual particles that are electrically charged and are commonly referred to as **alpha particles**. Alpha particles are the least penetrating of the three primary forms of radiation, as they cannot travel more than four to seven inches in air and a single sheet of paper or the outermost layer of dead skin that covers the body will stop them. However, if alpha particle emitting radioactive material is inhaled or ingested, they can be a very damaging source of radiation with their short range being concentrated internally in a very localized area.
- **Beta**: These are also actual particles that are electrically charged and are commonly referred to as **beta particles**. Beta particles travel faster and penetrate further than alpha particles. They can travel from a few millimeters up to about ten yards in open air depending on the particular isotope and they can penetrate several millimeters through tissue. Beta particle radiation is generally a slight external exposure hazard, although prolonged exposure to large amounts

can cause skin burns and it is also a major hazard when interacting with the lens of the eye. However, like alpha particles, the greatest threat is if beta particle emitting radioactive material is inhaled or ingested as it can also do grave internal damage.

- **Gamma**: Gamma rays are similar to x-rays, they are a form of electromagnetic radiation. Gamma rays are the most hazardous type of external radiation as they can travel up to a mile in open air and penetrate all types of materials. Since gamma rays penetrate more deeply through the body than alpha or beta particles, all tissues and organs can be damaged by sources from outside of the body. Only sufficiently dense shielding and/or distance from gamma ray emitting radioactive material can provide protection.

Bottom Line: All three of the primary types of radiation above can be a hazard if emitted from radioactive material that was inhaled or ingested. Protected food and water and even a simple inexpensive dust protector face mask can go a long ways to denying this route of entry. However, for the penetrating gamma rays, it is essential to be able to measure the strength of this type of radiation to then discover the best protected shielding and distance options available. Also, in a shelter or home, besides revealing the safest locations there, knowing the intensity of the local gamma radiation outside will better indicate when it is again safe. Or, safe enough to perform a brief essential chore outside.

Q: What's the Difference Between *Roentgen*, *Rad* and *Rem* Radiation Measurements?

A: Since nuclear radiation affects people, we must be able to measure its presence. We also need to relate the amount of radiation received by the body to its physiological effects. Two terms used to relate the amount of radiation received by the body are **exposure** and **dose**. When you are exposed to radiation, your body absorbs a dose of radiation.

As in most measurement quantities, certain units are used to properly express the measurement. For radiation measurements they are...

- **Roentgen**: The *roentgen* measures the energy produced by gamma radiation in a cubic centimeter of air. It is usually abbreviated with the capital letter "R". A milliroentgen, or "mR", is equal to one one-thousandth of a roentgen. An exposure of 50 roentgens would be written "50 R".
- **Rad**: Or, *Radiation Absorbed Dose* recognizes that different materials that receive the same exposure may not absorb the same amount of energy. A *rad* measures the amount of radiation energy transferred to some mass of material, typically humans. One *roentgen* of gamma radiation exposure results in about one *rad* of absorbed dose.
- **Rem:** Or, Roentgen Equivalent Man is a unit that relates the dose of any radiation to the biological effect of that dose. To relate the absorbed dose of

specific types of radiation to their biological effect, a "quality factor" must be multiplied by the dose in rad, which then shows the dose in rems. For gamma rays and beta particles, 1 rad of exposure results in 1 rem of dose.

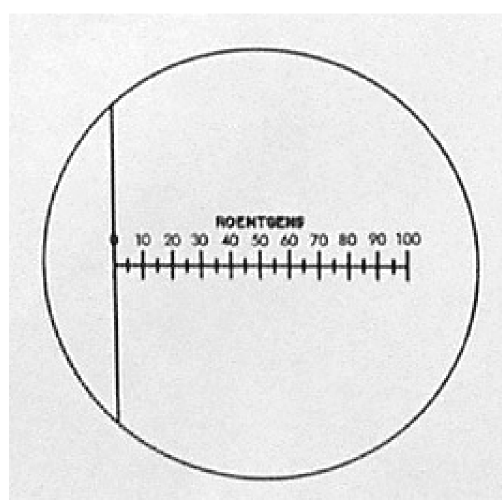
Other measurement terms: Standard International (SI) units which may be used in place of the *rem* and the *rad* are the *sievert* (Sv) and the *gray* (Gy). These units are related as follows: 1Sv = 100 rem, 1Gy = 100 rad. Two other terms which refer to the rate of radioactive decay of a radioactive material are *curie* (Ci) and *becquerel* (Bq).

Bottom Line: Fortunately, cutting through the above confusion, for purposes of practical radiation protection in humans, most experts agree (including FEMA Emergency Management Institute) that *Roentgen*, *Rad* and *Rem* can all be considered equivalent. The exposure rates you'll usually see will be expressed simply in terms of *roentgen* (R) or *milliroentgen* (mR). For details on *how much is too much* "R", see the Q&A section below entitled: **Which Survey Meter Would Be Best For My Needs?**

Q: What's the Difference Between Survey Meters, Geiger Counters and Dosimeters?

A: Survey meters, field survey meters, rate meters, radiac meters, radiation detection meters, low-range meters, high-range meters, airborne meters, fallout meters, remote monitors, Geiger counters, and even 'dose rate meters' are all describing instruments that **measure exposure rate** or the intensity of radiation at a location at some point in time. It's like the speedometer of a car; both present measurements relative to time. All of these above 'meters', the Geiger counter, too (which utilizes a Geiger tube rather than an ion chamber), will show their radiation intensity readings relative to time, such as R/hr or mR/hr like the scale at the right, same as a car speedometer will show miles/hr. If you entered a radioactive area and your meter says 60 R/hr then that means if you were to stay there for a whole hour you would be exposed to 60 R. Same as driving a car for an hour at 60 mph, you'd be 60 miles down the road after that hour, at that rate.

Dosimeters, which are also available in high or low ranges, can be in the form of a badge, pen/tube type, or even a digital readout and all measure exposure or the total accumulated amount of radiation to which you were exposed. (The Civil Defense pen/tube tube would show a reading like at the right when looking through it.)



It's also similar to the odometer of a car; where both measure an accumulation of units. The dosimeter will indicate a certain total number of R or mR exposure received, just as the car odometer will register a certain number of miles travelled.

Example of the relationship between a survey meter and a dosimeter; If you had a survey meter in one hand and a dosimeter in the other and walked into an area of measurable radiation and your survey meter said you were now standing in a 30 R/hr radiation field, and you stayed there for two hours, then your dosimeter at the end of those two hours would be indicating 60 R. The meter measured the exposure rate or intensity of the radiation there and the dosimeter accumulated the total amount of radiation you had been exposed to for having been there those two hours. (If you had left right after the first half-hour, then your dosimeter would have been reading only 15 R.)

Bottom Line: Both meters and dosimeters have their place, and their limitations, in indicating the presence of hazardous radiation levels, and when utilized by a person with the basic understanding of what they are each measuring, they can be critical life-saving tools to survival in a nuclear emergency.

Q: How Good Are Surplus FEMA Civil Defense Survey Meters, Geiger Counters and Dosimeters?

A: From the numerous FEMA technicians who have maintained, repaired and calibrated thousands of these Civil Defense Survey Meters, Geiger Counters and Dosimeters over many years, oftentimes even decades, we heard nothing but praise with a few specific maintenance cautions to be aware of. Most of these technicians have seen the same units come back in from active use in the field for their 1, 2 or 3 year re-calibration certification. (The calibration schedule varies based on the particular application they might be utilized for 'in the field'.) They know first-hand how well they hold up their calibration and can be counted on to perform. (Many thousands of these same exact type Civil Defense radiation survey meters and dosimeters are also deployed in various states and amongst their local governments First-Responders; the fire, police, EMT, and HazMat teams. I was also notified that a fair number of hospitals also utilize them to periodically check their X-Ray machines, etc. for leaks, too.)

All the technicians variously described the properly maintained, calibrated, and stored Civil Defense survey meter and dosimeter as "accurate", "reliable" and "dependable". Many of these same technicians and radiological officers are also atop the call lists in their respective states for any radiological emergency and many of these same survey meters and dosimeters are what they will be confidently responding with. They know them well and trust them.

However, surplus or auction acquired Civil Defense meters and dosimeters are often brought onto the market with little or none of their previous history known of their maintenence, repairs, last calibrations, and past storage conditions. Many of these units, unlike the reliability proven units described above and maintained on a regular basis, may have been out of that maintenance 'loop' for as long 10, 15 or 20 years. Or, they may be new-in-the-box units, produced in the 60's or 70's, that never even got into the maintenance 'loop'. The functionality, reliability and accuracy of any particular individual surplus Civil Defense meter or dosimeter **can not be assumed**, until actually verified and proven to be so. We know this from the experience of culling out the bad units from amongst the good as we've evaluated, tested, and had calibrations attempted on thousands of these same surplus meters. (We have over 100,000 of them here in our facility. Many of these surplus meters can be every bit as reliable and accurate as those described above, but it first requires a systematic evaluation and testing process to identify them.

Bottom Line: We found the above sentiments by FEMA technicians so universal, and witnessed the successful tests and calibrations of enough regularly maintained meters, some often well past their scheduled re-calibrations, that we are confident that a properly maintained, calibrated, and stored Civil Defense Survey Meter or dosimeter will give its owner very reliable and accurate service. The goal then needs to be to acquire only a quality Civil Defense meter or dosimeter that is first proven to be fully up to these maintenance, calibration and storage standards.

Q: What Are the Different Types of Civil Defense Survey Meters?

A: Amongst the Civil Defense Survey Meters there are four primary types, one low-range meter and three high-range meters. (There was one other high-range meter, the plastic encased CD V-710, that we don't see much of anymore and will not be including it here.) The following three survey meters are the most common Civil Defense high-range meters. The detector on all these high-range survey meters is an ionization chamber. It measures gamma radiation. The R/hr in the ranges indicated below refers to Roentgen per hour exposure rate. They each have a 1-5 numbered meter range and four multiplier scales: X100, X10, X1 and X0.1, with the exception of the CD V-720, that does not have the X0.1 scale. The CD V-715 and CD V-717 with the multiplier scale, X0.1, provides that the 0 - 5 range would be read as 0 - .5 R/hr when it's selected. The other differences between the three units is that the CD V-717 includes a 25' cable for remote sensing and the CD V-720 employs a sliding beta shield on the bottom to allow for beta radiation detection, too.

CD V-715 Civil Defense High-Range Survey Meter
0-500 R/hr range - 3.25 pounds, die cast aluminum and drawn steel case, watertight, will float. Powered with one D-sized battery, continuously for 150 hours, longer if on intermittent basis.

Instrument accuracy on any of its four ranges is within +-20% of true dose rate. Accuracy maintained throughout temperature ranges of -20 F to +125 F, relative humidities to 100% and altitudes up to 25,000'.

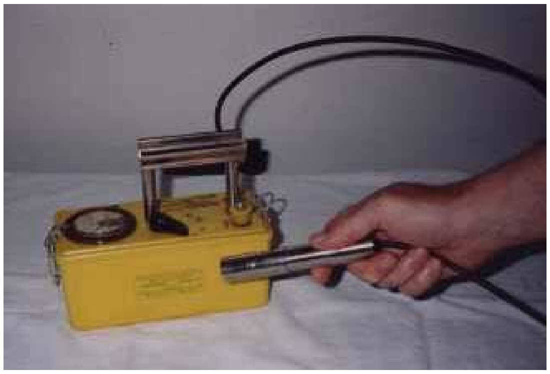
CD V-717 Civil Defense High-Range Survey Meter 0-500 R/hr range - 5.25 pounds, 3-part die cast aluminum case, watertight, will float. Powered with one D-sized battery, continuously for 150 hours, longer if on intermittent basis.

Instrument accuracy on any of its four ranges is within +- 20% of true dose rate. Use of remote cable (25') should not degrade accuracy more than 5%. Detachable bottom section, containing ion chamber, can be set up for remote sensing with included cable.

CD V-720 Civil Defense High-Range Survey Meter 0-500 R/hr range - 3.75 pounds, 2-part die cast aluminum case, watertight, will float. Powered with two D-sized batteries, continuously for 150 hours, longer if on intermittent basis.

Instrument accuracy on any of its three ranges is within +- 15% of true dose rate. (It does not have X0.1 range.) Has sliding shield door on bottom to allow detection, though not measurement, of beta particles.

The low-range Civil Defense survey meter is the **CD V-700 below...**



The detector on the CD V-700 is a Geiger-Mueller (GM) tube. It measures gamma radiation. It has a check source on the side and a headphone jack. The range selector switch allows you to measure up to 50 mR/hr. A milliroentgen (mR) is one thousandth of a Roentgen (R). The probe on the CD V-700 has a section in the center which rotates to expose a window for also detecting beta. When the window is open it detects both beta and gamma. This survey meter is calibrated only for gamma radiation, so you can not get an accurate reading of the exposure rate from beta particles, only an indication of their presence.

The CD V-700 according to the 1993 FEMA publication #SM 320 "Fundamentals Course for Radiological Monitors" states: *"It is only able to measure up to 50 mR/hr and unit may become "saturated" in a higher field of radiation and act erratically, even to the point of giving false low readings in radiation fields exceeding 1000 mR/hr (1 R/hr)."*

Q: Which Survey Meter Would Be Best For My Needs?

A: The first decision in selecting a survey meter is choosing whether a high-range meter or a low-range meter would best suit your goals and needs. A survey meter will be used to help make critical decisions, such as to flee, how far, and to where. Or, to stay in-place, and if staying then in determining the best-protected location in your home or shelter. Then, later, for determing when it is safe again and until then, when and for how long someone could briefly exit the protected area to perform a critical chore, etc.

Key to that high or low range decision should be to first understand and then determine the levels of radiation exposure one should be most concerned about in a nuclear emergency. Then the correct range meter best suited for the job will become obvious.

The following is from **Biological Effects of Radiation** and is part of the Radiation Worker Training (RWT) common to all DOE facilities. It is instructive in outlining the levels of radiation and their effects.

ACUTE AND CHRONIC RADIATION DOSE

Potential biological effects depend on how much and how fast a radiation dose is received. Radiation doses can be grouped into two categories, *acute* and *chronic* dose.

Acute dose

An acute radiation dose is defined as a large dose (10 rad or greater, to the whole body) delivered during a short period of time (on the order of a few days at the most). If large enough, it may result in effects which are observable within a period of hours to weeks.

Acute doses can cause a pattern of clearly identifiable symptoms (syndromes). These conditions are referred to in general as *Acute Radiation Syndrome*. Radiation sickness symptoms are apparent following acute doses ≥100 rad. Acute whole body doses of ≥450 rad may result in a statistical expectation that 50% of the population exposed will die within 60 days without medical attention.

As in most illnesses, the specific symptoms, the therapy that a doctor might prescribe, and the prospects for recovery vary from one person to another and are generally dependent on the age and general health of the individual.

Blood-forming organ (Bone marrow) syndrome (>100 rad) is characterized by damage to cells that divide at the most rapid pace (such as bone marrow, the spleen and lymphatic tissue).

Symptoms include internal bleeding, fatigue, bacterial infections, and fever.

Gastrointestinal tract syndrome (>1000 rad) is characterized by damage to cells that divide less rapidly (such as the linings of the stomach and intestines). Symptoms include nausea, vomiting, diarrhea, dehydration, electrolytic imbalance, loss of digestion ability, bleeding ulcers, and the symptoms of blood-forming organ syndrome.

Central nervous system syndrome (>5000 rad) is characterized by damage to cells that do not reproduce such as nerve cells. Symptoms include loss of coordination, confusion, coma, convulsions, shock, and the symptoms of the blood forming organ and gastrointestinal tract syndromes. Scientists now have evidence that death under these conditions is not caused by actual radiation damage to the nervous system, but rather from complications caused by internal bleeding, and fluid and pressure build-up on the brain

> Other effects from an acute dose include: 200 to 300 rad to the skin can result in the reddening of the skin (erythema), similar to a mild sunburn and may result in hair loss due to damage to hair follicles.
>
> 125 to 200 rad to the ovaries can result in prolonged or permanent suppression of menstruation in about fifty percent (50%) of women.
>
> 600 rad to the ovaries or testicles can result in permanent sterilization.
>
> 50 rad to the thyroid gland can result in benign (non cancerous) tumors.

As a group, the effects caused by acute doses are called *deterministic*. Broadly speaking, this means that severity of the effect is determined by the amount of dose received. Deterministic effects usually have some threshold level - below which, the effect will probably not occur, but above which the effect is expected. When the dose is above the threshold, *the severity of the effect increases as the dose increases*.

The following is interpreted from attached "official" and other "expert" sources. These sources often provide a 'range' for effects, but I have simplified this to a single number to make the table easier to memorize - and you should memorize it. You can then 'extrapolate' for your self the relative severity of effects of a number between a higher and lower number.

- 600R -- means 100% chance of fatality is expected.
  Some much earlier - but last within two weeks.
- 400R -- means 50% will die within one to three weeks.
  Those that don't die are going to be VERY sick and wish that they would. After a few days some may feel better but will often then turn, sicken and die in a few weeks.
- 200R -- lots of sickness, and radiation sickness is pretty terrible (Think of cancer treatment without pain killers.)

Lots of vomiting - hair falling out - and all that.
Not nice

- 50R -- No fatalities at this level. There is a difference of opinion, as to whether the sickness at this level is physical. Some think, as for example in this very authoritative study, that at this level the sickness is psychosomatic. Whatever its cause it is very general.

- 30R -- Most everyone will feel some sickness -
- maybe just "punky" and it may be "just" psychosomatic
but it certainly would not be beneficial for children
and pregnant mothers. Even this level is a thousand times higher than the maximum general population exposure permitted under peacetime standards.

In the final analysis, fatality is probabilistic, somewhat like car accident fatalities. There have been cases of people getting very much higher radiation and surviving, and others with much lower who have not. Cause and effect become clouded when working with probability issues. There are many impinging factors, such as age, health, medical care, or lack of medical care.

It should be readily apparent now that the more dangerous levels of radiation are well beyond the capability of a low-range survey meter, such as the CD V-700, which would be maxed out at 50 mR/hr which is only .05 R/hr. (A low-range meter is better suited for verifying successful decontamination and/or checking for low-level contamination in food or water.) With that meter alone, and maxed out, you would not know if you just walked into a 1 R/hr or a potentially fatal 1000+ R/hr environment.

Cresson H. Kearny, covers this point, too, in his book Nuclear War Survival Skills, Chapter 10 - Fallout Radiation Meters:

Instruments that measure only milliroentgen-range dose rates are sold for war use by some companies. Since most Americans have no idea what size of radiation doses would incapacitate or kill them, and do not even know that a milliroentgen is 1/1000 of a roentgen, some people buy instruments that are capable of measuring maximum dose rates of only one roentgen or less per hour. The highest dose rate that it can measure, one roentgen per hour, is far too low to be of much use in a nuclear war.

Q: OK, so if it's a high-range survey meter we would need, then which Civil Defense high-range survey meter is *'the best'*?

A: We asked this and other important related questions in all of our conversations with the FEMA technicians and radiological officers we interviewed. They responded;

#1 - Any of the high-range Civil Defense meters will work just fine IF it has been properly maintained, stored, and calibrated. Also, calibration no more frequently than every three years is normally sufficient IF stored properly, but is much more frequently required if subjected to rough handling, for example, bouncing around in the trunk of a car for most of the year. Also, they emphasized that the calibration needs to always be with a sufficiently strong enough radioactive source that a mid-scale meter reading can be attained for all the ranges, not just the lower ranges.

#2 - Universally, when pushed to rank them, most all of them said their preference for a particular survey meter model was in the following order: CD V-715, CD V-717, CD V-720. Asked to elaborate why this personal preference and most said it was for the lighter weight of the CD V-715 over the other two and the basic KISS principle in that the CD V-715 had no frill 'bells & whistles' that might invite complications in the field. Also, many were openly critical of the CD V-720 design 'feature' of its sliding beta shield for attaining beta readings. They felt it was more of a marketing 'feature' than of any real practical use. They also found it required more maintenance attention as it was more prone to allow the intrusion of humidity and dirt internally.

We also inquired how comfortable they were with used and visibly worn Civil Defense survey meters compared to any of the same type new and largely unused meters available there on their shelves, too. They made it clear that it didn't matter, used or new, just so long as it was properly maintained, calibrated, and stored until needed. If called on to respond to a radiological emergency, they would rush out the door with whatever unit, new or used, was known to them to of been properly maintained, calibrated, and stored correctly there.

Bottom Line: Low-range survey meters, like the CD V-700, do have their place, but without a higher-range survey meter first, and initially, warning you away from exposure to excessively high levels of lethal radiation, the opportunity to later even use a low-range meter may never come!

Q: Where Can You Buy a Civil Defense Survey Meter?

A: Civil Defense survey meters usually come on the market via very infrequent, but sometimes very large, FEMA auctions. They are most often bid on by surplus wholesalers, but sometimes by other unrelated businesses and even individuals hoping to turn them for a quick profit. They buy them by the pallet load lots, perhaps 40-80 pallets per lot and as many as a dozen lots or more in any one auction. But, of course, these auctions can be bigger or smaller, too.

Once acquired they are then typically sold in smaller lots to other wholesalers and any business that might have a potential customer base interested in them retail, such as Army/Navy surplus stores, preparedness companies and internet based companies catering to the same type clientele.

You can check any of the above, or search the internet ('geiger counter' is a good search term), and you'll always find some offered at www.ebay.com.

Most all these potential outlets are interested in moving them out with as little additional input (time/money/energy) as is possible. While that's understandable, you'll need to be aware of what these meters are, <u>and are not</u>, likely capable of when you consider getting yours, especially when they tell you that *"it works"*, and that's what you are relying upon.

We invested a lot of due-diligence homework in evaluating the possible acquisition of multiple lots from a recent FEMA action in Fort Worth early in 2001. What we learned is priceless, and should be well understood by anybody considering buying even just one unit as a serious nuclear radiation detection instrument. (Of course, if you are only wanting one as a 'cold war relic' conversational piece for the mantle, or as a doorstop, you can disregard the following and simply shop for the cheapest and neatest looking available.)

We made arrangements with one of the winning-bid companies we were negotiating with to go to the Fort Worth FEMA Federal Depot and pull 15 survey meters out at random for independent lab testing, evaluation and calibration. We had no illusions that a sample size of only 15 from amongst the 100,000+ items (80,000 of them these high-range survey meters) would yield significant statistical information about the whole lot, but we were not disappointed in what it did reveal.

By previous arrangement we also had the testing lab, which maintains, repairs and calibrates exclusively these exact same type Civil Defense survey meters, allow us to be present at the testing. (Normally you'd send off a meter to a lab, wait 2-3 weeks, at best, before getting it back and the results would be a simple pass/fail.) The technician we had been talking with there on numerous previous occasions was also the same technician we had do this work and he went far beyond the 'call of duty' for us there. He was good enough to really examine, test, and evaluate each closely rather than simply plug them into the calibrator to see if they would be functional enough for him to next commence the calibration. He answered all our questions (and we always have a lengthy list of them) and detailed for us the good/bad/ugly of each meter as it was throughly gone over.

The meters tested were 5 each of the CD V-715's, CD V-717's, and CD V-720's, 15 total with 8 being obviously well used units and 7 new-in-the-box. Before bringing them into the lab we put batteries in each to perform the 'circuit check' and, we were pleased to see, they all passed this initial test perfectly.

At the end of this long day of testing at the lab the final results were that we only had 4 meters successfully calibrated and certified, and 11 that were discovered not to be functioning sufficiently well enough to even be calibrated. Two of the used and two of the new had passed, one of each also required minimum adjustments to bring it into line suggesting that those two had held well their last calibration.

So, with 4 out of 15 functioning sufficiently enough to be calibrated, that's about a 27% success rate and a 73% failure rate. Again, this is too small a sample from amongst the 80,000 survey meters of this same type tested to read too much into these numbers. This total lot had come together from many states that had stored and maintained these meters often times very differently from each other. These ratios will vary a great deal, no doubt, from one states X number of pallets, contributing to the total, compared to the next.

What this does tell us very clearly, though, is that a survey meter 'passing' the 'circuit check' test does not guarantee you have a functioning meter that either is, or even can later be, successfully calibrated.
In our experience, and with the more meters we've gone through here the more we've come to expect, that of the ones successfully 'passing' the 'circuit check' test that less than 1/3rd of them will also be functioning sufficiently enough to even be calibrated.

Of course, investing in repair work on a meter that failed calibration could bring it up to full functionality. (We've since repaired most all of those original test meters that initially failed, and cannibalized the others for parts.) The early testing also showed, even with that small sample, that even those meters that are fully functioning to where they can then be successfully calibrated, they still needed that calibration adjustment and fine-tuning. In other words, none of them came already calibrated accurately enough to where they'd of been certified without that further investment of being sent off to a lab to be calibrated.

What this all means to you in selecting and acquiring a Civil Defense survey meter is that when the seller says simply *"It works."* or *"It passed the circuit test,"* they likely have only dropped a couple batteries in it and performed the 'circuit check' to arrive at those conclusions. And, it's extremely unlikely all, or possibly even the majority, of the meters they are selling will be functioning sufficiently enough for them to even be later calibrated without repair work first. And, even less likely that you'd be getting a functioning meter whose last calibration, who knows when, was still holding accurately enough that you didn't need to have the calibration re-done again. And, you will never know, unless you then attempt to get it calibrated yourself

<u>Bottom Line</u>: If you want/need a meter you can have confidence in that it will perform reliably and accurately when it'll count the most, then you've either got to...

Acquire a meter that was recently successfully calibrated ...or...

Buy an untested surplus meter and send it off to a qualified lab that will test if it is functioning sufficiently well enough to be calibrated without further repairs and, if so, then have it done correctly to accepted standards specifically required for these types of high-range Civil Defense meters.

...or...Try to find/buy a newly manufactured high-range survey meter for $1,100 - $1,500.

Q: Are all Lab Calibrations and Certifications Equal?

A: They should be, but all labs are not created equal, we know, we've talked to many in our quest for a calibration service we could be confident in. What some were willing to do to get our potential quantity business and/or cut costs per meter was surprising, like suggesting only requiring a 30% accuracy reading or only calibrating for the lower ranges. Many also simply do not have a source sufficiently 'hot' enough to do the top range, or to do it correctly. To get the required mid-scale meter reading on the top range (X100), to calibrate it, requires a N.I.S.T. Traceable Cs-137 (Cesium) source in the neighborhood of around 250 R or higher, and that's expensive for most labs who usually only deal with peacetime low-level meters. Also, we discovered, while many labs don't do these Civil Defence survey meters, many others that said they had done them before and would again, were very pricey to do it the way the standards required and that we insisted be followed. (Adjustment to within 1 scale division.) Few labs have the particular CD V-794 calibrator (seen here on the right, detailed below) made especially for these Civil Defense meters that allow the operator to put a meter in the chamber and remotely change the ranges and adjust the sensitivity potentiometers to tweak the calibration without again having to remove it until completed. (Which really only takes less than 10 minutes with the correct setup.) In fairness, without this specialized calibrator, labs know that it's a very time consuming and repetitive trial and error ordeal putting the meter into a radiation field, seeing where it's currently reading, taking it back out and making an adjustment, then back in to check it again, etc., etc. And, this would need to be done for all the 3 or 4 ranges, too. Anyways, point is, some labs are better equipped than others to calibrate these Civil Defense survey meters, and you'll need to inquire carefully of anyone claiming their meters for-sale are 'certified' and/or 'calibrated'. They should be able to answer to your satisfaction a string of *who, what, when, where, and how* questions before you'll proceed.

Cresson H. Kearny, also points up the need to test and verify with a full strength source calibration throughout all the available ranges in his book Nuclear War Survival Skills, [Chapter 10 - Fallout Radiation Meters]...

No U.S. Government agency or other Government facility advises the public regarding sources of the best available radiation-measuring instruments for use in time of war, or warns concerned individuals that certain instruments are either incapable of measuring adequately high dose rates or doses for wartime use, or are dangerously inaccurate. For example, a dose rate meter that in 1982 sold nationwide was tested in that year at Oak Ridge National Laboratory to determine its accuracy for measuring gamma radiation. This instrument was reasonably accurate at low dose rates, but at the high dose rates of life or death importance in a nuclear war its readings were dangerously low: When it should have read 150 R/hr, it read 13.9 R/hr. Another dose rate meter of this same model, tested in California by Dr. Bruce Clayton, read only 16 R/hr when it should have read 400 R/hr. Obviously, if this model were used and trusted by a person doing rescue work for hours outdoors in heavy fallout, while believing that he was receiving a non-incapacitating dose he actually would be getting a fatal dose!

Bottom Line: If you are exploring the purchase of a 'calibrated' Civil Defense Survey meter (which by now should be understood as the only meters worth considering) or having a meter you already own calibrated, it needs to be by a qualified lab that can perform the calibration to the required standards. Only then can you have full confidence in your families radiation survey meter when it'll really count.

Q: What about Dosimeters and Chargers?

A: Dosimeters and their required Chargers should be readily seen as an important additional asset by anyone that already understands the need for a survey meter.

The direct-reading pocket dosimeter is a portable instrument designed to measure the total dose of moderate and high levels of gamma radiation. The common dosimeters are designated the CD V-138, CD V-730, CD V-740, and CD V-742. The instruments make use of a small quartz fiber electoscope as an exposure detector and indicator. An image of the fiber is projected onto a film scale and viewed through the eyepiece lens. The scale is calibrated in milliroentgens (mR) or roentgens (R), depending on the model, and may be read by looking through the eyepiece toward a lamp or other source of light. A CD V-750 or 756 dosimeter charger must be used in conjunction with the dosimeter to set the instrument to zero. The charger may also be used to read the scale. FEMA generic basic operating instructions for dosimeters and high-range meters.

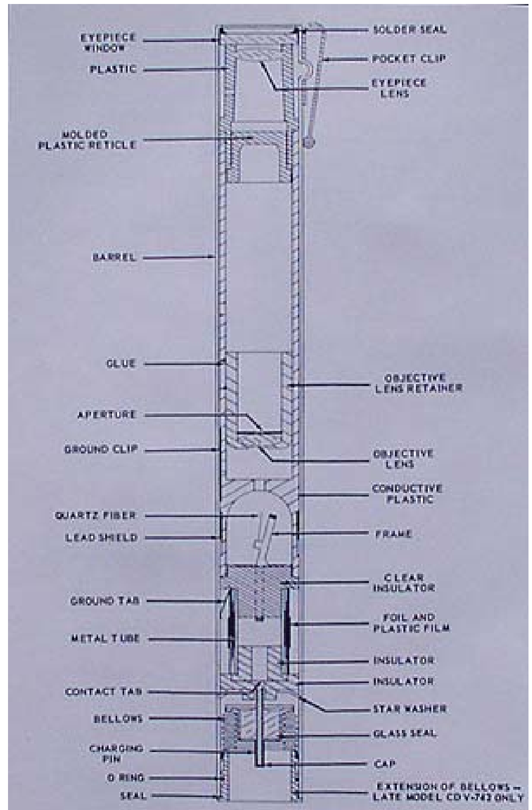


Figure 19-11. Detailed Cutaway View, Landsverk CD V-730, CD V-740, and CD V-742 with Bellows

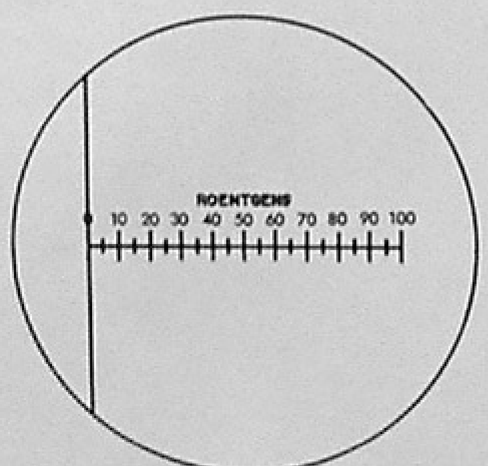


Figure 19-7. CD V-740 Scale

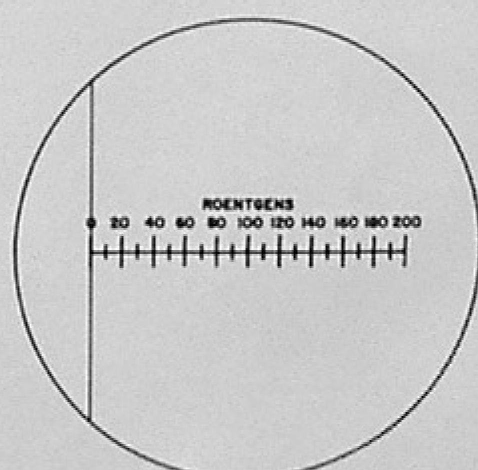


Figure 19-8. CD V-742 Scale

The "Operating and Maintenance Instructions", that come with each CD V-750/756 charger, explains how to zero your dosimeter with the charger. However, something we hadn't seen addressed in them, is that the fiber image may shift slightly when the dosimeter is removed from the charger. This hairline "kick" is a common occurrence, particularly on the lower-range dosimeters. Simply repeat the charging procedure until a zero reading is obtained. If this is difficult, a poor ground condition at the charging pedestal is likely. This condition may be more pronounced if the charger has not been used for a period of time.

Dosimeters can be defective, too, like any instrument. Electrical leakage in dosimeters creates movement or drift of the fiber from an initial setting OR towards an up-scale reading without the presence of radiation. There can be half-a-dozen reasons why, but typically it is caused by contaminates in the manufacturing process, outgassing of internal components, such as plastics, or broken hermetic seals allowing humidity intrusion. FEMA current requirements for field dosimeters is for electrical leakage to not exceed 5% of full scale for a 50 degree C five day test. (Maximum leakage limit is 1% of full scale per day.) The test procedure requirements are quite a bit more involved than just slow cooking them for five days, but that's the primary objective to encourage failure in any units prone to these problems. Any dosimeters failing to meet this standard are considered defective and should be repaired.

Dosimeters are also tested for accuracy by being exposed to a known radiation source that should hit midscale on their particular range. (Dosimeters are not completely linear and the only provided calibration points are always midscale.) FEMA specifications require that dosimeters should respond to within plus or minus 10% of true dose. But, because the calibrator 'box' geometry (positioning) and radiation scatter components makes absolute calibration impossible, they allow a deviation as great as 15%. Also, as an expediency, because they recognize that even dosimeters that are off by plus or minus 25% still provide valuable information, they also permit a label denoting a correction factor, but you need to keep in mind that dosimeters are not perfectly linear.

The above procedure for radiation exposure testing of dosimeters is much more involved than calibrating a survey meter, both time-wise and in required operator participation setting it up and monitoring it throughout its duration. And, if any are found to not pass that radiation exposure test they can't then be easily calibrated (adjusted) or fixed. (It can be done with the right equipment, it's just a very involved chore.) They are normally just relegated to a *'do it sometime much later'* repair box or auctioned off to unsuspecting bidders. (We recently passed on an offer of 30,000 dosimeters that with some diligent digging were eventually discovered to have been the collected defective rejects of a state agency that had tested 100,000 in-house over a number of years.)

However, those that do pass the electrical leakage test and, better yet, also the radiation exposure accuracy test, should be held in high confidence of performing accurately and reliably in the field. (BTW, Less than 1/4 of the dosimeters that we've performed the electrical leakage test on, now over 4,500 total to date, have passed that test. However, of those that do pass it, that we have then sent onto the lab for the radiation exposure accuracy testing, we've found a 93% success rate for that radiation exposure accuracy test.)

The logic of preferring a high-range dosimeter rather than a low-range dosimeter is the same as for survey meters. We will be offering two types of high-range dosimeters (CD V-740 and CD V-742) and those will be available in two grades, electrical leakage tested OR combined electrical leakage AND radiation exposure accuracy tested. The tested dosimeters passing the radiation exposure accuracy testing will have a certification sticker indicating such on them. Any dosimeters here that fail either test are put aside for possible future repairs, if/when we expand into that service.

Q: I Already Have a Survey Meter, Can You Calibrate It?

A: Only this, keep your current meters and acquire an inexpensive calibrated meter you can trust and then, *when the time comes*, use it to also test your other meters reliability and accuracy. If one of your current, uncalibrated, meters reads high or low, then mark on it a correction factor denoting that meters particular variance from a true reading. (You can also actually 'field calibrate' it by first studying the manual instructions detailing the adjustment calibration controls.) That's much better than having them sit on a shelf unused in a nuclear emergency or selling them to somebody else that doesn't know how important it is to only rely on a calibrated meter for protecting their own family.

FEMA says 3 years between calibrations, however if you know your meter had been exposed to rough handling then sooner would be wise.

Q: What other type meters, Civil Defense or not, are available?

A: We've got some Civil Defense 'exotics' that we'll bring out here soon in the future, such as a rugged 3-meters-in-one Aerial Fallout system for use in airplanes to detect and map fallout. (Which work just fine for gamma detection here on the ground, too.) Also, Civil Defense barrier demonstration units that can be utilized by educational facilities or their detectors/meters possibly incorporated into a remote monitoring station.

And, for a very inexpensive, non-FEMA, Civil Defense radiation detector we offer our popular KFM kit (Kearney Fallout Radiation Meter) or free plans... see this CD for the plans.