**GM Tubes Evaluated:**

This section should help you get a better idea about how some GM tubes perform, and may help in selecting a tube. It is by no means comprehensive. In fact, it's limited to only the tubes I've tested. When possible, I added the link to the specs and added *my own impressions* of each tube. Performance of each is on the comparison chart that follows.

* [SBM-20](http://www.google.com/url?q=http%3A%2F%2Fwww.gstube.com%2Fdata%2F2398%2F&sa=D&sntz=1&usg=AOvVaw2nYrKf9l5xhTmfz31D7ppd) - The quintessential Russian tube. Lower priced, and more sensitive to beta and gamma than most. *This is still one of my favorite all around beta gamma tubes.* The [STS-5](http://www.google.com/url?q=http%3A%2F%2Fwww.gstube.com%2Fdata%2F4540%2F&sa=D&sntz=1&usg=AOvVaw05ipqDYgC7tmpgyIpGbOhd) is pretty much the same tube and may be cheaper.
* [M4011](http://www.google.com/url?q=http%3A%2F%2Fcgi.ebay.com%2FNew-High-Sensitivity-M4011-Geiger-Counter-Tube-%2F260835055100%3Fpt%3DLH_DefaultDomain_0%26hash%3Ditem3cbafb15fc%23ht_928wt_862&sa=D&sntz=1&usg=AOvVaw0vyIpkcZL1IXpbiN4-aMPu) - Glass tube made (new) in China. Claimed to be more sensitive than the SBM-20. *Although I once got high readings, it now seems similar to the SMB-20. I am wary about this tube. It's quite possible this tube is light sensitive which would explain the initial high counts. There is a discussion about it's light sensitivity* [*here*](http://www.google.com/url?q=http%3A%2F%2Fwww.gqelectronicsllc.com%2Fforum%2Ftopic.asp%3FTOPIC_ID%3D4540&sa=D&sntz=1&usg=AOvVaw0qQRiN81Llhfc64Ir9pwUt)*.* It is reported that a good CPM to uSv/h conversion rate for this tube is 153.8.
* [SI-180G](http://www.google.com/url?q=http%3A%2F%2Fwww.sovtube.com%2Fproduct.php%3Fid_product%3D319&sa=D&sntz=1&usg=AOvVaw0UPN29_k_WBqPazizQs3II) - Very sensitive to background (84 CPM) but less to other sources. This might be the best tube I have for background. (I like the way it looks too.) However it's similar to the SI-29G on the other samples. *A user (Justin) said that a CPM to uSv/h rate of* ***321*** *gave a similar uSv/h as his GammaScout.* (I solder the wires to it like [**this**](https://www.google.com/url?q=https%3A%2F%2Fwww.dropbox.com%2Fs%2Fk9c6powx45b75ii%2FSI-180G%2520connection.JPG%3Fdl%3Draw&sa=D&sntz=1&usg=AOvVaw34LNh8-fp7JSJoG4wxuIaU).) **10/12/21** - Another user found a conversion factor of 575 was closer to a calibrated measurement..
* [SI-29BG](http://www.google.com/url?q=http%3A%2F%2Fwww.gstube.com%2Fphoto%2F2484.jpg&sa=D&sntz=1&usg=AOvVaw372-v2hVRarWH36eEDsk2l) - (specs: [here](http://www.google.com/url?q=http%3A%2F%2Fwww.gstube.com%2Fdata%2F2484%2F&sa=D&sntz=1&usg=AOvVaw3Ovc6pBfDAfSXkQCTithpW)) Good, smaller, cheaper, substitute for the SBM-20. *This is a nice tube for compact projects. Fairly good sensitivity at a good price.* In my tests this tube is about 70% as sensitive as the SBM-20. 122 might be a good ratio for uSv to CPM.
* [SBM-10](http://www.google.com/url?q=http%3A%2F%2Fwww.gstube.com%2Fdata%2F2396%2F&sa=D&sntz=1&usg=AOvVaw3PYv8Qdsf4KqUff40smADj) - (pulled it out of [this](http://www.google.com/url?q=http%3A%2F%2Fea4eoz.ure.es%2Fdrsb88.html&sa=D&sntz=1&usg=AOvVaw2fkAJYKYokzWeITYN44qBl) ). It's tiny, but may be good for hunting Uranium glass. *I wouldn't use it for much else.*
* [LND 712](http://www.google.com/url?q=http%3A%2F%2Fwww.lndinc.com%2Fproducts%2F711%2F&sa=D&sntz=1&usg=AOvVaw1DrRsnDldiYE_VhxBjr83w) - The gold standard in end window alpha tubes. *Good beta / gamma sensitivity and my best end window alpha detector. Nice size, but not cheap*. You can purchase from LND directly. They normally have a minimum order value $100, but you could try writing them to see if they will make an exception. The o*nly other source I know of is* [*this one*](http://www.google.com/url?q=http%3A%2F%2Fshop.boxtec.ch%2Fproduct_info.php%2FcPath%2F59_39_76%2Fproducts_id%2F40255&sa=D&sntz=1&usg=AOvVaw3rhBBbj4AxLswbBbjzKPTU)*.* Most people use a conversion ratio of 108 CPM to uSv.
* [SBT-9](http://www.google.com/url?q=http%3A%2F%2Fcgi.ebay.com%2Fws%2FeBayISAPI.dll%3FViewItem%26item%3D200635452140%23ht_2104wt_964&sa=D&sntz=1&usg=AOvVaw1uRJgxDsmbUKaJgcGBukwE) - Nice alpha tube for the price if you can get one. It was used in Russian space vehicles. *A good poor mans substitute for the LND 712 if you're looking for an alpha tube.* The SBT-9 seems to be about 50% as sensitive as the LDN-712 for beta and gamma, and about 35% as sensitive for alpha. (85 might be a good ratio for uSv to CPM if compared to the SBM-20 ratios) This tube and the STS-5 was used in [Russian spacecraft](http://www.google.com/url?q=http%3A%2F%2Fwww.mentallandscape.com%2Fv_instruments.htm&sa=D&sntz=1&usg=AOvVaw1kHu2rSE6-qJPqTBAijdEt).
* [LND 7317](http://www.google.com/url?q=http%3A%2F%2Fwww.lndinc.com%2Fproducts%2F17%2F&sa=D&sntz=1&usg=AOvVaw2fZzewwNubFYF8LmxgwqYS) **-** alpha pancake tube - Yippee! finally have one. At 60 cps/mRh for 60Co the CPM to uSv/h ratio for the kit comes out as 360. However, the "Inspector", which uses this same tube, seems to use a ratio of 330. (or 3300 for mR/hr)
* [RFT MKD VA-Z-115.1](http://www.google.com/url?q=http%3A%2F%2Fwww.ebay.com%2Fitm%2FRFT-MKD-VA-Z-115-1-Sensitive-Miniature-Tube-Geiger-Counter-German-Made-1-pc-%2F251053036548%3Fpt%3DBI_Security_Fire_Protection%26hash%3Ditem3a73ed5404%23ht_634wt_952&sa=D&sntz=1&usg=AOvVaw1qLRtMuwzHtucjrg8kvyzC) - This is an East German glass beta/gamma tube. Reasonably priced, and small (~2"/~5cm). Overall, it seems to be the most sensitive of the beta/gamma tubes. Unlike most glass tubes, this one is painted black - probably to reduce the effects of ambient light. [atomic.dave](http://www.google.com/url?q=http%3A%2F%2Fwww.ebay.com%2Fsch%2Fatomic.dave%2Fm.html%3F_nkw%3D%26_armrs%3D1%26_from%3D%26_ipg%3D%26_trksid%3Dp3686&sa=D&sntz=1&usg=AOvVaw29Ai64XM9er0xPhLZGcBf0) runs this tube with the kit at 450V with at 2M anode resistor and a CPM to uSv/h conversion ratio of 227. **Note:** I also bought its little brother - **VA-Z-114NR**. What a difference one digit makes! This tube is not sensitive at all - background is 4-5 CPM - thorite sample ~440 CPM vs. 16.3k CPM for the VA-Z-115.1. Lantern mantle ~72 CPM. Not recommended.
* [SBT-11A](http://www.google.com/url?q=http%3A%2F%2Fwww.sovtube.com%2Fproduct.php%3Fid_product%3D610&sa=D&sntz=1&usg=AOvVaw3Y3qoXae2novNbjLyzKRo_) - Just got this tube. It's a very sensitive alpha tube, comparable to the LND 7317 in some ways. It also seems sturdier and is certainly cheaper. The [data sheet](https://www.google.com/url?q=https%3A%2F%2Fdl.dropbox.com%2Fu%2F3572198%2FSBT-11A%2520data%2520sheet.jpg&sa=D&sntz=1&usg=AOvVaw2GJUTabzldK7Cg4AmASHY1) gives: 44-49 cps/uR/sec, so the CPM to uSv/h conversion ratio becomes **318** CPM/uSv/hr. (thanks Brian) [Pin-out diagram is here](https://www.google.com/url?q=https%3A%2F%2Fwww.dropbox.com%2Fs%2Fv193so7m6d4euhx%2FSBT-11A%2520Pinouts.jpg%3Fraw%3D1&sa=D&sntz=1&usg=AOvVaw0xOc66iLHI5RZtgnbPG384). **[12/8/17]** I learned that there is also an SBT-11 (no 'A') version of this tube that is reportedly less sensitive to alpha than the SBT-11A. My understanding is that tubes with thinner mica receive the 'A' designation. The degree the thicker mica affects alpha sensitivity is unknown. However since it wouldn't affect gamma, I suspect it would be hard to tell the difference..
* [JAN (LND?) 5979](http://www.google.com/url?q=http%3A%2F%2Flndinc.com%2Fproducts%2F382%2F&sa=D&sntz=1&usg=AOvVaw3ilr3vjrVpPm-CQQkT5G6y) - I got this NOS tube from [LeedsRadio on Etsy](http://www.google.com/url?q=http%3A%2F%2Fwww.etsy.com%2Flisting%2F156457364%2F5979-geiger-tube-for-geiger-counters-new%3Fref%3Dshop_home_active&sa=D&sntz=1&usg=AOvVaw3-jxPHRh8_7W-W1ldo160U). (He has lots of other cool stuff.) I also see that [Electronic Goldmine](http://www.google.com/url?q=http%3A%2F%2Fwww.goldmine-elec-products.com%2Fprodinfo.asp%3Fnumber%3DG20782&sa=D&sntz=1&usg=AOvVaw3aZ1X4f4aRcL_E2TjIo3Ey) now carries this tube. It's an end window alpha tube. I don't think LND makes it anymore - the one I bought is from the 70's. It's a solid thing! It was added to the comparison chart for alpha tubes below. Note that it's pulse amplitude seems to be pretty low, so you may get fewer clicks than counts with it. (This is due to a difference in sensitivity between the two circuits.) I run this tube at 700 - 750V. I'd estimate the CPM to uSv ratio to be about 44.
* [SBM-19 (STS-6)](http://www.google.com/url?q=http%3A%2F%2Fwww.sovtube.com%2Fen%2Fx-ray-and-geiger-tubes%2F340-sbm-19.html&sa=D&sntz=1&usg=AOvVaw12Xnx4uOqICGv876EzEdsB) - Well here's a fun tube! It's huge, cheap and very sensitive. I'm getting background in the range of 160 CPM. If you can spare the space this is a great tube for background. I found a few datasheets [here](https://www.google.com/url?q=https%3A%2F%2Fdl.dropboxusercontent.com%2Fu%2F3572198%2FWebsite%2520Images%2FSBM-19.gif&sa=D&sntz=1&usg=AOvVaw3IZqpalS9WQOGqUgY_vrNV) and [here](https://www.google.com/url?q=https%3A%2F%2Fdl.dropboxusercontent.com%2Fu%2F3572198%2FWebsite%2520Images%2FSTS-6.jpg&sa=D&sntz=1&usg=AOvVaw3SMP-OpA3TdR9ARw7ZDRF0). It's now added to the comparison charts. Compared to the SBM-20, it gives 5x the background (because of it's size), but only ~1.5x the readings for the other test samples which are more point sources. If I were using this tube for background, I'd use 5x the SB-20's rate of 175 or **875 CPM / uSv/h**. For point sources I'd use 1.5x the rate or **263 CPM / uSv/h**. (just my best guess )
* [SI-8B / CI-8b](http://www.google.com/url?q=http%3A%2F%2Fwww.sovtube.com%2Fen%2Fx-ray-and-geiger-tubes%2F333-ci-8b.html&sa=D&sntz=1&usg=AOvVaw3OhmICWhYmmvZf5oDrlAEA) - Sort of the Russian version of the LND 7313. It seems much sturdier due to a thicker mica window. It's also about half the price. I just got this tube but it's now on the comparison charts. [Here is a nice translation](https://www.google.com/url?q=https%3A%2F%2Fwww.dropbox.com%2Fs%2Fdpysxsbfdibnz5s%2FSI-8b%2520Translation.txt%3Fdl%3D1&sa=D&sntz=1&usg=AOvVaw24gi-N2jrZ1tnTchlg0C4m) of the [spec sheet](https://www.google.com/url?q=https%3A%2F%2Fwww.dropbox.com%2Fs%2F9wv7wz0hl5ofz75%2FSI-8b%2520page1.JPG%3Fdl%3D1&sa=D&sntz=1&usg=AOvVaw142NVBf7Nf1uEFN9ZeP8Ht) and here is a [pic of how to wire its socket](https://www.google.com/url?q=https%3A%2F%2Fwww.dropbox.com%2Fs%2Ftxm8x4whomzlp11%2FSI-8b%2520Pins.jpg%3Fdl%3D1&sa=D&sntz=1&usg=AOvVaw1kwVqjSLnZoDyZIY9wbsO-). I have heard that people are using a conversion rate of 430 - 450 for this tube. I did find this tube to be light sensitive and you should also run it within the specified (narrow), voltage range - 360 - 440V. Higher voltages give suspiciously higher counts. I also found [these specifications](http://www.google.com/url?q=http%3A%2F%2Fconsensus-group.ru%2Fradiation-counters%2Fbeta-gamma-radiation%2F166-si8b&sa=D&sntz=1&usg=AOvVaw3VyyyK5eGhhsTqhMprJPm9) (from the manufacturer?) that have some new info. **Regarding the load resistor:** The Russian spec sheet lists the max current through the tube as "18.2 mkA". This has been often translated as 18.2 **m**A. That would make the load resistor only 22**k**Ω at 400V. However I found the Russian use of "mk" is actually "micro". This makes the load resistor 22**M**Ω at 400V which is more reasonable. Note that the diagram in the manufacturer specifications (linked above) show the load resistor at 5.1MΩ. However, I went with the original spec and I increased the load resistor from 5MΩ to 20MΩ. I got ~5% more counts at 20MΩ so I left it at that. I think the less current through the tube the better. **So the short answer is that I recommend 20MΩ.**

**Converting CPM to a Dose Unit (uSv/h, mR/h):**

*This is a little messy but I don't think it's my fault! Over the years I have read a lot about conversion rates on the web and the information on this subject varies widely. It's interesting to read the* [*list compiled by 'paguyu'*](https://www.google.com/url?q=https%3A%2F%2Fsapporohibaku.wordpress.com%2F2011%2F10%2F15%2Fconversion-factor%2F&sa=D&sntz=1&usg=AOvVaw0Qn0lVXjyOhv2kkHefOD-t) *of the various conversion rates used by different sites. (*[*PDF here*](https://www.google.com/url?q=https%3A%2F%2Fwww.dropbox.com%2Fs%2Fqdzmuji59am85hq%2FVariations%2520in%2520Conversion%2520Rates.pdf%3Fdl%3D1&sa=D&sntz=1&usg=AOvVaw11Tszg0mGUJJV4ucxBUzGW)*) So as nice as it would be to state one method of making the conversion, I have yet to find what I feel is a single authoritative method. So instead I will simply report the various methods I have run across. I am not married to any of them frankly.*

We know that a GM tube provides pulses that correspond to "events" in the tube that occur from it's interaction with ionizing radiation - gamma rays, beta, and alpha particles (for some tubes). The events are counted by the Geiger Counter over a time period and eventually result in counts per minute - CPM. This is the raw data, but in some ways it is the most accurate due to it's simplicity. If you know what the CPM are for 'normal background' with your tube, the difference measured will give you a good sense of the intensity. Personally, I always tend to think in terms of CPM.

However, different models of GM tubes vary greatly in their sensitivity. This makes it difficult to compare readings between different counters or to published rates. Enter the "dose unit". Now at this point the subject can get very complicated, and I will avoid getting into detail. Suffice to say, that a dose unit defines how much radiation is absorbed. ("absorbed dose" and "equivalent dose" will be considered the same here.) Both uSv/hr and mR/hr will be considered to be dose units here.

The main point is that the spec sheets for most GM tubes define the CPM (or cps) that are equivalent to some dose unit (usually mR/hr). Since GM tubes also have varying sensitivity to different isotopes, there may be several values listed. Lets look at a part of the spec sheet for the SBM-20:

**Gamma Sensitivity Ra226 (cps/mR/hr) 29**

**Gamma Sensitivity Co60 (cps/mR/hr)** **22**

The object here is to convert this information into a ***ratio*** of CPM to dose unit - so how many CPM = 1 uSv, for example. These ratios are then set via the menu in the Geiger kit. The kit actually supports storing of 2 of these ratios, with the one in use selected by a switch. As shipped, a default ratio for each is provided - 175.43, the most common for the SBM-20 tube, and 100, common for the LND-712.

The following describes the methods of calculating this ratio that I have run across. They use the SBM-20 example above, but they should apply to other spec sheets as well.

**Method 1:**

This is the most straightforward method and the one I originally used. It only uses the Co60 value from the spec.: 22 cps = 1 mR/hr

That's counts per *second* so multiply by 60 to get CPM: 22 x 60 = **1320 CPM / mR/hr**

If your dose unit is uSv, convert from mR. The common conversion is 1 mR = 10 uSv. So divide the CPM by 10: 1320 / 10 = **132**

*(You could have just multiplied the 22 cps by 6 to get the same effect.)*

So **132** is the ratio that can be entered into the menu of the Geiger kit if you are using an SBM-20 GM tube.

**Method 2: (thanks to Mike)**

This starts by simply taking an average of the two cps values for the two isotopes. So: 29 + 22 / 2 = **25.5 cps**

Multiply counts per *second* by 60 to get CPM: 25.5 x 60 = **1530 CPM**

Now we introduce the **absorption rate**. There is a lot that can be said about this, but in a nutshell, it is the rate at which ionization events are absorbed into a *material*. (Jorge M. has written me with some very good details on the subject. You can read that [here](https://www.google.com/url?q=https%3A%2F%2Fdl.dropboxusercontent.com%2Fu%2F3572198%2FWebsite%2520Docs%2FAbout%2520the%2520absorption%2520constant.pdf&sa=D&sntz=1&usg=AOvVaw0Ioc4lk1UEoCjuA4pzeUfE). and there are references to others using it it [here](http://www.google.com/url?q=http%3A%2F%2Fwww.utsunomia.com%2Fy.utsunomia%2FKansan.html&sa=D&sntz=1&usg=AOvVaw11zzSayJXexOso9ztbBO_k) and [here](http://www.google.com/url?q=http%3A%2F%2Feinstlab.web.fc2.com%2Fgeiger%2Fgeiger3.html&sa=D&sntz=1&usg=AOvVaw0W1xjGfkzXEdtw_8vgNbGF) along with Japanese Wikipedia article [here](http://www.google.com/url?q=http%3A%2F%2Fja.wikipedia.org%2Fwiki%2F%25E3%2583%25AC%25E3%2583%25B3%25E3%2583%2588%25E3%2582%25B2%25E3%2583%25B3_%2528%25E5%258D%2598%25E4%25BD%258D%2529&sa=D&sntz=1&usg=AOvVaw2KJIot4UQk4aW7YAkpqjok). It appears that also built into this rate is a conversion from mR to uSv (1mR = 10uSv). Frankly, I am not too clear on how it is integrated!

The value for the absorption rate to be use is **8.77** which I understand is for air, and 9.56 is for soft tissue.

So finally the 1530 CPM is divided by the absorption rate of 8.77 to get ratio between CPM and uSv: 1530 / 8.77 = **174.46**

*(Or multiply 25.5 cps by 6.84)*

This is the ratio that can be entered into the menu of the Geiger kit if you are using an SBM-20 GM tube. It is also very close to **175.43** (or it's inverse .0057) that is commonly found on the web for that tube. To be consistent with this common ratio the Geiger kits use 175.43 as the default setting.

**Method 3:**

This method is similar to Method 2 except the two isotopes are not averaged and only Co60 is used.

Therefore: **22** x 60 / 8.77 = **150.51**

*(Or multiply 22 cps by 6.84)*

**Method 4: (thanks to Rick)**

It is more common to calibrate to Cs137 than Co60. In the process of truly calibrating an SBM-20 with a lab sample of Cs137, my friend found the conversion ratio turned out to be 65% too high based on the expected dose-rate. It turned out that this is related to the fact that ratio is derived from Ra226 and Co60, which are the only only two isotopes specified for most Russian tubes.(If your spec sheet has a value for Cs137 than just use Method 3.) From several sources, he found that "*The energy response for a GM tube will always be different for* Cs137 *compared to* Co60*, so an instrument will always show a higher reading at* Co60 *energies compared with* Cs137 *energies for a given dose rate.*" and he also found that the value for this difference is **65.5%**. (I don't have his sources at this writing.)

So to begin, we start with the ratio for Co60 already calculated using Method 3: **150.51** CPM/uSv/hr

To calibrate for Cs137 multiply that ratio by 65.5%: 150.51 x .655 = **98.58 CPM/uSv/hr**. That would be the ratio to use for Cs-137 samples.

(Using this ratio reportedly gave him readings of within <1% of measurements expected in his lab test.)

So there you have it! Four methods, four ratios! Take your pick.

**Using one of these methods did you actually *calibrate* your Geiger counter?** I would say no. First there are variations within the same model of GM tube, based on factors like the age of the tube, and the bias voltage used. Moreover, to *truly* calibrate your counter you must use a [standardized check source](http://www.google.com/url?q=http%3A%2F%2Fwww.unitednuclear.com%2Findex.php%3Fmain_page%3Dindex%26cPath%3D2_5&sa=D&sntz=1&usg=AOvVaw1vMWfNDjp6-4oIx9gGJXPo) of the isotope you want to calibrate to (usually Cs137 or Co60) and use procedures which include such things as distance from the source, tube geometry, etc. to fine tune your ratio of CPM to the dose unit you want to use. However, what you have done is to get a ballpark estimate that hopefully will be comparable to others using the same conversion methods.

**The Anode Resistor, Stray Capacitance, Cable:**

To be honest, I used to be pretty cavalier about these things - connected the tube - it clicks - yippee! But now I'm a more informed (and frightened ;) person.

The suggested value for the anode resistor is usually given in the datasheet for the tube. The kit uses 4.7M for this value. This is about right for the SBM-20 (5.1M) but the LND-712 needs 10M. So I put another 4.7M in series right at the tube. It's best to have the anode resistor right at the tube anyway, as it isolates the stray capacitance from the tube.

So what happens if you don't have the right value? Some have reported problems where the tube is in constant avalanche. In one case, the problem was solved by *lowering* the anode resistance. (This seemed counter intuitive to me, but Ed straightened me out (again) and said *"I know it seems the opposite should happen, pulse should get bigger, and it does to a point, but the more capacitance, the more the Plateau tilts up vertically, and then you get to the point where it’s getting smaller because the operating point voltage swing is getting shrunk, which means lower magnitude pulses , and lower dead time."*) So if your experiencing this type of problem with an uncommon tube, you might look at the spec sheet for the recommended anode resistor.

Stray capacitance can also cause problems. I've read it can increase the dead time of the tube which results in lower counts. Stray capacitance also makes it "harder" for the tube to discharge. This, in turn, can shorten the life of the tube.

Having the anode resistor at the tube, as previously mentioned, is perhaps the best defense. If you want to put all the anode resistance at the tube, you can easily do this by jumpering R7 on the board (RL\_JMP) and installing the appropriate resistor right at the anode clip of the tube. Careful! The HV at the screw terminals may now bite when touched. Keeping the wires to the tube short and separate also helps.

If you're going to use a cable,you should also keep in mind that the kit uses the "cathode sensing" technique. This means that events are sensed from the cathode (-) side of the tube. This is the preferred method of sensing by [several accounts](https://www.google.com/url?q=https%3A%2F%2Fdl.dropboxusercontent.com%2Fu%2F3572198%2FGeiger_Tube_theory.pdf&sa=D&sntz=1&usg=AOvVaw3KOb48SZiFq787p0rzuMXW). However, it means that the cathode is not at ground potential. Therefore it's a mistake to run the cathode side of the tube on the shield of the cable. Better to run with a 2 conductor cable. I did a quick experiment with 10 feet of an old multi-conductor shielded cable (26 AWG) and found no appreciable loss of counts with a 450V tube. The anode resistor was still on the kit and I did not ground the shield.

BTW a very good source with technical information on these two subjects can be downloaded [here](https://www.google.com/url?q=https%3A%2F%2Fwww.dropbox.com%2Fs%2Fyk9kln8hzecs9ca%2FGeiger_Tube_theory.pdf%3Fdl%3D1&sa=D&sntz=1&usg=AOvVaw1TpEkpgIkEe8dFyKSK7qiu).

**The Effect of "Dead Time" on Counts :**

Dead time is the time after an event in which the tube will not register a count. It's like the tube is resetting. Most specs on tubes list the dead time (in uS).

Someone pointed out the formula for calculating the counts lost to deadtime based on the observed count and the published dead time for the tube. (Thanks Al!) I thought it would be worth writing it up here. You can also read more about this subject [here](http://www.google.com/url?q=http%3A%2F%2Fwww2.astro.psu.edu%2F~niel%2Fastro485%2Fderivations%2Fgeiger1.pdf&sa=D&sntz=1&usg=AOvVaw2ta_-rg7xLlkcXSUrr-5YR).

To use an example from the chart above, I got **5253** CPM from the mantle on the SBM-20. The dead time for this tube is listed as **190** uS. The formula is:

**ACTUAL COUNTS = OBSERVED COUNTS / 1 - (OBSERVED COUNTS \* DEADTIME)**

Time is expressed in seconds, so counts are counts / second, and deadtime is in seconds. So the fist step is to make these conversions . . .

5253 CPM / 60 = **87.55 CPS** and 190 uS = **.000190** seconds

Plugging this in, we have . . .

**ACTUAL COUNTS = 87.55 / 1 - (87.55 x .000190)**

which is . . .

**ACTUAL COUNTS = 87.55 / 1 - .01663**

or . . .

**ACTUAL COUNTS = 87.55 / .98337**

or . . .

**ACTUAL COUNTS = 89.03 CPS or 5342 CPM**

So **~89** CPM was lost due to deadtime (5342 - 5253) - a 1.7% loss due to deadtime.

Not much at this lower count rate but it becomes significant at higher rates