

Help for Rad Pro Calculator

Note for Online Users: This help file was written for the desktop version of the software. Most everything applies to the online version as well. The major controls, selections and input/output boxes are identical. The section that discusses output format options is not available online, so ignore that. On the desktop version, the Decay and Half-Life calculators are combined whereas they are separate on the online version. You'll have to cull through the combined section in the help file and apply it appropriately to each individual online calculator. There are no Excel functions online. Ignore that section and those button descriptions. There are no menu selections or skins online, so ignore those sections.

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1.0 Software General Description

Rad Pro Calculator performs many nuclear calculations that are useful to the health physicist, radiological researcher, radiochemist, radiation safety officer, health physics technician (HP) and nuclear medicine professional. It calculates, among other things, radiation safety unit conversions (SI and US customary) and gamma emitter dose rate and activity. Other calculations include:

- Gamma shielding equations (with or without buildup)
- Beta emitter dose rate and activity
- Dose-rates for x-ray machines and devices
- Grams of plutonium (Pu) and uranium (U) from activity (specific activity)
- Decay and half life equations
- Bremsstrahlung x-ray calculations for beta interactions
- Uranium enrichment from U-234 and U-238 lab data for environmental levels of uranium (also works well for uranium fuel enrichment and U enrichment in nuclear waste)
- Inverse Square Law calculations for electromagnetic energies
- Minimum detectable concentration and contamination (MDC aka MDA) for counters and scan instruments (includes LLD and critical level calculations)
- ALARA calculations for dose and job planning

The software has gained popularity with many other nuclear professionals in medical engineering, medical physics and other nuclear physics disciplines. Included are the most common isotopes at nuclear power reactors and government and private research facilities. Isotopes were added for nuclear medicine use (such as P-32 (^{32}P), Tc-99m ($^{99\text{m}}\text{Tc}$), FDG / F-18 (^{18}F) and other positron emitters used in PET scanning). The x-ray machine/device calculator allows the choice of empirical data or the use of known x-ray tube output. The x-ray shielding equations are the same ones used in the gamma isotope calculator.

2.0 Menu Selections

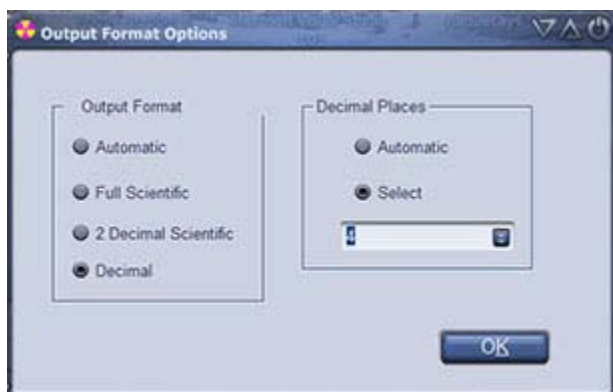
2.1 File

The two selections here are *Exit* and *Print*. *Exit* is simply to close the application. *Print* gives you a screen print of just the calculator with whatever data is showing at the time. The printer selection window opens for you to select your printer, if you have multiple printers connected.

2.2 Select Output Format

By default, the answers are outputted in full decimal place numbers until the number is either less than 0.001 or greater than 9999. At that point, it

switches to scientific notation with full decimal places ($x.xxxxxE+yyy$). If you click on *Select Output Format*, a window opens with selections so that you may hard code in your preference, overriding the default.



Automatic is the default setting as described above. *Full Scientific* always displays the output in full scientific notation ($x.xxxxxE+yyy$). *2 Decimal Scientific* always displays the output in scientific notation rounded to two decimal places ($x.xx E+yyy$). *Decimal* always displays the answer in decimal format, up to the limitations of the software (0.000000000000000000x or xxx,xxx,xxx,xxx,xxx,xxx,xxx,xxx have to be displayed in scientific notation).

Once you select *Decimal*, you may display all decimal places (*Automatic*) or *Select* how many decimal places to round to. The *Full Scientific* selection is new with version 3.00 and above. The format settings that you select are saved upon exiting the software and when you open the software again, those settings are loaded.

2.3 Skins

In version 2.60, the ability to change the way the controls and GUI interface look was added. With one click, a new *skin* can be added and the entire software looks totally different. The default setting is *Vista Style*, with the look of the operating system windows in Microsoft's Windows Vista. Try all of the selections until you find one that you like. The screen prints will also take on the look of your selected skin. You may also select *None* for the classic look with your Windows *Appearance* selections applied. Unfortunately, at this time, the software does not memorize your selection so you must select your favorite each time you start the program. The screenshots in this help file demonstrate the look of the different skins. The skin that you select is saved upon exiting the software and when you open the software again, that skin is loaded.

2.4 Help

The Help menu selections display this help file that you are reading now, as well the legal disclaimer, references utilized in doing the math and developing the software, an *About* window with the version number and release date and

contact information, the math formulas for uranium enrichment and a paper describing shielding equations and buildup factors.

3.0 The Calculators

3.1 Decay and Half-Life

Useful for calculating today's activity for any radioactive isotope. You may also back decay sources to find out the original activity (or for any date), knowing the current activity. Calendar pickers are included for date entry convenience.

If you use the online version, you will notice that there are separate pages for decay and half-life calculations. When this version was written, both calculations were included on this one tab. That complicates the usage a little and warrants explanation. Upon opening, the calculator is in the decay mode. In this mode, you select an isotope and enter original activity and two different dates and/or times and you can calculate the new activity. If you press the *Change to Half-Life* button, the GUI switches to the half-life calculator mode where you enter two activities at two dates and/or times and the half life will be calculated for you. This mode is generally used for identifying an isotope or mixture when they are unknown. For instance, this is a common calculation used in counting rooms for air samples. A fresh, undecayed air sample could have high levels of radon daughter products on it giving a false indication of high airborne man-made radioactivity. Rather than run it on a gamma spectrometer, some count rooms will count it and then count it again after 20 minutes of decay time and calculate the half-life. If the half-life falls within the normal range of radon daughters for the local region, it is determined that most of the radioactivity deposited on the filter is natural. If it is higher than the normal range, then it is sent for gamma spectroscopy because it more than likely has enough man-made isotopes on it to be of concern. To switch back from the half-life mode to the decay mode, press the *Change to Activity* button.



In the decay mode, when you select first an element, and then an isotope, the half-life is displayed for you. This can be useful for just looking up the half-life of an isotope. In this case, it replaces a look up table or a search database.

To use the decay calculator, select an element. Then select your isotope. If you have a different source of half-lives than we used (LLNL) you may type in your own half-life to replace the one automatically displayed. If your isotope is not listed, press the Enter Other Isotope button. The lists disappear and you may type in your own isotope and half-life. A group of option buttons also appears to select your half-life time units. To switch back to the default isotope drop down lists, press the Default Isotope List button. Select your activity units. Enter your original activity. For date entry, you may manually type them in or press on the boxes to pop up a calendar picker. The calculator defaults to date only entry. To enter time, press the Date and Time button. You may enter dates and times in the appropriate boxes. Enter and/or select your beginning and ending dates and/or times. Press the Calculate button to get your new activity.

To use the half-life calculator, select your activity units. Enter the initial and ending activities. Select either date only or date and time mode. Enter your initial and ending dates and/or times (or use the calendar pickers). Press calculate for the half-life. Select your option button for your time units. The half-life is automatically recalculated for you in the new time unit.

The Item ID textbox is optional and is used for the Excel spreadsheet options. The Start Excel button and other Excel functions are described in detail in the last section of this help file.

3.2 Timed Decay

This calculator is used to determine the amount of time that an isotope takes to decay to a preset activity, named "Desired Activity." You may also think of this as "Final Activity." It is useful for calculating the date that a drum of short lived waste reaches non-radioactive status, when sources reach exempt activity levels and when activated concrete is less than soil release limits, as well as other calculations.

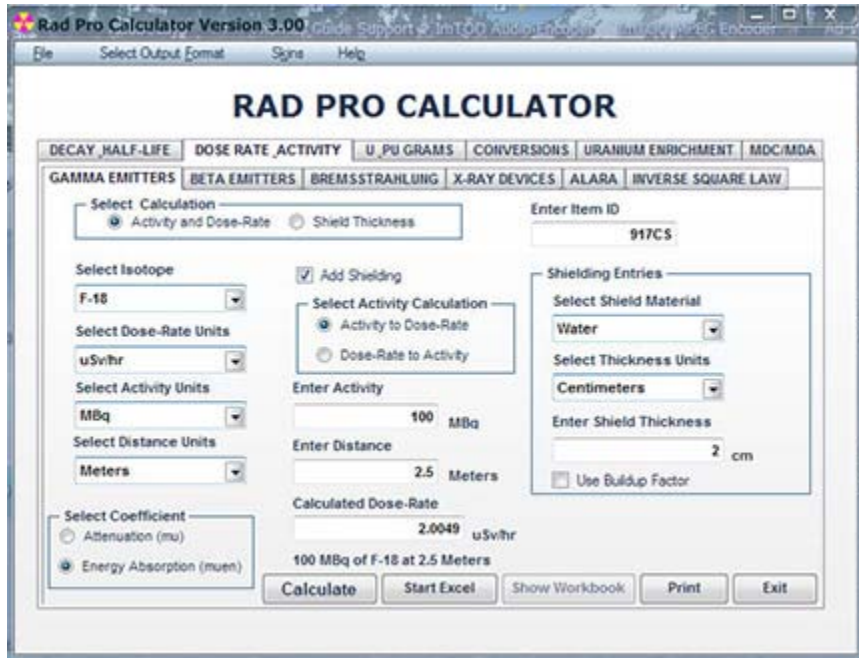
The screenshot shows the 'RAD PRO CALCULATOR' software interface. The 'TIMED DECAY' tab is selected. The 'Enter Source/Sample ID' field contains 'DR2379'. The 'Select Activity Units' dropdown is set to 'kBq/kg'. The 'Select Element' dropdown is set to 'Phosphorous (P)'. The 'Select Isotope' dropdown is set to 'P-32'. The 'Enter Original Activity' field contains '1289.45' kBq/kg. The 'Enter Desired Activity' field contains '37' kBq/kg. The 'Isotope Not Listed?' checkbox is unchecked. The 'Select Output Time Units' dropdown is set to 'Months'. The 'Half Life' field contains '14.262' Days. The 'Calculated Time to Decay' field contains '2.4' Months. The 'Date Desired Activity Reached' field contains '10 Sep 2008 (start decay today)'. At the bottom, there are three buttons: 'Calculate', 'Print', and 'Exit'.

Select your activity units from the drop down list. Select your time output units from the drop down list. Select an element from the drop down list, then select the isotope from the drop down list. Enter today's activity in the "Original Activity" textbox. Enter the final activity in the "Desired Activity" textbox. Press the calculate button. The amount of time to reach the desired activity and the date that it reaches that activity are given to you. If you exceed Microsoft date range limits, the date answer box displays "Date Out of Range." The Microsoft date ranges allowed are from 1/1/0001 to 12/31/9999. If the number entered into the desired activity textbox is greater than the number entered into the original activity textbox, you are back calculating activity. The answer will be a negative number of years, days, etc. and the date displayed will be a date in the past. This may be useful if you wish to know how long ago and when was the isotope stronger, at some date in the past.

If your isotope is not on the list, check the "Isotope Not Listed" checkbox. The dropdown lists will disappear and a textbox to enter the isotope name will appear, as well as a list of radio buttons to select the half-life time unit. Enter your Isotope name. Select the half-life time units from the radio button list. Enter your half-life. Enter today's activity in the "Original Activity" textbox. Enter the final activity in the "Desired Activity" textbox. Press the calculate button. The amount of time to reach the desired activity and the date that it reaches that activity are given to you.

If you change the output time units, the answer box will change automatically for you.

3.3 Gamma Emitter Dose-Rate, Activity and Shielding (Point Source)



This calculator is also multi-functional. Upon opening, it is in the calculate dose-rate mode. Select your activity, dose-rate and distance units. Select an isotope. (Note that these calculations are for single isotope point sources. For line, plane, cylinder, or box and multi-isotope calculations, you need an expensive commercial program such as MicroShield by [Grove Engineering](#) or MegaShield by [WGM Nuclear Services](#)). Enter your source activity and the measurement distance from the source. Click the *Calculate* button and your dose-rate is calculated and displayed. Check the *Add Shielding* checkbox to add a shield to your calculations. Select your shielding coefficient type. For guidance on which to use, look under the *Help* menu and select the *Shielding and Buildup Paper* menu item. Select your shielding material and thickness units. Enter your shield thickness or for lead blankets, enter your solid lead equivalency (i.e. 1 lead blanket is equivalent to 0.5 inches of solid lead or whatever your number is for your blankets, usually provided by the manufacturer). Press the *Calculate* button again for your new dose-rate.

Click the *Dose-Rate to Activity* option button. This switches to a mode that let's you calculate the activity of your source from a measured dose-rate at a measured distance. The instructions are the same as in the last paragraph except you enter your dose-rate and your measurement distance and then the activity is calculated for you. If your source is in a pig or behind shielding, click the *Add Shielding* checkbox and then proceed with selections and entries as in the last paragraph.

The final mode is turned on by selecting the Shield Thickness option button. This allows you to enter your initial dose-rate and a target dose-rate. Then a shield thickness is calculated for you. The more expensive programs won't do this calculation. It is a complex calculation, especially if you use the buildup factor method. To get your buildup factor, you need to know your shield thickness, but you are trying to calculate your shield thickness. This is a paradox that can only be solved by computer algorithms.

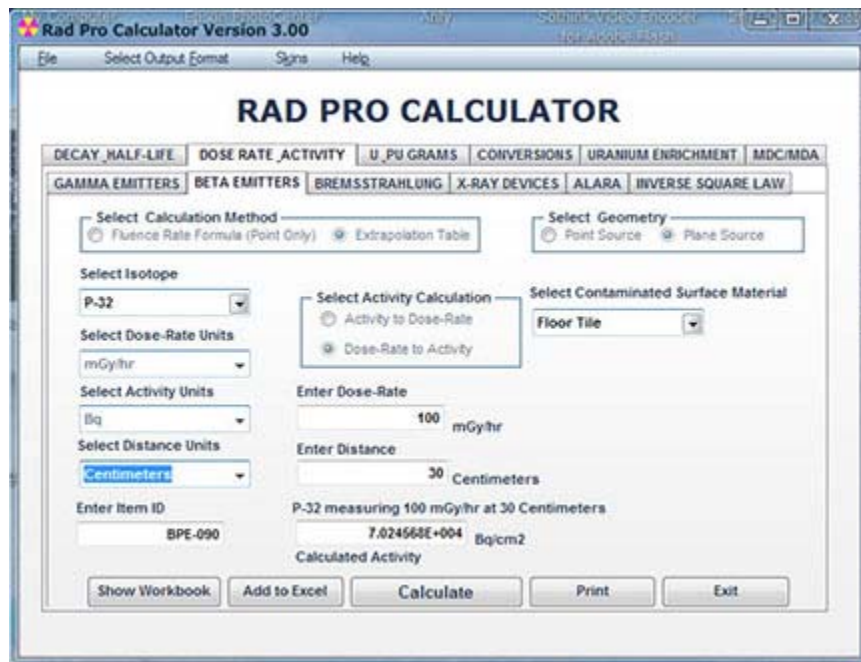
To see the fluence rate formulas used in this calculator, [click here](#) to read a very good white paper by George Chabot, PHD, CHP describing the formulas and explaining how they were derived.

Note: All energies below 18 keV are ignored.

The Item ID textbox is optional and is used for the Excel spreadsheet options. The Start Excel button and other Excel functions are described in detail in the last section of this help file.

3.4 Beta Emitter Dose-Rate and Activity (Point and Plane Sources)

The beta calculator is identical to the gamma calculator but for common beta emitters and with no shielding. After selecting your isotope and unit preferences for dose-rate, distance and activity, an activity and distance may be entered to calculate the dose-rate. Inversely by selecting the Dose-Rate to Activity option button, you may enter a dose-rate and a distance and calculate the isotope activity.



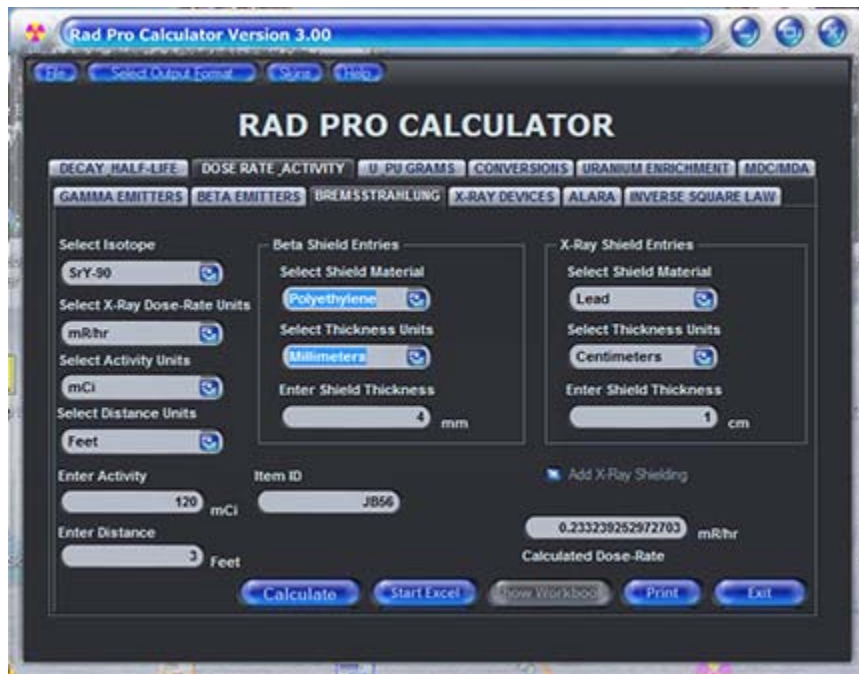
The formulas use data extrapolated from tables in the "Handbook of Health Physics and Radiological Health." You have the choice for calculating a point or a plane source. With the plane source, the activity is expressed per unit

area. This is useful for calculating and predicting spill levels. In plane source calculations, you may also select a surface material for backscatter factor inclusion.

Beta particles eventually lose all of their energy and disappear. The distance traveled is dependent on their original emission energy. If you input a distance that is great than e-max, the highest possible energy for the isotope, you're answer will be 0 if calculating dose-rate or you will get a message saying "Too Far," if calculating activity. For tritium (H-3), the maximum travel distance is less than 1 centimeter due to its very low beta energy. You will get the "Too Far" message for any distance that is less than 1 cm. If you select a very small distance, you will get a message saying "Too Close" because both methods utilize tables due to the fact that there was no table data available for that distance.

The *Item ID* textbox is optional and is used for the Excel spreadsheet options. The *Start Excel* button and other Excel functions are described in detail in the last section of this help file.

3.5 Bremsstrahlung from Beta Shielding



As beta particles travel, they interact with the atoms in their travel path and lose their energy. The electron or positron energy lost reappears as x-rays called Bremsstrahlung or braking radiation (as the betas put on the brakes, other, electromagnetic radiation appears). The number of x-rays produced in the beta shield material increases as the atomic number (Z) of the material increases. For Human radiation protection, a low Z shield material is a better choice because a higher Z shield could actually expose them to more radiation energy from the Bremsstrahlung than the original beta exposure would have been, especially at a distance. Low Z shields still produce x-rays though.

Common practice is to first shield the betas with a low Z material, like polyethylene to stop the betas and then shield the resulting x-rays with a higher Z material like iron or lead. This calculator allows you to first calculate the x-ray dose-rate coming from the beta shield and allows you to select a second x-ray shield and then calculate the secondary shielded dose-rate. It only calculates the electromagnetic energy resulting from shielding the betas. It does not calculate the beta dose-rate from using a very thin, low Z shield, i.e. shielding a Sr-90 source with one layer of Saran wrap.

First select your isotope, dose-rate units, activity units and distance units using the drop down boxes. Select your beta shield material and shield thickness units from those drop down boxes. Enter your source activity, the measurement distance from the source and the shield thickness. Then press the Calculate button to obtain the dose-rate. Check the Add X-Ray Shielding checkbox and the secondary shield entry box pops up. Select the x-ray shield material and thickness units. Enter the secondary shield thickness and then press the Calculate button for your new dose-rate.

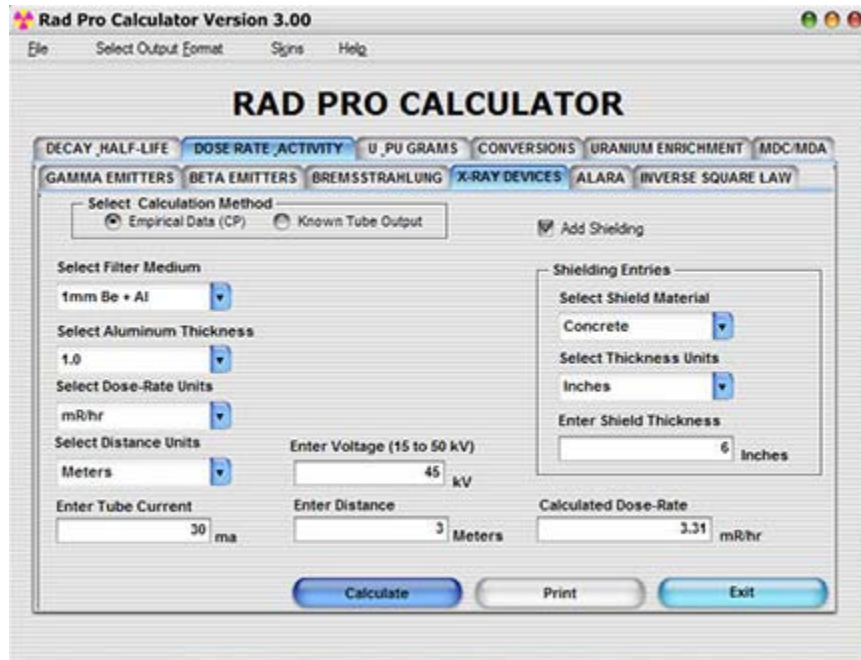
The Item ID textbox is optional and is used for the Excel spreadsheet options. The Start Excel button and other Excel functions are described in detail in the last section of this help file.

3.6 X-Ray Devices Dose-Rate and Shielding

This calculation is nearly impossible to do to any high level of accuracy due to the variability in x-ray devices. The target material, target angle and even small things like tube head plate spacing manufacturing tolerances all can make a noticeable difference in the output of a device. This calculator is provided to give engineers a ball park approximation to aid in tasks related to x-ray devices. Two methods are available, using empirical data from the British Standard BS 4094-2-1971 and using known device output. The shielding equations are standard shielding equations utilizing buildup factors. The standard recommends against this, but we provided it to you as another approximation calculation. It should always overestimate the amount of shielding required because e-max for the tube head is used when in reality the device produces an entire energy spectrum from lower energies up to e-max. We have been assured that many people use the standard in their planning and calculations, so this calculator saves you the time of looking up the data on the graphs in BS 4094-2-1971. Beware also that if you use manufacturer provided data from a factory manual, that is more than likely an average number and different tubes of the same model have slightly different outputs because of manufacturing tolerance differences.

If the Empirical Data (CP) option button is selected, the dose-rates calculated are extrapolated from the graphs in the BS 4094-2-1971 standard. The CP stands for constant potential. The data for pulsed machines in the standard was very sparse, so that option was not added. Select your filter medium, filter thickness, dose-rate units and distance units. You will notice that as you change the filter medium, the voltage range above the Enter Voltage Range textbox changes. This represents the data limits of the graphs provided in the standard. If you enter a voltage outside of the specified limits, you get and "Out of Range" error message.

Enter the tube current, tube voltage and distance from the tube. Press the Calculate button to obtain your dose-rate. Check the Add Shielding textbox and the shield entry box appears. Select your shield material and thickness units. Enter your shield thickness and then press the Calculate button to obtain the shielded dose-rate. Remember that the shielding numbers are not from the graphs in BS 4094-2-1971. They are theoretical numbers using mono-energy equations.



If the Known Tube Output option button is selected, the GUI changes to the option and entry controls needed. Select your answer dose-rate units, answer distance units, tube output dose-rate units and tube output distance units. Enter your tube output dose-rate and what distance it was obtained at (i.e. 20 kR/hr at 200 mm). Enter your measurement distance for your answer and press the Calculate button to obtain the dose-rate at that distance. Checking the Add Shielding checkbox opens the shielding options box. Select your shield material and thickness units. Enter your shield thickness and then press the Calculate button to obtain the shielded dose-rate.

Excel functions are not available on this calculator at this time. If you would find it useful, send us a request at [this link](#). If enough requests are received, Excel output will be considered for a future release.

3.7 ALARA (Time, Distance and Shielding)

This calculator was added at the request of emergency response personnel in the UK and the USA. Three calculations are available. In all three cases, the source strength must be known. This may be a measured value or a value calculated with the gamma calculator in Rad Pro Calculator. In all three

calculations, shielding may be added. If the shielding option is not invoked, you will notice that there is no isotope selection drop down box. That is because it is purely an Inverse Square Law calculation. Although attenuation due to air will differ from isotope to isotope, the effect is generally small so attenuation due to air is not considered. If your source is low energy, i.e. Am-241, your number will be conservative because the actual dose-rate at the working distance will be a little lower than the one calculated. If you do use the shielding option, the isotope drop down list appears because the effect of different shielding material varies greatly with gamma energy. You are also reminded that the shielding equations are for point source isotopes.



In the Stay Time calculation option, after selecting dose-rate, distance, stay time and dose limit units from the drop down boxes, enter the worker dose limit for the job and the working distance and press the Calculate button to obtain the worker stay time. If the Add Shielding option is invoked, select your isotope, shielding material and shield thickness units. Enter your shield thickness and press the Calculate button again to obtain your new stay time.

In the Distance calculation option, after selecting dose-rate, distance, stay time and dose limit units from the drop down boxes, enter the worker dose limit and the work time for the job and press the Calculate button to obtain the working distance. If the Add Shielding option is invoked, select your isotope, shielding material and shield thickness units. Enter your shield thickness and press the Calculate button again to obtain your new working distance.

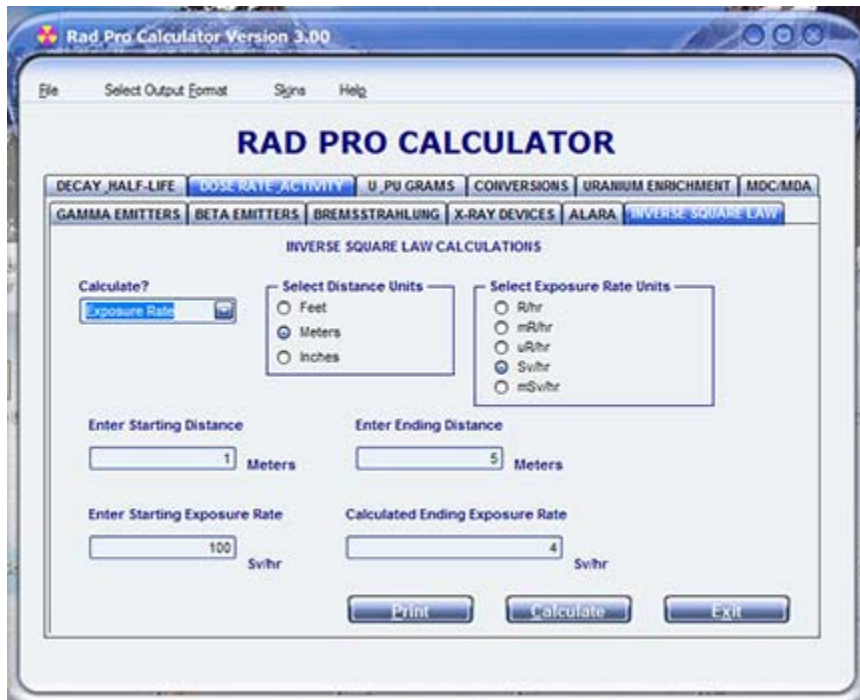
In the Dose Received calculation option, after selecting dose-rate, distance, stay time and dose received units from the drop down boxes, enter the work distance and the work time for the job and press the Calculate button to obtain the worker dose received. If the Add Shielding option is invoked, select your isotope, shielding material and shield thickness units. Enter your

shield thickness and press the Calculate button again to obtain your new dose received.

Excel functions are not available on this calculator at this time. If you would find it useful, send us a request at [this link](#). If enough requests are received, Excel output will be considered for a future release.

3.8 Inverse Square Law

This calculator easily demonstrates the principles of the Inverse Square Law. This law simply says that if you double the distance from an electromagnetic energy source (gamma or x-ray) the dose-rate goes down by a factor of four (the square of two for "double").



The screenshot shows the 'RAD PRO CALCULATOR' window, version 3.00. The 'INVERSE SQUARE LAW' tab is selected. The interface includes a 'Calculate?' dropdown menu set to 'Exposure Rate'. There are two sections for unit selection: 'Select Distance Units' with radio buttons for Feet, Meters (selected), and Inches; and 'Select Exposure Rate Units' with radio buttons for R/hr, mR/hr, uR/hr, Sv/hr (selected), and mSv/hr. Input fields show 'Enter Starting Distance' as 1 Meters, 'Enter Ending Distance' as 5 Meters, 'Enter Starting Exposure Rate' as 100 Sv/hr, and 'Calculated Ending Exposure Rate' as 4 Sv/hr. Buttons for 'Print', 'Calculate', and 'Exit' are at the bottom.

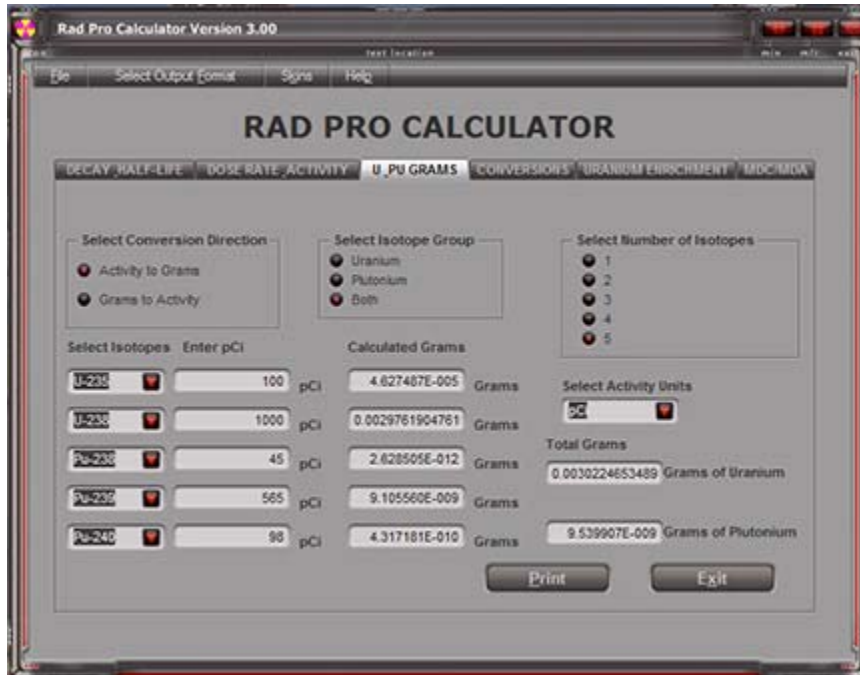
There are two calculations available, selectable through the Calculate drop down box. You may enter a starting distance, starting dose-rate and ending distance to calculate the dose-rate at the ending distance. You may also enter a starting distance, starting dose-rate and ending dose-rate to calculate the distance required to obtain the ending dose-rate.

Excel functions are not available on this calculator at this time. If you would find it useful, send us a request at [this link](#). If enough requests are received, Excel output will be considered for a future release.

3.9 Uranium and Plutonium Grams (Specific Activity)

In some instances, the regulations and procedures for uranium and plutonium are specified in units of mass rather than activity units, especially for the

fissile isotopes. It is sometimes also necessary to know total U and total Pu in grams for inventory, shipping and waste disposal. This calculator will do the math in both directions. You may calculate grams from activity or activity from grams for the most common uranium and/or plutonium isotopes.

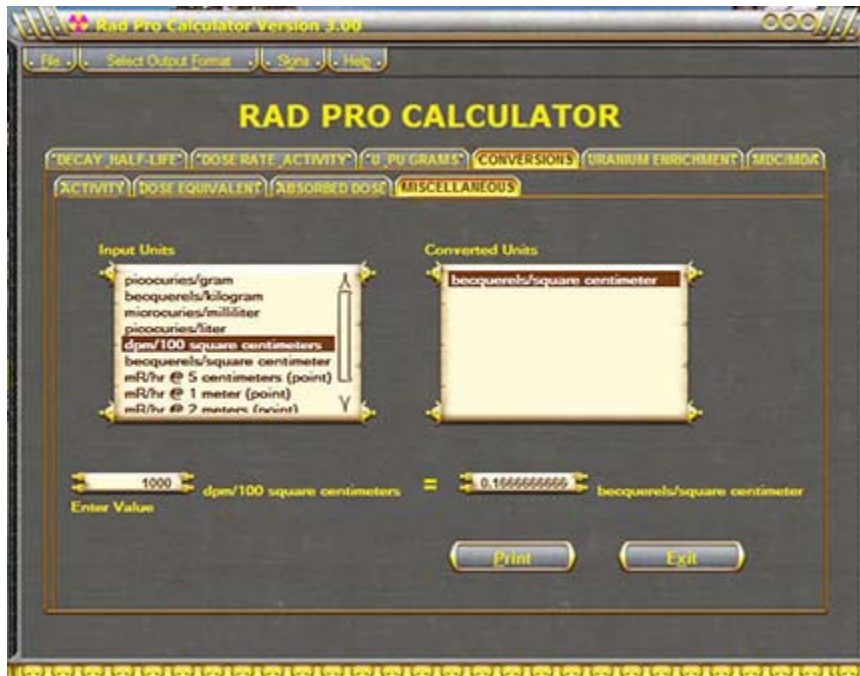


Select the option button for the direction that you wish to calculate, *Activity to Grams* or *Grams to Activity*. Select whether you are calculating *Uranium*, *Plutonium* or *Both* with the center option buttons. Select how many isotopes that you wish to calculate. With each addition, a new row of calculation boxes appears. If you select one, you get just the one answer box for that isotope. If you select two or more isotopes, one or two *Total* boxes appear for total U and/or total Pu. Select your isotope(s). Enter the activity(s) or grams in the box(es). Your calculated values appear automatically as you type, without having to press a *Calculate* button.

Excel functions are not available on this calculator at this time. If you would find it useful, send us a request at [this link](#). If enough requests are received, Excel output will be considered for a future release.

3.10 Units Conversion

Units may be converted for all of the common SI and US customary radiation units. There are four tabs under this calculator for *Activity*, *Dose Equivalent*, *Absorbed Dose* and *Miscellaneous* units. Miscellaneous converts common combined units such as dpm/100cm² to Bq/cm² and μCi/ml to pCi/L.



Select the unit category that you wish for your calculation. Select the input units and the output units from the left and right list boxes. Enter your original value and the converted value appears as you type.

Excel functions are not available on this calculator at this time. If you would find it useful, send us a request at [this link](#). If enough requests are received, Excel output will be considered for a future release.

3.11 Uranium Enrichment

This was initially developed as a separate software package named Uranium Enrichment Calculator and was programmed into Rad Pro Calculator in version 2.30 released on 9-4-2006. Many times, samples with low levels of uranium such as soil or water return < MDA values on U-235 and detectable values of U-234 and U-238 when sent to the laboratory for analysis. Since uranium enrichment is defined as the mass percent of U-235 in total uranium, a straight out percentage calculation cannot be performed from laboratory data. This calculator was developed for the purpose of calculating enrichment from U-234 and U-238 data, especially for use in environmental remediation and facility release projects. It is nice to have a calculation to help demonstrate to regulators that the uranium in remaining soil or groundwater is natural or 0.7% U-235.

Specific activity formulas were developed from empirical data collected from US gaseous diffusion plants and other sources. The lab data ratios are compared to the formula ratios. Since enrichment always ends up on both sides of the equation, creative computer algorithms had to be developed to calculate enrichment. Additional useful calculations are performed for you such as mass and activity ratios, ppm, etc. This calculator is useful for proving that uranium found in soil and water samples are all naturally occurring as well as other situations. If enriched or depleted uranium were

present, the enrichment would be higher or lower than normally found in soil and water (natural U = 0.7 mass percent U-235). The calculator is also useful for calculating the enrichment of man-enhanced uranium in contamination and radioactive waste. For further information about the formulas, read the text available by clicking the [About Enrichment Formulas](#) menu selection under the [Help](#) menu.

The screenshot shows the 'Rad Pro Calculator Version 3.00' window. The 'URANIUM ENRICHMENT' tab is active, and the 'ENRICHMENT' sub-tab is selected. The input fields are filled with the following values: Units: pCi/g, Sample Density: (empty), U-234: 0.71 +/-, U-234 Uncertainty: 0.15 pCi/g, U-238: 0.67 +/-, U-238 Uncertainty: 0.2 pCi/g. The calculated enrichment is 0.72 % Enrichment (U-235 by Mass), and the uncertainty range is 0.46 to 0.97 % Enrichment.

There are four tabs under [Uranium Enrichment](#). The first three are tied together as one calculation set. The fourth tab is a stand alone calculator to predict the U-234 to U-235 activity ratio, inputting enrichment.

On the first three tabs, the first tab, [Enrichment](#), has the input controls and boxes. The other two tabs contain all output data based on the input in the first tab. On the [Activity Ratios](#) tab, the theoretical specific activities for U-234, U-235 and U-238 have default values but you may input your own favorite values. Just remember to go back to tab 1, [Enrichment](#) to press the [Calculate Enrichment and Fractions](#) button again.

Select your units, pCi/g for solids or pCi/L for liquids. If you selected pCi/L, then enter your liquid's density in g/cc (1.0 for water). This is important for the parts per million (ppm) calculation. Enter the lab data for U-234 along with the reported uncertainty. Enter the lab data for U-238 along with the reported uncertainty. Press the [Calculate Enrichment and Fractions](#) button. The enrichment and enrichment uncertainty range are calculated and displayed. Select the second and third tabs to see the activity ratios and mass fractions.

Select the fourth tab, [Calculate Ratio](#). Enter your enrichment in mass percent U-235. Press the [Calculate Ratio](#) button. The ratio of U-234 to U-238 and the ratio of U-235 to U-238 are calculated and displayed.

Excel functions are not available on this calculator at this time. If you would find it useful, send us a request at [this link](#). If enough requests are received, Excel output will be considered for a future release.

3.12 MDC/MDA

Minimum Detectable Concentration/Minimum Detectable Contamination (MDC) was formerly called Minimum Detectable Activity (MDA). This calculation may be performed for timed counters such as lab analyzers and scalers and for count rate instruments used for frisking and scanning.

Under the *Scaler/Timed Count* tab, select your sample units, confidence level (default 95%), activity units and your instrument type from the drop down boxes. You may also select a correction factor for surface abnormalities, chemical yield (recovery factor) or filter efficiency. Enter the background, background count time, sample count time, efficiency, sample area (or sample mass or sample volume) and if a correction factor option was selected, enter that value. Press the *Calculate* button. The critical level (Lc), Lower Limit of Detection (LLD) and MDC are calculated and displayed.

Under the Scanner/Frisker tab, select your frisker type and MDC units. Enter your background, detector width, scan speed, efficiency and probe area (if alpha or beta frisker). Press the *Calculate* button. The critical level (Lc), Lower Limit of Detection (LLD) and MDC are calculated and displayed.

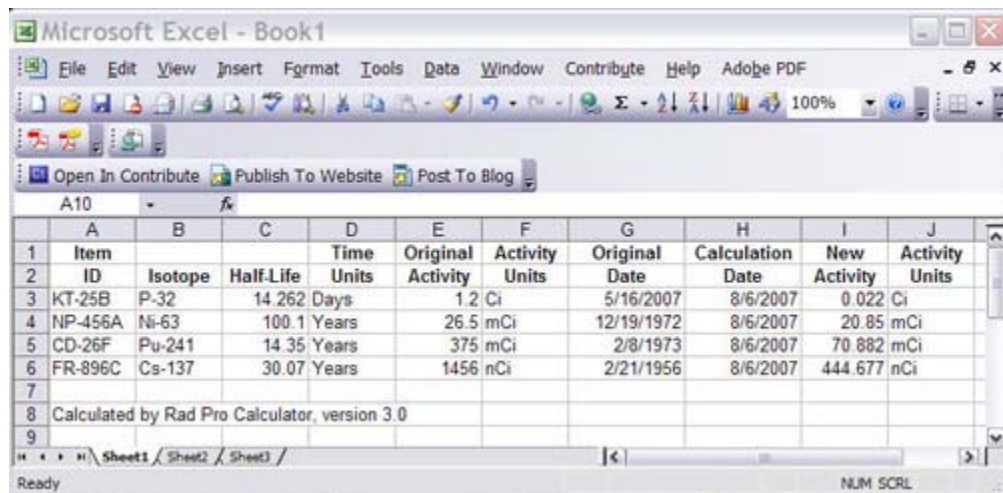
To learn more about these calculations, [click here](#) to go to the USA EPA MARSSIM site and read Chapter 6 or click here [Field Measurement Methods and Instrumentation](#).

Excel functions are not available on this calculator at this time. If you would find it useful, send us a request at [this link](#). If enough requests are received, Excel output will be considered for a future release.

4.0 Excel Output Functions

This is a major new feature added with version 3.0. With versions 1.xx and 2.xx, the only output available was the screen print of one calculation at a time. If you had multiple sources to decay or wanted to do multiple gamma shields and take the results to a meeting, you had to copy and paste the answers or hand type them into a spreadsheet or table one at a time. Now with a few mouse clicks you can create a spreadsheet of multiple calculations which can be saved, printed or copied and pasted into a database, Word document or Power Point presentation with ease. To learn how to use this new feature you should learn how it works and learn why limitations of its use were programmed into the software.

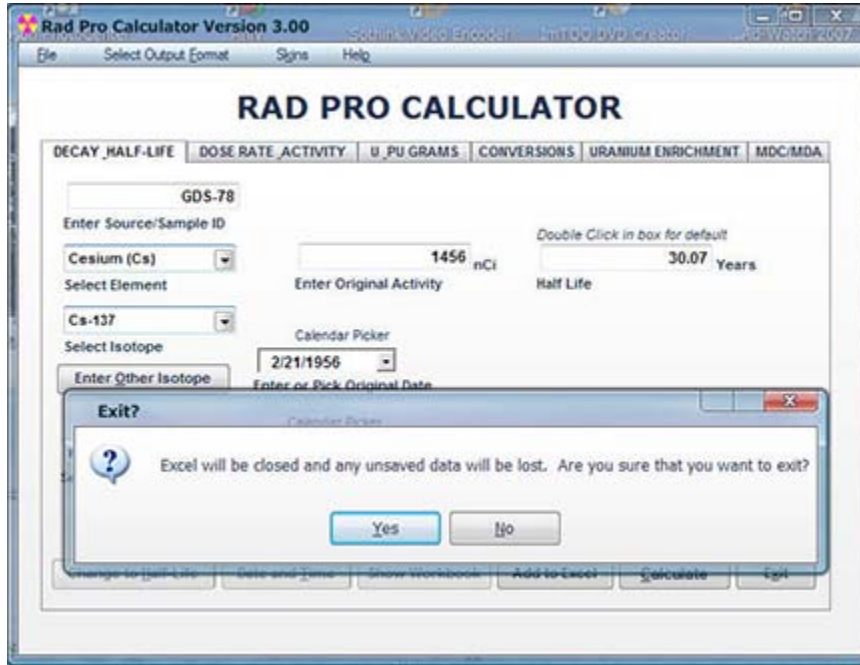
On each calculator that has the Excel output feature, you will see a Start Excel button. When this is pressed, an Excel object is created in memory. It is not visible at this time but is there awaiting your input. You may make the Excel spreadsheet visible at any time by pressing the Show Workbook button. You may still input more data after showing it by minimizing the Excel application. Whether visible or not, the input to the spreadsheet is the same. Once you start the Excel object, the button changes to an Add to Excel button. Each time that you press this button, the data that is currently in the calculator is added to new row in the spreadsheet object. This Add to Excel button is placed right next to the Calculate button to minimize mouse movement. Do your input. Press the Calculate button. Press the Add to Excel button. Enter the next input. Press the Calculate button. Press the Add to Excel button. Continue this process until you are finished. Press the Show Workbook button.



1	Item			Time	Original	Activity	Original	Calculation	New	Activity
2	ID	Isotope	Half-Life	Units	Activity	Units	Date	Date	Activity	Units
3	KT-25B	P-32	14.262	Days	1.2	Ci	5/16/2007	8/6/2007	0.022	Ci
4	NP-456A	Ni-63	100.1	Years	26.5	mCi	12/19/1972	8/6/2007	20.85	mCi
5	CD-26F	Pu-241	14.35	Years	375	mCi	2/8/1973	8/6/2007	70.882	mCi
6	FR-896C	Cs-137	30.07	Years	1456	nCi	2/21/1956	8/6/2007	444.677	nCi
7										
8	Calculated by Rad Pro Calculator, version 3.0									
9										

Save the spreadsheet, print it or format it as you wish first. Copy and paste the data into a database, Word document or Power Point spreadsheet if you like. Once you close the application, the object is killed and Excel is closed.

You are given one last chance to save the spreadsheet, if you forgot to do it before closing it.



The spreadsheet is attached to the object in memory. When you close Rad Pro Calculator, the object must be killed to free up memory. When the object is killed, the spreadsheet is closed and killed also. If you accidentally close the spreadsheet while the application is running, Rad Pro Calculator does not know it right away because the object is still in memory. If you then press the Add to Excel button, it knows that there is no spreadsheet and gives you an error message. The only way to recover or create a new Excel object on that calculator again is to close Rad Pro Calculator and reopen it and press the Start Excel button again. That is a limitation that you must learn.

When you press the Add to Excel button, you will notice that certain drop down boxes and option buttons freeze and cannot be used. This was necessary to preserve the integrity of the data under the column headings under the spreadsheet. If you are using the gamma calculator, calculating the dose-rate by inputting activity and distance and then start a spreadsheet, the last column heading says dose-rate in your selected dose-rate units. You may not switch dose-rate units then. Say you started with mSv/hr. If you were start a spreadsheet and switch to $\mu\text{Sv/hr}$, the column header would still read mSv/hr so the new values added would be wrong, when compared to the heading. Say you then wanted to do some activity calculations, inputting the dose-rate and distance. If you were allowed to make that switch while a spreadsheet was open, your answer would be in say MBq and the column header would still say mSv/hr. That is why the things that freeze are frozen for you. If you must make a change, you have no choice but to close Rad Pro Calculator, reopen it and start a new spreadsheet. You must learn that limitation also.

Here is what you can do. You may open a gamma dose-rate spreadsheet, and then open a decay calculator spreadsheet. You may switch back and forth between the two tabs on the software and between the two spreadsheets, if you show them both. You may even copy data from one spreadsheet to another one. All in all, we think that you will find this new feature useful.

Ray McGinnis

Rad Pro Calculator

Software Development

[Click to Contact Me](#)