A Lead Case (bin) for G-Ray measurements (*)

(*CAUTION: Use it ONLY to measure Background G-Ray Spectrum or materials with WEAK radioactivity like the test specimens described in these G-Rays Amateur Spectrometry web pages !!!)

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WHICH IS THE PROBLEM ?

When we perform a Gamma-Ray measurement session in a normal room space, the results is affected by an unwanted amount of Alpha-Beta-Gamma Rays coming from “The Universe”. These rays, and in particular Gamma ones, hit your scintillator's nose from EVERY direction and generate the so called “Natural Background”. Obviously also some other radioactive parts that are present near or close to our working space can produce these gamma rays emissions and consequently affect your tests.

This is why is preferable to take a measure adopting a good shield, A lead case (shield) can do this job for you. A perfect shield should have a thickness of several centimeters/inches, let say 15cm (or 6 inches) and totally enfolds your test sample.

This is quite difficult to obtain, especially if we don't want to spend much money and manage a very heavy case.

We need a simple, cheap and portable solution.

THE SOLUTION: BUILDING THE LEAD CASE ENTIRELY FROM A LEAD SHEET

The Lead case I've built consists into four pieces: a base plate and three concentric “cylindrical pipes” varying for dimension and thickness for a good match with my PMT sensor/detector: suitable gap between concentric pipes have been taken into account, for a quick and easy assembling and disassembling of the whole setup.

The “brass” colored parts are made with LEAD indeed, while gray color stands for the sensor's

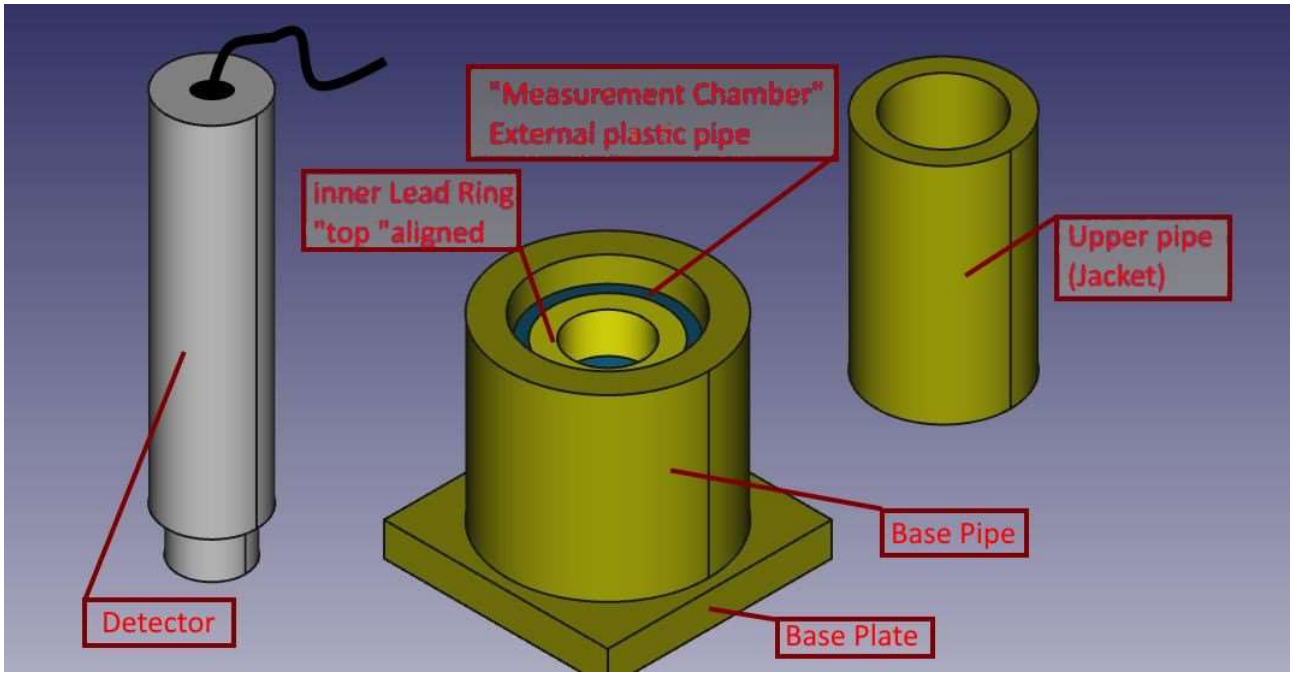
alloy case and blue is the only plastic part I've used - a short and large plastic pipe for the inside “Measurement Chamber”-, which has also a concentric and thick lead ring on the upper side.

Every lead object has been created starting from a lead sheet (1,5 mm thickness = about 0,06 inches). The lead sheet was cut into strips with a simple pair of metal sheet scissors. Single or multiple strips were wrapped together to form cylindric pipes of various diameters and thickness.

Other various pipes/cylinders I've around my workshop (maybe plastic, alloy, iron, it doesn't matter) were used as template for hand-wrapping the lead sheets and shape them into “pipes”.

The base plate was made with a similar technique, bending 3 - 4 times multiple lead strips in order to obtain the right thickness for a good shield effect. Lead strips easily bend by putting them near a right angled edge of your workbench, doing the job by hand and refining with small hammer blows. Lead is really a 'soft' metal!

A picture showing all the parts:



After building them, all lead parts were covered by adhesive masking tape (made with paper) in order to avoid touching lead with hands when using these parts. Because of this paper coating, it is a good idea to leave gaps between each cylindric pipe (keep this in mind when calculating diameters) so they can easy fit one into other. The same paper tape is useful to fix the strips into their cylindrical shape during wrapping operations, when you overlap two or more strips in order to get the proper thickness. Also remember to fix the lead strip to the template with a short piece of tape when you begin wrapping operations.

TAKING MEASURES

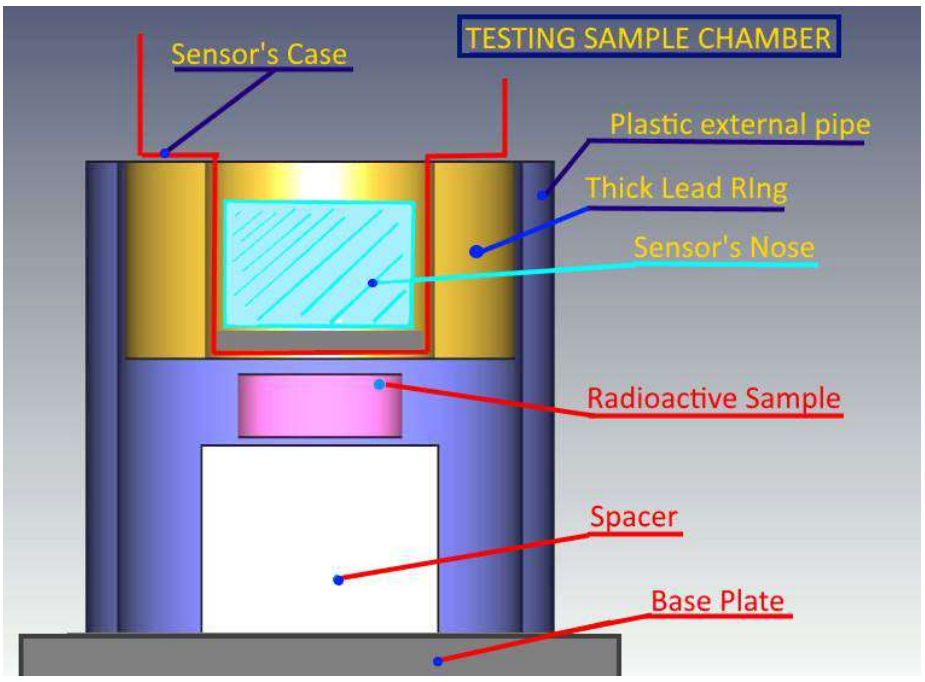
To take measures follow these steps:

1. put your base plate onto a flat horizontal surface;

2. put the sample to be tested centered uponthe base plate, keeping it at the right height so that the top of the sample must be slightly under the low side of the lead ring of your measuring “chamber” (see next step): our goal is to put the sample as close as possible to the detector: use one or more suitable spacers to do this;
3. insert the inner “measurement chamber”. I've shaped it as two concentric pipes, an external plastic pipe and an internal thick lead pipe which is shorter than the plastic one and both are top aligned. After doing that, put the base pipe centered around the chamber;

   According to my detector's shape, this allows the front part, with less diameter, to enter into the lead ring and directly face the sample;

A Schematic drawing that shows what is inside the base pipe: The Test (or Measurement) Chamber



4. Put the last pipe (upper jacket) into position (it fits inside the base pipe and lays over the plastic tube)
5. ok we are ready to go now.... : the detector itself can be inserted into this “Lead Bin. Remember to press “run” into Theremino MCA software to startup with measurements !

.The detector is now protected (not totally, depends from the pipes and plate thickness) from external gamma rays: if you want more protection you can imagine (and build !) a “lead cap” to put over your sensor.

Without a cap and with a mean thickness of lead pipes of 1 cm (0,4 inches) I obtain a reduction of background noise from the original 20 cps (detector on tabletop without protection) to 3,1 cps (detector inside “Lead Bin”).

Best regards to everybody and many thanks to Livio and all the “Theremino Group” for their HW/SW support!

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