(More) analysis of uncertainties in contamination monitor testing

Pete Burgess

- Consistently not very wonderful results from IRMF surface contamination monitor intercomparisons
- Mini EP15 spread of mean responses
  - C-14, +25 to −28 % C-14
  - Cl-36, +12 to −15 %
  - Sr-90 + Y-90, +10 to −10 %

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- Battery condition and warm-up
- Parallax
- Orientation
- Sparse scale
- Mechanical zero offset
- Plateau
- Linearity
- Source non-uniformity and spacing
- Temperature

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- Nominal voltage of a PP3 = 9 V

- Real value can be up to 9.5 V

- Vmin marked = 6.71 V

- Once warmed up, influence of battery condition, audio on or off, < 2% at 340 cps indicated

- Drop in indication over first 5 minutes or so of 6%

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Influence of orientation – using battery test function

On feet (cps)	On back (cps)	Change (%)
150 exact	145	3
97	100 exact	3
20 exact	19	5
4.7	5.0 exact	6

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- Same detector in same position at the same HT connected to the EP15 and then an Electra in averaging mode

Nuclide	Mini (cps)	Electra (cps)	Tav (s)	Mini/Electra
Sr-90	284	315	100	0.90
C-14	151	157	200	0.96
Pu-239	32.1	34.9	600	0.92
Unat	10.7	10.7	600	1.00
BG	0.3	0.42	600	0.7

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GM plateau

Mini HV	Mini cps	Mini Change (%)	Electra HV	Electra cps	Electra change (%)
491	278	-6	500	282	- 9
540 (Vnom)	295	--	550	310	--
589	290	-2????	600	345	+11

- Counting pulse rate to produce an exact indication on the Mini 900

Mini	Reference	Difference (%)
20	20.3	-1.5
50	50.5	-1
100	100.0	0
200	198	+1
300	296	+1
500	481	+4 (dead time compensation)

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- Pulse generator used to set up a random indication on the Mini 900 and then measured accurately

Mini cps	Reference (cps)	Difference (%)
25	25.1	0
36	36.3	-1
120	123	-3
177	179	-1

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Methods of averaging

- Comparison of the average of readings at 10 second intervals and the average of the extremes of the recorded values

| Mean (cps)	Number of readings	Average of extremes	Difference (%)
284	12	288	+2
151	12	150	0
32.1	16	33	+3
10.7	21	10.5	-2
0.39	6	0.45	+20

Effects of source-detector spacing

- Using the Electra in averaging mode for better reading precision and statistical quality

Separation (mm)	Sr-90+	Change (%)	C-14	Change (%)	Pu-239	Change (%)
vc	310	--	150	--	32.6	--
1.65	308	-1	143	-5	28.5	-12
3.30	304	-2	135	-10	25.2	-23
4.95	304	-2	129	-14	21.2	-35

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- Effects of 12 mm thick, 78 mm deep, 163 mm long blocks placed up against the detector edge, Sr-90 +Y-90 15 x 10 cm source
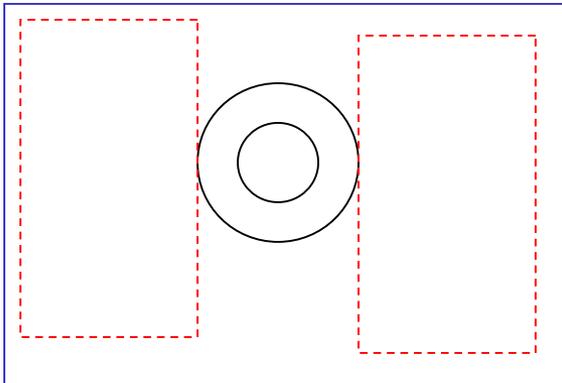
Detector to source (mm)	Open (cps)	1 block (cps)	2 blocks (cps)
0	335	331	334
3	--	--	341

Example source uniformity

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 1   2   3

 4   5   6

 7   8   9

10  11  12
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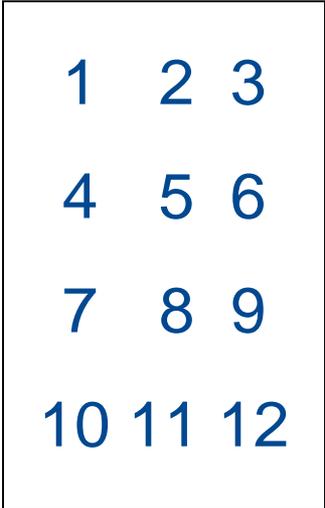
Position	Count rate (cps)	Normalised to mean
1	283	0.95
2	290	0.96
3	296	0.98
4	277	0.92
5	275	0.91
6	283	0.95
7	298	0.99
8	302	1.00
9	307	1.02
10	313	1.04
11	335	1.11
12	366	1.21

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- From the type test, variations observed were – 20 % at –10^0 C and + 20 % at +40^0 C.

- Assuming a likely temperature range of 15 to 25^0 C gives a variation of 5 %.

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Summary

- The variation in observed results for the more energetic beta emitters look very creditable, given the uncertainties present.

- The variation for C-14 is not explicable.

- The next step will be to measure the emission rate from some of the sources and comparing that value with the instrument indication and the nominal emission rate.

- And then measure the uniformity with the same detector.

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- Average instrument indication correlates well with measured emission rate but measured emission rate differs from nominal value – activity loss?

- Average instrument indication correlates well with measured emission rate and with nominal value but uniformity is very poor. Look at the method employed for the intercomparison.

- Indication does not correlate with measured emission rate – spectral differences?

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