

CHAPTER 11

CONVERSION FACTORS FOR WEAPONS

GRADE PLUTONIUM

Assumptions:

1. Conversions are for weapons grade plutonium only with no Americium
2. Density of soil 1.5 g/cm³. “
3. Specific activity (alpha only) 0.075 Ci/g.
4. Contamination of soil is to the depth of 1 cm.

TABLE 11-1. Conversion Factors for Weapons Grade Plutonium.

<u>To Convert</u>	<u>Into</u>	<u>Multiply by</u>
$\mu\text{Ci}/\text{m}^2$	$\mu\text{g}/\text{m}^2$	13
$\mu\text{Ci}/\text{m}^2$	dpm/m ²	2.2×10^{-6}
$\mu\text{Ci}/\text{m}^2$	dpm/cm ²	220
$\mu\text{Ci}/\text{m}^2$	dpm/g	150
$\mu\text{Ci}/\text{m}^2$	$\mu\text{Ci}/\text{g}$	6.7×10^{-5}
$\mu\text{Ci}/\text{m}^2$	pCi/g	67
$\mu\text{g}/\text{m}^2$	$\mu\text{Ci}/\text{m}^2$	0.075
$\mu\text{g}/\text{m}^2$	dpm/m ² *	1.7×10^5
$\mu\text{g}/\text{m}^2$	dpm/cm ²	17
$\mu\text{g}/\text{m}^2$	dpm/g	11
$\mu\text{g}/\text{m}^2$	$\mu\text{Ci}/\text{g}$	5×10^{-7}
$\mu\text{g}/\text{m}^2$	pCi/g	5
dpm/m ²	$\mu\text{Ci}/\text{m}^2$	4.5×10^{-7}
dpm/m ²	$\mu\text{g}/\text{m}^2$	6.1×10^{-6}
dpm/m ²	dpm/cm ²	10^{-4}
dpm/m ²	dpm/g	6.7×10^{-5}
dpm/m ²	$\mu\text{Ci}/\text{g}$	3.0×10^{-11}
dpm/m ²	pCi/g	3.0×10^{-5}
dpm/cm ²	$\mu\text{Ci}/\text{m}^2$	4.5×10^{-3}
dpm/cm ²	$\mu\text{g}/\text{m}^2$	6.1×10^{-2}
dpm/cm ²	dpm/mi ²	10^4
dpm/cm ²	dpm/g	0.67
dpm/cm ²	$\mu\text{Ci}/\text{g}$	3.0×10^{-7}
dpm/cm ²	pCi/g	0.3
dpm/g	$\mu\text{Ci}/\text{m}^2$	6.8×10^3
dpm/g	$\mu\text{g}/\text{m}^2$	0.091
dpm/g	dpm/m ²	1.5×10^4

TABLE 11-1: Conversion Factors for Weapons Grade Plutonium (Continued)

<u>To Convert</u>	<u>Into</u>	<u>Multiply by</u>
dpm/g	dpm/cm ²	1.5
dpm/g	μCi/g	4.5 x 10 ⁻⁷
dpm/g	pCi/g	0.45
μCi/g	μCi/m ²	1.5 x 10 ⁴
μCi/g	μg/m ²	2 x 10 ⁵
μCi/g	dpm/m ²	3.3 x 10 ¹⁰
μCi/g	dpm/cm ²	3.3 x 10 ⁶
μCi/g	dpm/g	2.2 X 10 ⁶
μCi/g	pCi/g	10 ⁶
pCi/g	μCi/m ²	1.5 x 10 ⁻²
pCi/g	μg/m ²	0.20
pCi/g	dpm/m ²	3.3 x 10 ¹⁰
pCi/g	dpm/cm ²	3.3
pCi/g	dpm/g	2.2
pCi/g	μCi/g	1 0 ⁻⁶
μ units	units	10 ⁻⁶
units	μ units	10 ⁶

The conversion of alpha instrument readings in **cpm** into quantifiable units is affected by the type of surface and meter efficiency. For accurate conversions, a surface **sample** from the area measured should be analyzed with laboratory equipment and the conversion factor for that area computed. The table below provides approximate factors for conversion of alpha readings in cpm into **μg/m²** for various surfaces using the following equation:

$$\mu\text{g}/\text{m}^2 - \text{correction factor} \times \text{cpm}$$

TYPE OF SURFACE	CORRECTION FACTOR
Soil	.006
Concrete	.005
Plywood	.004
Stainless Steel	.0025

The correction factors consider unit and area conversions, nominal instrument efficiency during field use, and assume a 60 sq cm probe area (**AN/PDR-60** or **PAC-1 S**). Correction factors should be multiplied by 4 for use with the **AN/PDR-56**. Tables 11-2 and 11-3 were prepared from the **preceding** conversion table and equation for users of the **AN/PDR-56** and **AN/PDR-60**, respectively.

TABLE 11-2. Conversion Table (CPM to $\mu\text{g}/\text{m}^2$ or $\mu\text{Ci}/\text{m}^2$) AN/PDR 56 Alpha Meter.

CPM	SOIL		CONCRETE		PLYWOOD		STAINLESS STEEL		
	AN/PDR 56	$\mu\text{g}/\text{m}^2$ Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239	$\mu\text{g}/\text{m}^2$ Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239	$\mu\text{g}/\text{m}^2$ Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239	$\mu\text{g}/\text{m}^2$ Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239
50		1.2	.09	1.0	.075	.8	.06	.5	.038
100		2.4	.18	2.0	.15	1.6	.12	1.0	.075
200		4.8	.36	4.0	.30	3.2	.24	2.0	.15
400		9.6	.72	8.0	.60	6.4	.48	4.0	.30
600		14.4	1.08	12.0	.90	9.6	.72	6.0	.45
800		19.2	1.44	16.0	1.20	12.8	.96	8.0	.60
1,000		24.0	1.80	20.0	1.50	16.0	1.20	10.0	.75
1,200		28.8	2.16	24.0	1.80	19.2	1.44	12.0	.90
1,500		36.0	2.70	30.0	2.25	24.0	1.80	15.0	1.13
1,000		43.2	3.24	36.0	2.70	28.8	2.16	18.0	1.35
2,200		52.8	3.96	44.0	3.30	35.2	2.64	22.0	1.65
2,500		60.0	4.50	50.0	3.75	40.0	3.00	25.0	1.88
2,800		67.2	5.04	56.0	4.20	44.8	3.36 “	28.0	2.10
3,000		72.0	5.40	60.0	4.50	48.0	3.60	30.0	2.25
4,000		96.0	7.20	80.0	6.00	64.0	4.80	40.0	3.00
5,000		120.0	9.00	100.0	7.50	80.0	6.00	50.0	3.75
8,000		192.0	14.40	160.0	12.00	128.0	9.60	80.0	6.00
10,000		240.0	18.00	200.0	15.00	160.0	12.00	100.0	7.50
11,000		264.0	19.80	220.0	16.50	176.0	13.20	110.0	8.25
12,000		288.0	21.60	240.0	18.00	192.0	14.40	120.0	9.00
25,000		600.0	45.00	500.0	37.50	400.0	30.00	250.0	18.75
50>000		1200.0	90.00	1000.0	75.00	800.0	60.00	500.0	37.50
75,000		1800.0	135.00	1500.0	112.50	1200.0	90.00	750.0	56.25
100,000		2400.0	180.00	2000.0	150.00	1600.0	120.00	1000.0	75.00
150,000		3600.0	270.00	3000.0	225.00	2400.0	180.00	1500.0	112.50
200,000		4800.0	360.00	4000.0	300.00	3200.0	240.00	2000.0	150.00
300,000		7200.0	540.00	6000.0	450.00	4800.0	360.00	3000.0	225.00

NOTE: To convert $\mu\text{Ci}/\text{m}^2$ to **Becquerels/ m^2** (Bq/ m^2) multiply by 3.7×10^{13} .

TABLE 11-3. Conversion Table (CPM to $\mu\text{g}/\text{m}^2$ or $\mu\text{Ci}/\text{m}^2$) AN/PDR 60 or AN/PDR 54 Alpha Meter

CPM	SOIL		CONCRETE		PLY WOOD		STAINLESS STEEL	
	AN/ PDR 60 $\mu\text{g}/\text{m}^2$ AN/ PDR 54 Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239	$\mu\text{g}/\text{m}^2$ Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239	$\mu\text{g}/\text{m}^2$ Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239	$\mu\text{g}/\text{m}^2$ Pu-239	$\mu\text{Ci}/\text{m}^2$ Pu-239
50	0.3	.023	.25	.019	.2	.015	.125	.009
100	0.6	.045	.50	.38	.4	.03	.25	.019
200	1.2	.09	1.0	.075	.8	.06	.5	.038
400	2.4	.18	2.0	.15	1.6	.12	1.0	.075
600	3.6	.27	3.0	.23	2.4	.18	1.5	.113
800	4.8	.36	4.0	.30	3.2	.24	2.0	.15
1,000	6.0	.45	5.0	.38	4.0	.30	2.5	.19
1,200	7.2	.54	6.0	.45	4.8	.36	3.0	.23
1,500	9.0	.68	7.5	.56	6.0	.45	3.8	.28
1,800	10.8	.81	9.0	.68	7.2	.54	4.5	.34
2,200	13.2	.99	11.0	.83	8.8	.66	5.5	.41
2,500	15.0	1.13	12.5	.94	10.0	.75	6.3	.47
2,800	16.8	1.26	14.0	1.05	11.2	.84	7.0	.53
3,000	18.0	1.35	15.0	1.13	12.0	.90	7.5	.56
4,000	24.0	1.80	20.0	1.50	16.0	1.20	10.0	.75
5,000	30.0	2.25	25.0	1.88	20.0	1.50	12.5	.94
8,000	48.0	3.60	40.0	3.00	32.0	2.40	20.0	1.50
10,000	60.0	4.50	50.0	3.75	40.0	3.00	25.0	1.88
11,000	66.0	4.95	55.0	4.13	44.0	3.30	27.5	2.06
12,000	72.0	5.40	60.0	4.50	48.0	3.60	30.0	2.25
25,000	150.0	11.25	125.0	9.38	100.0	7.50	62.5	4.69
50,000	300.0	22.50	250.0	18.75	200.0	15.00	125.0	9.38
75,000	450.0	33.75	375.0	28.13	300.0	22.50	187.5	14.06
100,000	600.0	45.00	500.0	37.50	400.0	30.00	250.0	18.75
150,000	900.0	67.50	750.0	56.25	600.0	45.00	375.0	28.13
200,000	1200.0	90.00	1000.0	75.00	800.0	60.00	500.0	37.50
300,000	1800.0	135.00	1500.0	112.50	1200.0	90.00	750.0	56.25

NOTE: To convert $\mu\text{Ci}/\text{m}^2$ to Becquerels/ m^2 (Bq/ m^2) multiply by 3.7×10^{13} .

TABLE 11-4. Conversion Table (MBq to mCi and uCi).

<u>MBq</u>	mCi	<u>MBq</u>	uCi
7000	189.	30	810
6000	162.	20	540
5000	135.	10	270
4000	108.	9	240
3000	81.	8	220
2000	54.	7	189
1000	27.	6	162
900	24.	5	135
800	21.6	4	108
700	18.9	3	81
600	16.2	2	54
500	13.5	1	27
400	10.8	0.9	24
300	8.1	0.8	21.6
200	5.4	0.7	18.9
100	2.7	0.6	16.2
90	2.4	0.5	13.5
80	2.16	0.4	10.8
70	1.89	0.3	8.1
60	1.62	0.2	5.4
50	1.35	0.1	2.7
40	1.08		

TABLE 11-5. Conversion To **SI Units**.

$$1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$$

$$1 \text{ Bq} = 2.7 \times 10^{-11} \text{ Ci}$$

$$1 \text{ REM} = 10^{-2} \text{ Sv}$$

$$1 \text{ Sv} = 100 \text{ REM}$$

$$1 \text{ RAD} = 10^{-2} \text{ Gy}$$

$$1 \text{ Gy} = 100 \text{ RADs}$$

SI Units:
Becquerels (Bq)
Sieverts (Sv)
Grey (Gy)