



Find your old friends again!

classmates

>>> Click Here!

[LinkExchange](#)

On nukes - the short form.

The important formula is:

$$(D/D1) = (w/W1)^{1/3}$$

where D is the slant range of the theoretical weapon, D1, the referent distance, and W is the theoretical weapons's yield in kt, and W1 is the referent weapon in kt. If the referent W1 = 1kt, then the formula is $D = D1$ times the cube root of the Weapon's Yield. $D = D1 * W^{(1/3)}$. In short - if an over pressure of 15psi is measured at a distance of D1 feet from the hypocenter (that spot directly under the detonation) for yield W1, you can compute the D for a larger or smaller yield to cause the same over pressure to occur. In theory. Remember - the real world is analog, not digital.

There are a number of fudge factors to account for variations in altitude, temp and such, but ... who cares, this is good enough for government work.

Ufda - lots of numbers, but ... Oh yes, something I didn't address in the program: Underground damage from a surface burst is going to extend two more crater width in all directions (in other words, for a 500 kt weapon if your shelter is within a mile of ground zero - you are going to be in serious trouble, just from the ground shock wave.) But it is also dependent on the soil type: hard rock, "soft" rock, dirt; wet or dry, smoking or non-smoking, etc, etc.

I've shortened the output to include just a 1 kt, 20 kt (nominal Hiroshima size), 335 & 500 kt (as those are (were) the two popular sizes in the US and USSR inventories,) 1, 10, 20 and 24 megatons TNT equivalent, just for comparison. My own feelings on the matter is that the Chinese might have 1 meg devices, but those are realistically city busters. More efficient to use the equivalent yield in a number of smaller weapons - cover's much more area.

I. NUKE DET - OR "HOW BIG A HOLE DOES THAT FIRE CRACKER MAKE"

Nuclear devices (jargon for A-bombs, H-bombs and other bombs using nuclear physics as the source of the bang) are simple applications of Boyles law: a thing heated expands, things heated a lot expand a lot, and gases expand to equalize pressure. For a good description of the sequence, read Clancy's "Sum of All Fears", chapter 35 has a very good description of what's going on.

Nukes are a nerd engineering toy. Lots of time and effort goes into creating conditions lasting a fraction of a second (technically "three shakes of a lamb's tail - about 3 nanoseconds). In those three shakes the energy released

heats the 'device' beyond merely hot, and then it is Mechanics 101: X kilos of metal heated to Y degrees forms Z plasma at what internal pressures? How much time elapses until the plasma expands and equalize pressure with the surrounding environment? (assume STP) What will the initial speed of a shock wave propagating through the fireball? Show all work.

I dunno - I'm a history major. The technical stuff is based on Gladstone, et. al., work: Effects of Nuclear Weapons published by the Dept of Defense in several editions. They have enough mathematics to satisfy most nerds. Information about the yields, ranges, effectiveness, etc. are drawn from Dunnigan's How to Wage War. Keep in mind that most of the published information (and this program) is based on tests done under restricted conditions: a desert in Nevada and Pacific Atolls, under optimal weather conditions. Nobody (that I know of) has conducted a realistic test since August 1945, e.g. in the rain, at night, in the winter, or on a target not on level terrain. Nor was there been any real ballistic tests of the intercontinental ballistic missiles over the courses they would have been taking in time of war. On the other hand - if the US ever declares war on Kwajalien Atoll - it's toast.

As far as war fighting capabilities, all ballistic missiles have two targeting errors that accumulate. One error is generally similar for all of a model or production run. In rifle terms - one model will 'shoot low and left', another 'high and right'. The end result of this is that a model of rocket may have its aiming point off by as much as ten miles. At the final end of the mission is the "CEP" [Circle of error probability]: half the warheads will arrive inside the CEP, which will be centered on that mythical aiming point, which will be somewhere in the vicinity of the actual target. Note that cumulative error might put a warhead directly on the target desired. Don't bet on it. :)

II. JARGON:

Breakaway That time when the expansion of the fireball slows below the speed of sound, and the shockwave 'breaks away' from the expanding fireball. Remember, speed of sound is a relative constant. And note well that the fireball follows the laws of physics and is rising on the thermal it is creating. Rather rapidly too, I gather.

CEP Circle of Error Probability. A circle around the aim-point in which fifty percent of projectiles will land within. Compares to the strike-zone in baseball, only there is no bat. Early rockets had CEP measured in miles, the most recent ICBMs claim CEPs in the tens of meters.

Tomahawks have CEPs measured in fractions of a meter.

EMP Electro-Magnetic Pulse. As a 'side effect' of releasing all this energy is what is called the EMP. Think of it as a lightening strike - and the effects are similar. Things most affected by EMP are electronics - chips, and least affected are tubes and standard AC equipment. It also screws up radio and radar reception.

HOB Height of Burst. In feet, it affects fallout, destructive area. For for a 24 megaton warhead, 'ground' zero is 27 feet in the air.) For 'soft targets, HOB can be higher, to maximize the extent of the damage.

There are six representative HOBs: a surface burst, a low altitude airburst for minimum fallout, two middle altitudes for maximum damage to ordinary buildings, and a high altitude burst to break the most glass.

Overpressures of 200 psi effectively clears an area down to ground level. Nothing remains. 15 psi will seriously damage even the most earthquake resistant structure, making it uninhabitable even if standing. 4 psi will render a standard American house uninhabitable (shift it off the foundation, and similar structural damage). 1 psi will cause 'light damage' - watch for flying glass, poodles and stuff. Window glass is vulnerable to a 0.1 psi overpressure - I couldn't determine this distance.c

K Kill factor. Targets have a K factor (how hard are they to destroy) and Weapons have a K factor (how well they destroy). K for nukes is computed as $Yield^{.66} / [CEP * CEP]$. Obviously, the more accurate, the lower the required yield to reach a given K.

Serviceability Not all systems are ready at all times. Routine maintenance, inspections, upgrades, transit to patrol station makes some weapons unready.

Reliability: Ability of a delivery system to continue functioning from its launch until it delivers the payload. For Aircraft, this includes a SWAG on getting shot down along the way. A combination of known factors and SWAG.

SWAG Scientific Wild Ass Guess. Guesswork ennobled by having been run through a computer. Just because it's printed on greenbar only changes a Wild Guess into a SWAG, no better than the assumptions.

Targets: Hard Usually military targets that have been reinforced to withstand blast damage, e.g. missile silos, command bunkers, armored vehicles. Other hard targets are those which are naturally less vulnerable to blast damage: bridges, highways and railroads.

Targets: Soft Things that will not withstand a great deal of dynamic overpressure: most buildings, airplanes, people, shipping, trains, forests.

Yield: explosive equivalent, usually expressed in Tons of TNT.

Damage Measurements: There really isn't a 'Richter Scale' for damage assessment. But the rule of thumb for Strategic Air Command for military targets: Light is rubble, Moderate is gravel, Severe is sand or dust.

III. Table layout

The table reads across as Yield, Weapon Name, Owner, a two character code

[Tactical|Strategic][Gun|Bomber|Missile] for Type, the CEP and K for Strategic Missiles, number of Delivery Systems, their Serviceability and Reliability, Number of Warheads per delivery system, the Range in miles and the Year first deployed.

The entry for A Bomb has the last date the information was checked by me: 27 March 1987. This does not reflect START, STOP, or the break up of the Soviet Union.

1	A Bomb;	Other	TG	-	-	27	3	87	0	1	45
40	Poseidon C3;	USA	SM	463	1.9	480	60	80	10	4600	71

The second line 'reads': 40 kiloton yield, Poseidon C3 (a sub launched ICBM); it is American made, a Strategic Missile, CEP in yards is 463, it has a K of 1.9, 60% are ready at anyone time, and 80% of those ready are expected to arrive on target, delivering 10 warheads 4600 milies, and was first deployed in 1971.

1	A Bomb;	Other	TG	-	-	27	3	87	0	1	45
2	155mm Howitzer;	Nato	TG	-	-	1800	90	90	2	16	64
5	203mm Howitzer;	Warsaw	TG	-	-	300	90	90	4	16	62
10	Lance;	Nato	TM	0	0.0	108	90	90	6	110	72
20	Pluton;	Frog	TM	0	0.0	42	75	90	3	120	74
40	Poseidon C3;	USA	SM	463	1.9	480	60	80	10	4600	71
50	FROG-7;	Warsaw	TM	0	0.0	480	65	90	3	70	67
100	SS-22;	Soviet	SM	0	0.0	200	65	90	2	2000	79
125	Trident C4;	USA	SM	200	18.5	48	60	80	10	7400	79
150	SSBS S-3 (Fr);	Frog	SM	359	7.5	18	90	85	1	3000	80
175	Minuteman III;	USA	SM	315	10.8	250	90	85	3	12800	70
200	ACLM;	USA	SC	30	1302.7	2300	60	40	1	2400	85
335	Minuteman III;	USA	SM	220	34.2	300	90	85	3	12800	70
500	SS-N-20;	Soviet	SM	1000	2.2	10	65	70	6	9000	83
550	SS-19 mod 1;	Soviet	SM	400	14.4	280	75	75	6	8000	74
600	Polaris A3;	Brit	SM	463	11.4	64	60	80	10	4600	64
750	SS-17 mod 1;	Soviet	TM	400	17.7	160	75	75	4	880	75
800	B-52 G/H;	USA	SB	-	-	240	75	70	12	12000	59
900	SS-18 mod 2;	Soviet	SM	400	20.0	107	75	75	8	8800	76
950	SS-11 mod 3;	Soviet	SM	1400	1.7	470	75	80	1	9700	66
1000	MSBS M-20;	Frog	SM	926	4.0	80	60	75	1	3100	77
1500	SS-N-6;	Soviet	SM	1300	2.7	468	35	65	1	2500	68
3000	SS-8;	Soviet	SM	1900	2.0	0	75	75	1	11000	67
4000	SS-7;	Soviet	SM	1900	2.4	0	75	75	1	10000	62
5000	CSS-4;	PRC	SM	1500	4.5	18	70	65	1	12000	70
6000	SS-17 mod 2;	Soviet	SM	400	70.7	20	80	85	1	9000	77
9000	Titan II;	Other	SM	1482	6.8	0	75	75	1	11665	63
10000	SS-19 mod 2;	Soviet	SM	250	254.5	100	85	85	1	8800	78
20000	SS-18 mod 3;	Soviet	SM	350	206.1	26	85	85	1	12000	77
24000	SS-18 mod 1;	Soviet	SM	400	178.2	0	80	85	1	9600	74

The results format is straight forward. The times mentioned in each column are arrival times for the shock wave. You haven't got much time to do more

than "duck and cover". Two notes: the "Safe" level of radiation in the fallout table is based upon the estimated dosage received and survived by members of a Mexican family when the Co-60 gamma source for an X-ray machine was left in a pickup truck outside their home for several months. Secondly the area contaminated is a SWAG, and has no credibility with me and I computed it. If you want to print this out - set your character size to 20 cpi, and it should line up nicely. The dashed line is one page width.

Theoretically the detonation Of a 1 kt device has the following results.

for an airburst with negligible FallOut:0.0045 secs after detonation the FireBall reaches Breakaway and 220 Feet in diameter.

0.6000 secs after detonation the FireBall reaches Maximum Size 440 Feet in diameter.

for a Ground burst0.0060 secs after detonation the FireBall reaches Breakaway and 293 Feet in diameter.

0.8000 secs after detonation the FireBall reaches Maximum Size 587 Feet in diameter.

Crater dimensions are:Width 260 Feet, the lip extending another 70 Feet.

Apparent Crater Depth is 30 Feet. Buildup Of ejecta over original surface is 8 Feet.

volume Of Crater is 597289.1 cubic Feet.(About 1.371 AcreFeet,or 0.00000406 cubic

Miles.) Nice Lake.

HOB 1 psi	200 psi	15 psi	10 psi	8 psi	6 psi	4 psi	2 psi
1 Feet	200 Feet	820 Feet	1020 Feet	1150 Feet	1350 Feet	1650 Feet	2500 Feet
3800 Feet	0.0400 secs	0.3000 secs	0.4300 secs	0.5000 secs	0.6000 secs	0.9000 secs	1.600 secs
2.900 secs	200 Feet	880 Feet	1111 Feet	1200 Feet	1500 Feet	1800 Feet	3000 Feet
4500 Feet	0.0700 secs	0.3500 secs	0.5000 secs	0.5800 secs	0.8000 secs	1.100 secs	2.000 secs
3.400 secs		1100 Feet	1310 Feet	1350 Feet	1700 Feet	2200 Feet	3500 Feet
500 Feet		0.5500 secs	0.8000 secs	0.8000 secs	1.000 secs	1.500 secs	2.500 secs
4900 Feet		300 Feet	760 Feet	1500 Feet	2000 Feet	2700 Feet	4200 Feet
3.400 secs		0.5000 secs	0.7000 secs	1.100 secs	1.500 secs	2.200 secs	3.300 secs
1000 Feet					750 Feet	1500 Feet	3200 Feet
1.2 Mile					1.000 secs	1.400 secs	2.600 secs
5.000 secs							
1500 Feet							
1.4 Mile							
6.500 secs							
2000 Feet						500 Feet	2600 Feet
1.5 Mile							
						1.300 secs	2.400 secs
6.500 secs							

Distances for Thermal and Gamma/Xray Radiation

HOB	500 Rads	1000 Rads	12 Cal/cm)	8 Cal/cm	5 cal/cm	
1 Feet A: prompt radiation	640 Feet B:	100 Feet C:	600 Feet D:	900 Feet E:	500 Feet	A:Distance To 500 rads
200 Feet A: prompt radiation	630 Feet B:	90 Feet C:	580 Feet D:	880 Feet E:	490 Feet	B:Distance To 1000 rads
500 Feet A: Fires (12 cal/sq cm).	590 Feet B:	40 Feet C:	520 Feet D:	830 Feet E:	440 Feet	C:Distance To ignition Of
1000 Feet A: burns (8 cal/sq cm).	440 Feet B:	840 Feet C:	240 Feet D:	610 Feet E:	290 Feet	D:Distance To 3rd degree
1500 Feet A: burns (5 cal/sq cm).	170 Feet B:	470 Feet C:	57 Feet D:	160 Feet	-	E:Distance To 2nd degree
2000 Feet A:	720 Feet B:	40 Feet	-	- E:	500 Feet	

Assuming average winds Of 15 mph in One direction, ideal fallout patterns are ellipses Of these dimensions:

Initial dosage Rate (rad/hr)	Distance from GZ downwind	Ground Zero (GZ)radius	Maximum Width (Crosswind)	Contaminated Area (Sq Miles)	Wait To decay To "Safe" Level Of 0.25 rad/hr
3000	0.9500 Mi.	0.0260 Mi.	0.0076 Mi.	0.0233 Mi.	2500 Hr (3 months,2 Weeks).
1000	0.8000 Mi.	0.0600 Mi.	0.0360 Mi.	0.0205 Mi.	1000 Hr (6 Weeks.)
300	4.4990 Mi.	0.2000 Mi.	0.1300 Mi.	0.1122 Mi.	370 Hr (15 days.)
100	8.9000 Mi.	0.3900 Mi.	0.3600 Mi.	0.2218 Mi.	150 Hr (6 days,6 hours).
30	16.0000 Mi.	0.5299 Mi.	0.7600 Mi.	0.3945 Mi.	54 Hr (two days)
10	24.0000 Mi.	0.6800 Mi.	1.4000 Mi.	0.5892 Mi.	22 Hr
3	30.0000 Mi.	0.8900 Mi.	2.1990 Mi.	0.7374 Mi.	8 Hr
1	40.0000 Mi.	1.5000 Mi.	3.3000 Mi.	0.9908 Mi.	3 Hr

Theoretically the detonation Of a 20 kt device has the following results.

for an airburst with negligible FallOut:0.0149 secs after detonation the FireBall reaches Breakaway and 319 Feet in diameter.

1.980 secs after detonation the FireBall reaches Maximum Size 458 Feet in diameter.

for a Ground burst0.0199 secs after detonation the FireBall reaches Breakaway and 425 Feet in diameter.

2.640 secs after detonation the FireBall reaches Maximum Size 611 Feet in diameter.

Crater dimensions are:Width 706 Feet, the lip extending another 190 Feet.

Apparent Crater Depth is 81 Feet. Buildup Of ejecta over original surface is 22 Feet.

volume Of Crater is 11890799.5 cubic Feet.(About 27.296 AcreFeet,or 0.00008089 cubic Miles.) Nice Lake.

HOB	200 psi	15 psi	10 psi	8 psi	6 psi	4 psi	2 psi
1 psi							
3 Feet	543 Feet	2226 Feet	2769 Feet	3122 Feet	3664 Feet	4479 Feet	1.3 Mile
2.0 Mile							
	0.1086 secs	0.8143 secs	1.167 secs	1.357 secs	1.629 secs	2.443 secs	4.343 secs
7.872 secs							
543 Feet	679 Feet	2389 Feet	3016 Feet	3257 Feet	4072 Feet	4886 Feet	1.5 Mile
2.3 Mile							

	0.1900 secs	0.9500 secs	1.357 secs	1.574 secs	2.171 secs	2.986 secs	5.429 secs
9.229 secs							
1357 Feet		2986 Feet	3556 Feet	3664 Feet	4615 Feet	1.1 Mile	1.8 Mile
2.5 Mile							
		1.493 secs	2.171 secs	2.171 secs	2.714 secs	4.072 secs	6.786 secs
9.229 secs							
2714 Feet		814 Feet	2063 Feet	4072 Feet	5429 Feet	1.4 Mile	2.2 Mile
3.3 Mile							
		1.357 secs	1.900 secs	2.986 secs	4.072 secs	5.972 secs	8.958 secs
13.572 secs							
4072 Feet					2036 Feet	4072 Feet	1.6 Mile
3.9 Mile							
					2.714 secs	3.800 secs	7.057 secs
17.643 secs							
5429 Feet						1357 Feet	1.3 Mile
4.1 Mile							
						3.529 secs	6.515 secs
17.643 secs							

Distances for Thermal and Gamma/Xray Radiation						
HOB	500 Rads	1000 Rads	12 Cal/cm)	8 Cal/cm	5 cal/cm	
3 Feet A:	800 Feet B:	820 Feet C:	540 Feet D:	760 Feet E:	210 Feet	A:Distance To 500 rads
prompt radiation						
543 Feet A:	770 Feet B:	780 Feet C:	510 Feet D:	740 Feet E:	200 Feet	B:Distance To 1000 rads
prompt radiation						
1357 Feet A:	610 Feet B:	570 Feet C:	390 Feet D:	640 Feet E:	120 Feet	C:Distance To ignition Of
Fires (12 cal/sq cm).						
2714 Feet A:	960 Feet B:	690 Feet C:	950 Feet D:	270 Feet E:	850 Feet	D:Distance To 3rd degree
burns (8 cal/sq cm).						
4072 Feet A:	550 Feet	- C:	110 Feet D:	610 Feet E:	370 Feet	E:Distance To 2nd degree
burns (5 cal/sq cm).						
5429 Feet	-	- C:	640 Feet D:	550 Feet E:	650 Feet	

Assuming average winds Of 15 mph in One direction, ideal fallout patterns are ellipses Of these dimensions:

Initial dosage Rate (rad/hr)	Distance from GZ downwind	Ground Zero (GZ)radius	Maximum Width (Crosswind)	Contaminated Area (Sq Miles)	Wait To decay To "Safe" Level Of 0.25 rad/hr
3000	3.6570 Mi.	0.1477 Mi.	0.0999 Mi.	1.1940 Mi.	2500 Hr (3 months,2 Weeks).
1000	3.0800 Mi.	0.3309 Mi.	0.3508 Mi.	1.0700 Mi.	1000 Hr (6 Weeks.)
300	17.3200 Mi.	0.8424 Mi.	0.9389 Mi.	5.7010 Mi.	370 Hr (15 days.)
100	34.2600 Mi.	1.3720 Mi.	2.1720 Mi.	11.1800 Mi.	150 Hr (6 days,6 hours).
30	61.6000 Mi.	1.8100 Mi.	4.0680 Mi.	19.9000 Mi.	54 Hr (two days)
10	92.4000 Mi.	2.3220 Mi.	6.8490 Mi.	29.7300 Mi.	22 Hr
3	115.5000 Mi.	3.0390 Mi.	9.8370 Mi.	37.2100 Mi.	8 Hr
1	154.0000 Mi.	5.1220 Mi.	13.8900 Mi.	49.9400 Mi.	3 Hr

Theoretically the detonation Of a 335 kt device has the following results.

for an airburst with negligible FallOut:0.0460 secs after detonation the FireBall reaches Breakaway and 251 Feet in diameter.

6.140 secs after detonation the FireBall reaches Maximum Size 503 Feet in diameter.

for a Ground burst0.0613 secs after detonation the FireBall reaches Breakaway and 335 Feet in diameter.

8.187 secs after detonation the FireBall reaches Maximum Size 671 Feet in diameter.

Crater dimensions are:Width 1806 Feet, the lip extending another 486 Feet.

Apparent Crater Depth is 208 Feet. Buildup Of ejecta over original surface is 56 Feet.

volume Of Crater is 199809191.2 cubic Feet.(About 458.680 AcreFeet,or 0.00135925 cubic Miles.) Nice Lake.

HOB	200 psi	15 psi	10 psi	8 psi	6 psi	4 psi	2 psi
1 psi							
7 Feet	1389 Feet	5695 Feet	1.3 Mile	1.5 Mile	1.8 Mile	2.2 Mile	3.3 Mile
5.0 Mile	0.2778 secs	2.084 secs	2.986 secs	3.472 secs	4.167 secs	6.251 secs	11.112 secs
20.140 secs							
1389 Feet	1736 Feet	1.2 Mile	1.5 Mile	1.6 Mile	2.0 Mile	2.4 Mile	3.9 Mile
5.9 Mile	0.4862 secs	2.431 secs	3.472 secs	4.028 secs	5.556 secs	7.640 secs	13.890 secs
23.613 secs							
3473 Feet		1.4 Mile	1.7 Mile	1.8 Mile	2.2 Mile	2.9 Mile	4.6 Mile
6.4 Mile		3.820 secs	5.556 secs	5.556 secs	6.945 secs	10.417 secs	17.362 secs
23.613 secs		2084 Feet	5278 Feet	2.0 Mile	2.6 Mile	3.6 Mile	5.5 Mile
1.3 Mile		3.472 secs	4.862 secs	7.640 secs	10.417 secs	15.279 secs	22.918 secs
8.5 Mile							
34.725 secs							
2.0 Mile					5209 Feet	2.0 Mile	4.2 Mile
10.0 Mile					6.945 secs	9.723 secs	18.057 secs
45.143 secs							
2.6 Mile						3473 Feet	3.4 Mile
10.5 Mile						9.029 secs	16.668 secs
45.143 secs							

Distances for Thermal and Gamma/Xray Radiation						
HOB	500 Rads	1000 Rads	12 Cal/cm)	8 Cal/cm	5 cal/cm	
7 Feet A:	440 Feet B:	710 Feet C:	4500 Feet D:	1.7 Mile E:	1.6 Mile	A:Distance To 500 rads
prompt radiation						
1389 Feet A:	330 Feet B:	570 Feet C:	4500 Feet D:	1.7 Mile E:	1.6 Mile	B:Distance To 1000 rads
prompt radiation						
3473 Feet A:	690 Feet B:	750 Feet C:	4300 Feet D:	1.7 Mile E:	1.6 Mile	C:Distance To ignition Of
Fires (12 cal/sq cm).						
1.3 Mile A:	800 Feet	- C:	3500 Feet D:	1.6 Mile E:	1.5 Mile	D:Distance To 3rd degree
burns (8 cal/sq cm).						
2.0 Mile	-	- C:	2200 Feet D:	1.4 Mile E:	1.3 Mile	E:Distance To 2nd degree
burns (5 cal/sq cm).						

