DEMOLITION CARD

GTA 05-10-033

Table 1. Characteristics of block demolition charges

Explosive	Unit (pounds)	Size (inches)	Detonation Velocity m/sec¹	Detonation Velocity ft/sec¹	RE Factor	Packaging/ Weight²
TNT	0.25	1 ½ D x 3 ½ L	6,900	22,600	1.00	200 per box/55 lb
	0.50	1 ¾ x 1 ¾ x 3 ¾	6,900	22,600	1.00	96 per box/53 lb
	1.00	1 ¾ x 1 ¾ x 7	6,900	22,600	1.00	48 per box/53 lb
M112 block	1.25	1 x 2 x 10	8,040	26,400	1.34	30 per box/40 lb
M118 block	2.00	1 x 3 x 12	7,300	24,000	1.14	4 sheets per block;
M118 sheet³	0.50	¼ x 3 x 12	7,300	24,000	1.14	20 per box/42 lb
M186 roll	25.00	¼ x 3 x 50 ft	7,300	24,000	1.14	3 per box/80 lb
Ammonium nitrate	43.00	7 x 24	3,400	11,000	0.42	1 per box/52 lb
M1 dynamite	0.50	1 ¼ D x 8 L	6,100	20,000	0.92	100 per box/62 lb

¹The volume of M112 is 20 cubic inches. The volume of one sheet of M118 is 9 cubic inches.
²Packaging weights include packaging material and weight of container.

Table 2. Safe distances for personnel (near bare charges)

Explosive Weight (pounds)	Safe Distance feet	Safe Distance meters	Explosive Weight (pounds)	Safe Distance feet	Safe Distance meters
27 or less	965	300	175	1,838	560
30	1,021	311	200	1,920	585
35	1,073	327	225	1,999	609
40	1,123	342	250	2,067	630
45	1,168	356	275	2,136	651
50	1,211	369	300	2,199	670
60	1,287	392	325	2,258	688
70	1,355	413	350	2,313	705
80	1,415	431	375	2,369	722
90	1,474	449	400	2,418	737
100	1,526	465	425	2,461	750
125	1,641	500	500	2,625	800
150	1,752	514			

For charges over 500 pounds, use the following:

- Distance in feet = 300 x $\sqrt[3]{\text{pounds of explosives}}$
- Safe distance in meters = 100 x $\sqrt[3]{\text{pounds of explosives}}$
- Minimum distance for personnel in a missile-proof shelter is 328 feet.

Safety Reminders

1. In training, safety regulations override all training requirements.
2. In combat, observe safety regulations to the fullest extent permitted by time, materials available, and mission requirements.
3. Always handle explosives carefully.
4. Never divide responsibility for preparing, placing, priming and firing charges. One soldier should supervise all phases of a demolition mission.

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5. Be at least 1,000 meters away from the detonation site if in the open and at least 100 meters away if in a missile-proof shelter when detonating explosives on steel, Bangalore torpedoes, or mines.
6. See Table 2 for minimum safe distance for troops in the open.
7. For further information, see AR 385-63.
8. Do not mix explosives and detonators during transport.
9. Investigate and clear misfires using minimum personnel.
10. Do not take chances.

Conversion factors for all tables

1 meter = 3.28 feet
1 kilogram = 2.20 pounds
1 foot = 0.3048 meter
1 pound = 4.536 kilograms

Table 3. Safe distances for blasting near radio frequency energy

Average or Peak Transmitter Power (watts*)	Minimum Safe Distance (meters)
0 to 29	30
30 to 49	50
50 to 99	110
100 to 249	160
250 to 499	230
500 to 999	305
1,000 to 2,999	480
3,000 to 4,999	610
5,000 to 19,999	915
20,000 to 49,999	1,530
50,000 to 100,000	3,050

*When the transmission is a pulsed- or pulsed, continuous-wave type and its pulse width is less than 10 microseconds, the left-hand column indicates average power. For all other transmitters, including those with pulse widths greater than 10 microseconds, the left-hand column indicates peak power.

Electric Power Lines. Do not perform electric firing within 155 meters of energized power transmission lines. When conducting blasting operations at distances closer than 155 meters to electric power lines, use nonelectric firing systems or de-energize the power lines (AR 385-63).

Caution. If you transport electric blasting caps near operating transmitters or in vehicles (including helicopters) that use operating transmitters, place the caps in a metal can that has a cover which fits snugly and laps over the body of the can at least ½ inch. Do not remove the caps from the container when close to an operating transmitter unless you evaluate the hazard and estimate it to be acceptable.

Note (for Table 4): When estimating, use next larger dimension if measured dimension is not in Table 4.

Problem-solving format

1. Identify and measure critical dimensions.
2. Calculate for TNT/Rule of thumb.
3. Divide by RE factor.
4. Divide by package weight/volume round up to next whole package.
5. Calculate number of charges.
6. Calculate total amount of explosive.

Table 4. Timber cutting charges test shot

Type of charge	Explosive	Least dimension of timber (inches) 6	8	10	12	15	18	21	24	27	30	33	36
		Explosive (pounds)											
Internal	Any	½	½	½	1	1	1 ½	2	2 ½	3	4	4 ½	5 ½
External	TNT	½	1	2	2 ½	4	6	8 ½	11 ½	14 ½	18 ½	22 ½	27 ½	32 ½
Abatis	TNT	1	1 ½	2	3	4 ½	6 ½	9	11 ½	14 ½	18	22	26

- Rules of Thumb -

1. For dead stumps, use 1 pound of explosive per foot of diameter. Place charge 1 foot in depth for each foot in diameter.
2. For green stumps, use 2 pounds of explosive per foot of diameter. Place charge 1 foot in depth for each foot in diameter.
3. For standing timber, increase charge size by 50 percent.

Steel Cutting Charges

Pounds of TNT = 3/8 x area of cross section, in square inches.
(Calculate rectangular area, then add to obtain total area.)

Hasty calculations

Step 1. Obtain critical dimensions.
a. Flange: 8" x 5/8" (2 each)
b. Web: 18" x 1" (1 each)
Step 2. From Table 5, obtain pounds of TNT explosive.
Flange: 1.9 lb x 2 = 3.8 lb
Web: = 6.8 lb
Step 3. Divide by RE factor, if required
Step 4. Divide by packaged weight/volume and round up to next whole package.

10.6 = 10.6 $\overline{1}$ = 11 pkg of TNT
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Step 5. Calculate number of charges:
1 beam = 1 charge
Step 6. Calculate total amount of explosives:
(Step 4 x Step 5)
1 x 11 = 111 pkg of TNT

Placement of charges on steel members

TNT placed on one side of I-beam

Explosive charge divided in half, offset both sides of web.

For cutting high-carbon steel, alloy steel, or slender steel members. P (TNT) = D²

Rules of thumb for mild circular steel sections such as chains, rods, cables –
1. Less than 1 inch in diameter, use 1 pound of TNT.
2. More than 1 inch, but less than 2 inches in diameter, use 2 pounds of TNT.
3. Over 2 inches, use P = 3/8A

Table 5. Hasty steel-cutting chart for TNT

| Average Thickness of Section (inches)	Height of Section (inches) Pounds of TNT for Rectangular Steel Sections of Given Dimensions 2	3	4	5	6	7	8	9	10	12	14	16	18	20	22	24
¼	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.5	1.7	1.9	2.1	2.3
3/8	0.3	0.5	0.6	0.7	0.9	1.1	1.2	1.3	1.4	1.6	1.7	2.0	2.3	2.6	2.8	3.1	3.4
½	0.4	0.6	0.8	1.0	1.2	1.4	1.5	1.7	1.9	2.1	2.3	2.7	3.0	3.4	3.8	4.2	4.5
5/8	0.5	0.7	1.0	1.2	1.4	1.7	1.9	2.2	2.4	2.7	2.9	3.3	3.8	4.3	4.7	5.2	5.7
¾	0.6	0.9	1.2	1.4	1.7	2.0	2.3	2.6	2.8	3.1	3.4	4.0	4.5	5.1	5.7	6.3	6.8
7/8	0.7	1.0	1.4	1.7	2.0	2.4	2.7	3.0	3.3	3.7	4.0	4.6	5.3	6.0	6.6	7.3	7.9
1	0.8	1.2	1.5	1.9	2.3	2.7	3.0	3.4	3.8	4.2	4.5	5.3	6.0	6.8	7.5	8.3	9.0

To use Table 5 –
1. Measure rectangular sections of members separately.
2. Find the charge for each section, using the table.
3. Add charges for sections to find total charge.
4. Use next larger dimension if dimension is not on the table.

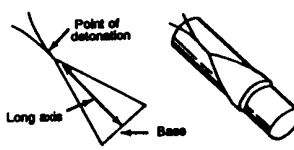### Special Demolition Techniques

These techniques are intended to supplement conventional methods.

Diamond Charge
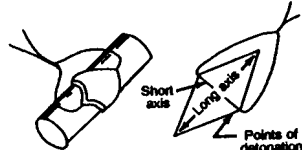
Long axis: Circumference of a target
Short axis: ½ the circumference of a target.
Thickness of a charge: 1-inch C4 block (should be cut; not molded)
Detonation: Simultaneous at each end of short axis.
Explosive: C4 or sheet

Saddle Charge

Base: ½ of the circumference
Long axis: = circumference
Thickness of charge: 1-inch
Detonation: From apex of triangle, diameter only for mild steel up to 8 inches.
Explosive: C4 or sheet.

- Rules of Thumb -

1. For railroad rails 5 inches or higher, use 1 pound of any explosive (C4 preferred).
2. For railroad rails less than 5 inches in height, use ½ pound of any explosive (C4 preferred).
3. For a ditch that measures a cubic yard of earth, use 1 pound of explosive.

Ribbon Charge (for steel up to 3 inches thick)

Thickness: ½ the thickness of the target but not less than ⅛ inch
Width: 3 times the thickness of the charge
Length: Same as the length of the desired cut
Explosive: C4 or sheet

Counterforce Charge
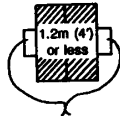
Size: 1 ½ pounds per foot of concrete. Place half of the charge on each side of the target, directly opposite each other. Detonate both charges simultaneously using a British Junction. Use on cubes and columns, not on walls or piers.

Explosive Shaped Charge
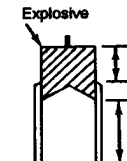
Height of charge: 2 times the height of the cone.
Cone angle: 45° to 60°.
Standoff: 1 ½ times the diameter of the cone.
Detonation: Exact top center of the charge.

Platter Charge

Explosive weight should be equal to the platter weight (2 to 6 pounds) Recommended detonation: From the rear center platter: the platter need not be round or concave.

### Special Demolition Techniques (continued)

Material	M3 40 pounds Penetration	M3 40 pounds Diameter of hole	M3 40 pounds Standoff	M2A3 15 pounds Penetration	M2A3 15 pounds Diameter of hole	M2A3 15 pounds Standoff
Reinforced concrete	60"	3 ½"	Standard	30"	2 ¾"	Standard
Armor plate	20"	2 ½"	Standard	12"	1 ½"	Standard
Permafrost	72"	8" to 5"	50"	72"	6" to ½"	30"
Ice	12'	6"	42"	7'	3 ½"	42"
Soil	7'	14 ½"	48"	7'	7"	30"

Cratering Charges

Formula for number of holes – N = L-16 / 5 + 1.
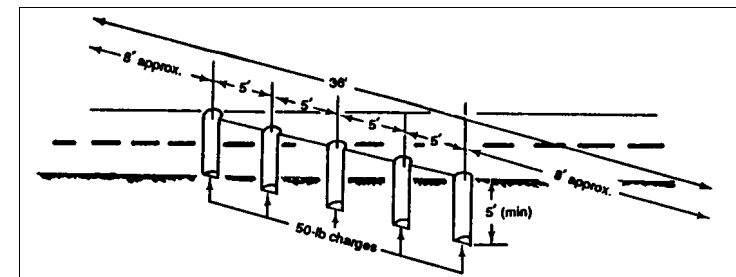
Hasty Crater

Dig all holes (minimum of three) at least 5 feet deep.

Use 10 pounds of explosive per 1-foot depth.

The crater should be 1 ½ times the depth of the boreholes. Its width should be about 5 times the depth of the boreholes.

Notes:
1. Dual prime all cratering charges with 1 pound of explosives.
2. Prime cratering charges with detonating cord, for safety.
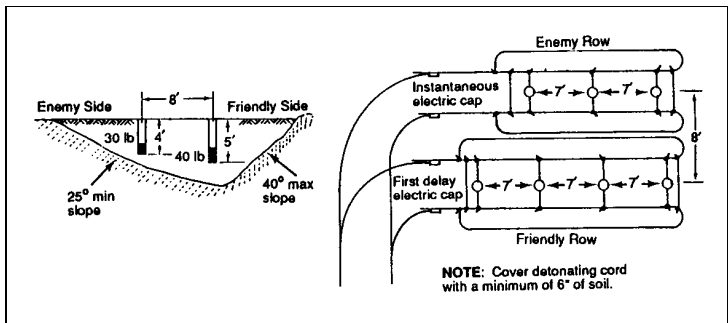3. Do no use blasting caps below ground.
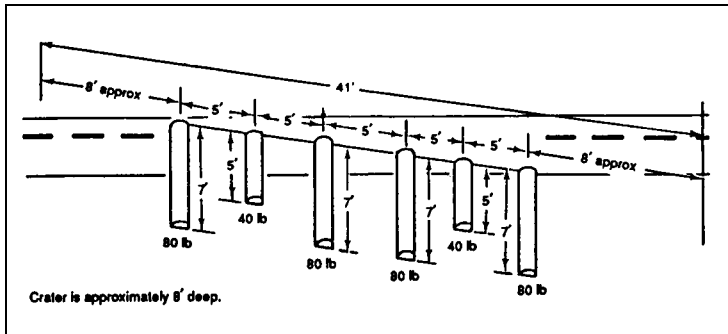
Deliberate Crater

Deliberate Crater

Alternate 5-foot and 7-foot holes spaced on 5-foot centers.

Never place two 5-foot holes next to each other. Place 7-foot holes at the ends.

Use 40-pound charges in 5-foot holes and 80-pound charges in 7-foot holes.

The crater should be 8 feet deep and 25 feet wide.

Relieved-Face Cratering

Lay out friendly row first. Lay out enemy row with holes centered between friendly holes. Detonate enemy row first. Detonate friendly row with a ½- to 1 ½- second delay after the enemy row.

NOTE: Cover detonating cord with a minimum of 6" of soil.

The formula for the number of holes for a friendly row is as follows:

$$N_F = L - 10 / 7 + 1$$

The formula for the number of holes for an enemy row is as follows:

$$N_E = N_F - 1$$

Table 6. Breaching charges for reinforced concrete

Concrete Thickness (feet)	Placement methods				
	R (C=1.0)	R (C=1.0)	R (C=1.8)	R (C=2.0)	R (C=3.6)
	Packages of M112 (composition C4)				
2.0	1	5	10	10	17
2.5	2	9	17	18	33
3.0	2	13	24	26	47
3.5	4	21	37	41	74
4.0	5	31	56	62	111
4.5	7	44	79	88	157
5.0	9	48	85	95	170
5.5	12	63	113	126	226
6.0	13	82	147	163	293
6.5	17	104	186	207	372
7.0	21	111	200	222	399
7.5	26	137	245	273	490
8.0	31	166	298	331	595

NOTE: The results of all calculations for this table have been rounded UP to the next whole package.

Table 7. Conversion factors for material other than reinforced concrete

Material	Conversion Factor
Earth	0.1
Ordinary masonry, hardpan, shale, rock, good timber, ordinary concrete, earth construction	0.5
Dense concrete and first-class masonry	0.7

Breaching Charges

When using the tables to calculate breaching charges –

1. Determine the type of material in the object you plan to destroy. If in doubt, assume the material to be of a stronger type (for example reinforced concrete).
2. Measure the thickness of the object.
3. Decide how you will place the charge against the object. Compare your method of placement with Table 6. If you are not sure as to which column to use, always use the column that will give you the greater amount of C4.
4. Use Table 6 to determine the amount of C4 that would be required if the object were made of reinforced concrete.
5. Use Table 7 to determine the appropriate conversion factor.
6. Multiply the number of packages of C4 (from Table 6) by the conversion factor.

Breaching charge formula:

$$P = R^3 KC$$

where –

P = pounds of TNT required.
R = breaching radius, in feet.
K = material factor from Table 8.
C = tamping factor from illustration, page 9.

Number of charges:

$$N = \frac{W \, (width)}{2R \, (breaching \, radius)}$$

Example: A timber and earth wall 6 ½ inches thick and an explosive charge placed at the base of the wall without tamping. If this wall were made of reinforced concrete, 372 packages of C4 would be required to breach it (see Table 6, page 7). The convenience factor is 0.5 (see Table 7, page 7). Multiply 372 packages of C4 by 0.5. The result is 186 packages of C4 needed to breach the wall.

Example: Breach a 4-foot reinforced-concrete wall with an untamped elevated charge.

R = 4 feet
K = 0.8
C = 1.8
P = 64 x 0.80 x 1.8
P = 92.16 pounds of TNT; use 93 packages.

Round-off rule for N:

If N is less than 1.25, use 1 charge.
If N is 1.25 to 2.49, use 2 charges.
If N is over 2.50, round off to the nearest whole number.

- Rules of Thumb -

1. For best results, place charge in shape of a flat square, flat side to the target.
2. For charges less than 5 pounds, use charge thickness of 1 inch.
3. For charges 5 pounds to less than 40 pounds, use charge thickness of 2 inches (1-block thick).
4. For charges of 40 pounds to less than 300 pounds, use a charge thickness of 4 inches.
5. For charges greater than 300 pounds, use a charge thickness of 8 inches.
6. For breaching hard surface pavement, use 1 pound for every 2 inches of pavement and tamp charge twice the thickness of the pavement.

Table 8. Material factor (K) for breaching charges

Material	Breaching Radius (R)	K
Earth	All Values	0.07
Poor masonry, Shale, Hardpan, Good timber, Earth construction	Less than 1.5 m (5 ft)	0.32
	1.5 m (5 ft) or more	0.29
Good masonry, Concrete block, Rock	0.3 m (1 ft) or less	0.88
	Over 0.3 (1 ft) to less than 0.9 m (3 ft)	0.48
	0.9 m (3 ft) to less than 1.5 m (5 ft)	0.40
	1.5 m (5 ft) to less than 2.1 m (7 ft)	0.32
	2.1 m (7 ft) or more	0.27
Dense concrete, First-class masonry	0.3 m (1 ft) or less	1.14
	Over 0.3 m (1 ft) to less than 0.9 m (3 ft)	0.62
	0.9 m (3 ft) to less than 1.5 m (5 ft)	0.52
	1.5 m (5 ft) to less than 2.1 m (7 ft)	0.41
	2.1 m (7 ft) or more	0.35
Reinforced concrete (Factor does not consider cutting concrete)	0.3 m (1 ft) or less	1.76
	Over 0.3 m (1 ft) to less than 0.9 m (3 ft)	0.96
	0.9 m (3 ft) to less than 1.5 m (5 ft)	0.80
	1.5 m (5 ft) to less than 2.1 m (7 ft)	0.63
	2.1 m (7 ft) or more	0.54

Breaching charge formula:

$$P = R^3 KC$$

where --
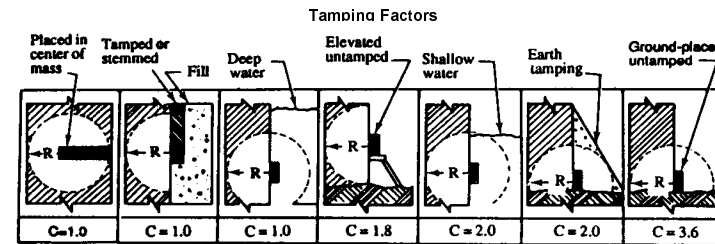
P = pounds of TNT required
R = breaching radius, in feet
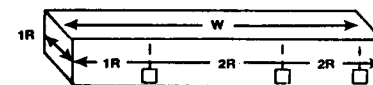K = material factor from Table 8.
C = tamping factor from illustration below

Number of charges:

$$N = \frac{W \, (width)}{2R \, (breaching \, radius)}$$

Tamping Factors

**Placement of breaching charges**

Bridge Abutment Destruction

For abutments that are 5 feet or less thick –

- Place 40-pound cratering charge in holes that are 5 feet deep, 5 feet on centers, and 5 feet behind the river face of the abutment. Begin 5 feet in from one side of the road.
- Calculate a row of breaching charges on the river face of the abutment if the abutment is over 200 feet high.

40-lb charges
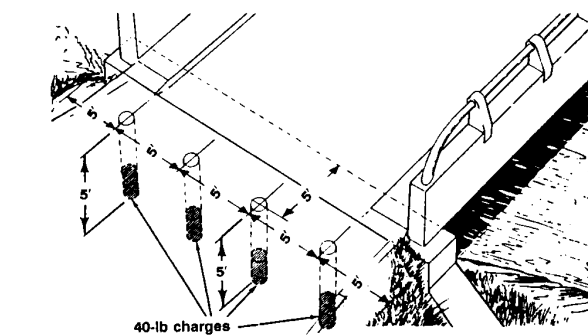
For abutments that are more than 5 feet thick –

- Calculate the number of charges using the breaching formula and place the charges against the rear face at a depth equal to the thickness of the abutment. Space the charges as per Table 8, page 8.
- Add a row of breaching charges on the river face at the base of the abutment when the abutments are more than 20 feet high. Fire all the charges simultaneously.
- If wing walls on abutments, can be used to support follow-on bridging, destroy the wing walls with breaching charges.

Abutment Destruction

Notes:
1. Abutment thickness is measured 5 feet below road surface.
2. Distance between charges is equal to 2R.
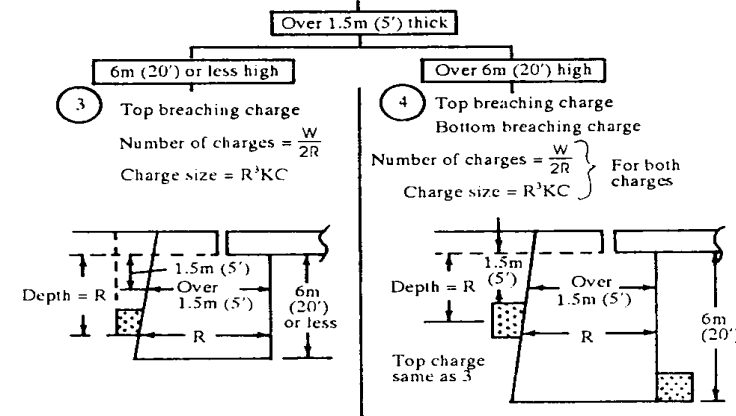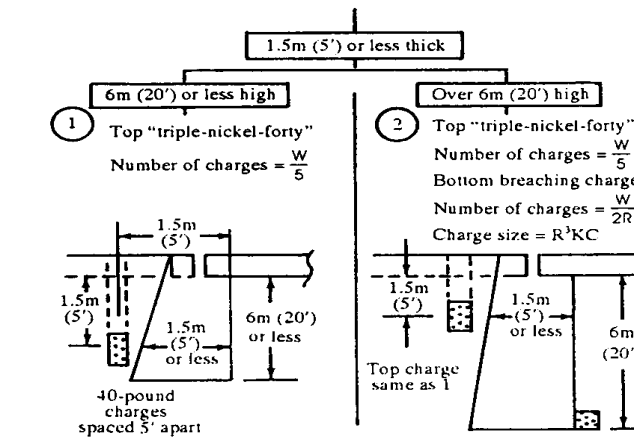
W = Width of abutment
R = Thickness of abutment (feet) at charge center of mass

Notes: 1. If depth R can not be reached, use C = 2.0.
2. C factor for bottom of abutment will be 3.6; top will always be 1.0.