UNITED STATES MARINE CORPS
Infantry Training Battalion
School of Infantry
Camp Lejeune, NC 28542-0161

AM1501
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STUDENT OUTLINE

INTRODUCTION TO URBAN MOBILITY

LEARNING OBJECTIVES.

a. TERMINAL LEARNING OBJECTIVES: N/A

b. ENABLING LEARNING OBJECTIVES:

1. Given different types, amounts, and configurations of explosives used in assault breaching, compute the Net Explosive Weight (NEW) in accordance with the Guidebook For Assault Entry Techniques Volume I. (51TR.04.01b)

2. Given different types, amounts, and configurations of explosives used in assault breaching and a stand off distance table, identify the stand off distance in accordance with the Guidebook For Assault Entry Techniques Volume I. (51TR.04.01c)

3. Given a list of choices, identify breaching hazards in accordance with the Guidebook For Assault Entry Techniques Volume I. (51TR.04.02a)

4. Given a list of choices, identify the characteristics of military explosives used in assault breaching in accordance with the Guidebook For Assault Entry Techniques Volume I. (51TR.04.02c)

5. Given a target, breaching charge, Assault Breacher Kit, and necessary materials, while wearing a fighting load, construct a priming system in accordance with the Guidebook For Assault Entry Techniques Volume I. (51TR.04.02e)

1. PURPOSE OF BREACHING. Breaching is the method by which an assault team gains access to a hostile stronghold. Personnel assigned to the duty of breaching are known as "Breachers." The primary goal of the Breacher is to provide the assault force with rapid, positive and dynamic access to an objective through any obstruction (wall, door, roof, window, etc.). An assault force, during a breach, uses speed, surprise and violence of action to accomplish the mission. Without a successful breach to provide access to the objective, there is no assault and no assault results in a failure of the mission. A Breacher's knowledge of mechanical and explosive breaching, combined with the ability to penetrate any target encountered, substantiates the Breacher as an important asset of the assault force.

2. NET EXPLOSIVE WEIGHT.

a. **Definition.** Net Explosive Weight is the total amount of explosive material in a given charge expressed in a pounds of TNT equivalent.

b. Every breaching charge is designed and constructed to defeat a specific target. These charges may be modified as necessary to ensure penetration on any given target. By calculating the NEW for every charge, we will be able to determine the safest location for assault teams that will still allow rapid entry into the structure.

c. **NEW Formula.** All calculations are figured to hundredths (two decimal places) of a pound.

(1) $$\textbf{NEW} = \frac{W}{7000}$$

(a) NEW is the net explosive weight in pounds equivalent to that of TNT.

(b) W is the weight, in grains, of **all** explosives in the charge converted to TNT equivalent.

(c) There are 7000 grains in a pound; thus the 7000 is used to convert grains to pounds.

(2) **Use of the Formula**

(a) Determine the total amount of explosives used by weight. Shock tube is not included since it is expended before the charge detonates. Explosive weights and measures can be found in the Explosive Charge Logbook, and in the table below.

ITEM	UNIT OF MEASURE	WEIGHT
FLSC	Grains per foot	(1)
LHFLSC	Grains per foot	(1)
Sheet	Grams per square inch	(2)
Detonating	Grains per foot	(1)
Booster	Grams	20 (3)
Blasting Cap	Grains	13.5 (3)
C-4 (M112)	LBS	1.25 (3)

(1) Issued in various sizes that can be used to calculate weight.
(2) Issued in different thicknesses that can be used to calculate weight.
(3) Weight of one item.

(b) Ensure the total weight is expressed in grains. Multiply grams by 15.4 to get grains.

(c) Multiply weight in grains by the RE factor for that explosive to get grains TNT equivalent. RE factors can also be found in the Explosive Charge Logbook, and in the table below.

EXPLOSIVE RE FACTORS		
FLSCS	**CH-6**	**1.50**
LHFLSC	**SX-2**	**1.25**
SHEET	**PETN BASED**	**1.66**
DET CORD	**PETN**	**1.66**
BLASTING CAP	**RDX**	**1.60**
C-4	**RDX BASED**	**1.34**
CRATER CHARGE	**NITRATE**	**.42**

(d) Add the weight of all components together.

(e) Divide the weight of all components by 7000.

(f) Calculations for NEW should be figured out to hundredths of a pound.

DEMONSTRATION.

STUDENT ROLE: Follow the demonstration using your handout and your Explosive Charge Logbook.

REFERENCES

FM 5-250 Explosives and Demolitions
Breacher's Engineer Charge Logbook

3. STAND-OFF DISTANCE. Assuming the role of a Breacher is a dangerous job, and accidents in this profession can result in costly losses like loosing a Breacher or a team member. Other losses may include lost manpower (due to injuries) and damaged equipment, which is expensive to repair or replace. To avoid these losses, it is necessary to prevent the accidents that may cause them. Reducing accidents will save lives and money. One way of reducing accidents is to know what your standoff distance is for all the explosive charges you will use. The table that you will use to determine standoff distance is title Stand-off Distance Table and it is at the end of this chapter. The formula the table uses is $D=K\ (W^{1/3})$. D equals the distance you need to be from the point of detonation. K equals the constant, which in this case is 18. W equals the NEW of the charge you are trying to find the standoff distance for. Once you know the NEW, you need to find the cube root.

4. BREACHING HAZARDS. During training or in a combat situation, a Breacher must take into consideration all hazards that could either delay the mission or cause the mission to fail. One of the hazards that the Breacher has to take into consideration is Blast pressure. Blast Pressure is a mass of expanding gas that moves outward in a circular pattern from the detonation like a giant tidal wave smashing and shattering any object in its path. The farther the pressure wave travels from the point of detonation, the less

power it possesses until it dwindles to nothing. The blast pressure wave has two distinct phases, which exert two different types of pressures, the positive pressure phase and the negative pressure phase.

a. **Positive Pressure**. When the blast pressure wave is formed at the instant of detonation, the pressures actually compress the surrounding atmosphere. The compressed layer of air becomes visible in some cases as a white, rapidly expanding circle. This layer of compressed air, known as the shock front, is the leading edge of the positive pressure wave. The shock front is only a fraction of an inch thick and is the part of the atmosphere, which is being compressed before it is set in motion to become part of the positive pressure wave.

As the shock front moves outward, it applies a sudden shattering blow to any object in its path. Thus, if it should strike an object such as a brick wall, the shock front would deliver a massive blow to the wall followed instantly by the strong winds of the positive pressure wave. The shock front shatters the wall and the positive pressure wave gives it a cyclone like sudden and violent push, which may cause all or part of the wall to topple in a direction away from the point of detonation. The positive pressure phase lasts only a fraction of a second. After striking the wall the positive pressure wave continues to move outward until it's power is lost in the distance traveled.

b. **Negative Pressure**. At the instant of detonation when the positive pressure wave is formed, it begins to push the surrounding air away from the point of detonation. This outward compressing and pushing of air forms a partial vacuum at the point of detonation so that when the pressure wave finally dwindles to nothing, a broad partial vacuum causes the compressed and displaced atmosphere to reverse it's movement and rush inward to fill the void. This relation of the partial vacuum and the reverse movement of the air are known as the negative pressure or suction phase. The displaces air rushing back toward the point of detonation has mass and power and although this air is not moving nearly as fast inward as the pressure wave was moving outward, it still has great velocity. If the force of a positive pressure wave is comparable to a cyclone, then the negative pressure wave is comparable to a strong gale.

In addition to having two phases, the blast effect creates various types of pressure phenomenon. Because these pressures can cause major problems for the breacher and the assault team, the breacher must understand blast and the pressures generated. All of this is taken into consideration when ensuring suitable protection for the assault team.

c. **Incident Pressure**. Incident pressure is the pressure measured at 90 degrees to the direction of travel of the blast shock front. A person standing behind a barrier, wall, building, etc., which is in the line of travel of the blast shock front, would be exposed to incident pressure. Incident pressure is equal to one half dynamic pressure. Incident pressure and its strength in relation to dynamic pressure are very important to the breacher. With the proper safety protection it allows the assault team to stack closer to the breaching charge.

d. **Dynamic Pressure**. Dynamic pressure is the transitional pressure exerted on an object by the blast. This is in effect the pressure felt and damage caused by the impact of the shock front with the object. Resulting damage is caused by the force of the impact and the tearing apart of the

object. A person standing in the open, in the line of travel of a blast shock wave, would be exposed to dynamic pressure.

e. **Reflective Pressure**. Reflective pressure is a rapid build up of a pressure that occurs when a shock front strikes a surface (any surface) in the line of travel. When this occurs, there is a rapid amplification of pressure as a result of the piling up and a reflection of the wave off the surface. This reflection results even though the exposed surface may fail or collapses. The reflected wave travels away from the target surface and decays at the same rate proportional to the cube root of the distance traveled from the reflected surface. Whatever the angle the incident pressures, the reflected pressure always reflects at right angles to the exposed surface. The reflected surface does not determine the amplification of the reflected wave. A reinforced concrete wall and a glass window will produce the same reflection from the same incident wave.

f. **Secondary Blast Effects**. Explosive breaching inflicts a degree of structural damage upon the target by design. In most cases, no critical structural members will be damaged. Breachers should be aware of building construction methods prior to conducting any explosive breaching operations. Construction methods should be addressed during breach planning. Charges/techniques should be selected so that the stability of a structure is not affected. In many cases, structural damage from blast pressure will cause false ceilings, lights, wallboard, etc… to fall or become dislodged.

g. **Loss of Night Vision**. During low light conditions, personnel will experience a loss of night vision due to the bright flash or fire- ball at the instant of detonation. Measures to protect personnel against night vision loss must be incorporated into training. Personnel protective measures to prevent night vision loss consists of turning away or of closing your eyes during the detonation.

h. **Smoke**. Smoke created during the detonation can make target identification very difficult. Breachers should use materials on charges that do not contribute to smoke generation. Personnel should rehearse and train in low visibility situations to overcome the effects of smoke.

i. **Sympathetic Detonation**. A sympathetic detonation occurs when a detonated explosive transmits its explosive wave to another explosive causing it to detonate. During breaching operations, sympathetic detonation becomes a problem when improvised explosive devices and booby traps are employed near breach points. Dependable intelligence and conscientious planning will prevent unnecessary casualties and mission failure due to sympathetic detonation.

j. **Chemical Poisoning (Asphyxiation)**. The detonation of all explosives produces toxic fumes. The chemicals used in explosives are, in themselves, poisonous. For these reasons, personnel should be cautioned against inhaling fumes or ingesting explosives. When explosives are used in closed area, appropriate respiratory protection should be used. Many materials used in building construction are also toxic when ignited or involved in detonations. Respiratory protection should also be used to protect personnel from these materials.

k. **Dust Explosion**. Any material that will burn in air when it is in a solid form may explode when it is in the form of a finely divided powder. Even materials that oxidize slower than would normally be implied by the term “burning” can ignite catastrophically if the size of the particles is small.

Explosions of foods, pharmaceuticals, grain products, organic materials, polymers and metal will occur.
Dust explosions can occur whenever there is a combination of a dust cloud within an explosive concentration range in the air and an initiation source is also present. Initiation sources are provided by electrical or electrostatic sparks, hot surfaces, overheated powder particles or any other source of sufficient energy to initiate reaction in a few particles. If an explosive cloud could occur in an area due to explosive breaching, other breaching methods should be used to prevent this phenomenon.

5. Priming Systems.

a. **Shock Tube.** Shock Tube is available in the Ammunition Supply System. The current Shock Tube is the instantaneous, dual lead, issued in 100ft. spools. Commercial Shock Tube is available in a variety of configurations and delays from instantaneous to 9.6 seconds. Military issue Shock Tube is 175 msec delays, which is instantaneous for our purposes. It is recommended that you never use delay shock tube. Anytime you use an initiation set with a delay, the Breacher loses all control of the detonation.

To properly use shock tube you must:

1. Test fire you initiator if applicable.

2. Cut and remove the crimped ends of the Shock Tube. Once your Shock Tube has been cut you should use it within 24 hours because moisture absorbed over time could cause a misfire.

3. Cut and remove an additional six inched from the Shock Tube. This is necessary because some of the HMX dust may have been blown out by overpressure during the first cut. This overpressure can occur during hot days or from Shock Tube being stored in hot areas.

4. If using Shock Tube for interior charges, you need to cut the shock tube to the appropriate length. When using Shock Tube for exterior charges, use the full length of the spool. This will provide slack for going around obstacles at the breach point.

5. Insert the cut ends into you initiator or firing device.

b. **Advantages and Disadvantages of Shock Tube Assembly.**

1. Advantages:

Simple to use

Safer to use and employ.

Provides the Breacher with command detonation.

Have the control of electrical systems but the safety of a non-electrical system.

2. Disadvantages:

a) Risk of moisture getting into the system.

b) Must use system within 24 hrs. of being prepared.

c. **Non-electric Firing Devices**.

1. MK 54 mod 0 firing device uses two spring driven, dual firing pins to strike shotgun primers, which in turn, initiate the Shock Tube. A crossbar assembly connects the firing pins, which allow them to move simultaneously. This crossbar assembly is referred to as the charging handle for the firing device. Each barrel of the MK 54 mod 0 is threaded to accept brass Shock Tube adapters. Additionally, it is issued with two heads and a bag of waterproofing spacers. The training head is also referred to as a land head and the operational head is referred to as a water head.

2. There are two safeties that are a part of the MK 54 mod O and the first safety is called a positive safety. This safety is a brass rod inserted through holes located in the firing device barrels between the firing pins and primers.

3. The second safety is the cam safety, which is located on the right side of the firing device. This safety blocks the trigger from being depressed. Each side of the cam safety is marked safe or fire. Red means fire and silver or black indicates safe.

d. **Preparing and firing the MK54 mod O firing device**.

The first thing you need to do is verify that the positive safety is pin is inserted and the cam safety is flipped forward.

Then open the head release latch and remove the head.

Load the head with two shotgun shell primers and reinstall the head onto the firing devices. Ensure the primers are facing up and the firing device is pointed down.

Unscrew the thumbnut on top of the head counter-clockwise to fit the diameter of the shock tube.

Install the shock tube and then tighten down the head thumbnut.

e. **Accessories**.

1. Brass Adaptors: There are two types of brass adaptors, the long and the short. Brass adaptors are used to connect shock tube to various firing devices. Each adaptor consists of a main body, a threaded collar nut, and a collet-tightening nut. To use the adaptors, simply put a small amount of Breacher’s paste on the beveled lip of the brass adaptor, and then insert a shotgun primer into the adaptor. With the shotgun primer facing skyward, slowly screw the adaptor into the applicable firing device. Next run down the threaded collar nut until it butts up against the firing device, then insert your shock tube into the collet end of the adaptor till it stops, then tighten the collet tightening nut.

2. The 2 block: The 2 block is designed to turn a single instantaneous firing device into an instantaneous firing system using two M60s. To do this, two M60s are installed using long brass adaptors. The 2 block is extremely helpful especially when you don’t

have a MK 54 mod O. The thing to remember is to remove the safeties from the M60s, and reinstall them so they point outboard. This will aid in the removing of safeties when firing a breach.

3. The Stomper: The stomper is designed to turn a single instantaneous firing device into a dual instantaneous firing system using two M142s. To do this, two M142s are installed using long brass adaptors. The stomper is extremely helpful especially when you don't have a MK 54 mod O. The thing to remember is to remove the safeties from the M142s, and reinstall them so they point outboard. Once the safeties are reinstalled, turn the pressure bar towards the brass adaptors. When ready to fire, simply remove the appropriate safeties; turn the pressure bar 90 degrees and place the stomper on the deck. Then stomp on the pressure bar to fire the device.

f. **Priming Breaching Charges**.

1. Direct Priming: The direct primed method is only used on interior charges. Direct priming consists of simply inserting a single blasting cap directly onto the charge explosives and taping it in place. This is the quickest method, but runs the risk of falling out of the charge if not taped in place. It is the hardest to clear in the case of misfire or assault abort, yet it is the easiest priming system for the Breacher to prepare.

2. Detonating Cord Loop: The det. cord loop priming system is the preferred method of priming because it is easy to connect and disconnect from the charge, especially in the dark.

(a) To prepare the detonating cord loop priming system, cut 12" of 50 grain detonating cord.

(b) Bend the detonating cord in half and tape the ends together. Then tape the detonating cord together about 1" from the earlier taping. This will provide you with an exposed area of detonating cord to place your caps on.

(c) Tape the blasting caps to the Detonating cord loop in the exposed space. (Between the two taped areas)

(d) When ready to prime, slip the loop over the charge-priming loop and slide the detonating cord connector until it locks into the detonating cord from the charge.

(e) To clear a misfire or abort, slide the connector back off the charge loop and pull it away.

(f) Ensure that the explosive weight of the priming system is added when calculating the net explosive weight.

3. Misfire Procedures for the MK54 mod O and M60:

a. If firing device or charge fails to fire, recock the firing device and try to fire again.
b. If the charge or device fails to fire again.
c. Yell "MISFIRE!!!" and stand-by.

(Combat situations go to the alternate breaching site)

(Training situations no one will move from the Stack)

The instructor will provide the breacher and stack with further instructions.

g. **Priming systems Advantages/disadvantages**.

(1) **Advantages:** Provides the Breacher with a degree of control over command detonation.

(2) **Disadvantages:**

Requires a power source

Requires pre-priming testing with a circuit tester. (Galvanometer)

It is very difficult to use when employing.

May not be instantaneous

It is considered less safe than non-electric because of static, EMR, etc…

More time is required to built an electric priming system.

Stand-off Distance Table

NEW TNT Equivalent		Safe-blast Distance w/o Shield	Safe-blast Distance w/ Shielding
0.01		4	2
0.02		5	3
0.03		6	3
0.04 Thru 0.05		7	4
0.06 Thru 0.08		8	4
0.09 Thru 0.12		9	5
0.13 Thru 0.17		10	5
0.18 Thru 0.22		11	6
0.23 Thru 0.29		12	6
0.30 Thru 0.37		13	7
0.38 Thru 0.47		14	7
0.48 Thru 0.57		15	8
0.58 Thru 0.70		16	8
0.71 Thru 0.84		17	9
0.85 Thru 1.00		18	9
1.01 Thru 1.17		19	10
1.18 Thru 1.37		20	10
1.38 Thru 1.58		21	11
1.59 Thru 1.82		22	11
1.83 Thru 2.08		23	12
2.09 Thru 2.37		24	12

2.38 Thru 2.67		25	13
2.68 Thru 3.01		26	13
3.02 Thru 3.37		27	14
3.38 Thru 3.76		28	14
3.77 Thru 4.18		29	15
4.19 Thru 4.62		30	15
4.63 Thru 5.99		31	16
6.00 Thru 6.99		33	17
7.00 Thru 8.00		36	18
8.01 Thru 10.00		38	19
10.01 Thru 11.00		40	20
15		45	23
20		49	25
30		56	28
35		59	30
40		61	31

REFERENCES: Guidebook for Assault Entry Volume I
Page/Chapter: 8-1 through 8-34 and 9-1 through 9-47