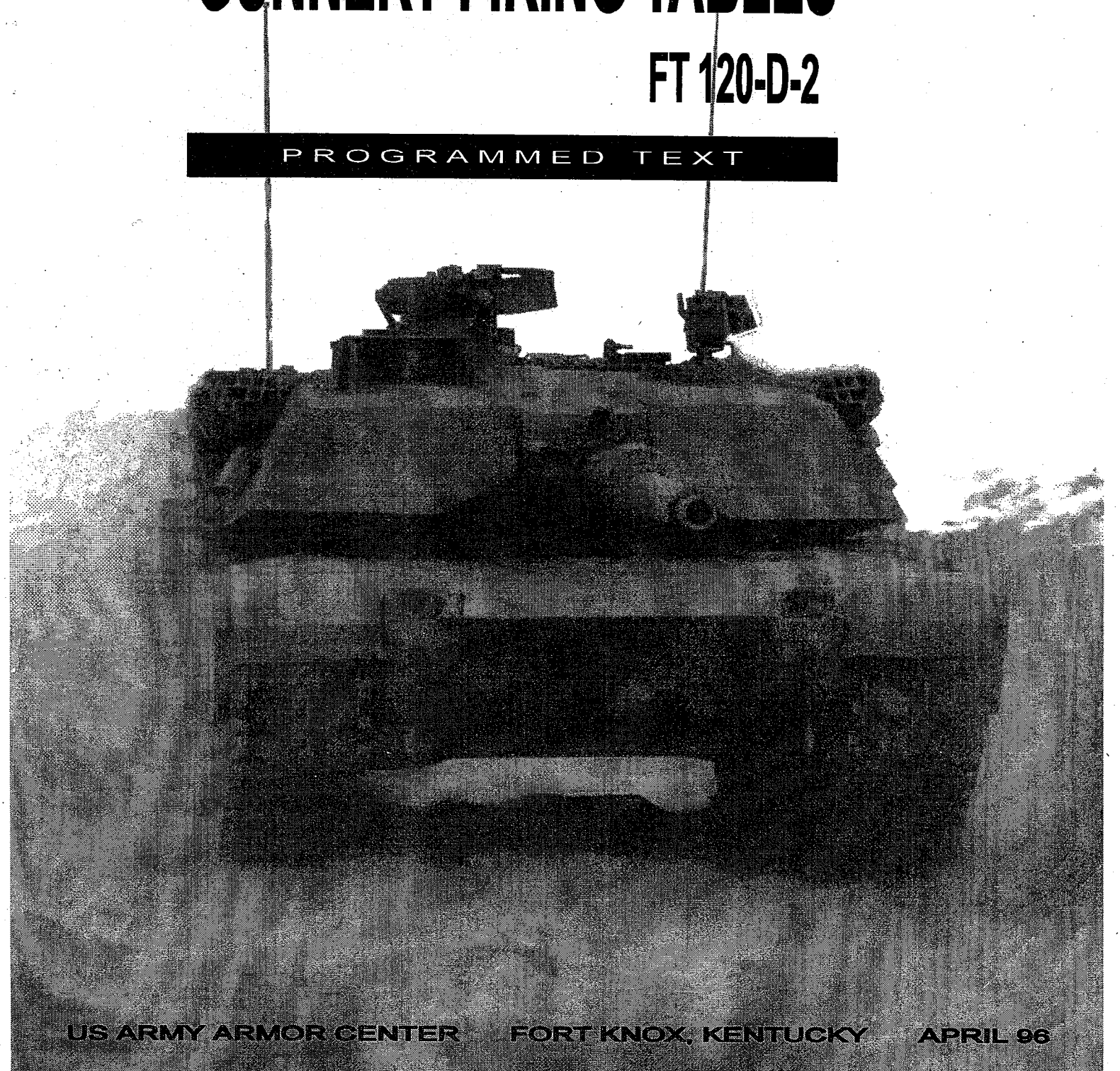
FKSM 17-6-2

USE OF BALLISTIC GUNNERY FIRING TABLES

FT 120-D-2

PROGRAMMED TEXT



US ARMY ARMOR CENTER FORT KNOX, KENTUCKY APRIL 96

TITLE: USE OF BALLISTIC GUNNERY FIRING TABLES

SCOPE: This programed text is designed to be used as an introduction to the use of 120mm gunnery firing tables.

INSTRUCTOR'S REFERENCE: FT 120-D-2

MATERIAL REQUIRED: FT 120-D-2 and a calculator.

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CONTENTS

PREFACE

This programed text is designed to familiarize you with elementary ballistic terminology and the use of gunnery firing tables. Read each teaching part before answering any questions.

Since all tank gunnery firing tables have the same format, student who successfully complete this text, FT 120-D-2, date 15 April 94, on the 120-mm gun, can be expected to be able to determine the same data for other tank guns.

This programed text is divided into six parts. Do not skip from part to part. The teaching sections will discuss and show sketches of the determined data. You must have a FT 120-D-2 to complete this programed text.

The answer to each question is found on the reverse side of the page on which the question appears.

PERFORMANCE OBJECTIVES

When given a gunnery firing table, the student will be able to determine the following data:

1. Superelevation requirements, effects of 1, 2, 3-mil change in gun elevation for range and superelevation of round at initial range, effects of 100, 200, 300, 400-meter change in sight picture for elevation of round at initial range, time of flight.

2. Crosswind deflection, maximum ordinate, range to maximum ordinate, angle of fall, and remaining muzzle velocity at each range.

3. Range and maximum ordinate limits under standard conditions.

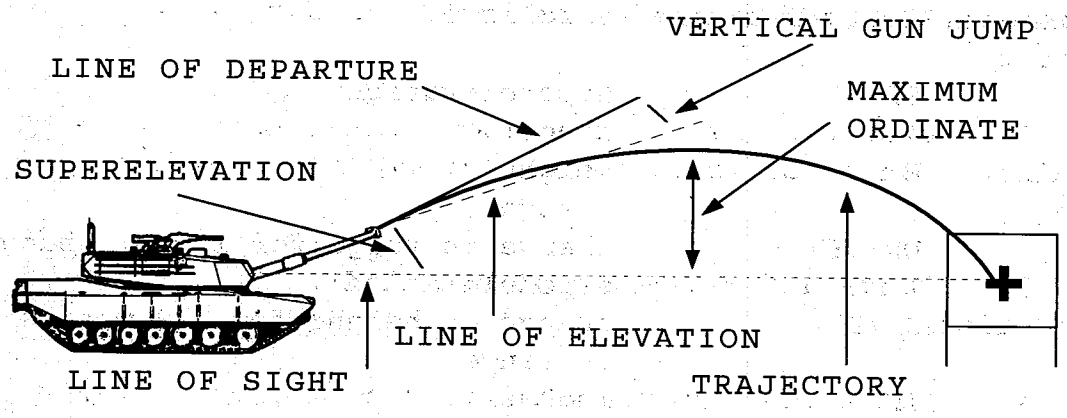
4. Range and maximum ordinate limits under non-standard conditions.

5. Determine battlesight range and general information found in firing tables.

6. Comprehensive test.

BALLISTIC TERMINOLOGY

Part One is designed to refresh and familiarize you with elementary ballistic terminology. It consists of a diagram and several definitions that will provide insight into the later parts of this program text. A short paragraph containing common symbols found in gunnery firing tables is also included.



Sketch 1.

Ballistics: Ballistics is the science of the motion of projectiles. It is the theoretical foundation on which all improvements to the design of tank guns and ammunition are based. Its study leads to the increased power and accuracy of tank guns and increased efficiency of tank crews.

Trajectory: The trajectory is the path of the projectile from the muzzle of the gun to the first point of impact.

Line-of-Sight: The line of sight is a straight line between the gun sight and the target.

Maximum Ordinate: The maximum ordinate is the maximum height that the projectile will travel above the gun, under standard conditions on its path to the point of impact.

Line of Elevation: A prolongation of a line running through the axis of the gun bore.

Line of Departure: A prolongation of a line running through the axis of the gun bore as the projectile leaves the muzzle.

Vertical Gun Jump: Vertical gun jump is the angle, measured in mils, between the line of departure of the projectile and the line of elevation.

Superelevation: Superelevation is the angle, measured in mils, between the line-of-sight and the line of elevation.

Common symbols and abbreviations found in gunnery firing tables (FT 120-D-2) are as follows:

SE	superelevation
R	range
H	height
D	change
DR/DSE	change in range for 1 mil; change in superelevation
DH/DR	change in height for 100 meters; change in range
IN	inches
LB	pounds
M	meters
M/S	meters per second
Sec	seconds
m	mils
F	Fahrenheit
C	Celsius

PART ONE
SUPERELEVATION

The firing table enables us to determine the superelevation requirements for a specified round to travel a specified range.

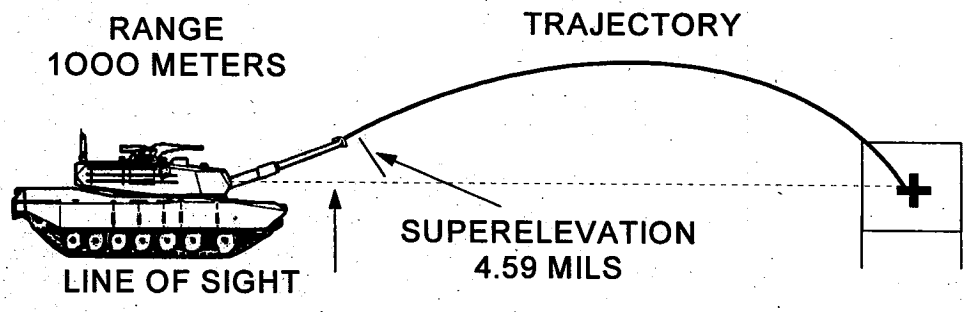
To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(1), first column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the SUPERELEVATION column(2), second column, (i.e., 4.59 mils).

4. 4.59 mils is the required superelevation (angle between gun and line of sight) for HEAT-MP-T, M830 to travel 1,000 meters.



Sketch 2.

Notice that all ranges are expressed in hundreds of meters and superelevation is expressed in mils.

We can estimate superelevation requirements between 100-meter intervals by interpolation. This will not be covered during this portion of this programmed text.

SUPERELEVATION
Questions:

1. HEAT-TP-T, DM18 at a range of 2,100 meters requires _____ mils of superelevation.

2. TPCSDS-T, M865 PIP at a range of 4,700 meters requires _____ mils of superelevation.

3. TP-T, M831A1 at a range of 1,700 meters requires _____ mils of superelevation.

4. When firing APFSDS-T, M829 at a range of 1,600 meters, _____ mils of superelevation are required.

SUPERELEVATION
Answers:

1. 12.21 mils

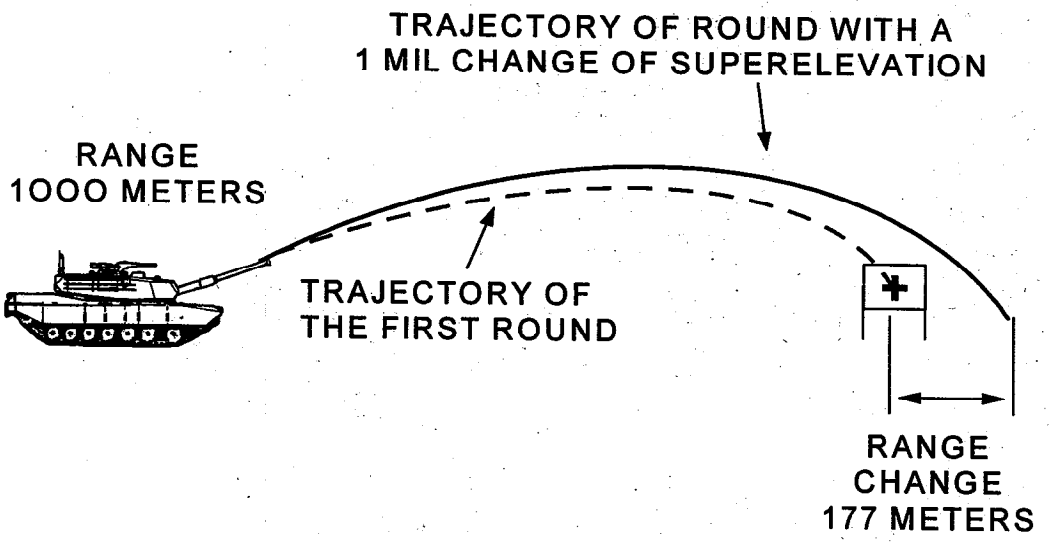
2. 28.30 mils

3. 8.99 mils

4. 2.99 mils

PART ONE
RANGE CHANGES
DR/DSE

The third column of the firing table is DR/DSE, which by looking in the front of the firing table book, we find this means the adjustment in range for a one mil change in the angle of superelevation.



Sketch 3.

In other words, if the gunner upon completion of firing the first round elevates 1 mil above his original sight picture, the round will fly so many meters beyond the first round.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(1), first column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the DR/DSE column(3), third column, (i.e., 177 meters).

4. 177 meters is the change in distance the round will travel for a one mil change in superelevation for HEAT-MP-T, M830 with 1,000 meters indexed in the computer.

Note. To determine the change in range, always multiply the mil change by DR/DSE. If the change is 1.5 mils multiply 1.5 by the amount in the DR/DSE column.

1.5 X 177 = 265.5 meters

DR/DSE

Questions:

1. If the gunner fired TP-T, M831A1 with 1,900 meters in the fire control system, an elevation change in sight picture of 1 mil will change the range of the round _____ meters.

2. If the gunner fired APFSDS-T, M829A2 with 2,300 meters in the fire control system, an elevation change in sight picture of 1 mil will change the range of the round _____ meters.

3. In situation 2 the gunner added 2.5 mils of elevation, at a range of 2,300 meters with APFSDS-T, M829A2. This would change the range of the second round by _____ meters.

DR/DSE
Answers:

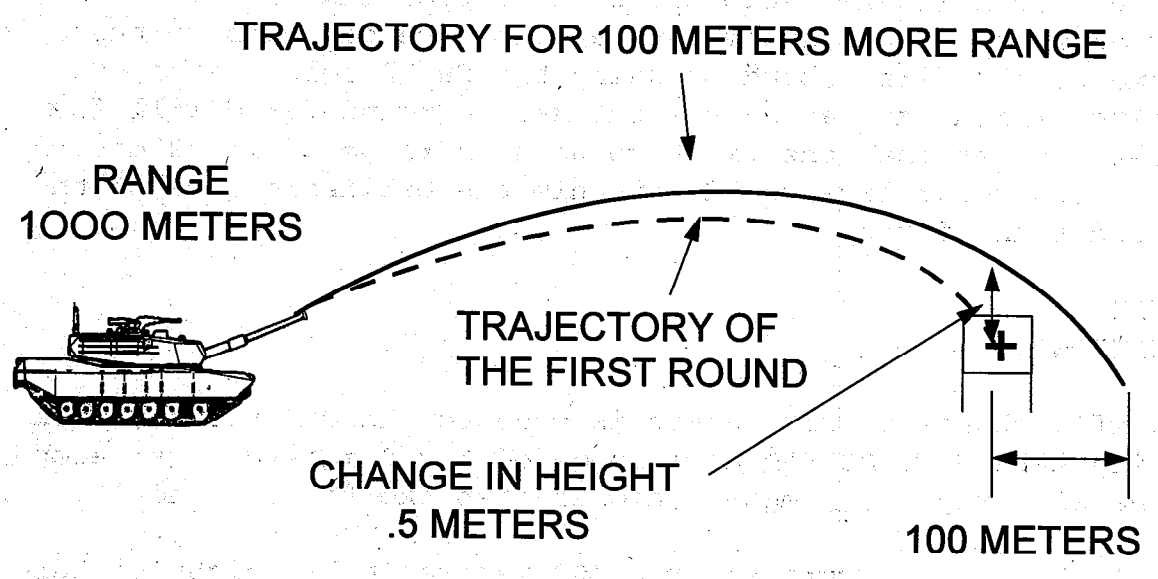
1. 122 meters

2. 499 meters

3. 1,247.5 meters

PART ONE
ELEVATION CHANGES
DH/DR

The fourth column of the firing table is DH/DR, or change in height for a 100 meter change in range. This column gives us the height difference between one round fired with a specific range indexed in the fire control and another round fired with additional range applied to the fire control.



Sketch 4.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(1), first column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the DH/DR column(4), forth column, (i.e., .5 meters).

4. .5 meters is the change in the height of the second round with a 100 meter change in range for HEAT-MP-T, M830 with 1,000 meters indexed in the computer.

Note. 1. To determine the change in range, always multiply the mil change by DH/DR. If the change is 150 meters multiply 150 by the amount in the DH/DR column and divide by 100 or move the decimal point two digits to the left and multiply i.e.,

150 X .5 = 75 divided by 100 = .75 meters

2. If the TC fires a round of HEAT-TP-T, M830 with 1,000 meters indexed into the fire control and then fires a second round with 1,100 meters applied, he can compare the second round to the first round by using the DH/DR column at 1,000 meters, which indicates that the second round fired will fly .5 meters higher than the first round at a range of 1,100 meters. The 1,100 meter line would give him the ballistic data of the second round fired.

DH/DR
QUESTIONS:

1. If a change of 250 meters is made to the GAS retical when firing APFSDS-T, M829A1 at a range of 1,900 meters, the second round will fly _____ meters higher than the first round.

2. If the gunner were to drop 300 meters in his sight picture when firing TPCSDS-T, M865 PIP at a range of 2,000 meters, the second round would fly _____ meters lower than the first.

3. In situation 2, if the gunner dropped 50 meters when firing at a range of 2,000 meters the second round would fly _____ meters lower than the first.

4. If the TC were to add 100 meters into the fire control system, after a round of HEAT-TP-T, M831 was fired at 2,500 meters index, how high above the first round would the second round fly at 2,600 meters?

Answer: _____.

DH/DR
Answers:

1. 1 meter
2. 2.1 meters
3. .35 meters
4. 2.7 meters

PART ONE
TIME OF FLIGHT

The fifth column of the firing table is the time-of-flight column. This simply indicates how much time it will take the round to get to a specific range.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(1), first column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the TIME OF FLIGHT column(5), fifth column, (i.e., 1.00 seconds).

4. 1.00 seconds is the amount of time it take for HEAT-MP-T, M830 to reach the level point (point of impact/line of sight)at 1,000 meters.

TIME OF FLIGHT
Questions:

1. Time-of-flight to 4,000 meters for TPCSDS-T, M865 PIP, is _____.

2. At what distance will a APFSDS-T, M829 travel from the muzzle in 1.77 seconds? _____.

3. How long will it take a TP-T, M831A1 to reach the level point at 1,300 meters? _____.

TIME OF FLIGHT
Answers:

1. 4.60 seconds.

2. 2,800 meters.

3. 1.36 seconds.

POST TEST ONE

Answer the questions below.

1. When firing HEAT-MP-T, M830A1, how many mils of superelevation are required to hit a target at 1,200 meters?

Answer: _____.

2. When firing APFSDS-T, DM13, how many mils of superelevation are required for a round to hit a target at 1,200 meters?

Answer: _____.

3. When firing TPFSDS-T, DM28 at a range of 1,200 meters, a 2-mil change in gun elevation will change the range of the round how many meters?

Answer: _____.

4. When firing HEAT-MP-T, M830 at a range of 1,200 meters, a 1.5-mil change in gun elevation will change the range of the round how many meters?

Answer: _____.

5. When firing HEAT-MP-T, M830 at a range of 1,200 meters, a 2-mil change in elevation will change the height of the second round _____ meters.

6. If a 2.5-mil increase was made in gun elevation after firing the first HEAT-TP-T, M831 at 3,100 meters, the second round will travel _____ meters further in range than the first.

7. When firing APFSDS-T, DM13 at a range of 1,200 meters, a 100 meter change in range will raise the height of the second round by _____ meters.

8. Time of flight for TPFSDS-T M866 at 2,400 meters is _____ seconds.

9. An APFSDS-T, M829A1 will travel _____ meters in 1.97 seconds.

POST TEST ONE answers:

1. 3.42 mils
2. 2.29 mils
3. 984 meters
4. 246 meters
5. 328 meters
6. 165 meters
7. .2 meters
8. 1.57 seconds
9. 2,900 meters

PART TWO
10 KM/HR CROSS WIND DEFLECTION

The listed effects of wind deflection in the 10 km/hr column assumes a 10 km/hr crosswind. The correction is applied by the ballistic computer into the wind, i.e., if the wind is blowing from right to left, the correction will be to the right. The crosswind deflection is applied by the ballistic computer, in the event of a crosswind failure zero out your crosswind. Even though the wind effect is listed for a 10 km/hr crosswind, it may be applied to any crosswind speed by determining what factor of 10 km/hr the observed speed is. For example, if the observed crosswind is 5 km/hr, the effect is halved, or if 20 km/hr the effect is doubled.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(11), eleventh column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the 10 KM/HR CROSS WIND DEFLECTION (6), sixth column, (i.e., .3 mils).

4. .3 mils is the amount of deflection your ballistic computer will adjust for a 10 KM/HR crosswind firing HEAT-MP-T, M830 1,000 meters.

Note When the is a crosswind of 27 KM/HR simply divide that number by 10. (27 divided by 10 = 2.7)

10 KM/HR CROSS WIND DEFLECTION
Questions:

1. When firing TPCSDS-T, M866 at a range of 3,100 meters, and there is a 10 km/hr wind blowing from left to right, how many mils will the ballistic computer compensate for?

Answer: _____.

2. When firing TPFSDS-T, M866 at a range of 3,100 meters, and there is a 23 km/hr wind blowing, how many mils will the ballistic computer compensate for?

Answer: _____.

3. When firing TPFSDS-T, DM28 at a range of 2,400 meters, a crosswind of 20 km/hr is blowing, how many mils would be required to offset this deflection error?

Answer: _____

4. In question 1 above, in what direction will the ballistic computer compensate for the crosswind?

Answer: _____

10 KM/HR CROSS WIND DEFLECTION Answers:

1. .2 mils

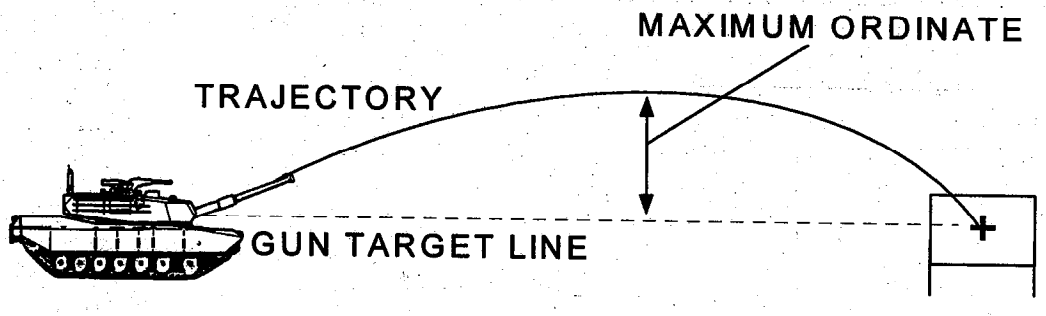
2. .46 mils

3. .4 mils

4. left

PART TWO
MAXIMUM ORDINATE

The MAXIMUM ORDINATE column enables us to determine the maximum height of the round above the gun during the flight of the round. The column can be used when determining battlesight ranges to prevent the round from going over the average height of tank-line targets(discussed in part 5).



Sketch 5.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(11), eleventh column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the MAXIMUM ORDINATE column(7), seventh column, (i.e., 1.2 meters).

4. 1.2 meters is the highest point above the gun the HEAT-MP-T, M830 projectile will reach in its flight path to the level point (point of impact/line of sight) at 1,000 meters.

MAXIMUM ORDINATE
Questions:

1. What is the maximum ordinate for HEAT-TP-T, DM18 at 1,300 meters?

Answer: _____

2. What is the highest point above the gun a TP-T, M831A1 projectile will travel if the indexed range is 1,500 meters?

Answer: _____

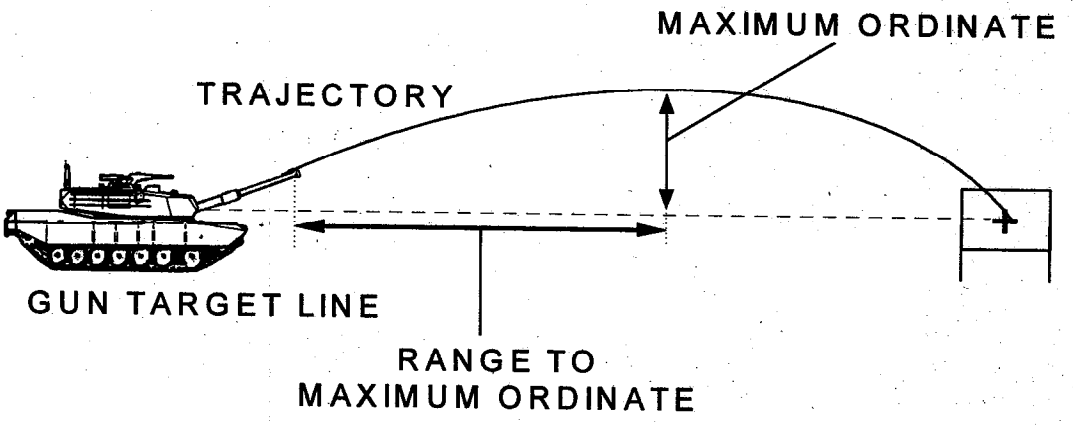
MAXIMUM ORDINATE
Answers:

1. 2.3 meters

2. 3.2 meters

PART TWO
RANGE TO MAXIMUM ORDINATE

The RANGE TO MAXIMUM ORDINATE column simply indicates at what range from the muzzle maximum ordinate will occur.



Sketch 6.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(11), eleventh column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the MAXIMUM ORDINATE column(8), eighth column, (i.e., 522 meters).

4. 522 meters is the distance from the muzzle HEAT-MP-T, M830 projectile will reach the highest point above the gun (MAXIMUM ORDINATE) in its flight path to the level point (point of impact/line of sight) at 1,000 meters.

RANGE TO MAXIMUM ORDINATE
Questions:

1. When firing HEAT-TP-T, M831 at 1,500 meters, the range to the maximum ordinate is _____meters.

2. At what distance from the muzzle will an APFSDS-T, M829A2 projectile reach its maximum ordinate of 3.8 meters?

Answer: _____.

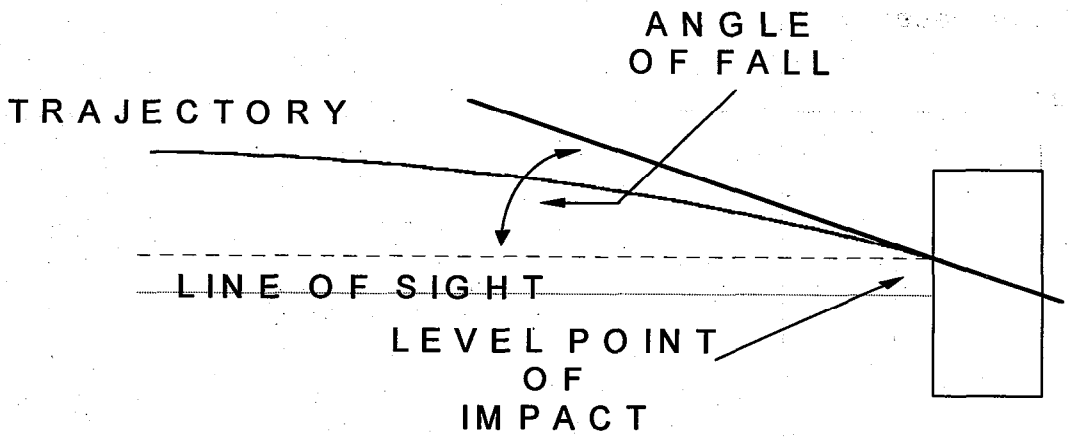
RANGE TO MAXIMUM ORDINATE
Answers:

1. 802 meters

2. 1,426 meters

PART TWO
ANGLE OF FALL

The angle of fall is an angle measured clockwise from the horizontal in mils to a line tangent to the trajectory at the level point.



Sketch 7.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(11), eleventh column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the ANGLE OF FALL column(9), ninth column, (i.e., 5 mils).

4. 5 mils is the angle measured clockwise to a line tangent to the trajectory at the level point (point of impact/line of sight) for a HEAT-MP-T, M830 projectile at 1,000 meters.

ANGLE OF FALL
Questions:

1. The angle of fall for APFSDS-T, DM13 at a range of 2,600 meters is _____ mils.

2. What is the angle of fall for TPFSDS-T, M866 at a range of 4,300 meters?

Answer: _____.

ANGLE OF FALL
Answers:

1. 6 mils

2. 12 mils

PART TWO
REMAINING MUZZLE VELOCITY

This column gives the speed of the projectile at the level point. It is used primarily with kinetic energy rounds, in order to determine penetration capability.

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Go down the RANGE column(11), eleventh column, to the range desired (i.e., 1,000 meters).

3. Read across this row to the REMAINING VELOCITY column(10), tenth column, (i.e., 875 meters per second).

4. 875 meters per second is the remaining velocity of the HEAT-MP-T, M830 projectile at the level point(point of impact/line of sight) at 1,000 meters.

REMAINING VELOCITY
Questions:

1. The remaining velocity of APFSDS-T, M830A1 at a range of 2,000 meters is _____meters per second.

2. At 3,400 meters the remaining velocity for a HEAT-MP-T, DM12 will be _____.

REMAINING VELOCITY
Answers:

1. 1,008 meters per second
2. 370 meters per second

POST TEST TWO

Answer the questions below.

1. If there is a 5 km/hr crosswind at 2,000 meters when firing TP-T, M831A1, how many mils will the ballistic computer correct for the deflection error?

Answer: _____.

2. If there is a 25 km/hr crosswind at 2,500 meters when firing HEAT-MP-T, M830A1, how many mils will the ballistic computer correct for the deflection error?

Answer: _____.

3. When firing APFSDS-T, M829A1 at a range of 1,000 meters, the maximum ordinate is _____ and range to maximum ordinate is _____.

4. When firing HEAT-TP-T, M831 at a range of 1,600 meters, the maximum ordinate is _____ and range to maximum ordinate is _____.

5. When firing APFSDS-T, M829 at a range of 2,400 meters, the angle of fall of the round is _____.

6. When firing APFSDS-T, M829A2 at a range of 2,200 meters, the remaining velocity is _____.

Answers to POST TEST TWO:

1. .4 mils
2. 1.25 mils
3. .5 meters at 505 meters
4. 3.8 meters at 859 meters
5. 5 mils
6. 1,548 meters per second

PART THREE

RANGE AND MAXIMUM ORDINATE LIMITS (under standard conditions)

Table B is very useful for determining range distance under standard and non-standard conditions. It gives the range in meters and maximum ordinate for each round at / so many / degrees of gun elevation.

Maximum Range Limits

To do this:

1. Turn to the table for the round concerned (i.e., HEAT-MP-T, M830).

2. Using Table B go down the QUADRANT ELEVATION column(1), first column, to the elevation desired (i.e., 10 degrees).

3. Read across this row to the MAXIMUM ORDINATE column(2), second column, (i.e., 545 meters), and the RANGE column(3),third column, (i.e., 6,595 meters).

4. 6,595 meters is the distance the HEAT-MP-T, M830 projectile will travel from the muzzle under standard conditions. 545 meters is the maximum ordinate of the round at 10 degrees quadrant elevation.

To determine the maximum range distance under standard conditions for degrees other than what is shown in Table B use interpolation.

To do this:

Example for RANGE at 12 degrees quadrant elevation using, APFSDS-T, M829,

1. Determine what known elevation your desired elevation falls within (12 degrees falls within 10 degrees and 15 degrees). Subtract the lower known range 29,511 meters, from the higher known range 35,412 meters, this gives you the total range difference (5,901 meters). Now subtract lower degree angle from the higher degree angle to determine the degree difference (15 degrees - 10 degrees = 5).

2. Determine what 1 degree is, divide the total range difference (5,901 meters) by the degree difference 5. This equals 1180.2 meters per 1 degree, the difference between 10 degrees and 15 degrees.

3. Multiply 1,180.2 meters by 2 for 2,360.4 meters. The reason you multiply by 2 is that's the difference between your desired degree angle (12 degrees) and the lower known degree angle (10 degrees).

4. Add this amount (2,360.4 meters) to your lower known range 29,511 meters for a total of 31871.4 meters at 12 degrees. Round off to the nearest whole meter (31,871 meters)

Maximum ordinate limits are determined by the same method as maximum range limits.

Basics steps to remember:

Step 1. Subtract lower from higher.

Step 2. Divide by degree difference, usually 5.

Step 3. Multiply by number of degrees needed.

Step 4. Add to lower amount from step 1.

MAXIMUM ORDINATE
Questions:

1. What is the range _____ and maximum ordinate _____ for HEAT-TP-T, M831 at 13 degrees quadrant elevation?

2. What is the range _____ and maximum ordinate _____ for APFSDS-T, DM13 AT 7 degrees quadrant elevation?

3. When firing APFSDS-T, M829, what is the maximum range _____ and ordinate_____ for an elevation of 13 degrees?

4. When firing HEAT-TP-T, DM18, what is the maximum range _____and ordinate_____ for an elevation of 11 degrees?

5. When firing HEAT-TP-T, M831, what is the maximum range _____ and ordinate_____ for an elevation of 11 degrees?

MAXIMUM ORDINATE

Answers:

Note. MAXIMUM ORDINATE and RANGE are round off to the nearest whole meter.

1. Maximum range is 7,091 meters
   Maximum ordinate is 790 meters

2. Maximum range is 21,125 meters
   Maximum ordinate is 1,158 meters

3. Maximum range is 33,052 meters
   Maximum ordinate is 3,347 meters

4. Maximum range is 6,745 meters
   Maximum ordinate is 625 meters

5. Maximum range is 6,772 meters
   Maximum ordinate is 627 meters

PART FOUR
RANGE LIMITS UNDER NONSTANDARD CONDITIONS

The range column in Table B is the range limit under standard conditions. Table B provides a Range Effects For table (columns 4 - 9) used to determine range limits under non-standard conditions, useful when determining approximate point of impact of rounds fired out of an impact area. When the range effects for are known use Table B. When the range effects are not known use Tables C and D in conjunction with Table B. Table C is used to determine the effect on velocity due to ammunition temperature and is measured in meters per second. Table D is used to determine the effects on air density due to altitude and is measured as a percentage.

To determine range limit the following information must be known:

1. Ammunition fired.
2. Quadrant elevation of the gun.
3. Range effects for:
   a. Muzzle velocity decrease or increase.
   b. Head wind or tail wind.
   c. Air density decrease or increase.

Interpolation can be done for columns 4 - 9 of Table B, Table C and Table D for greater accuracy when determining range limits. Interpolation was discussed under determining maximum ordinate and range under standard conditions earlier in the lesson and will not be included in this portion of the lesson.

Note. Never multiply two negative numbers together in your calculator, the answer will result in a positive number. If a range effect has a negative sign you will need to subtract that total from the range.

RANGE LIMITS UNDER NONSTANDARD CONDITIONS

When firing APFSDS-T, M829, with a quadrant elevation of 10 degrees at what distance will the round travel from the muzzle under the following conditions:

1. Ammunition temperature is 80 degrees F.
2. Head wind of 6 KM/HR.
3. Altitude 500 meters above sea level.

The first step in determining the distance the round traveled from the muzzle is determine the range at the known quadrant elevation (10 degrees elevation the range is **29,511** meters). The next step is to determine the Range effect for any nonstandard conditions. This will be discussed in three separate parts.

29,511

1. When the decrease or increase in muzzle velocity is known, multiply that known number to the corresponding column either 4 or 5 of Table B which intersects with the known quadrant elevation. When the effect on muzzle velocity is not known use Table C to determine the effect on velocity due to ammunition temperature (Ammunition temperature is 80 degrees F, using Table C the effect on velocity is 12.7 M/S). Multiply 12.7 to the corresponding column in Table B, Muzzle Velocity 1M/S (because 12.7 is a positive number use the increase column of the muzzle velocity range effect for) 12.7 X 23.4 = **297** meters (rounded to the nearest whole meter).

29,511 + 297

2. Determine the effect for range wind determine whether you have a head wind or tail wind in kilometers per hour. Multiply the range wind to the corresponding column in Table B, 6 KM/PH X -7.5(head wind) = **-45** meters (rounded to the nearest whole meter).

29,511 + 297 - 45

3. Determine the range effect for air density. When the true increase or decrease in air density is not known use Table D to determine the percentage of decrease in air density due to altitude. The firing tank is at 500 meters above sea level, use Table D to determine that 500 meters above sea level is equal to 4.7 percent decrease in air density. Multiply the percentage change with the corresponding column in Table B, 4.7 X 243.2 = **1,143** meters (rounded to the nearest whole meter).

29,511 + 297 - 45 + 1,143

4. The last step is to add algebraically the range effects determined above and the range for standard conditions.

29,511 + 297 - 45 + 1,143 = **30,906** meters

RANGE LIMITS UNDER NONSTANDARD CONDITIONS
Questions:

1. When firing TPFSDS-T, M866, with a quadrant elevation of 15 degrees at what distance will the round travel from the muzzle under the following conditions:

a. Ammunition temperature is -6.7 degrees C.
b. Tail wind of 30 KM/HR.
c. There is an increase in air density of 2.3 percent.

Answer: _____.

2. When firing TPFSDS-T, DM28, with a quadrant elevation of 25 degrees at what distance will the round travel from the muzzle under the following conditions:

a. There is an increase of muzzle velocity of 3 M/S.
b. Head wind of 13 KM/HR.
c. The firing tank is at 200 meters above sea level.

Answer: _____.

3. When firing APFSDS-T, M829A2, with a quadrant elevation of 5 degrees at what distance will the round travel from the muzzle under the following conditions:

a. Ammunition temperature is 60 degrees F.
b. Tail wind of 3 KM/HR.
c. There is a decrease in air density of 2 percent.

Answer: _____.

4. When firing APFSDS-T, M829, with a quadrant elevation of 10 degrees at what distance will the round travel from the muzzle under the following conditions:

a. Ammunition temperature is 80 degrees F.
b. Head wind of 6 KM/HR.
c. Altitude 500 meters above sea level.

Answer: _____.

5. When firing HEAT-TP-T, DM18, with a quadrant elevation of 15 degrees at what distance will the round travel from the muzzle under the following conditions:

a. Ammunition temperature is 15.6 degrees C.
b. Head wind of 16 KM/HR.
c. Firing tank is at sea level.

Answer: _____.

6. When firing TPFSDS-T, M866, with a quadrant elevation of 5 degrees at what distance will the round travel from the muzzle under the following conditions:

a. There is an increase of muzzle velocity of 6 M/S.
b. Tail wind of 30 KM/HR.
c. There is an increase in air density of 2 percent.

Answer: _____.

RANGE LIMITS UNDER NONSTANDARD CONDITIONS
Answers:

Note. All figures are shown. The answer is in bold print.

1. 19,526 - 453 + 294 - 348 = **19019** meters

2. 23,310 + 54 - 187 + 488 = **23,665** meters

3. 22,464 - 257 + 10 + 281 = **22,498** meters

4. 29,511 + 297 - 45 + 1,143 = **30,906** meters

5. 7,379 - 23 -104 = **7,252** meters

6. 13,868 + 58 + 114 - 188 = **1,385** meters

PART FIVE
DETERMINE BATTLESIGHT AND GENERAL INFORMATION

BATTLESIGHT

Is an engagement technique that is used when an accurate tank-to-target range cannot be determined, or when the computer is inoperative. This technique is the quickest, and most preferred when targets are within battlesight range.

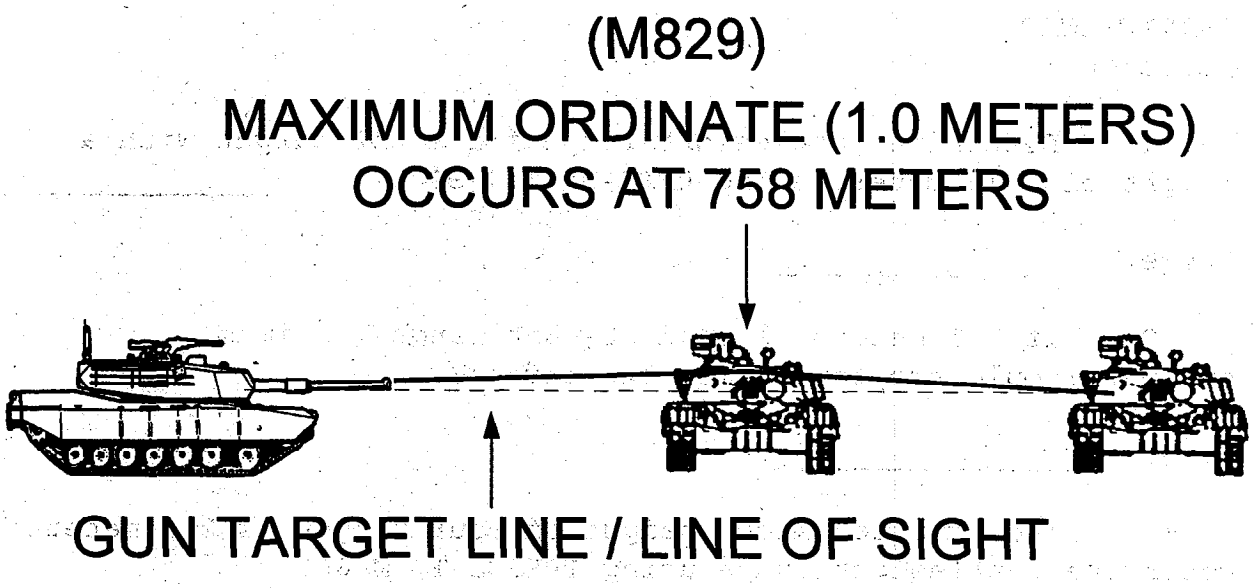
Battlesight gunnery takes advantage of the relatively flat trajectories of armor-defeating ammunition to ensure a high probability of first-round hits. Battlesight can also be used in surprise situations.

Battlecarry is a posture in which the main gun is preloaded with a round of ammunition, and a specific battlesight range is applied to the computer.

Unit SOP will set battlecarry ranges based on the commanders analysis of mission, enemy, terrain, troops, time, and weather (METT-T).

Battlecarry posture should be consistent with the most likely targets and direct-fire engagement ranges your unit will encounter.

The FM 17-12-1 recommends battlesight range for SABOT 1,200 meters and HEAT at 900 meters, if the most likely target to be engaged is 1.5 meters or larger. To determine a battlesight other than 1,200 or 900 use FT 120-D-2.



Sketch 8.

To determine battlesight do the following:

1. Turn to the table for the round concerned (i.e., APFSDS-T, M829).

2. Determine the expected height of the threat target. T-72 = 2.3 meters; T-72 turret = 1 meter; BMP = 2.15 meters, and divide by 2 (we divide by two because we aim center mass of all visible targets) (i.e., 2.3 divided by 2 = 1.15 meters).

3. Go down the MAXIMUM ORDINATE column (7), seventh column of Table A, and locate the corresponding number in the maximum ordinate column. The range desired When the exact number cannot be found, round down. This will ensure the projectile will not go over the target at the range to maximum ordinate.(i.e., 1.15 meters falls between 1.0 and 1.2 in the MAXIMUM ORDINATE column).

4. Read across this row to the RANGE column (11), eleventh column, (i.e., 1.0 meters occurs at 1,500 meters). 1,500 meters is the battlesight range for a APFSDS-T, M829 with an expected target height of 2.3 meters.

Note. If 1.2 is used a target can be missed 809 meters (RANGE TO MAXIMUM ORDINATE column 8).

BATTLESIGHT
Questions:

1. Determine battlesight range for a BMP target with a height of 2.15 meters using HEAT-MP-T, M830A1. _____.

Answer _____.

2. If 1.1 meters is used at what range (maximum ordinate) could the round miss the target?

Answer _____.

3. The expected known height of your target is 2.2 meters. Determine battlesight range using TPFSDS-T, M866.

Answer _____.

4. The expected known height of your target is 1.8 meters. Determine battlesight range using HEAT-TP-T, M831.

Answer _____.

BATTLESIGHT
Answers:

1. 1,100 meters

2. 619 meters

3. 1,500 meters

4. 800 meters

GENERAL INFORMATION

On the first page of each type round in the Firing Table is general data that might be useful in some situations.

For example:

1.	The types of rounds that have the same ballistic data in the table.	Cartridge TP-T, M831A1
2.	The initial velocity or speed of the rounds.	Muzzle Velocity, 1140 M/S
3.	The weight of the fired projectile.	Projectile Weight, 26.80 lbs
4.	Model Number.	Aerodynamics Package 83E
5.	Ballistic coefficient.	1.455 lb/in2

GENERAL INFORMATION
Questions:

1. What is the weight of the HEAT-TP-T, DM18 projectile?

Answer: _____.

2. What is the muzzle velocity of an APFSDS-T, DM13?

Answer: _____.

GENERAL INFORMATION
Answers:

1. 29.54 pounds

2. 1650 meters per second

CONVERSION FACTORS

On page III on the bottom of the page you will find a conversion chart. To use the chart multiply your known expression by the number in the center column to obtain a desired expression from the right column amount.

(i.e., 5 meters X 1.0936 = 5.468 yards).

CONVERSION FACTORS
Questions:

1. Covert 6 feet to meters.
Answer _____.

2. Convert 12 knots to miles per hour.
Answer _____.

3. Convert 7 mils to minutes.
Answer _____.

CONVERSION FACTORS

Answers:

1. 1.8288 meters

2. 13.8096 miles per hour

3. 23.625 minutes

POST TEST FIVE

1. Determine battlesight range for an APFSDS-T, M827 for a target with an expected height of 2.4 meters.

Answer _____.

2. Determine battlesight range for an HEAT-MP-T, DM12 for a target with an expected height of 3.0 meters.

Answer _____.

3. Determine battlesight range for an APFSDS-T, M829A2 for a target with an expected height of 2.0 meters.

Answer _____.

4. What is the muzzle velocity of the APFSDS-T, M829A1.

Answer _____.

5. What is the weight of a HEAT-MP-T, DM12 projectile.

Answer _____.

6. Convert 6 mils to degrees _____.

Answer _____.

7. Convert 17 miles to kilometers _____.

Answer _____.

8. What is the aerodynamics package of the TP-T, M831A1?

Answer _____.

Answers to POSTTEST FIVE

1. 1,600 meters
2. 1,100 meters
3. 1,500 meters
4. 1,575 meters per second
5. 29.73 pounds
6. .3375 degrees
7. 27.3581 kilometers
8. 83E

PART SIX

COMPREHENSIVE TEST

Now that you have completed the programmed text on Use of Gunnery Firing Tables, it is time to see if you can work problems that involve the firing tables. Work the problems below and, after you have completed them, check your answers on page 48. If you miss any 1 or 2 problems, go to the teaching sections where they were taught and retake the section. If more than two of your answers are wrong, retake this programmed text.

1. What is the superelevation required for APFSDS-T, M829A2 for a range of 1,700 meters?

Answer _____.

2. What is the range change caused by a 1/2-mil change in gun elevation when firing TP-T, M831A1 at a range of 3,000 meters?

Answer _____.

3. What is the height change of the round for a 200 meter change in range when firing HEAT-TP-T, DM18 at a range of 1,500 meters?

Answer _____.

4. Maximum ordinate for HEAT-MP-T, M830A1 at 1,600 meters is _____ and the range to the maximum ordinate is _____

5. At 1,500 meters APFSDS-T, M827 will have a remaining velocity of_____ and strike the target at an angle of fall of _____.

6. The maximum range for TPCSDS-T, M865 PIP with a gun elevation of 23 degrees is _____.

7. The time of flight for HEAT-TP-T, DM18 to travel 1,400 meters is_____.

8. A 15 km/hr crosswind at 2,000 will affect HEAT-TP-T, M831 by how many mils?

Answer _____.

9. The expected known height of your target is 3.0 meters. Determine battlesight range using TPFSDS-T, M866.

Answer _____.

10. When firing APFSDS-T, DM13, with a quadrant elevation of 15 degrees at what distance will the round travel from the muzzle under the following conditions:

a. Ammunition temperature is -6.7 degrees C.
b. Tail wind of 30 KM/HR.
c. The firing tank is 600 meters above sea level.

Answer: _____.

Answers to COMPREHENSIVE TEST

1. 3.14 mils

2. 31 meters

3. 2 meters

4. 2.0 meters; 835 meters

5. 1,540 meters per second; 3 mils

6. 8,435 meters

7. 1.49 seconds

8. 1.2 mils

9. 1,700 meters

10. 28,619 - 825 + 315 + 1,536 = **29645** meters

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