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UNITED STATES MARINE CORPS
WEAPONS TRAINING BATTALION
MARINE CORPS COMBAT DEVELOPMENT COMMAND
QUANTICO, VIRGINIA 22134-5040

DETAILED INSTRUCTOR GUIDE

LESSON TITLE

EFFECTS OF WEATHER

COURSE TITLE

ANNUAL RIFLE TRAINING

UNITED STATES MARINE CORPS
Weapons Training Battalion
Marine Corps Combat Development Command
Quantico, Virginia 22134-5040

DETAILED OUTLINE

EFFECTS OF WEATHER

INTRODUCTION (3 MIN)

1. GAIN ATTENTION. The well-trained shooter who understands how to obtain a steady position, maintain a full field of view, and execute perfect trigger control may not hit the center of the target. Failure to hit the target can occur because the shooter did not compensate for the effects of weather. Some conditions, such as wind, can cause significant changes in bullet impact. Other conditions such as light, temperature, and precipitation have less of an effect, but can easily cause the shooter to miss the center of the target. Once the shooter recognizes how weather conditions affect him, his rifle, and ammunition, he can take appropriate measures to correct for these effects and keep his shots centered on the target.

2. OVERVIEW. This lesson will cover the effects of weather on shooting to include the effects on the shooter; the effects of wind; wind classification; wind velocity; and determination of correct windage adjustment utilizing change of hold. It will also cover the effects of different lighting conditions, temperature, and precipitation on the shooter, the rifle, the optic, and the trajectory of the bullet.

3. INTRODUCE LEARNING OBJECTIVES. The Terminal Learning Objective and Enabling Learning Objective pertaining to this lesson are as follows:

a. TERMINAL LEARNING OBJECTIVE. Given a service rifle/carbine, RCO, sling, magazines, cartridge belt, magazine retention device (pouches or load-bearing vest), ammunition, target, and data book, without the aid of references, zero the rifle/carbine IAW MCRP 3-01A. (0300.M16.1004)

b. ENABLING LEARNING OBJECTIVE. Given a service rifle/carbine, RCO, sling, magazines, cartridge belt, magazine retention device (pouches or load-bearing vest), ammunition, target, and data book, adjust the sights to compensate for the effects of weather while firing IAW MCRP 3-01A. (0300.M16.1004a)

4. METHOD. This lesson will be taught in a classroom setting using lecture.

5. EVALUATION. The Marine will be evaluated on this material during Table 1 firing.

TRANSITION: There are two ways the weather can affect the shooter before he delivers a shot. The weather can cause feelings of physical discomfort and can affect mental attitude, distracting the shooter from successful target engagement. Proper preparation and practice can eliminate these problems and allow the shooter to shoot accurately in adverse weather conditions.

BODY (45 MIN)

1. (1 MIN) EFFECTS OF WEATHER ON THE SHOOTER

a. Mental Attitude. The accomplishments made on the firing line and in the field stem partly from the ability to mentally adjust to unusual or adverse weather conditions. To engage the target accurately, concentration must be maintained on the fundamentals of marksmanship, and the mental discipline must be developed to overcome the effects of adverse weather conditions.

b. Physical Effects. Adverse weather conditions have definite physical effects on every shooter. The shooter must be prepared for the weather so he is comfortable when shooting. Attention must not be diverted from shooting.

Confirm by questions.

TRANSITION: The weather condition that has the greatest effect on shooting performance is wind. Wind can have a great effect on the shooter as he prepares for his shot and on the bullet once it leaves his rifle. Dry fire practice and knowledge of the measures to compensate for the wind will minimize the effects of wind on shooting performance.

2. (4 MIN) EFFECTS OF WIND

a. The Shooter. The effect the wind has on the shooter will depend on the velocity of the wind and the firing position. The stronger the wind, the more difficult it will be to hold the weapon steady. The wind is the one weather condition that affects all shooters in the same way. However, measures can be taken to counter the effects the wind has on your ability to fire accurately:

1) If the situation permits, choose a shooting position that is the least susceptible to the effect of the wind. The prone shooting position offers the most stable firing position in windy conditions, while windy conditions make the standing position the least stable.

2) If the situation permits, counteract the effects of wind by timing your shots. By waiting for a steady wind or a lull in the wind, the shooter can balance himself properly and deliver a well-aimed shot on the target.

3) The effects of wind can be partially offset if the shooter trains carefully and has a positive mental attitude.

(ON SLIDE #1)

b. The Bullet. The effect the wind has on the round as it travels down range is referred to as deflection. The wind deflects the bullet laterally in its flight path to the target. It is an effect that increases with the distance to the target. The deflection of the bullet can be compared to that of a boat crossing a river with a strong current. The skipper of the boat may aim for a point directly across the river but will end up farther downstream because of the current. There are four factors that affect the amount of deflection of the bullet:

1) The Velocity of the Wind. The greater the velocity of the wind, the more it will deflect the bullet.

2) The Range to the Target. Because the initial velocity of the bullet as it leaves the muzzle of the rifle is high, the wind will have little effect on bullets traveling short distances. The velocity of the round decreases as it travels down range, causing the wind to produce a greater deflection. Therefore, the wind deflection increases the farther a round must travel before it strikes the target.

Confirm by questions.

TRANSITION: As we have learned, the wind has a significant impact on not only the shooter but also the bullet once it leaves the rifle. Winds blowing from different angles have different effects on the bullet. The velocity and direction of the wind in relation to the bullet must be determined to offset the wind's effects.

3. (5 MIN) WIND CLASSIFICATION

Classifying the wind is a two step process; first the direction of the wind must be determined and then the value of the wind must be determined.

a. Wind Direction. Winds are classified according to the direction from which they are blowing in relation to the direction of fire. For example, if the flag is blowing left, the wind is known as a right wind because it is coming from the right. The direction of the wind can be determined in several different ways. When shooting takes place on the range, the direction of the range flags indicates the direction of the wind. When shooting takes place in the field, any means available should be used to determine the direction of the wind such as observing the direction vegetation is moving or feeling the wind against the body.

(ON SLIDE #2)

b. The Clock System. The clock system is used to determine the value of the wind as full, half, or no value. The clock system refers to a sectored circle in which winds blowing from different directions are assigned different values. These values, along with the speed of the wind, are used to calculate the sight adjustments to compensate for the wind. The direction of fire to the target is always considered to be 12 o'clock. The direction from which the wind is blowing determines the relative value of the wind. The relative value of a wind indicates its ability to deflect the bullet in its flight to the target.

1) Full Value Wind. Wind blowing from either right or left directly across the shooter's front (3 o'clock or 9 o'clock) is assigned a full value since it will have the greatest effect on bullet deflection.

2) No Value Wind. Winds blowing directly in the shooter's face (12 o'clock) or at his back (6 o'clock) are of no value since they will not deflect the bullet.

3) Half Value Wind. Winds blowing from other directions are assigned intermediate values. For example, wind blowing from 1:30 is referred to as a half value wind. A half value wind deflects a bullet half the distance laterally as a full value wind. For example, if a 10 mph wind from 3 o'clock (full value) deflects a bullet 9 inches to the left at 300 yards, the same 10 mph wind from 1:30 (half value) would deflect the bullet only 4.5 inches to the left at 300 yards.

Confirm by questions.

TRANSITION: Once the direction of the wind is determined and the corresponding value assigned to it, velocity must be determined to make the final adjustments to your rifle sights to compensate for deflection. Velocity is the speed the wind is blowing. There are two field expedient methods for determining wind velocities in mph: the Observation Method and the Flag Method.

4. (10 MIN) DETERMINING WIND VELOCITY

a. The Observation Method. The observation method is the primary method to determine wind velocity in a tactical situation. Using the observation method, the shooter observes his surroundings and gauges the wind velocity by the movements of the objects around him and the feel of the wind on his body.

1) Under 3 mph. The wind can hardly be felt on the face, but the presence of a slight wind can be detected by drifting smoke.

2) 3 to 5 mph. Wind can be felt lightly on the face.

3) 5 to 8 mph. Wind keeps tree leaves in constant motion.

4) 8 to 12 mph. Wind will raise dust and loose paper.

5) 12 to 15 mph. Wind will cause small trees to sway.

6) 15 to 25 mph. Wind will cause large trees to sway.

(ON SLIDE #3)

b. The Flag Method

1) The flag method of determining wind velocity is the primary method used on the KD range. During KD firing, the flag method is an ideal learning tool to get the shooter familiar with observing his surroundings to determine wind velocity. For example, the range flags may move in different directions making it difficult to gauge the wind. This includes the flags at either end of the firing points in the pits, as well as, the flags at each yard line. In these cases, shooters will have to determine by observing the terrain closest to the target. A shooter can achieve this by associating flags moving with trees moving, or grass near the impact area, or dust created by another shooter's round impacting the berm near the target.

2) The flag method is based on the observation of a flag or some other cloth object which is blowing in the wind. It requires the shooter to estimate the angle (in degrees) that the flag is blowing away from its vertical pole. Dividing this angle by 4 will give the wind velocity in mph.

a) $\frac{\text{Angle of the flag from the pole}}{4} = \text{Speed in mph}$

b) This information is based on a dry flag. A wet flag is heavier and may give a false reading by indicating a lesser velocity than the wind is really blowing.

Confirm by questions.

TRANSITION: As we have discussed, it is important to understand the effects of wind on marksmanship and accurately estimate the wind's direction, value, and velocity. With this knowledge, the shooter need only apply the proper point of aim technique to determine the correct adjustment to ensure an accurate shot on the target.

5. (15 MIN) DETERMINING CORRECT AIMING ADJUSTMENTS

a. Points of Aim. To calculate the hold required for an accurate placement of shot, you must determine the velocity, value, and range to the target. Predetermined points of aim sector the target horizontally. One point of aim half the distance of the target across the shoulders, the target is 20 inches so one point of aim is 10 inches for a forward facing target.

b. Recording Types of Wind Conditions in the Data Book. The types of wind conditions that existed during firing are recorded in the data book. This information helps determine how different wind conditions affect your battlesight zero (BZO).

Confirm by questions.

TRANSITION: While windy conditions can affect the path of the bullet as well as your mental state, light conditions affect marksmanship in a different way. The effects of different light conditions do not affect the trajectory of the bullet, but the way that the target is perceived. The effects of light and how they can affect your shooting must be understood before you can learn how to overcome them.

6. (5 MIN) EFFECTS OF DIFFERENT LIGHT CONDITIONS

Many inexperienced shooters do not recognize that light conditions can affect their shooting accuracy and affect a weapon's BZO. A change in light condition, which may not be noticed, can cause the shooter to aim at what he thinks is the correct aiming point, but really is not. What appears to be center of mass on the target may in fact be several inches higher or lower, left or right. The BZO on your rifle may need to be adjusted to compensate for the effects of changing light conditions. Maintaining a center of mass hold, regardless of how indistinct the target appears, ensures the best chances for an effective shot. Common light conditions include:

a. Bright Light. Bright light conditions exist in a cloudless or clear blue sky with no fog or haze present.

1) Bright Light on the Target. Bright light can make a target appear smaller and farther away. As a result, it is easy to overestimate range.

(ON SLIDE #8)

2) Bright Light on the RCO. With the RCO bright light

can affect how large your Battle Drop Compensator (BDC) appears. You want the BDC as thin as you can make it for a more accurate aiming area 300m and closer. Too much light causes it appear larger. When using the RCO during daylight you may need to cover the light gathering device with tape. Riggers tape and electrical tape are ideal. The amount of coverage depends on the amount of collective light desired. The tape will allow the shooter to make quick adjustments to the desired effect as the light changes.

b. Haze. Haze exists when smog, fog, dust, or humidity is present. Haze is not bright, but it can be uncomfortable to the eyes. Haze can make a target appear indistinct by making the bull's-eye appear smaller than it is. This effect can make it difficult to establish a full field of view.

c. Overcast. Overcast conditions exist when a solid layer of clouds blocks the sun. The amount of light changes as the cloud cover thickens.

1) Light Overcast. Light overcast conditions exist when no blue sky is visible and a thin layer of clouds is present. Light overcast is comfortable on the eyes with no glare present, making probably the best light condition for shooting.

2) Dark Heavy Overcast. Dark heavy overcast conditions exist when the sky is completely overcast with most of the light blotted out by the clouds. Your eyes may need some time to adjust to the diminished light after being in bright light conditions.

d. Scattered Clouds. Scattered cloud conditions exist when the clouds are broken up into small patches with the sun appearing at times between the clouds. Your eyes may have problems adjusting between a target which is brightly lit and one that is shadowed.

e. Moving Clouds. Moving clouds exist when scattered clouds move across the sky rapidly, making the sun appear periodically. Rapidly moving clouds can fatigue the eyes due to the rapid changes from bright light to shadows. This condition is probably the most difficult to contend with because the light changes rapidly. If the situation permits, this condition can be compensated for by selecting one of the two light conditions (bright light or shadow) in which to fire. Best results will be obtained if each shot is fired under the same light condition.

f. Record Light Condition in the Data Book. A significant change in light condition should be recorded in the REMARKS block of the data book. This information will help

determine how the type of light condition or change in condition affects your BZO.

Confirm by questions.

TRANSITION: In addition to the effects that wind and light conditions have on a shooter, the trajectory of the bullet, and the appearance of the target, excessive heat and cold can also affect a shooter, the trajectory of the bullet, and the weapon. It is essential to learn how to compensate for extremes in temperature to engage a target effectively.

7. (4 MIN) EFFECTS OF TEMPERATURE

a. Extreme Heat

1) The Shooter. Hot temperatures can lead to rapid fatigue and cause distractions that can result in inaccurate shooting. This can cause blurred vision and reduce concentration levels. Excessive heat can cause muscle cramps, heat exhaustion, or heat stroke. Increased fluid intake, good physical condition, and periodic rest breaks (if possible) will help offset these effects.

2) Target/RCO. At high temperatures, ground mirage can cause a target to appear indistinct and drift from side to side. Heat waves or mirage may distort the target shape or the appearance of the range to the target. Mirage created by the heat of the rifle barrel can cause difficulty in seeing the target clearly. Maintaining a center of mass hold will ensure the best chance for accurate target engagement.

3) Extreme heat can cause damage to your RCO if it is not managed correctly. The prism is "glued" in with loctite inside of the optic's housing. If the scope is left in the sun uncovered for a prolonged amount of time, it can cause that epoxy to melt and the prism may drift. If the sight must be in the direct sun for an extended period of time and it is not being used the neoprene protective cover should be on.

4) The Rifle and Bullet. In hot weather, rifle chamber pressure increases, causing the bullet to exit the muzzle at a higher velocity and impact the target above the point of aim. To avoid changes in propellant temperature, ammunition should be protected from direct exposure to the sun. Hot air is less dense than cooler air and provides the bullet with less resistance

allowing it to travel faster, causing the bullet to experience less deflection when there is wind.

b. Extreme Cold

1) The Shooter. Extreme cold can cause the shooter to shiver, feel uncomfortable, have lapses in memory, and difficulty holding a frigid rifle with numb hands. Shivering can make aiming very difficult, if not impossible. Trigger control is also difficult to execute properly if the fingers are numb. Additionally, the potential for frostbite is a concern. Proper dress in cold climates is paramount.

2) The Rifle and the Bullet. Extreme cold will affect the rifle and the bullet. In cold weather, rifle chamber pressure decreases, causing the bullet to exit the muzzle at a lower velocity and impact the target below the point of aim. The air is denser at lower temperatures and tends to slow the speed of the bullet, causing the bullet to experience a greater deflection when there is wind.

c. Record Temperature in the Data Book. A substantial temperature change (20 degrees or more) should be recorded in the REMARKS block of the data book. A substantial change will require the rifle to be rezeroed.

Confirm by questions.

TRANSITION: Precipitation in the form of rain, snow, hail, and sleet, like temperature, can affect shooting performance. The temperature and wind that accompany precipitation affect the bullet. However, if a shooter is distracted by precipitation, he may shoot poorly regardless of any corrections he may have made to compensate for the effects of temperature and wind.

8. (1 MIN) EFFECTS OF PRECIPITATION

a. The Shooter. Precipitation can affect concentration and comfort. Depending on the amount of precipitation, the target may be obscured or not visible at all making it difficult to establish sight picture. A positive mental attitude will provide the best performance.

b. The Rifle and Bullet. Freezing rain and other types of precipitation can make the weapon difficult to handle or may foul the weapon and cause stoppages. Water buildup in the barrel or compensator can cause erratic shots. The bullet will veer off its trajectory if it strikes water droplets on its way out of the barrel. Care should be taken to keep the weapon covered and dry until ready to shoot and to ensure only dry ammunition is used. If the rifle has been submerged, ensure the bore is drained before firing.

c. The RCO. The RCO is waterproof up to 66 feet with the caps on. If the caps are left off during firing, there is a chance water can enter around the adjustment screws. If condensation appears within the RCO, the ability to engage targets will become more difficult.

Confirm by questions.

TRANSITION: To become a combat-effective shooter, it is vital to develop the ability to compensate for the effects of weather through proper holding techniques, and mental and physical preparation. Through an understanding of how wind, temperature, light, and precipitation affect him and the trajectory of the bullet, the shooter can develop the skill and confidence to engage targets accurately under a variety of adverse weather conditions.

OPPORTUNITY FOR QUESTIONS: (1 MIN)

1. Respond to questions from the class.

2. Prompt students with questions to the class.

a. QUESTION: What is the shooter's greatest weapon against adverse weather conditions?

ANSWER: A good mental attitude.

b. QUESTION: On which of the four shooting positions does wind have the greatest effect on?

ANSWER: The standing position.

c. QUESTION: What are the two methods for determining wind velocity?

ANSWER: The Flag Method and the Observation Method.

INSTRUCTOR'S NOTE: *Ask Marines as many questions as necessary to ensure they fully understand*

the material presented in this class.

SUMMARY: (1 MIN)

On the range and in combat, the shooter will be subjected to a wide variety of adverse weather conditions including wind, excessive temperatures, precipitation, and light conditions. Understanding how these conditions can affect your performance, the rifle, and the trajectory of the bullet can aid learning to compensate for these conditions. Through physical and mental preparation and sight adjustment, combined with practice and adherence to the fundamentals of marksmanship, the effects of adverse weather on your performance can be overcome.

SLIDES

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