UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Service Support Schools
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MTCC 4405

DETAILED OUTLINE

VEHICLE RECOVERY

INTRODUCTION ***(3 Min)***

(SHOW SLIDE NO. 1, VEHICLE RECOVERY)

1. GAIN ATTENTION: Many times a vehicle is mired or damaged and no one knows "what to do about it," or they attempt to use improper equipment to recover the vehicle. As motor transport supervisors, it's your duty to ensure that personnel under your supervision know the basic techniques to recover a mired or disabled military vehicle. The only way to do this is by knowing the basic methods and techniques.

(SHOW SLIDE NO.2, OVERVIEW)

2. OVERVIEW: The purpose of this period of instruction is to teach you how to recover a mired/disabled vehicle so that you will be able to direct vehicle recovery operations when you return to the fleet.

(SHOW SLIDES NO. 3-6, ELO'S)

INSTRUCTORS NOTE: HAVE STUDENTS READ LEARNING OBJECTIVES

3. LEARNING OBJECTIVES:

a. Terminal Learning Objectives

(1) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, perform vehicle self-recovery operations, per the references. (35XX.03.04)

(2) Given a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, perform emergency repairs, per the references. (35XX.03.05)

b. Enableing Learning Objectives:

(1) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, reconnoiter the site, per the references. (35XX.03. 04a)

(2) Provided with a task to perform vehicles self-recovery operation, a vehicle to be recovered, required tools and equipment, and the references, identify the tactical posture, per the references. (35XX.03. 04b)

(3) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, estimate the situation, per the references. (35XX.03. 04c)

(4) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered required tools and equipment, and the references, calculate the ratio, per the references. (35XX03.04d)

(5) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, obtain resistance, per the references. (35XX. 03.04e)

(6) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, verify the solution, per the references. (35XX.03.04f)

(7) Provided with a task to perform vehicle self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, erect the rigging, per the references. (35XX.03.04g)

(8) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, recheck the rigging, per the references. (35XX.03. 04h)

(9) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools and equipment, and the references, recover the equipment using mechanical anchors, per the references. (35XX.03.04i)

(10) Provided with a task to perform vehicles self-recovery operations, a vehicle to be recovered, required tools

and equipment, and the references, recover the equipment using natural anchors, per the references. (35XX.03.04j)

(11) Given a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, replace a flat tire using the front log lift, per the references. (35XX.03.05a)

(12) Given a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, replace a flat tire using the rear log lift, per the references. (35XX.03.05b)

(13) Given a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, perform emergency fan clutch override service on the HMMWV, per the references. (35XX.03.05c)

(14) Given a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, perform vehicle radiator fan clutch service on a M-Series vehicle, per the references. (35XX. 03.05d)

(15) Given a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, cage the spring brake chamber on a M-Series vehicle, per the references. (3511.03.05e)

(16) Gives a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, cage the spring brake chamber on a Logistics Vehicle System, per the references. (35XX. 03.05f)

(17) Given a requirement to perform emergency repairs on various types of M-Series tactical vehicles, Basic Issue Items (BII), and the references, identify how to recover a vehicle using a tow bar, per the references. (35XX.03.05g)

(SHOW SLIDE NO.7, REFERENCES)

4. <u>METHOD/MEDIA</u>: **A** ***combination lecture, demonstration, and practical application will be used to explain field expedient repairs and vehicle recovery operations. I will be added by computer generated graphics and the actual items.***

INSTRUCTORS NOTE: Explain the Instructional Rating Form to the students.

5. EVALUATION: You will be evaluated by a performance test prior to the field exercise. Following the lecture, a combined practical application exercise and performance examination will give you the opportunity to practice and prove your ability to perform field expedient repairs and recover a mired/disabled vehicle.

TRANSITION: During the first portion of this lesson, we will discuss some field expedient repairs that can be performed on 5-ton and 1 1/4-ton vehicles that might eliminate the need for a recovery operation.

(SHOW SCREEN NO. 8, FIELD EXPEDIENT REPAIRS)

BODY ***(224 Min)***

1. FIELD EXPEDIENT REPAIRS: An expedient repair or measure is any method by which a task is accomplished using materials that are on hand; however, expedient repairs should only be used as a last resort in emergency situations. To prevent injury to personnel or more damage to equipment, an assistant should always be available to the operator when field expedient measures are being employed.

(SHOW SLIDE NO. 9, FRONT WHEEL REMOVAL)

a. Changing a Flat Tire on a 5-ton Truck Without a Jack

(1) Replacement of a flat front tire on a 5-ton vehicle can be accomplished as follows:

(a) First, the vehicle operator should make sure wheel chocks or rocks of sufficient size are available to chock the wheels once the vehicle is raised, and that the spare tire and wheel assembly has been positioned close to the vehicle.

(b) Now the parking brake should be engaged and then the lug nuts securing the wheel that has the flat tire should be loosened but not removed.

(SHOW SLIDE NO. 10, POSITIONING OF TIMBER/FRONT WHEEL)

(c) Next, a timber about five feet long should be secured at an angle to the front bumper with a chain or rope. The timber should be placed off center of the front bumper in front of the frame rail on the side of the vehicle with the flat tire.

(d) Once the timber is secured to the front bumper, the bottom of the timber must be placed in a shallow hole to prevent it from moving when the vehicle is driven forward.

(e) The operator will release the parking brake and, watching the assistant, very carefully and slowly move the vehicle forward until the timber is in a vertical position and the wheel has cleared the ground.

(f) Now, the brakes must be set and the wheels chocked. The flat tire and wheel assembly can now be replaced with the spare assembly.

(g) Once the spare tire has been secured in position on the axle, the wheel chocks should be removed. The operator should slowly drive the vehicle in reverse until the tire is back on the ground and the stress has been removed off the timber.

(h) Finally, the operator must tighten the lug nuts and remove the timber from the front bumper.

(SHOW SLIDE NO. 11, POSITIONING OF TIMBER)

b. Changing a flat on the intermediate axle or rear axle of a vehicle.

(1) First, the vehicle operator must find a piece of timber of sufficient strength that is longer than the distance from the bottom of the axle housing to the ground, and position the spare tire and wheel assembly close to the vehicle.

(2) Next, the operator should make sure wheel chocks or rocks of sufficient size are available to chock the wheels once the vehicle is raised.

(3) With all the required material at hand, the vehicle operator should loosen but not remove the lug nuts securing the wheel that has the flat tire.

(4) Next, he should wedge one end of the timber against the bottom of the axle at an angle and the other end in a shallow hole in the ground.

(5) Now watching the assistant, the vehicle operator should slowly drive the vehicle onto the timber until the wheel clears the ground.

(6) Once the wheel clears the ground, he should set the brakes and have the assistant chock the wheels.

(7) With the vehicle secured in place and the wheel off the ground, now he can remove the wheel and tire assembly and replace it with the spare tire.

(8) Once the spare has been positioned and secured to the axle, the wheel chock should be removed; and the vehicle operator should slowly move the vehicle forward or in reverse until the tire is on the ground and the piece of timber is no longer wedged under the axle.

(9) Finally, the vehicle operator should tighten the lug nuts.

TRANSITION: ***Now let's find out what must be done if the engine in a M998 series vehicle overheats.***

(SHOW SLIDE NO. 12, M988 EMERGENCY FAN CLUTCH OVERRIDE)

2. M998 SERIES VEHICLE EMERGENCY FAN CLUTCH OVERRIDE SERVICE

a. The radiator fan on the M998 series vehicle engine normally activates when the engine temperature exceeds 220^{o} Fahrenheit which is within the normal operating range of 190^{o} to 230^{o} Fahrenheit and deactivates when engine temperature drops to 190^{o} Fahrenheit. If the engine overheats in an emergency situation the emergency fan clutch override service should be performed to ensure continuous fan operation.

b. The emergency fan clutch override service is performed as follows:

(1) First, the vehicle operator should make sure the engine is stopped, the transmission is in neutral, and the parking brake is set.

(2) Next, he should raise and secure the hood.

(3) With the engine off and the hood raised, the time delay module connector must be disconnected from the control valve connector.

(4) Now the vehicle operator should start the engine, and check the fan for continuous operation.

(a) If the fan does not operate continuously, the vehicle operator should shut down the engine and immediately notify his supervisor or unit maintenance section.

(b) If the fan does operate continuously, the engine should be allowed to cool at an idle until the engine temperature

lowers to a normal operating temperature of 190^{o} - 230^{o} Fahrenheit.

(c) After the completion of his mission, the vehicle should be turned into the unit maintenance section and they should be made aware of the emergency service performed on the vehicle.

TRANSITION: Now let's take a look at what has to be done if the engine in a M939 series vehicle overheats.

3. M939 SERIES VEHICLE RADIATOR FAN CLUTCH EMERGENCY SERVICE

a. The radiator fan on the M939 Series vehicle engine normally activates when the engine coolant temperature exceeds 195^{o} Fahrenheit, which is within the normal operating range of 175^{o} Fahrenheit to 200^{o} Fahrenheit.

(1) Engine overheating is normally caused by damage to the thermostat that governs the operation of the cooling system fan.

(2) In an emergency situation the operator may, if unit maintenance personnel are not available, perform a radiator fan clutch emergency service.

(3) The operator can bypass the fan thermostat by securing the fan to the engine's fan clutch assembly.

Instructors Note: This procedure will be explained later in the lesson because there are a couple of other procedures that should be performed prior to the service.

b. Symptoms of engine cooling system overheating.

(1) The engine coolant temperature exceeds 200^{o} Fahrenheit as so indicated by the engine coolant temperature gage.

(2) The engine coolant temperature has not decreased after the operator has stopped the vehicle and allowed the engine to idle. At this point, the operator will also check the following areas of the engine cooling system and take the appropriate corrective action:

(SHOW SLIDE NO. 13, SURGE TANK)

(a) Check the radiator core for obstructions, and if clogged, removes any debris.

(b) Check the coolant level in the surge tank, and if low, adds coolant to the surge tank to a level at the bottom of the surge tank fill neck.

(c) Check for coolant leakage from surge tank, coolant hoses, and hose connections, and if loose, tighten the connections.

(SHOW SLIDE NO. 14, ENGINE OIL LEVEL)

(d) Remove the dipstick and check engine oil level, if low, add oil to the proper level.

(e) Check radiator fan clutch operation, if the fan blade is not turning, shut down the engine and installs the override lockup bolts.

c. Radiator fan clutch emergency service.

(1) First, stop the engine by turning the ignition switch and battery switch to the "OFF" position. If anyone is in the vehicle's cab, make sure that they are aware of the danger in engaging these switches while the emergency service is being performed.

(2) Next, raise the hood and secure it in the up position. Make sure the retaining bar retaining pin is placed completely through the retaining bar once the bar is attached to the bumper bracket.

(SHOW SLIDE NO. 15, FAN CLUTCH OVERRIDE BOLTS)

(3) Now remove the two clutch override lockup bolts from the storage boss on the fan clutch support bracket.

(SHOW SLIDE NO. 16, ALIGNMENT MARKS)

(4) With the storage bolts removed, line up the alignment mark on the side of the fan mounting plate with the alignment mark on the side of the fan clutch assembly. The fan mounting plate should turn freely by hand.

(a) The alignment mark for the fan clutch assembly should be positioned at approximately three o'clock.

(b) If the alignment mark for the clutch assembly is not in its proper location, without starting the engine, have an assistant tap the engine ignition switch to move the alignment mark to its proper position.

(c) With the alignment marks lined up, insert the two clutch override lockup bolts into the holes of the fan mounting plate and tighten the bolts by hand.

(d) Now, using the appropriate size wrench, tighten the override bolts until fully seated to secure the fan mounting plate to the fan clutch assembly.

(e) With the fan mounting plate secured to the clutch assembly, close and secure the hood.

(f) Now start the engine and allow the engine to cool at idle speed until the engine coolant temperature drops to a normal operating temperature range of 175^{o} Fahrenheit to 195^{o} Fahrenheit.

(g) Finally, as soon as possible, make certain your unit maintenance section is made aware of the emergency service performed on the vehicle.

TRANSITION: Now that you know what to do if the engine overheats in a M998 or M939 series vehicle, let's find out what must be done if the brakes on the M939 series vehicle or Logistics Vehicle Systems (LVS), lockup.

4. CAGING THE SPRING BRAKE CHAMBERS

a. The brakes on our tactical wheeled vehicles with a straight air brake system will automatically lock and stop the vehicle whenever a large loss of air pressure occurs. If this occurs and before the vehicle can be towed or moved off the road, the spring brakes must be manually released.

b. The vehicle operator should manually release/cage the spring brakes only in an emergency to move the vehicle out of danger or to prevent an accident if the vehicle has stopped on the road and traffic is being impeded.

c. The spring brake chambers will be caged as follows:

(1) First, make sure the parking brake control release valve is engaged and the wheels are properly chocked before releasing/caging the springs in the spring brake chambers.

(SHOW SLIDE NO. 17, SPRING BRAKE CHAMBER)

(2) Next, remove the dust cap/rubber plug from the brake chamber to be caged and place the item in the map compartment so

it won't get lost. Be sure to inform maintenance personnel as to the location of the item for re-installment after the brake system is repaired.

(3) After removal of the cap, inspect the inside of the chamber to ensure it is free of debris. If the chamber is clogged with mud, sand, or dirt, do not attempt to cage the brake chamber unless the chamber can be cleared.

(a) Air pressure may be used to clean out a clogged spring brake chamber.

(b) If the chamber cannot be cleaned out with air pressure, do not attempt to clean it out by removing the rim clamp bolt or nut and separating the chamber halves. High pressure inside the brake chamber will cause injury or death if released.

(c) If the chamber cannot be cleaned out, replace the dust cap and notify organizational maintenance personnel of the situation.

(SHOW SLIDE NO. 18, RELEASE/CAGING BOLT)

(4) Now remove the nut, washer, and release/caging bolt from the storage housing on the brake chamber. Notice that the bolt is threaded on one end and has a "T" at the other end.

(SHOW SLIDE NO. 19, RELEASE/CAGING BOLT (CONT'D)

(5) Insert the T-end of the release/caging bolt into the hole in the top center of the brake chamber and position it into the key-way of the metal diaphragm inside the brake chamber.

(6) With the T-end of the bolt inserted in the key-way, turn the release/caging bolt one-fourth of a turn clockwise until the T-end of the bolt catches on a stop inside the brake chamber.

(7) Now pull on the bolt to make sure it is firmly holding in the diaphragm within the chamber. If the bolt cannot be pulled directly out of the spring brake chamber after it has been turned, the bolt is properly seated.

(8) With the release/caging bolt properly seated, install the washer and nut on the bolt. Tighten the nut finger tight until it comes in contact with the washer on top of the spring brake chamber.

(SHOW SLIDE NO. 20, CAGING BRAKE CHAMBER)

(9) The length of the threaded end of the release/caging bolt extending out of the chamber must be measured with a ruler. The proper length of the bolt when the chamber is fully caged is three inches for the M939 series vehicles and two and one-half to three inches for the LVS when measured from the top of the nut to the end of the threaded end of the bolt.

(10) Finally, turn the nut clockwise on the release/caging bolt until the proper length is obtained. Repeat this procedure with all spring brake chambers.

OPPORTUNITY FOR QUESTIONS ***(2 Min)***

QUESTIONS FORM THE CLASS:

1. QUESTIONS TO THE CLASS:

QUESTION: When should the vehicle emergency fan clutch override service be performed on a M998 Series vehicle?

ANSWER: Only during an emergency situation when the engine overheats.

QUESTION: What item is used to cage/release the brakes when they lock up and where is it located?

ANSWER: The caging/release bolt that is located in its storage housing on each spring brake chamber.

SUMMARY: ***(1 Min)***

During the first hour of this lesson we discussed replacing a flat tire without a jack, performing the M998 emergency fan clutch override service, performing the M939 vehicle radiator fan clutch emergency service, and caging the spring brake chambers.

BREAK ***(10 Min)***

(SHOW SLIDE NO. 21, VEHICLE RECOVERY)

INTRODUCTORY TRANSITION: Recovering a mired vehicle can at times be a very simple task, but if improperly performed, it can be a time consuming and backbreaking job. The job will be a lot easier if the methods and techniques that will be discussed in the following instructions are applied.

(SHOW SLIDE NO. 22, RECOVERY PROCEDURES)

5. PROCEDURES FOR RECOVERING VEHICLES. In any recovery operation, the following eight steps should be used to make the recovery task less time consuming and as easy as possible.

(SHOW SLIDE NO. 23-27, RECONNOITER AREA)

a. Reconnoiter the Area

(1) Check the terrain for an approach to the load; then determine the method of rigging and the availability of natural anchors. As with any tactical mission, a recovery crew must know the problem before making decisions.

INSTRUCTOR'S NOTE: Explain to the students that the various types of anchors will be discussed later in the lesson.

(2) A complete ground survey of the area should be made and then the best route of approach to the disabled vehicle should be selected to prevent possible disablement to the recovery vehicle. This disablement occurs when you do not have the proper fleet angle. Fleet angle is the angle of the cable as it is coming off the winch. Check your vehicles TM for the fleet angle for the vehicle you are using. On the M-809/M-939 series vehicles, the angle is one and one half degrees, on the LVS its ten degrees

(SHOW SLIDE NO. 28, ESTIMATE THE SITUATION)

b. Estimate the Situation

(1) Estimate the resistance created by the load and determines the capacity of the available effort. For most recovery operations involving winching, the available effort would be the maximum capacity of the winch.

INSTRUCTOR'S NOTE: Explain to the students that computing load resistance will be discussed later in the lesson.

(2) In some recovery operations, the maximum distance between the winch and the disabled vehicle could be restricted, making the available effort as little as half the winch capacity.

(SHOW SLIDE NO. 29, CALCULATE THE RATIO)

c. Calculate the Ratio. Compute an estimated mechanical advantage (MA) for the rigging by dividing the resistance of the

load by the available effort (AE), winch capacity. Always round off the number.

(SHOW SLIDE NO. 30, OBTAIN RESISTANCE)

d. Obtain Resistance. Compute the tackle resistance and the total resistance.

INSTRUCTOR'S NOTE: Explain to the students that the computing of resistance will be discussed later in the lesson.

(SHOW SLIDE NO. 31, VERIFY SOLUTION)

e. Verify the Solution

(1) Compute the line forces to compare with the winch and deadline capacities, and divide the total resistance by the mechanical advantage. The result is the force of the fall line. The fall line force must be less than the capacity of the effort. This step in the recovery procedure is the key step to solving the problem.

(2) When verifying the solution, if the computed fall line force is greater than the effort, the mechanical advantage must be increased. Note that no physical work has taken place up to this point. As a result, no time is lost in moving equipment or having to re-erect rigging equipment. Compute the deadline force, determine the required strength of equipment capacity, and choose the correct equipment to use as deadlines.

(SHOW SLIDE NO. 32, ERECT RIGGING)

f. Erect Rigging

(1) First, orient the crew, they should be instructed to assemble the tackle and then move to a safe location. Advise the crewmembers of the plan, direct them to erect the tackle, and assign specific tasks.

(2) Next, inform the crewmembers who have finished their task to assist those who are having difficulty. The crewmembers can save time by having a thorough knowledge of the tackle to be erected and by helping each other.

(3) Finally, and most important, make sure all safety precautions are observed.

(SHOW SLIDE NO. 33, RECHECK RIGGING)

g. Recheck Rigging

(1) First, make sure that the tackle is rigged for proper and safe operation. Direct the operator to remove the slack from the lines and to inspect for correct assembly. If any corrections must be made, direct the crewmembers to make them.

(2) Next, explain the actions of the operation to the operators of the recovery vehicle and the other vehicle(s) involved.

(3) Now, the operators should be prepared to act on prearranged signals, and move to a safe location where signals can be observed by all participating in the recovery operation.

(SHOW SLIDE NO. 34, YOU ARE READY)

h. You Are Ready. The operators should be signaled to apply winch power to recover the load. All personnel involved in the recovery operation should be on the alert and make sure that nothing obstructs the operation of the equipment, and that all are in a safe location.

TRANSITION: Now that you know what procedures must be used during a vehicle recovery operation, let's discuss a couple of areas that were mentioned in the recovery procedures. First, let's talk about resistance.

(SHOW SLIDE NO. 35, RESISTANCE)

6. COMPUTING THE TOTAL LOAD RESISTANCE

a. Resistance is the force that tends to oppose or retard motion. In recovery operations, resistance is caused most often by terrain conditions such as mud, sand, water, or the recovery tackle itself.

(SHOW SLIDE NO. 36, CAUSES)

b. Types of Resistance

(SHOW SLIDE NO. 37, GRADE RESISTANCE)

(1) Grade resistance

(a) Grade resistance is created when a vehicle moves up a slope and gravity affects the weight of the vehicle.

(b) Grade resistance is estimated as equal to the weight of the disabled vehicle, plus the cargo. Even though the actual grade resistance may be less than the weight of the vehicle, the most resistance encountered on a grade is the weight of the disabled vehicle and its load.

(SHOW SLIDE NO. 38, OVERTURNING RESISTANCE)

(2) Overturning resistance

(a) Overturning resistance is that part of the weight of the vehicle which acts against the force exerted to bring the vehicle back on its wheels.

(b) Overturning resistance is estimated at approximately half the weight of the disabled vehicle. Half the weight of the vehicle is the most that will be beyond the center of gravity.

(SHOW SLIDE NO. 39, MIRE RESISTANCE)

(3) Mire resistance

(a) Mire resistance is created when mud, snow, or sand becomes impacted around the wheels, axle, or cab of the vehicle.

(b) Mire resistance is estimated depending on how deep the vehicle is mired. A vehicle is mired when it is stuck in snow, mud, or sand and can no longer move under its own power. There are three depths of mire resistance.

(SHOW SLIDE NO. 40, MIRED DEPTH WHEELS)

1 Wheel depth. A vehicle mired up to, but not over, the center of the hub. Estimate the wheel-depth resistance as equal to the weight of the vehicle plus cargo.

(SHOW SLIDE NO. 41, MIRED DEPTH FENDER)

2 Fender depth. A vehicle mired from the top of the hub and up to, but not over the fenders. Estimate the fender-depth resistance as twice the total weight of the vehicle plus cargo.

(SHOW SLIDE NO. 42, MIRED DEPTH CAB)

3 Cab depth. A vehicle mired over the fenders or on the cab of the vehicle. Cab-depth resistance is estimated as three times the weight of the vehicle plus cargo.

4 When estimating the resistance for a mired vehicle that is loaded, estimate the resistance by adding the weight of the load to the weight of the vehicle times the mire depth factor.

(SHOW SLIDE NO.43, WATER RESISTANCE)

(4) Water resistance. Water resistance occurs when submerged vehicles are pulled from water to land. The amount of resistance met will be estimated the same way as land resistance.

(SHOW SLIDE NO. 44, TACKLE RESISTANCE)

(5) Tackle resistance. Tackle resistance is that part of the total resistance that is added to the recovery because of the friction created in the tackle. Tackle resistance is estimated as an additional ten percent of the load resistance for each sheave used in rigging.

TRANSITION: Before the total load resistance can be computed we must also take into consideration items that may be used to give us a mechanical advantage.

(SHOW SLIDE NO. 45-47, MECHANICAL ADVANTAGE)

7. USING A MECHANICAL ADVANTAGE TO OVERCOME RESISTANCE

a. A mechanical advantage is a small amount of force applied over a long distance to move a heavy load a short distance. A mechanical advantage is the multiplication of force.

b. A mechanical advantage is needed whenever the load resistance is greater than the capacity of the available effort.

(SHOW SLIDE NO. 48-55, COMPUTING MECHANICAL ADVANTAGE)

TRANSITION: Now that we know what mechanical advantage is let's talk about how to compute the mechanical advantage.

8. COMPUTING THE MECHANICAL ADVANTAGE (MA)

a. To determine the amount of mechanical advantage necessary in a recovery operation, divide the load resistance (LR) and the vehicle weight plus cargo by the available effort (AE) (winch capacity), and round any fraction up to the next higher number.

b. The mechanical advantage is the only item in the recovery application that is rounded to a whole number. Rounding up is required because only whole numbers can be rigged.

TRANSITION: Before the total load resistance can be computed we must know the resistance of the tackle, if a tackle is going to be used in the recovery operation.

(SHOW SLIDE NO. 56, TACKLES)

9. COMPUTING THE RESISTANCE OF A TACKLE

a. A tackle is a combination of ropes or cables and blocks used to gain a mechanical advantage or to change the direction of pull. The tackle is classified as simple or compound.

(1) The simple tackle is one rope or cable with one or more blocks. Since the winch has only one cable, the simple tackle will almost always be used for recovery operations.

(2) The compound tackle is more than one rope or cable used with two or more blocks. The compound tackle is a series of two or more simple tackles. The output of one simple tackle is used as the effort for the other.

b. Computing tackle resistance

(1) Friction created by a tackle sheave rotating on its pin, the rope flexing around the sheave, or the rope scuffing in the groove of the sheave causes a loss in energy as the rope passes around the sheave. This loss is resistance and must be overcome before the resistance of the load can be overcome. Each sheave in the rigging will create resistance.

(2) To determine the tackle resistance, multiply ten percent of the load resistance by the number of sheaves in the rigging.

TRANSITION: Now that we have all the information that is required to compute the total load resistance, let's discuss how it is done.

c. Total Load Resistance. Since tackle resistance must be overcome before a load resistance can be moved, the two resistances (load and tackle) are added. This resistance is the total resistance that the available effort must overcome.

INSTRUCTOR'S NOTE: ***Complete the formula on the chalkboard to demonstrate to the students how to compute the total load resistance.***

OPPORTUNITY FOR QUESTIONS ***(2 Min)***

QUESTIONS FROM THE CLASS:

1. QUESTIONS TO THE CLASS:

QUESTION: ***What are five types of resistance?***

ANSWER: ***Grade, overturning, mire, water, and tackle.***

QUESTION: ***What is a combination of ropes or cables and blocks used to gain a mechanical advantage referred to as?***

ANSWER: ***Tackle.***

SUMMARY: ***(1 Min)***

During this portion of the lesson we covered the procedures for recovering vehicles and computing load resistance. Take a ten-minute break.

(SHOW SLIDE NO. 57, SAFETY)

INTRODUCTORY TRANSITION: ***Now that you know how to compute the total load resistance of a vehicle that needs to be recovered, let's discuss some of the safety precautions that must be adhered during vehicle recovery operations.***

10. IDENTIFICATION OF SAFETY REQUIREMENTS FOR VEHICLE RECOVERY OPERATIONS

(SHOW SLIDE NO. 58, HANDLING CABLES)

a. Handling Cables and Wire Ropes

(1) Cables and wire ropes may become damaged through normal or improper use. The wires that make up the strands of the rope may break through normal operation.

(2) Make sure when handling wire ropes to always wear heavy, leather-palmed gloves to prevent injuries or cuts to your hands from broken wires.

(3) Never let a moving cable slide through your hands even when you are wearing gloves since broken wires can cut through the gloves.

(SHOW SLIDE NO. 59, HOOK POSITION)

b. Positioning of the Hook

(1) When rigging for recovery, the hook should be positioned with the open part (throat) upward. If the hook should straighten out from an overload, the rigging would be forced downward.

(2) If the hook were positioned with the open part down, the rigging would travel upward unrestrained and cause serious injury to personnel and damage to equipment.

(SHOW SLIDE NO. 60, SAFETY KEYS AND SHACKLE PINS)

c. Placement of Safety Keys in Shackle Pins

(1) Some shackles use a threaded-type pin. If the pin is not completely threaded into the shackle part, the shackle or pin can be bent or broken when force is applied.

(2) Safety keys should be in place on all tow hooks, shackles, or other items of rigging equipment requiring them. Even though the safety key supports no great load, its absence can allow a pin to move and place an excessive force on only a part of a connection.

(3) When using pins with safety keys, such as the type in some tow bars, all pins in a vertical plane should have their heads pointing up. Then, even if the safety key should break or fall out, the pins will remain in position if the load shifts.

(SHOW SLIDE NO. 61, RIGGING BETWEEN VEHICLES)

d. Rigging Between Vehicles

(1) When rigging is being erected between vehicles, turn the engines off on all vehicles and apply the parking/emergency brakes. This prevents possible injury to the rigging personnel or damage to the vehicles.

(2) When riggings are erected using a recovery vehicle that must have its engine running to operate the equipment, the driver will remain in position in the vehicle, the wheels will be chocked, and the brakes applied to prevent movement of the recovery vehicle.

(SHOW SLIDE NO. 62, INSPECT EQUIPMENT)

e. Inspecting Rigged Equipment

(1) All rigging equipment used in the recovery operations should be inspected thoroughly before the recovery operation starts.

(2) The recovery vehicle operator should be directed to apply power to the winch to remove the slack from the rigging cable, and then the operation should be stopped so the rigging can be inspected without endangering personnel.

TRANSITION: Now let's find out what must be done to prevent injury to personnel and damage to equipment. Let's talk about safety.

(SHOW SLIDE NO. 63, SAFETY PRECAUTIONS)

f. Safety Precautions

(1) Inspection of rigging for crossed cables

(a) Before the winching operation is continued, make sure the rigging lines are not crossing each other. Crossed rigging lines can rub against each other causing damage to the cables and increase the amount of tackle resistance.

(b) Crossed cables are only recommended for towing not recovering disabled vehicles.

(SHOW SLIDE NO. 64, SAFETY PRECAUTIONS (CONT'D)

(2) Inspection for the spillage of fuel or oil

(a) If fuel or oil has spilled from the disabled vehicle, there must be NO SMOKING and NO OPEN FLAMES. Make sure the exhaust flash from other vehicles is not directed at the vehicle with spilled fuel or oil.

(b) Make sure that spilled fuel or oil is thoroughly cleaned up before attempting to start the engines of the vehicles used in the recovery operation.

(c) When winching or lifting a disabled fuel carrier, thoroughly ground the vehicle to keep static electricity from igniting the fuel. The fuel carrier should have the grounding equipment needed.

(SHOW SLIDE NO. 65, SAFETY PRECAUTIONS (CONT'D)

(3) Acceleration impact. Do not apply loads suddenly. This puts excessive strain on the equipment and it may fail. Failure of the rigging equipment occurs when a weight is allowed to fall for a distance and is suddenly stopped. A similar strong force occurs when power is engaged suddenly.

(4) Avoidance of backlash

(a) Make every effort to stand clear of any wire rope that is under tension. When a wire rope is drawn taut and then released suddenly by a break, its recoil (or backlash) will cut a person in two or damage equipment.

(b) A broken winch cable snapping back could be compared with a rifle bullet except the bullet makes a fairly clean hole and the winch cable makes a messy wound.

(c) Wire rope under stress should be treated with the same respect you would a loaded rifle.

(SHOW SLIDE NO. 66, SAFETY PRECAUTIONS CONT'D)

(5) Employment of the ground guide

(a) For safe control of a recovery operation, there should be only one ground guide. To prevent confusion, the ground guide should stand separately from other personnel at the recovery site and where operators can easily observe the signals.

(b) The operators in the recovery operation must know the meaning of the signals to be used and act only on the signals given by the ground guide.

(6) Operator/driver safety. Operators and other personnel, in both the recovery and disabled vehicles, should keep their doors closed and windshields in place and be observant of all signals.

TRANSITION: Now that we know how to compute the load resistance and what safety requirements we must follow are; let's recover a mired vehicle.

(SHOW SLIDE NO. 67, ANCHORS)

11. RECOVERING A VEHICLE USING MECHANICAL AND NATURAL ANCHORS

a. Vehicles used in a recovery operation frequently may have to use a rigid point of support when moving heavy loads with winch and tackle(s). An anchor can assist in holding the recovery vehicle, in providing a change in the direction of pull, or in supporting part of the load during a recovery operation.

b. There are two types of anchors, natural and mechanical, that can be used in the recovery of a disabled vehicle.

(SHOW SLIDE NO. 68, NATURAL ANCHORS)

(1) A natural anchor is an anchor that does not have to be constructed. Examples are trees, tree stumps, large rocks, or other vehicles. Avoid dead or rotten trees or stumps and rocks that are not large enough or embedded firmly in the ground.

(SHOW SLIDE NO. 69-70, MECHANICAL ANCHORS)

(a) A vehicle can be used as an anchor to assist in the recovery of a mired vehicle with a winch.

1 The winch cable of the mired vehicle is extended to the anchoring vehicle and the mired vehicle winches itself out.

2 The anchoring vehicle should not attempt to pull; it is only an anchor. This eliminates the chance of damage to the winch.

(2) There are several types of mechanical anchors. The type constructed depends on the holding ability requirements, the type of soil, availability of materials, and the situation.

(SHOW SLIDE NO. 71, PICKETT HOLDFAST)

(a) A picket holdfast is constructed by using two or more sound wooden pickets at least three inches in diameter and five feet long.

1 The pickets should be driven about three feet into the ground, three to six feet apart, and in line with the deadline.

2 The pickets should be tied together with a fiber rope by first tying one end of the rope to the top of the front picket with a clove hitch. Then make four to six wraps of the rope, starting from the top of the front picket to the bottom of the rear picket, and tie the other end of the rope to the bottom of the rear picket with a clove hitch.

3 Finally, pass a stake between the ropes wraps midway between the pickets, tighten the rope by twisting it with the stake, and then drive the stake into the ground. Repeat this operation for each successive pair of pickets.

4 The strength of the picket holdfast depends mainly on the first, or front picket. To reinforce it, drive two or more pickets into the ground close to the front picket. Tie them together before tying to the rear picket.

(SHOW SLIDE NO. 72, SAND PARACHUTE)

(b) A sand parachute is used as an anchor in a sandy area with no trees.

1 Dig a large, deep hole and line it with a tarpaulin.

2 The tarpaulin is then filled with the sand removed from the hole, the four corners are lashed together, and the rigging is attached.

3 The sand parachute has limited holding ability and should not be used when a major effort is required.

(SHOW SLIDE NO. 73, SCOTCH ANCHOR)

(c) A scotch anchor is used to anchor a truck during a winching operation when natural anchors are not available.

1 First, select a log at least six inches in diameter and two feet longer than the vehicle is wide.

2 Dig a shallow trench about three to four inches deep, parallel to the front axle, just ahead of the front wheels.

3 Next, lay a tow chain or a couple of chains, across the trench, place the log in the trench, and move the vehicle forward until both front tires are against the log.

4 Finally, attach both chain ends to the lifting shackles and remove all slack from the chain.

5 As power is applied to the winch, the front wheels are pulled onto the log, pulling the chain taut and anchoring the vehicle.

(SHOW SLIDE NO. 74, LOG DEADMAN)

(d) The log deadman is one of the best types of constructed anchors and can be used for heavy loads. It consists of a log, timber, steel beam, or other similar objects buried in the ground with a deadline connected to it at the center. To construct a log deadman, the following steps must be completed:

1 First, select a place where the direction of pull is as nearly horizontal as possible, such as a sharp bank or crest. You can obtain more holding power with less digging.

2 Next, when digging, slant the trench at least fifteen degrees from the vertical and undercut towards the disabled vehicle.

3 When the digging is complete, lay the deadline over the trench, lay the deadman in the hole over the deadline, and drive the stakes in front of the deadman at each end to hold it in place.

4 Next, tie the deadline to the center of the deadman so the main or standing part of the line leads from the bottom of the deadman. Dig a narrow trench for the deadline, bearing to the deadman. If the deadline has a tendency to cut into the ground, place a log or plank under the line at the outlet from the inclined trench.

5 Now, tie the deadline to the center of the deadman so that the main part of the line leads to the bottom of the deadman. This will prevent the deadman from rotating out of the hole.

(SHOW SLIDE NO. 75, QUESTIONS)

OPPORTUNITY FOR QUESTIONS ***(2 Min)***

QUESTIONS FROM THE CLASS:

1. QUESTIONS TO THE CLASS:

QUESTION: What type of protective covering should rigging personnel put on their hands before handling winch cables or wire ropes?

ANSWER: Heavy, leather-palmed gloves.

QUESTION: Of the picket holdfast, sand parachute, and the log deadman, which one is preferred as an anchor for heavy loads?

ANSWER: Log deadman.

SUMMARY: ***(1 Min)***

During this portion of the lesson, we discussed the identification of safety requirements for vehicle recovery operations and the recovery of vehicles using mechanical and natural anchors.

BREAK ***(10 Min)***

INTRODUCTORY TRANSITION: ***Now that you know how a disabled vehicle can be recovered and the safety precautions that must be followed, let's discuss how to operate the winches mounted on the front of our tactical vehicles.***

12. THE M1038 WINCH CHARACTERISTICS AND OPERATION

(SHOW SLIDE NO. 76, M1038 FRONT WINCH)

a. M1038 Vehicle Winch Characteristics and Capabilities

(1) The M1038 is equipped with an electrical winch that is powered by the vehicle's electrical system.

(a) The winch is equipped with an electronic current limiter switch to prevent winch overload. If the winch stops repeatedly during operation and restarts in approximately five seconds, the current limiter is being activated, indicating an overload condition.

(b) The electronic winch is also equipped with a thermal cut-off switch to prevent the winch from over heating.

1 If the winch stops during operation, and does not restart within five seconds, wait approximately two minutes to let the winch cool off and allow the thermal switch to reset.

2 If the winch is still inoperative after five minutes, notify unit maintenance per established SOP.

(2) The listed maximum capacity for the M1038 front winch is 6,000 pounds.

(3) The winch employs one hundred feet of three-eights inch diameter wire rope/cable.

b. Nomenclature and Purpose of the M1038 Winch Components

(SHOW SLIDE NO. 77, M1038 WINCH COMPONENTS)

(1) The manually operated clutch lever, located at the right front of the winch, when turned counterclockwise will place the winch in the free spool position, and when turned clockwise will engage the winch.

(2) The remote control switch with electric cable, located in the stowage box on the left side of the winch, operates the winch motor to turn the winch in and out.

(3) The cable guide at the front of the winch is used to control the winch cable during winching operations.

c. Operation of the M1038 Winch

(1) Preparation of the winch for use.

(a) First, park the vehicle directly facing the vehicle to be winched, and place the transmission in the "N" (neutral) position.

(b) Next, apply the parking brake.

(c) If the engine is running leave it on, if not start the engine.

(d) Now chock the wheels of the winching vehicle to prevent it from moving during the winching operation.

(2) Unwinding the winch cable.

(a) First, turn the clutch lever counterclockwise to "FREE SPOOL."

1 Do not power out the winch cable for more than ten feet.

2 Free spooling should be used for paying out long lengths of winch cable to prevent damage to the winch.

3 Make sure that four wraps of winch cable remain on the drum at all times when fully extending the winch cable. Failure to do so may cause injury or death to personnel.

4 To allow for winch motor startup for maximum pulling power, allow one foot of slack in the winch cable prior to starting winching operations.

(b) Now, connect the winch cable to the load.

d. Using the M1038 winch to pull a load.

(1) First, direct all personnel to stand clear of the winch cable during the winching operation.

(2) Next, remove the remote control switch from the stowage box.

(3) Now, turn the clutch lever clockwise to the "ENGAGE" position.

(4) With the clutch lever in the engaged position, pull out the hand throttle until the desired engine speed is obtained. Do not fully apply the hand throttle during an engine "NO LOAD" condition.

(5) Now, operate the remote control switch "IN" or "OUT" until the vehicle has been retrieved.

e. Securing the M1038 winch after operation.

(1) First, wind the winch cable onto the drum until the hook is four feet from the cable guide. The winch cable must be wound on to the drum under a load of at least five hundred pounds or the outer wraps will draw into the inner wraps damaging the winch cable.

(2) Next, turn the clutch lever counterclockwise to the "FREE SPOOL" position, and rotate the drum by hand to retrieve the remaining cable.

(3) Now, place the remote control switch in the stowage box, and turn the clutch lever clockwise to the “ENGAGED” position.

(4) Finally, release the hand throttle and turn off the retrieving vehicle's engine.

TRANSITION: Now, let's discuss the capabilities of the M809 series vehicles front mounted winch and find out how to retrieve a load with the winch.

13. THE M813 FRONT WINCH CHARACTERISTICS AND OPERATION

(SHOW SLIDE NO. 78, M813 FRONT WINCH)

a. M813 Vehicle Winch Characteristics and Capabilities

(1) The M813 vehicle is equipped with a transmission driven power takeoff (PTO) front mounted winch.

(2) The maximum single part line pull for the winch is 10,000 pounds.

(3) The winch cable is 200 feet long and five eights inches in diameter.

(4) The winch also has an internal automatic safety break designed to hold the winch load when the PTO is shifted or the power to the winch is interrupted.

b. Nomenclature and Purpose of the M813 Front Winch Components

(SHOW SLIDES NO. 79-80, M813 WINCH PREPARATION)

(1) The drum lock knob located on the left side of the winch is pushed in to lock the winch drum when not in use and pulled out and turned one-quarter turn to unlock the winch drum when the winch is in use.

(2) The drum clutch lever located on the left rear portion of the winch is pulled away from the winch to engage the winch and pushed in to disengage the winch.

(3) The front winch control lever located in the cab, center on the floor, is pulled back to wind the front winch and pushed forward to unwind the winch.

(4) The power divider control lever, located to the left of the vehicle operator's seat, is pushed forward to provide power to auxiliary equipment (winch) and pulled rearward to disconnect the power source.

(SHOW SLIDE NO. 81, M813 SHEAR PIN)

(5) The winch is connected to the PTO by a drive shaft, which is secured to the winch input shaft by an aluminum shear pin.

(6) Never substitute the aluminum shear pin with rivets, pins, bolts, or nails. The use of these items will result in damage to components.

TRANSITION: Now let's discuss the operation of the winch mounted on the front of the M813 vehicle.

c. Operation of the M813A1 Front Winch

(1) Preparation of the winch for use.

(a) First, start the vehicle engine.

(b) Next, park the vehicle directly facing the vehicle to be winched, place the gearshift lever in the "N" (neutral) position, and engage the parking brake by pulling it up.

(c) Now pull the drum lock all the way out, turn it one-quarter turn, and release it. This will allow the drum to turn freely so that the cable can be pulled out.

(2) Unwinding the winch cable.

(a) First, engage the drum jaw by moving the drum clutch lever away from the winch.

(b) Next, unhook the winch cable chain hook from the right lifting shackle and pass the hook through the left lifting shackle.

(c) Now pull the winch cable chain hook down and under the center of the front bumper.

(d) With the winch cable chain hook free, pull the cable hook until enough cable has been unwound to reach the load that is to be pulled.

1 Leave at least four turns of the cable on the drum. The cable clamp screw by itself will not hold the cable around the drum when a load is being pulled.

2 To stop the cable from unwinding too fast, an internal drag brake is installed in the winch.

(3) Using the M813 winch to pull a load.

(a) First, depress the clutch pedal, lift the hinged locking plate on the floorboard and pull the winch control lever into the wind position, and push the transfer control lever in the "L" (low) position.

(b) Now make sure the transmission gearshift lever is in the "N" (neutral) position.

(c) The winch operating speed can be regulated by either depressing the accelerator pedal, or pulling out the hand throttle control handle.

(d) Do not operate the winch at excessive or erratic speeds, which may cause an overload, resulting in a broken winch shear pin.

TRANSITION: Now let's discuss the operation of the front winch mounted on the M939 Series vehicles.

14. THE M925 WINCH CHARACTERISTICS AND OPERATION

(SHOW SLIDE NO. 82, M925 FRONT WINCH)

a. Characteristics and Capabilities

(1) The M925 is equipped with a hydraulic powered front winch.

(a) The winch is powered by a hydraulic system that converts mechanical power from the engine into fluid power by the use of a hydraulic pump, and back into mechanical power at the winch drives motor.

(b) The transmission power takeoff (PTO) provides the driving power to the hydraulic pump.

(c) The winch motor converts the hydraulic power into mechanical power as this hydraulic oil is forced, under pressure, through worm gears in the winch motor. This action rotates the winch drum.

(2) The most important single item in vehicle recovery is the wire rope. The front winch on the M925 employs 200 feet of 5/8-inch wire rope that we commonly call a cable. Wire rope is made of many wires, usually plow steel for winches. These strands are twisted together around a core to make the wire rope.

(3) The listed capacity for the winch is 17,000 pounds. Do not attempt to recover vehicles that weight over 17,000 pounds with this winch using a straight-line pull.

b. Preparation of the Vehicle

(1) Position the vehicle. First, we need to position the vehicle for winching.

(a) Park the vehicle directly facing the direction of the pull, if possible. A direct pull provides less resistance on the cable.

1 If the vehicle cannot be lined up in a direct line with the load, line the vehicle up with a strong go-between object, such as a large tree.

2 The winch cable is then run to this go-between object, placed through a snatch block, then on to the load.

(b) Place the transmission in the "N" (neutral) position and apply the parking brake.

(2) Next, turn the ignition switch and battery switch to the "OFF" position.

(SHOW SLIDE NO. 83, HYDRAULIC OIL RESERVOIR)

(3) Now, check the oil level in the hydraulic oil reservoir. The reservoir is located on the right side of the vehicle between the toolbox and the rear tires. Remove the filler cap and pull out the dipstick. The oil level must be above the red area of the dipstick.

(SHOW SLIDE NO. 84, M925 FRONT WINCH PREPARATION)

c. Unwinding the Winch Cable. The next step is to unwind (pay out) the winch cable. There are two methods for doing this.

(1) The first method is called "freewheeling." This method must be used if there is only one individual present to do the winching. It is also used when a lot of cable is needed, or when the entire cable is stretched out to clean it. To use this method:

(a) Free the winch cable chain and hook from the vehicle bumper and lifting shackles.

(b) Pull out the drum lock knob, rotate it 90 degrees in either direction, then release the knob.

(c) Grab the chain hook and simply pull out as much cable as you need. Don't pull to fast or the cable may try to kink or knot.

(d) The winch drum will continue to be freewheeling until the drum lock is placed in the locked position or the winch clutch is engaged.

(e) Don’t pull out the entire cable unless you are changing cables. Always leave at least four turns of the cable on the drum. This will prevent you from pulling the cable from the drum.

(SHOW SLIDE NO. 85, M925 FRONT WINCH PREPARATION CONT’D)

(2) The other method used to pay out the cable uses the vehicle's power and requires two individuals, one to operate the controls and one to handle the cable. This method is used primarily when just a short length of cable is required or when the operator wants to keep the cable wound tight around the drum. To use this method:

(a) First, free the winch cable chain and hook from the bumper and lifting shackles.

(b) Pull out the drum lock knob, rotate it 90 degrees in either direction, then release the knob.

(c) Release the hinged latch and pull the clutch lever in the direction away from the winch as far as it will go.

(d) Make sure the transfer case shift lever is in high range.

(e) Make sure the parking brake is set and start the vehicle's engine.

(f) Place the transmission selector in "1-5" (drive) and pull the transmission power takeoff control lever back to "ENGAGE." Then return the transmission selector lever to "N" (neutral).

(g) Direct the cable handler to maintain tension on the cable to prevent it from kinking.

(h) Push the front winch control lever forward to "UNWIND" and hold.

(i) The winch speed and capacity is regulated by the engine rpm. To increase the speed, depress the accelerator pedal or adjust the hand throttle control.

(j) When the desired amount of cable is played out, release the winch control lever and it will return to neutral.

d. Rewinding the Winch Cable. The procedures are the same if you are rewinding a cable after cleaning it or pulling a load.

The rewinding procedures require two individuals, one to operate the controls and one to manipulate the cable.

(1) The first step is to start the engine.

(2) Pull the clutch lever as far in the direction away from the winch as it will go. This will have to be done only if the freewheeling method was used. Otherwise, it will be in this position.

(3) Engage the PTO. It will be engaged, unless the freewheeling method was used.

(4) Pull the winch control lever back to the "WIND" position and hold it there for winding or pulling. Wind the cable slowly.

(5) The other crew member will guide the cable onto the drum with a piece of wood, making sure each layer of cable is wound on the winch drum evenly.

(6) If a disabled vehicle is being recovered, make sure the cable is not guided onto the winch drum. All personnel on the ground should be a safe distance away from the cable, in case the cable should break.

(7) If the temperature is above 70 degrees Fahrenheit stop the winding operation by releasing the winch control lever after every 100 feet of cable has been winched in. Stop the operation for six minutes. During this period of time, leave the truck engine idling and the power takeoff control lever engaged. Failure to do this may cause damage to the winch. Resume winding after six minutes.

(8) Release the winch control lever just before the chain reaches the winch drum. The crewmember handling the cable will signal this.

(9) The crewmember will maintain manual tension on the cable and disengage the drum clutch by pushing the clutch control lever toward the winch. Do not force the clutch control lever. If it does not easily disengage, slightly engage the winch control lever in "WIND" until the clutch can be disengaged without force.

(10) Swing the hinged latch down to lock the clutch control lever in the disengaged position.

(11) Pull out and rotate the drum lock 90 degrees to the lock position. You may have to rotate the drum slightly to ensure the lock plunger engages.

TRANSITION: Next, we will discuss the procedures for preparing the winch cable for travel.

e. Preparing the Winch Cable for Travel

(1) First, run the winch cable chain and hook under and over the right frame extension, then across the top of the right bumper.

(2) Next, remove the right towing shackle by unsnapping the safety key and removing the shackle bolt.

(3) Now, place the towing shackle over the chain and reinstall the shackle.

(4) Finally, attach the cable hook to the left towing shackle.

TRANSITION: Now that you know how to recover a disabled vehicle using the winch and other field expedient measures let's talk about towing the vehicle.

(SHOW SLIDE NO. 86, TOWS)

15. TOW BAR OPERATIONS

a. Tow bar handling.

(1) Before attempting to tow a vehicle, make sure you are familiar with the location, features, and operation of all the components of the tow bar. Make sure you have the right bar for the vehicle being towed, and the correct end pieces to connect the bar to the vehicle. Depending on the type of tow you will need a safety chain, and air hoses.

(2) Before attaching the tow bar to a disabled vehicle, chock the wheels and/or set the emergency brake. After the tow bar is attached, ensure you remove the chocks and release the brakes before moving the vehicle.

(3) Refer to manual of the vehicle being towed, for information about setting up the vehicle for towing i.e. gear selection.

(4) Ensure the proper pin assemblies are in the clevis holes and always be sure the quick release pins are properly secured.

(5) Refer to your SOP for speed limitations while towing a vehicle.

b. Types of Tows

(1) Highway Tow. Attach the recovery vehicle's tow bar to the tow lugs of the disables vehicle, using the proper adapter. Place the lunette of the tow bar in the recovery vehicles tow pintle. Close the pintle, and attach safety chain. The safety chain is attached to the rear tow shackle of the recovery vehicle. Wrap the chain loosely around one bar of the tow bar, and secure it to a structural member of the disabled vehicle. Attach the airlines so the towed vehicle will have brakes, unless the air system is damaged. Insure the vehicle transmission and transfer case are both in the neutral position. Depending on the distance towed refer to the TM manual to see if the drive shaft needs to be removed. Remove the parking brake.

(2) Cross Country Tow. Only in extreme cases, or as a back up should cross-country tow cables be used. To connect the vehicles is simple. Connect a chain from the left rear of the tow vehicle to the right front of the disabled vehicle, and vise versa with another chain. An operator is required to operate the brakes and steering of the towed vehicle to prevent it from hitting the recovery vehicle.

(SHOW SLIDE NO. 87, COMBAT TOW)

(3) Combat Tow. This is to be done in the danger area.

(a) Connect your V-Chain to the recovery vehicle's pintle.

(b) Move the recovery vehicle into the danger area. Back up until contact is made with the disabled vehicle.

(c) If possible a crewmember in the disabled vehicle can connect the chains to the front of the disabled vehicle.

(d) The recovery vehicle then moves out. Do not tow more than one-quarter mile.

OPPORTUNITY FOR QUESTIONS (2 Min)

QUESTIONS FROM THE CLASS:

1. QUESTIONS TO THE CLASS:

***QUESTION**: In what direction should the open part or throat of the hook be pointing when rigging for recovery operations?*

***ANSWER**: Upward*

***QUESTION**: What is the force that tends to oppose or retard motion referred to as?*

***ANSWER**: Resistance.*

***SUMMARY**: (1 Min)*

(SHOW SLIDE NO. 88, SUMMARY)

During the past few hours we discussed field expedient repairs, procedures for recovering vehicles, computing the total load resistance, identification of safety requirements for vehicle recovery operations, recovery of vehicles using mechanical and natural anchors, operation of the winches mounted on the M1038, M813, and M925, of motor transport vehicles.

***BREAK** (10 Min)*

REFERENCES

1. FMFRP 4-19, Battle Field Damage Assessment and Repair

2. FM 21-305, Manual for Wheeled Vehicle Driver

3. Applicable Vehicle Operator's Manuals