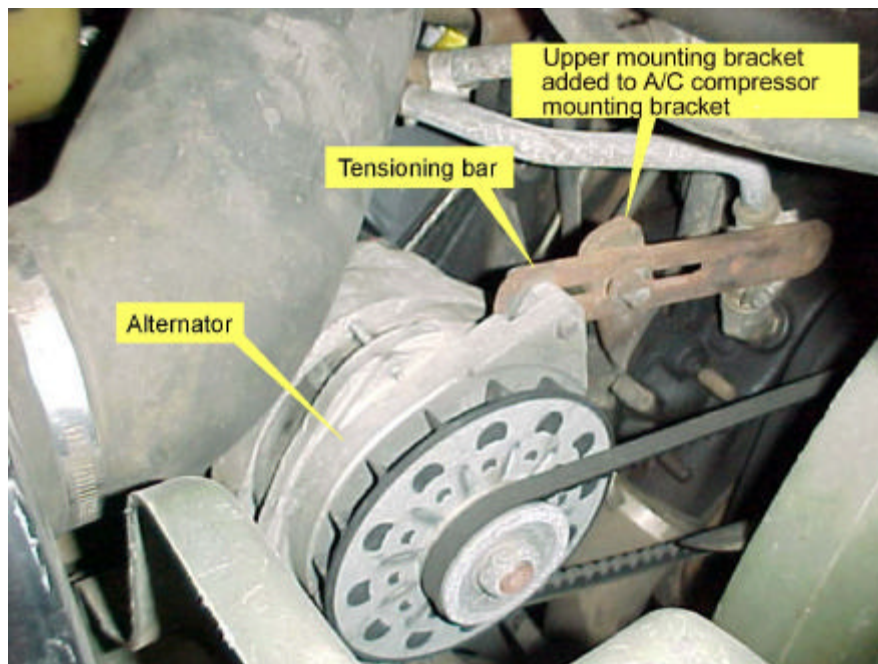


# **ROSCOMMON EQUIPMENT CENTER**

Project Number 56C

January 2002



## ***HMMWV 12 Volt Alternator Bracket***

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National Association of State Foresters  
*in Cooperation with*  
Michigan's Forest Fire Experiment Station

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# REC Project No. 56C

## Making a 12 Volt Alternator Bracket

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### Disclaimer

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## Introduction

A major decision for those converting a military vehicle to a fire truck concerns the electrical system. The military vehicle will be 24 volt and most fire appliances require 12 volt. The HMMWV's are no exception. Three choices are available:

- Find radios, hose reel motors, emergency lights, and other add-ons in 24 volt and use the existing system. Many items will be difficult to find in 24 volt.
- Change the vehicle's electric system to 12 volt, which requires considerable time, expense, and expertise.
- Add a separate 12 volt electric system, keeping the 24 volt one for the vehicle and using the 12 volt for add-ons.

Project 56C guides you through the last choice by showing how to add an alternator. Appendix A provides a schematic for wiring the system.

## Alternator Mounting Bracket Overview

The military HMMWV has little room under the hood for mounting additional items. There is one spot available in the right front corner of the engine compartment (passenger side) (Figure 1). This is normally reserved on ambulance units for an air conditioner compressor. Most military vehicles will not have air conditioning. If yours does, you will need to remove it to accomplish this mounting.

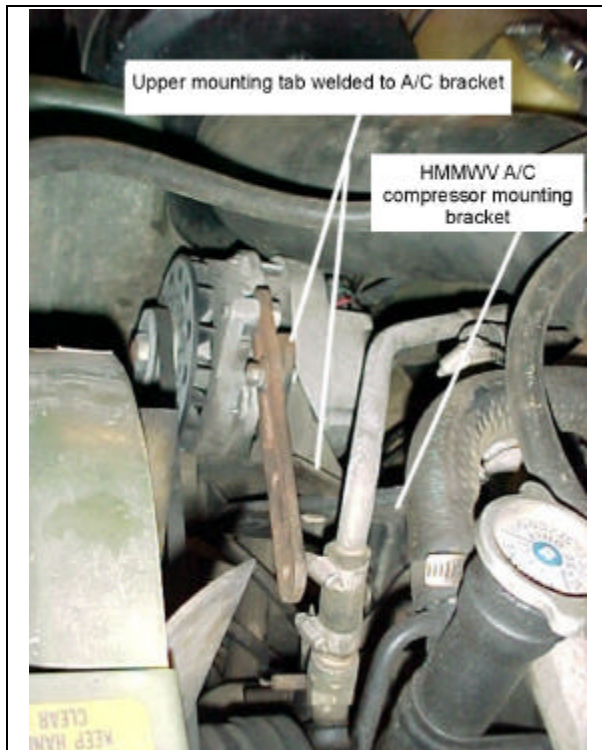


Figure 1 - The upper right side of the engine compartment has an open area suitable for mounting an alternator. Above is a 12 volt alternator mounted to a modified HMMWV compressor bracket.

A HMMWV air conditioner mounting bracket makes a good starting point for making an alternator bracket. Appendix B shows the part number for this component (Item #13 on the drawing.). Its mounting surfaces and holes were made to fit on the engine. The pivot hole used to swivel the compressor for belt tightening also works well as a pivot for alternators. A pivot mounting tab was welded to the bracket to help stiffen and secure the alternator. A steel bar was also added to serve as the upper mounting tab. Several models and photos illustrate this. Figure 2 shows the five main parts of the system. The air conditioner compressor bracket (silver), upper mounting bracket (red), and pivot mounting tab (blue), are welded to form a single weldment. This will be described in more detail later.

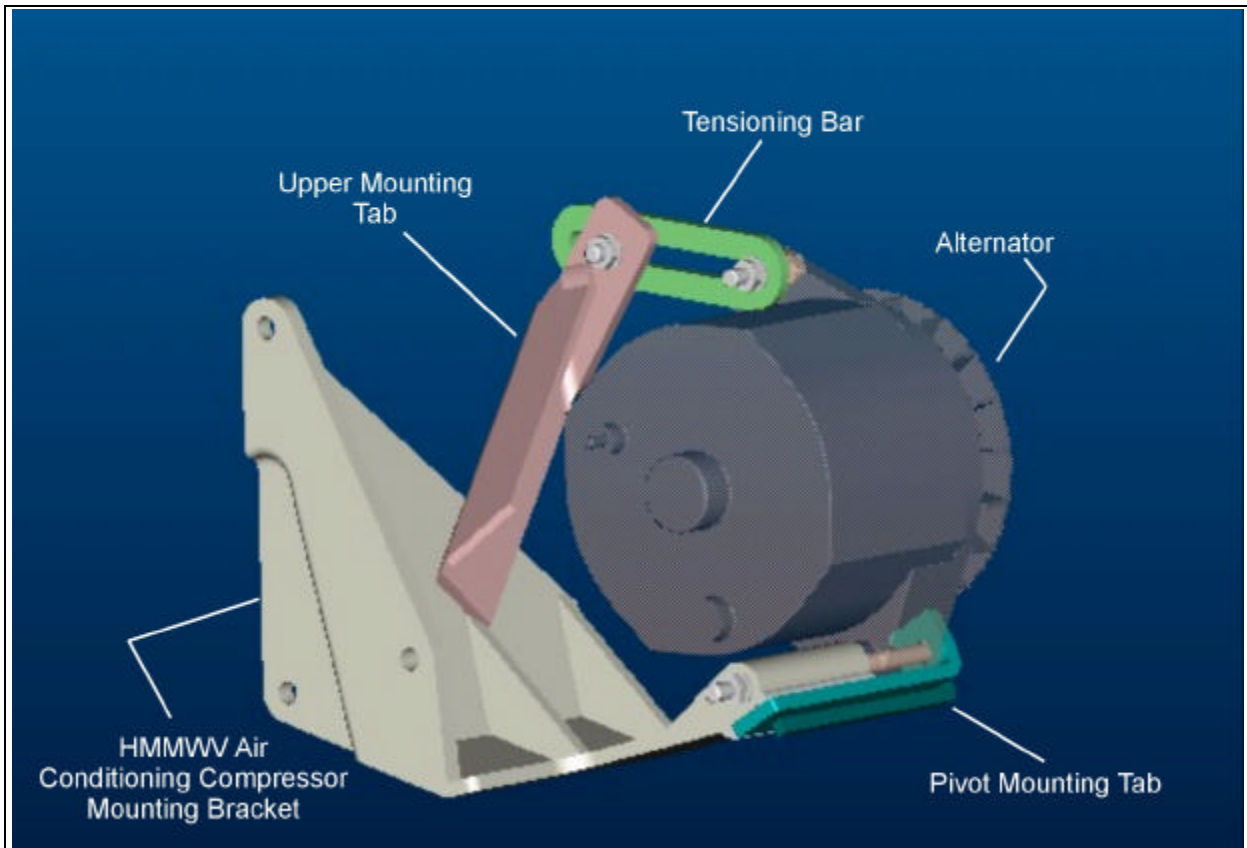


Figure 2 - Rear view model of REC's 12 volt alternator mounting for a HMMWV. The mounting consists of five major parts, shown here. The upper mounting tab, tensioning bar, and pivot mounting tab must be fabricated.

### Drive Pulley

Appendix C shows the fan pulley from the military HMMWV manual drawing. A fifth sheave (Item #21) can be added to the normal four sheave pulley for driving the alternator. This is the sheave that drives the compressor on air conditioner models.

### Tensioning Bar

Make a tensioning bar from steel bar stock. There is not much swing clearance for alternator belt tensioning in the space discussed, hence the bar does not need to be very long. A 3/8 inch wide by 4 inch long slot cut or milled into the center of a 1/4 inch x 1-1/4 inch x 5 inch long steel bar should be adequate.

## Aligning the Belt

Install the drive sheave and the unaltered compressor mounting bracket on the engine. Mount the alternator temporarily to the front face of the compressor bracket pivot hole. Check to see if the drive sheave and alternator pulley are aligned. With the Delco-Remy alternator used by REC, alignment was very close. Achieve alignment by using washers or similar items as shims. Misalignment causes wear that reduces belt life. Wildfire vehicles have relatively low use so some misalignment is tolerable as belt life will be a relatively minor issue. However, aim for the best alignment possible.

## Completing the Mounting Bracket Weldment

With the alternator aligned to the drive sheave, the mounting bracket can be completed. Bolt the tensioning bar to the back of the alternator's tensioning tab. Pivot the alternator midway in its available swing range. Bend an approximate-shaped bar for the upper mounting tab. This might take some trial and error. Use a piece of poster board to estimate and make a template. For the upper mounting tab:

- Drill a mount hole (3/8 inch diameter) located so that it mates with the tensioning bar in a location that allows adequate adjustment.
- Make sure the upper mounting tab will mate with the compressor bracket to which it will be welded.
- The upper mounting tab must have at least 1 inch of overlap with the compressor bracket for adequate weld attachment.
- 1/4 inch x 1-1/4 inch steel bar will make a sturdy base for the piece.
- Add gusset to stiffen the upper mount tab. Make sure that the gusset overlaps the portion welded to the compressor bracket.

Add the pivot mounting tab by bending a 1/4 inch x 1 inch steel bar as shown in Figure 3. This bar will stiffen the alternator pivot, reducing vibration. A stiffener may be required as shown welded to the bottom of the bar.

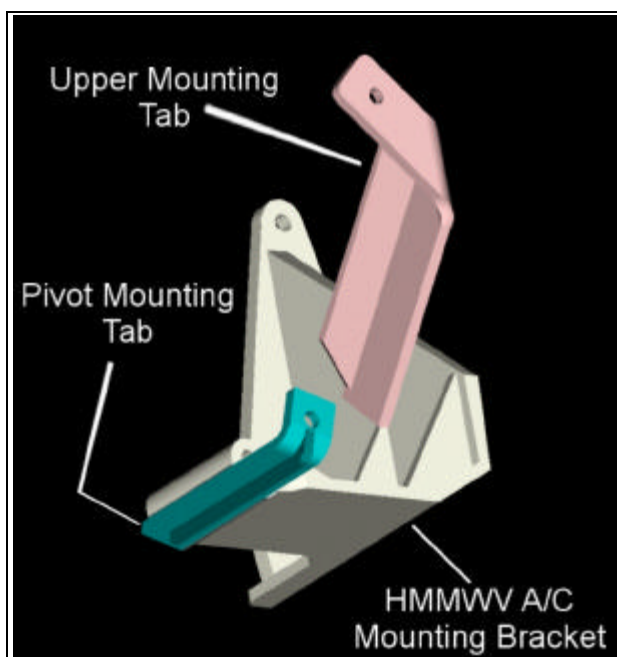


Figure 3. The completed alternator mounting bracket will look like this. The upper mounting tab and pivot mounting tab are welded to a HMMWV air conditioning compressor bracket.

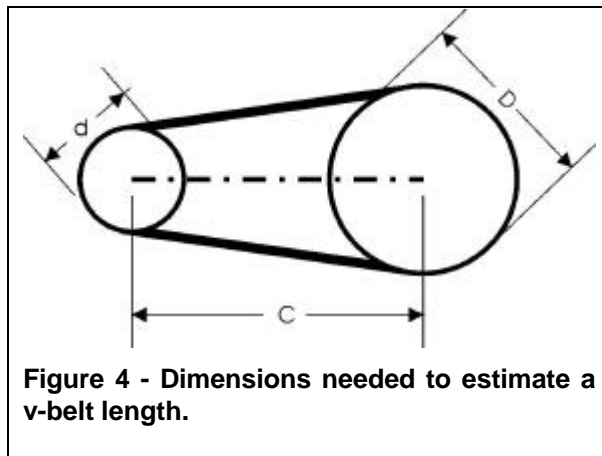
## Belt Sizing

After the alternator mount is welded on the bench, reinstall it and the alternator. The length of the v-belt can be determined using the following equation.

$$L = 2C + 1.57 (D + d) + (D - d)^2/4C$$

Where L = Length of the v-belt.  
C = The center-to-center distance between the pulleys.  
D = Diameter of largest pulley.  
d = Diameter of smallest pulley.

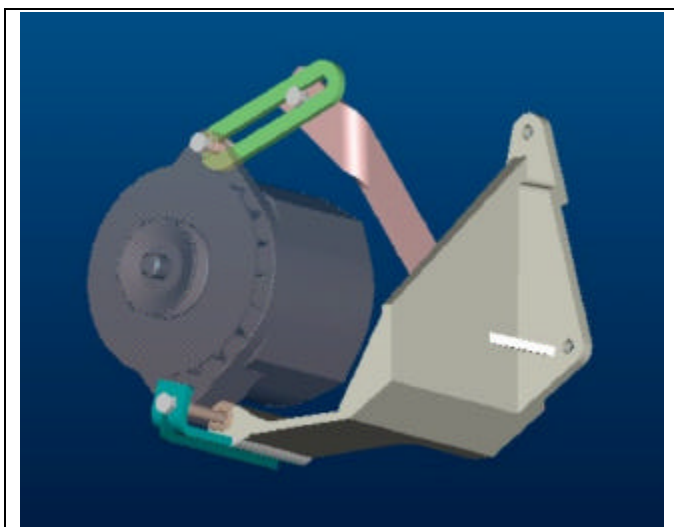
It is not easy to measure the center-to-center distance under the hood. Estimate the distance as close as possible. Get belts a little smaller or larger than the estimate so you can determine the best fit empirically. Install the shortest belt that will work so it can be tightened when it stretches.



**Figure 4 - Dimensions needed to estimate a v-belt length.**

## General

A specific design for the alternator system has been avoided, because exact dimensions will depend on which alternator used. If modifying several vehicles, work out the details on one and from it make templates. Welding fixtures can reduce the time needed to make the others. The cover photo and Figure 5 provide additional views of the assembly.



**Figure 5 - Front quartering view of the alternator bracket. Alternator is shown semi-transparent.**

## Adding a 12 Volt DC Charging Circuit

*Roscommon Equipment Center*  
**Northeast Forest Fire Supervisors**  
*in Cooperation with*  
**Michigan's Forest Fire Experiment Station**

U.S. Military vehicles operate with 24 volt DC electrical systems. Fire departments converting excess military vehicles to fire fighting equipment generally need 12 volt DC to power many of their accessories. REC Project #2, *Wiring Conversion on Military Vehicles*, highlighted several ways to provide 12 volt power. This Newsnote provides an updated look at one of REC Project #2's alternatives, installing an additional and separate 12 volt electrical system.

In many cases it is not practical to change the vehicle's 24 volt system over to 12 volt. The procedure discussed here allows all of the major components of the 24 volt system to stay intact. The engine starter, the ignition system, generator, regulator and the two 12 volt batteries connected in series continue to function as original equipment. The vehicle's 24 volt lighting system may be transferred to the 12 volt system or left alone on a 24 volt system.

Any additional 12 volt loads such as lights (including head, tail, stop, turn, clearance, emergency beacon), two-way radios, electric rewind hose reels, electric pump engine starters can be connected to the separate 12 volt system. The separate 12 volt system components include a 12 volt alternator with a regulator and a 12 volt storage battery.

The major considerations for installing a separate 12 volt system include:

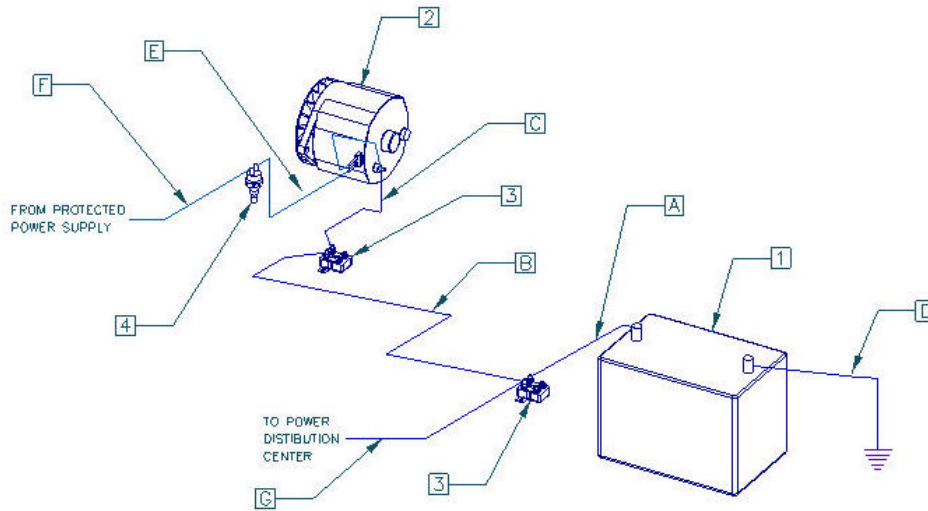
- Finding a space to mount the alternator. The alternator will be driven by a belt. It is desirable to have the alternator drive sheave installed directly on the end of the engine crank shaft. Drive sheaves can be installed on existing alternators, generators, fan or water pump shafts, but this imposes an additional load on the drive belts and bearings of these components that was not originally intended. This may reduce the life of the belts and bearings.

Often an extra sheave is not available and one must be specially machined to fit the crank shaft or drive components shaft.

Normally, automotive alternators have a drive ratio of about 2:1. This means that the alternator RPM is twice as great as the engine RPM. Make sure that you determine the correct drive ratios. For example, if a drive sheave is connected to the existing 24 volt generator shaft which already runs twice as fast as the engine, a 1:1 ratio would be correct.

- Determine the mounting bracket for the 12 volt alternator. It is important to establish good mounting points for the 12 volt alternator mounting bracket. REC has mounting bracket designs for some military vehicles. Make sure your bracket is attached to the engine block or a component attached to the block and that the belt alignment between the drive and driven pulleys is square.
- Completing the 12 volt circuit. An alternator needs an outside source of current to excite its' magnetic field before it can produce current. We suggest connecting a wire from the power distribution panel (fuse or circuit breaker) to the alternator activation terminal.
- Avoiding battery drain. A switch is needed to disconnect the alternator field activation wire to prevent battery drain. You want the 12 volt electrical circuit to be closed only when the engine is operating. This can be done in a number of ways. The preferred method is using an oil pressure switch to close the field activation wire part of the circuit. This is automatic and will close the circuit only when the engine is running. Other alternatives are use the ignition activated circuit or a manual control in which the operator switches on a toggle switch at startup and turns it off in shutdown. While simple to install, the manual toggle switch operation will result in battery drain or other problems if the procedure is forgotten.

The one page diagram on the next page of this report shows a complete 12 volt DC charging circuit and provides additional details.

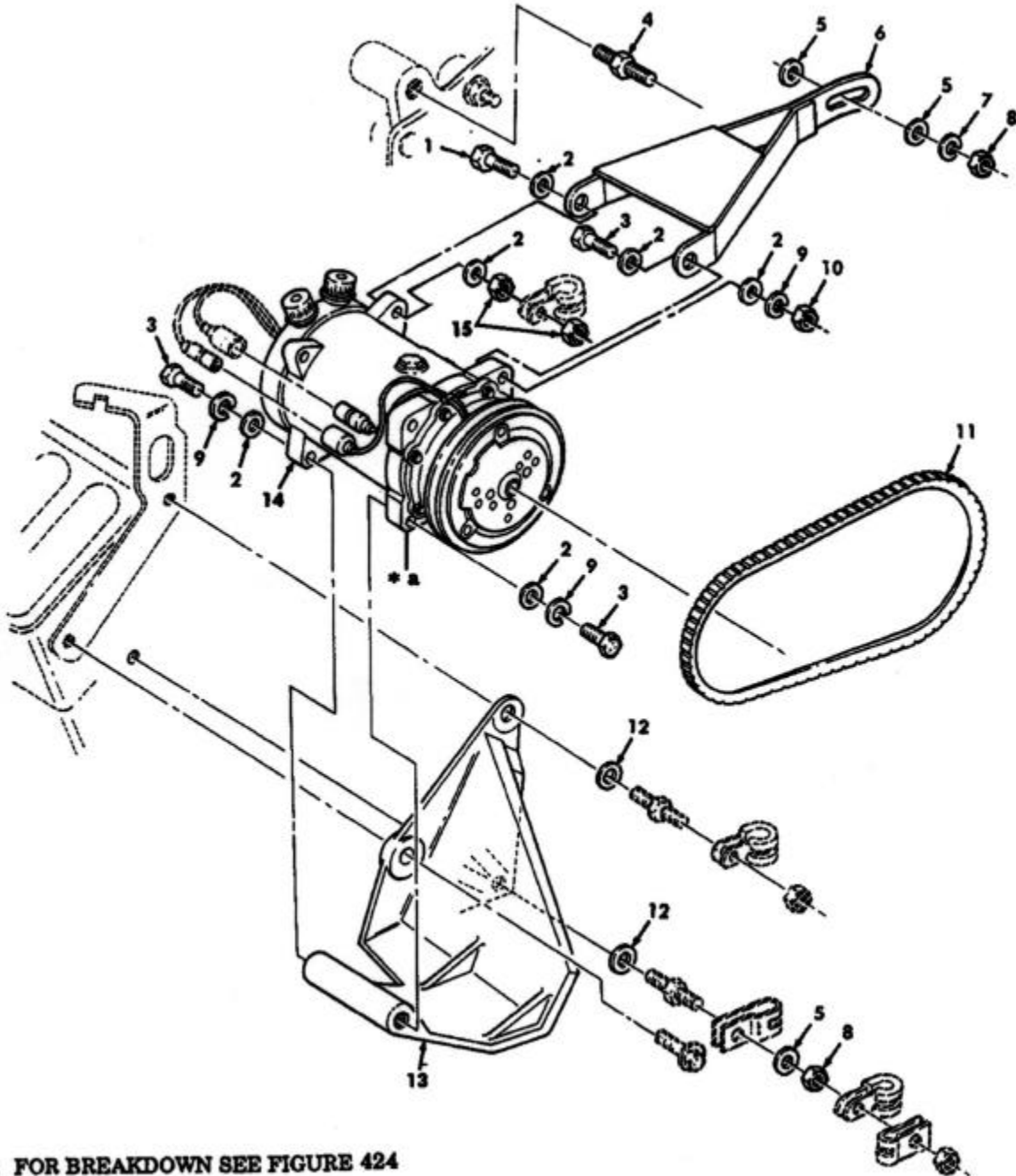


Item	Description	Capacity	Note
A	Charging wire (alternator end)	Cross sectional area sufficient to handle full alternator output.	This section of wire is unprotected unless a fusible link type wire is used. If standard wire is used this section should be kept as short as possible.
B	Charging wire	Cross sectional area sufficient to handle full alternator output.	
C	Charging wire (battery end)	Cross sectional area sufficient to handle full alternator output.	This section of wire is unprotected unless a fusible link type wire is used. If standard wire is used this section should be kept as short as possible.
D	Ground wire	Cross sectional area sufficient to handle the sum of all the loads that may be used at one time.	
E	Alternator Field activation wire	This is a low amperage load usually less than 2 amps. The wire should be sized to handle a load equivalent to the circuits fuse.	If this wire has power and the engine/alternator is not running there will be a small drain on the battery.
F	Power supply for alternator field activation wire	This is a low amperage load usually less than 2 amps. The wire should be sized to handle a load equivalent to the circuits fuse.	In order to install a separate 12VDC system, a power distribution (fuse/circuit breaker) panel should be installed. All accessory circuits including this circuit should be connected to the protected side of this panel. All accessory circuit wiring should be sized to handle an electric load at least 125% of the capacity of the fuse/circuit breaker protecting the circuit (NFPA 1906).
G	Power supply to vehicle accessories	Size equal to the rating of the circuit breaker/fuse in the charging wire circuit. (Item #3)	This wire can be used to power accessories that have an individual electrical demand less than the output of the alternator. If an accessory has a load requirement higher than the alternator output it should be connected directly to the battery with proper short circuit protection.
1	Battery; 12 Volt	Size dependent on electrical component demands.	
2	Alternator; 12 Volt	Size dependent on electrical component demands.	
3	Circuit breaker/Fuse	Size equal to the rating of the alternator.	A circuit breaker or fuse may be used. Two are required because with the engine running there are two power sources, one at each end of the charging wire circuit.
4	Oil pressure switch	Sized to handle a load equivalent to the circuits fuse.	The requirement of this switch is to disconnect the alternator field activation wire to prevent battery drain. This can be done in a number of ways: 1) engine oil pressure switch(Normally Open non-grounded), 2) use an ignition activated circuit, 3) toggle switch turned on by operator at start up and off at shut down, etc.

## Appendix B

SECTION II

TM 9-2320-280-24P-2



• a FOR BREAKDOWN SEE FIGURE 424

Figure 423. Air Conditioner Compressor and Mounting Hardware, M997, M997A1, and M997A2 Ambulance.

SECTION II				(5)	(6)
(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	DESCRIPTION AND USABLE ON CODES(UOC)	QTY
GROUP 52 REFRIGERATION, AIR CONDITIONER, HEATER AND AIR CONDITIONING COMPONENTS 5203 AIR CONDITIONING COMPONENTS					
FIG. 423 AIR CONDITIONER COMPRESSOR AND MOUNTING HARDWARE, M997, M997A1, AND M997A2 AMBULANCE					
1	PAOZZ	80204	B1821BH038C150N	SCREEN, CAP, HEXAGON H 3/8-16 X 1.50..... UOC:A15, B15, H15	1
2	PAOZZ	96906	MS27183-13	WASHER, FLAT 3/8 ..... UOC:A15, B15, H15	7
3	PAOZZ	80204	B18218H038C200N	SCREW, CAP, HEXAGON H 3/8-16 X 2.00 ..... UOC:A15, B15, H15	3
4	PAFZZ	19207	12339406-2	STUD, SHOULDERED#10-1.5 X 30 ..... UOC:A15, B15, H15	2
5	PAFZZ	11862	11502474	WASHER, FLAT #10 ..... UOC:A15, B15, H15	3
6	PAFZZ	19207	12341599	BRACKET, MOUNTING ..... UOC:A15, B15, H15	1
7	PAOZZ	11862	11500207	WASHER, LOCK 10 MM.-..... UOC:A15, B15, H15	1
8	PAOZZ	80204	B18241A100	NUT, PLAIN, HEXAGON #10-1.5 ..... UOC:A15, B15, H15	2
9	PAOZZ	96906	MS35338-46	WASHER, LOCK 3/8 ..... UOC:A15, B15, H15	3
10	PAOZZ	96906	MS51943-35	NUT, SELF-LOCKING, HE 3/8-16..... UOC:A15, B15, H15	1
11	PAOZZ	34623	5598282	BELT, V 3/8 X 43.75 ..... UOC:A15, B15, H15	1
12	PAFZZ	24617	11500324	WASHER, FLAT ϕ10 ..... UOC:A15, B15, H15	2
13	PAFZZ	19207	12339906	BRACKET.MOUNT1N6 ..... UOC:A15, B15, H15	1
14	PAFFF	63829	9140-6000	COMPRESSOR, RECIPROC..... UOC:A15, B15, H15	1
15	PAOZZ	96906	MS51967-8	NUT, PLAIN, HEXAGON 3/8-16..... UOC:A15, B15, H15	2

END OF FIGURE

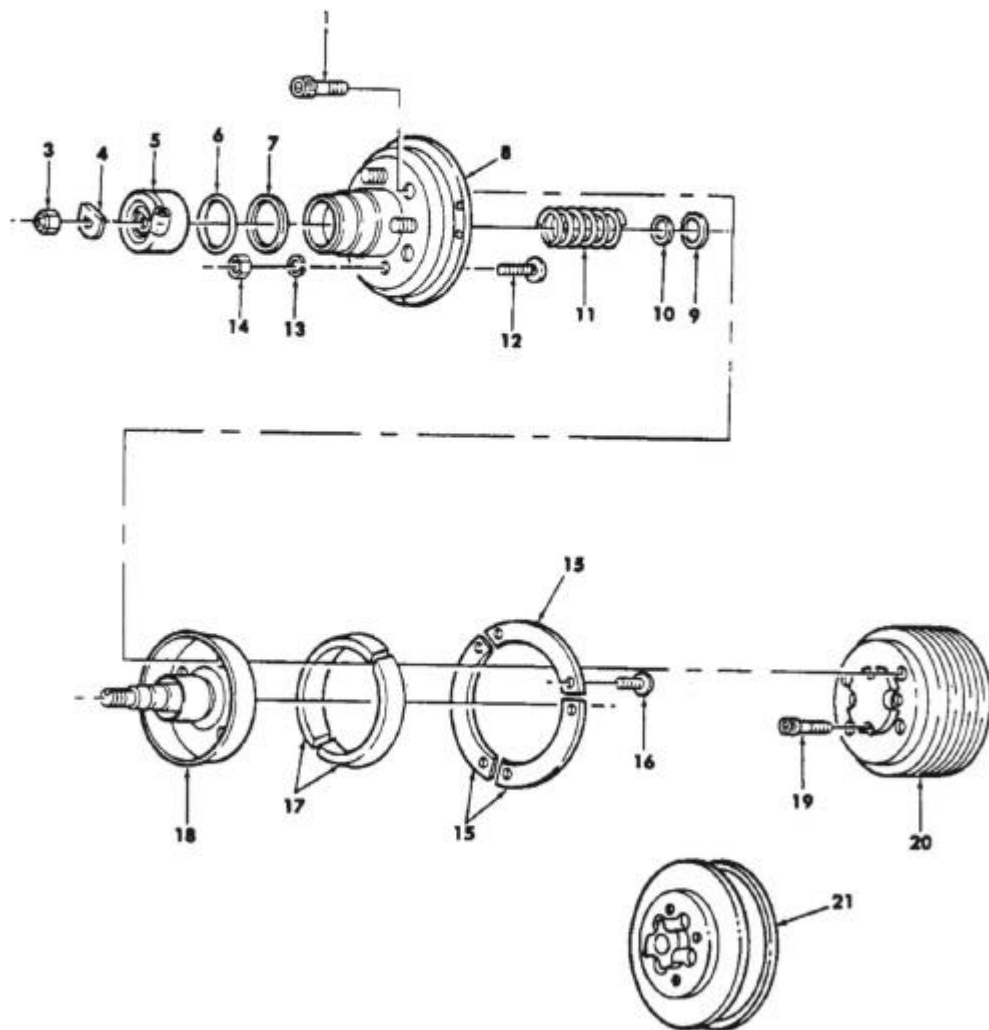
# Appendix C

Section II.

TM 9-2320-280-24P-1

2 — 

3 thru 18
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USE WITH A2 VEHICLES

Figure 31. Fan Drive and Pulley.

## SECTION II

TM9-2320-280-24P-1

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES(UOC)	(6) QTY
GROUP 0505 FAN ASSEMBLY					
FIG. 31 FAN DRIVE AND PULLEY					
1	PAOZZ	24617	138242	SCREW 3/8-16 X 1.00 .....	4
2	PAOFF	51377	1090-06404-01	IMPELLER, FAN, AXIAL.....	1
3	PAFZZ	51377	3029-01371-01	.NUT, SELF-LOCKING, HE.....	1
4	PAFZZ	51377	3058-01264-02	WASHER, FLAT .....	1
5	PAFZZ	51377	4043-38443-01	CYLINDER ASSEMBLY, F .....	1
6	PAFZZ	51377	3018-01265-01	.PACKING, PREFORMED.....	1
7	PAFZZ	51377	3018-01339-01	.DUST SEAL .....	1
8	XAFZZ	51377	4040-38442-01	.HOUSING ASSEMBLY .....	1
9	PAFZZ	51377	9002-00741-58	.PACKING, PREFORMED.....	1
10	PAFZZ	51377	9002-00181-48	.PACKING, PREFORMED.....	1
11	PAFZZ	51377	4088-35869-01	.SPRING, HELICAL, COMP .....	1
12	PAFZZ	51377	3051-01405-01	.STUD, PLAIN 3/8-24 X 1.16 .....	4
13	PAOZZ	96906	MS35338-46	.WASHER, LOCK .....	4
14	PAOZZ	51377	3030-00364-01	.NUT, PLAIN, HEXAGON.....	4
15	XAOZZ	51377	4073-38424-01	.LINING, FAN CLUTCH.....	3
16	PAOZZ	96906	MS16996-10	.SCREW, CAP, SOCKET HE .....	6
17	PAOZZ	51377	4026-38368-01	.LINING, FRICTION .....	2
18	XAFZZ	51377	4079-38441-01	.SHAFT ASSEMBLY .....	1
19	PAOZZ	19207	12339240	SCREW, CAP, SOCKET HE 8-1.25 X 20 MM .....	4
20	PAOZZ	19207	12338782	PULLEY, GROOVE .....	1
				UOC: A15, H15	
20	PAOZZ	19207	12338781	PULLEY, GROOVE .....	1
				UOC: AVY, A11, A13, A14, A20, A24, A25, A26, A27, B16, B17, B18, HVY, H11, H13, H14, H16, H17, H18, H20, H21, H24, H25, H26, H27, H28	
21	PAOZZ	34623	RCSK17073	PULLEY .....	1
				UOC: BVY, B15, B20, B24, B25, C17	

END OF .FIGURE