AIR FORCE

QUALIFICATION TRAINING PACKAGE (AFQTP)

FOR

ELECTRICAL POWER PRODUCTION

(3E0X2)

MODULE 14

GENERAL POWER PRODUCTION TASKS

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MODULE 14

GENERAL POWER PRODUCTION TASKS

Career Field Education and Training Plan (CFETP) references from 1 Aug 02 version.

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(SMSgt Michael A. Trevino)
Supersedes AFQTP 3E0X2-23, 1 Oct 99

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AIR FORCE QUALIFICATION TRAINING PACKAGES
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(3E0X2)

INTRODUCTION

Before starting this AFQTP, **refer to and read the "AFQTP Trainer/Trainee Guide."**

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks*.*

MANDATORY minimum upgrade requirements:

Core task:
AFQTP completion
Hands-on certification

Diamond task:
AFQTP completion
CerTest completion (80% minimum to pass)

Note*: Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location*.

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOF revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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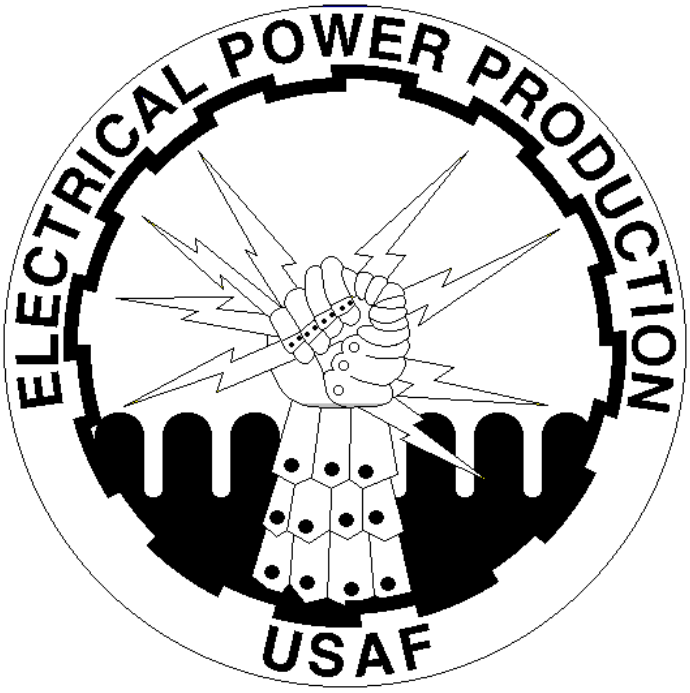
Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.



BATTERY CHARGERS

MODULE 14 AFQTP UNIT 5

TROUBLESHOOT (14.5.2.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

TROUBLESHOOT BATTERY CHARGERS

Task Training Guide

STS Reference Number:	14.5.2., Troubleshoot Battery Chargers.
Training References:	1. Career Development Course (CDC) 3E052B, Vol. 1, Sect. 008. 2. 35 series Technical Orders (TOs). 3. Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-45, *Hazardous Energy Control and Mishap Prevention Signs and Tags.* 4. Manufacturer's manuals.
Prerequisites	1. **Possess, as a minimum a 3E032 AFSC.** 2. **Review the following references:** 2.1. CDC 3E052B, Vol. 1, Sect. 008. 2.2. AFOSHSTD 91-45 for lockout/tag out procedures. 2.3. Applicable technical order or manufacturers manual.
Equipment/Tools Required:	1. Multimeter. 2. Stationary Battery Charger.
Learning Objective:	Troubleshoot basic static battery charger faults and conditions.
Samples of Behavior:	Trainee will be able to successfully troubleshoot basic battery charger faults and conditions.
Notes:	
1. Prior to performing any maintenance, technician **MUST** isolate the starting system, and apply lock-out/tag-out procedures. 2. Any safety violation will constitute automatic failure.	

TROUBLESHOOT BATTERY CHARGERS

1. Background: An important part of the Power Production career field is being able to maintain the working integrity of the generator set and its related equipment. In order to keep the unit running in top-notch condition; a few minutes spent inspecting the batteries and battery chargers before each generator run could mean the difference between 100% power reliability, or answering why it didn't start. Troubleshooting the battery charging system is the only way to get to the root of your starting woes. The following basic troubleshoot tips cover expedient contingency scenarios where depot level maintenance to chargers is not warranted!

2. As a general rule of thumb, most chargers usually have several different charging rates, which may be selected/adjusted manually or automatically. Paying close attention to what rate the batteries are being charged will prevent possible damage to the batteries. Example: If the batteries are overcharged, it will cause the cells to dry and damage the battery. On gel-cell batteries, it will cause the side to expand and possibly explode. The only time a charger should read anything over two amps is upon initial engine start-up, after long periods of drain (cranking, etc.) or if on the "equalize" setting.

SAFETY:

BEFORE TROUBLESHOOTING BATTERY CHARGERS, TREAT ALL AC INPUT AND DC OUTPUT CIRCUITS, AS THEY WERE LIVE. TAKE OFF ALL WATCHES, RINGS, AND JEWELRY! THIS IS A POTENTIALLY DANGEROUS SOURCE OF ELECTRICITY, AND SHOULDN'T BE TAKEN LIGHTLY!

3. Basic troubleshooting steps: The five basic troubleshooting steps of any electrical circuits and components are as follows:

3.1. Perform operational check.

3.2. Analyze malfunction.

3.3. Locate malfunction.

3.4. Perform corrective action.

3.5. Perform operational check.

4. We will discuss three major categories of battery chargers: stationary; engine-driven; and solar. However, the stationary battery charger will probably be the only one that you will troubleshoot, since depot level maintenance on engine-driven and solar are usually not cost effective besides replacing fuses.

4.1. Stationary. Stationary battery chargers are used for the sole purpose of keeping batteries at their peak amp-capacity. That is to say the batteries are kept fully charged for their next use, whether it be for starting an engine, powering a Uninterruptible Power System (UPS); or powering the controls on a generator (MEP-012, or air-start engines). Stationary battery chargers use an external AC power source as input power, typically 120VAC. The batter charger in-turn converts the input voltage to the required output DC voltage and DC amperage. The amperage is dictated by the desired charging rate.

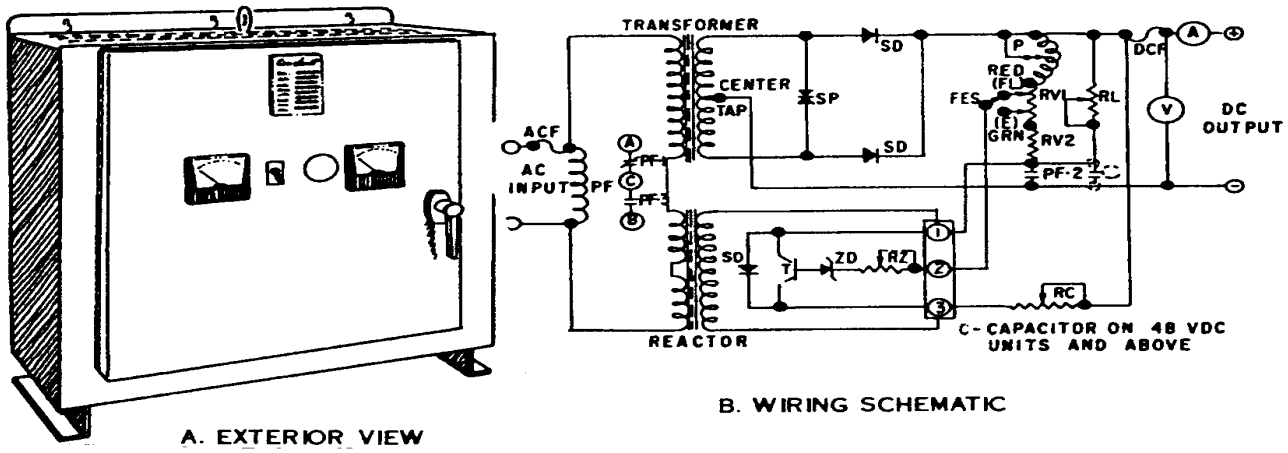
4.1.1. Some of the equipment and modes of the stationary battery chargers (Figure 1) that should be briefly explained are:

4.1.1.1. Voltmeter: this meter indicates the output voltage of the battery charger.

4.1.1.2. Ammeter: amperage needed to charge the battery to a particular voltage.

4.1.1.3. Float mode: normal charging mode of the battery charger.

4.1.1.4. Equalize mode: higher level of charge used to eliminate any charge level differences among the individual cells of the batteries.



Self-contained battery charger and schematic.

Figure 1. Self Contained Battery Charger and Schematic

4.1.2. Repair any of the components or conditions listed in the troubleshooting chart (next page) within what is financially reasonable (<75% of replacement cost of the unit), or replace charger. After repairing the unit, or replacing the entire charger, perform an operational check to avoid further failures.

TROUBLESHOOTING CHART FOR STATIONARY BATTERY CHARGER

Trouble	Possible Cause	Corrective Action
No DC output.	1. Blown DC fuse.	1. Correct possible overload and replace fuse (be sure to use fuse with same ratings).
	2. Blown AC fuse.	2. Replace fuse (be sure to use fuse with same ratings).
	3. No AC input.	3. Check for tripped circuit breaker for AC input.
	4. Defective wiring or connections.	4. Replace wiring or terminal.
	5. Defective power switch.	5. Replace switch.
	6. Defective transformer.	6. Secondary output voltage for 12 vdc should be between 11.5-14.5 vdc; 24 vdc should be between 23-29 vdc. Replace if defective.
	7. Defective rectifier.	7. Use ohmmeter to check diode(s). Resistance must be high in one direction, and low in the opposite direction. Replace if defective.
	8. Defective control rectifier (SCR).	8. Check by replacement.
	9. Defective regulator assembly.	9. Check by replacement.
Low DC output.	1. Incorrect float or equalize voltages	1. Adjust to proper settings.
	2. Faulty battery	2. Replace battery.
	3. Charger failure	3. Refer back to #6,7,8,and 9 of “no DC output”.
High DC output.	1. Incorrect float or equalize voltages	1. Adjust to proper settings.
	2. Charger failure	2. Refer back to #6,7,8,and 9 of “no DC output”.
Float charge rate only.	1. Defective equalizer timer	1. Check timer contacts open when timer is operating. Replace if defective.
	2. Defective regulator assembly	2. Check by replacement.
Equalize charge rate only.	Defective equalize timer	Check timer contacts close when timer is not operating. Replace if defective.

4.2. <u>Engine-Driven</u>. Engine-driven battery chargers (Figure 2 and 3) are mounted on the prime mover to keep the start and control batteries at their peak amp-capacity. In today's machines these devices are more often referred to as battery charging alternators. They use the battery's power to provide the field strength to the rotating magnetic field (rotor). The AC output of the alternator is then rectified into DC for use in the engine control circuits. Typically an internal voltage regulator varies the DC output depending upon need. The engine-driven battery charging alternator also serves to power the DC control circuit while the engine is running. This way, the batteries are not being constantly drained and charged at the same time, which would decrease their life expectancy tremendously. Many of these battery-charging alternators (see below) have an internal voltage adjust rheostat, which allows for minor adjustments to be made. *Note adjustment screw in Figure 3*

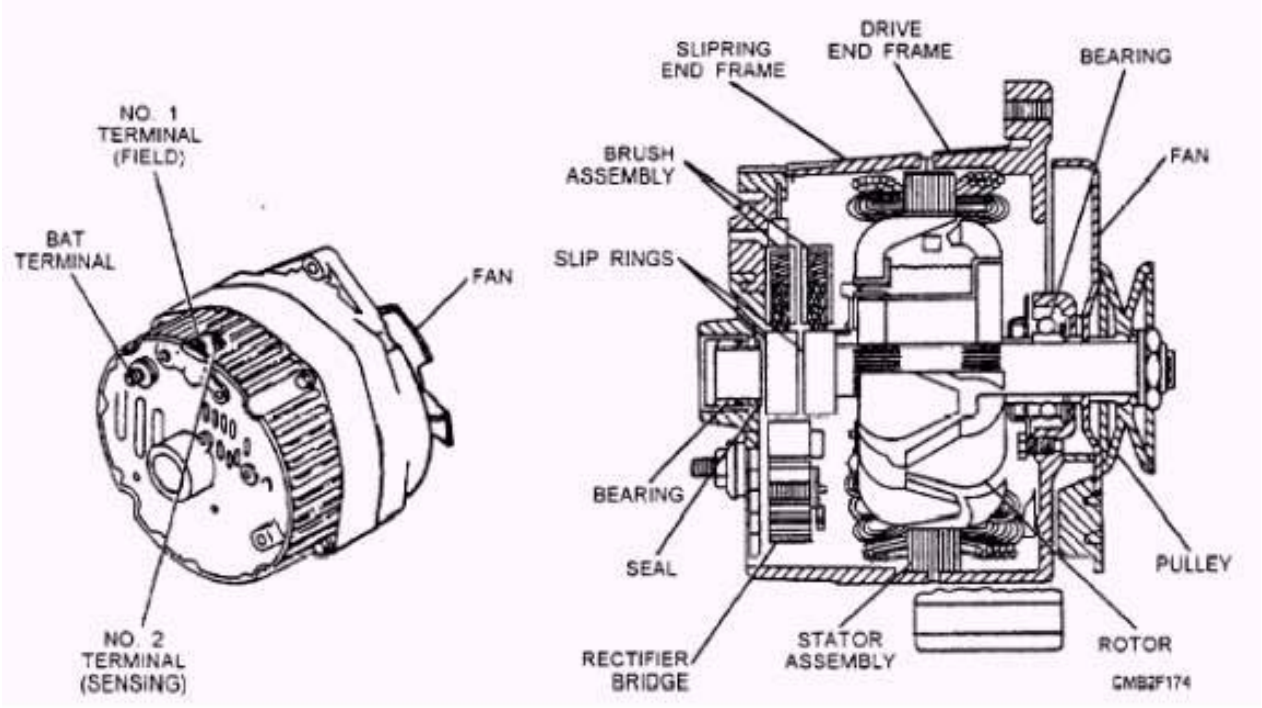
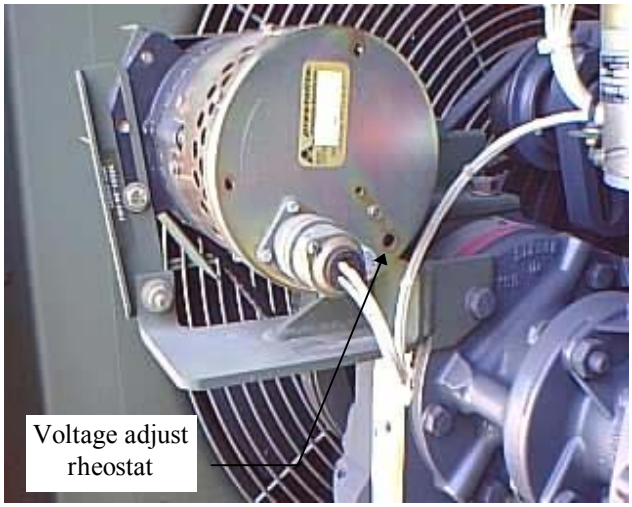


Figure 2. Engine Driven Battery Charging Alternator



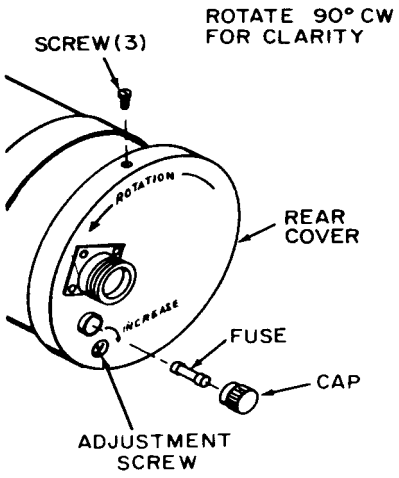


Figure 3. Engine Driven Battery Charging Alternator

4.2.1. Along with the basic troubleshooting steps you need to verify the following:

4.2.1.1. All wiring free of wear, frays, and defects.

4.2.1.2. Proper input/output voltage and amperage meter readings and adjust accordingly with multimeter and DC clamp-on ammeter. Turn adjustment screw clockwise to increase battery voltage setting.

4.2.1.3. Fuses for continuity and proper amperage rating.

4.2.1.4. All electrical connections are clean, free of corrosion, tight, and serviceable.

4.2.1.5. Enclosure is free of dust, dirt, corrosion and moisture.

4.2.1.6. Belt tension set to 1/2” deflection. Lack of tension leads to loss of charging rate.

4.2.1.7. Belt sheave (pulley) properly installed and free of nicks, burrs, and dents.

4.2.2. Repair any of the above components or conditions within what is financially reasonable (<75% of replacement cost of the unit), or replace charger. After repairing the unit, or replacing the entire charger, perform an operational check to avoid further failures.

4.3. Solar-Powered. Solar-powered battery charger (Figure 3) is one of the latest forms of battery chargers. They were developed to keep the batteries at their peak amp-capacity by utilizing the light from the sun to charge the batteries. The sunlight will cause the molecules of the solar panel to excite, creating an electric field used for charging. Usually the size of the solar panel dictates the amount of amperage that can charge a battery. The charge for a typical charger will vary from 50 to 500 milliamps, depending on its size, and the intensity of the sun. The more sophisticated chargers will have a commercial backup source for night-time charging, and a desulfator to keep charging bi-products from “choking” the battery, and keeping the batteries as charged as possible.

Figure 4. Solar Powered Battery Charger

SAFETY:

BEFORE WORKING ON THE BATTERY CHARGER, MAKE SURE THAT ALL POWER IS ISOLATED FROM THE CHARGER. THE SOLAR PANEL HAS TO BE FULLY DARKENED AND THE DC GOING TO THE BATTERIES NEEDS TO BE DISCONNECTED TO PREVENT BACK-FEEDING. THIS IS A POTENTIALLY DANGEROUS SOURCE OF ELECTRICITY, AND YOU SHOULDN'T TAKE IT LIGHTLY!

4.3.1. As with the previous battery chargers, troubleshooting a solar battery charger involves verifying the following:

4.3.1.1. All wiring free of wear, frays, and defects.

4.3.1.2. Corrosion and cleanliness of the solar panel and monitor group.

4.3.1.3. All electrical connections are clean, tight, and serviceable.

4.3.2. Repair any of the above components or conditions within what is financially reasonable (<75% of replacement cost of the unit), or replace charger. After repairing the unit, or replacing the entire charger, perform an operational check to avoid further failures.

NOTE TO TRAINER:

Trainer/Certifier must provide equipment and scenario for troubleshooting battery chargers in order to complete task. Use the previous troubleshooting chart for guidelines if needed.

5. ***To perform this task, follow these steps:***

Step 1. Trainee is provided equipment and scenario in which to perform task.

Step 2. Use five-step process in troubleshooting:

2.1. Perform an operational check.
2.2. Analyze the malfunction.
2.3. Locate the malfunction.
2.4. Perform corrective action.
2.5. Perform an operational check.

REVIEW QUESTIONS
FOR
TROUBLESHOOT BATTERY CHARGERS

QUESTION	ANSWER
1. What could be a possible cause of no DC output from the static battery charger?	a. Incorrect float adjustment. b. Faulty battery. c. Blown AC fuse. d. Belt tension too loose.
2. Which type of battery charger is used with UPS systems?	a. Solar. b. Stationary. c. Engine-driven. d. Portable.
3. What do you check a fuse for on most battery chargers?	a. Continuity. b. Amperage rating. c. Voltage rating. d. All the above.
4. During an inspection, you discover the batteries are dry, what could be the possible cause?	a. Broken battery charger. b. Low charging rate. c. High charging rate. d. Battery charger is off.
5. What do you check when inspecting an engine driven battery charger drive belt?	a. Belt tension set to 1/2” deflection. b. Belt sheaves (pulley) properly installed and free of nicks, burrs, and dents. c. Correct manufacturer. d. Both a and b.

TROUBLESHOOT BATTERY CHARGERS

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

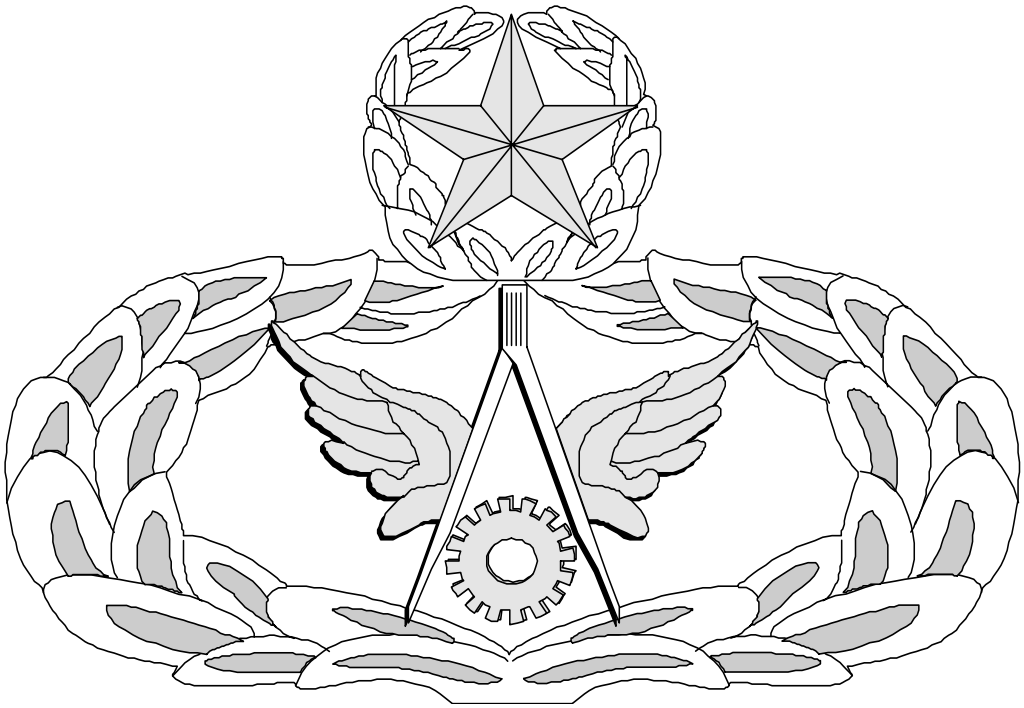
DID THE TRAINEE….?	YES	NO
1. Have the proper equipment and scenario to perform task		
2. Perform an operational check		
3. Analyze the malfunction		
4. Locate the malfunction		
5. Perform corrective action		
6. Perform an operational check		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

ANSWER KEY



FOR

POWER PRODUCTION

(3E0X2)

MODULE 14

GENERAL POWER PRODUCTION TASKS

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TROUBLESHOOT
(3E0X2-14.5.2.)

Question	Answer
1. What could be a possible cause of no DC output from the static battery charger!	c. Blown AC fuse.
2. Which type of battery charger is used with UPS systems?	b. Stationary.
3. What do you check a fuse for on most battery chargers?	d. All the above.
4. During an inspection, you discover the batteries are dry, what could be the possible cause?	c. High charging rate.
5. What do you check when inspecting an engine driven battery charger drive belt?	d. Both a and b.

MEMORANDUM FOR HQ AFCESA/CEOF
139 Barnes Drive Suite 1
Tyndall AFB, FL 32403-5319

FROM:

SUBJECT: Qualification Training Package Improvement

1. Identify module.

   Module # and title_____

2. Identify improvement/correction section(s):

   _____ STS Task Reference
   _____ Training Reference
   _____ Evaluation Instructions
   _____ Performance Resources
   _____ Steps in Task Performance
   _____ Performance Checklist
   _____ Feedback
   _____ Format
   _____ Other

3. Recommended changes--use a continuation sheet if necessary.

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

4. You may choose to call in your recommendations to DSN 523-6392 or FAX DSN/Commercial 523-6488 or (850) 283-6488 or email ceof.helpdesk@tyndall.af.mil.

5. Thank you for your time and interest.

YOUR NAME, RANK, USAF
Title/Position