

# AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)



FOR  
ELECTRICAL POWER PRODUCTION  
(3E0X2)  
MODULE 18  
ENGINE DC ELECTRICAL SYSTEM

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

OPR: HQ AFCESA/CEOF  
 (SMSgt Michael A. Trevino)  
 Supersedes AFQTP 3E0X2-15, 1 Oct 99

Certified by: HQ AFCESA/CEOF  
 (CMSgt Myrl F. Kibbe)  
 Pages: 26/Distribution F

**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.

**AIR FORCE QUALIFICATION TRAINING PACKAGES  
FOR  
ELECTRICAL POWER PRODUCTION  
(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:**

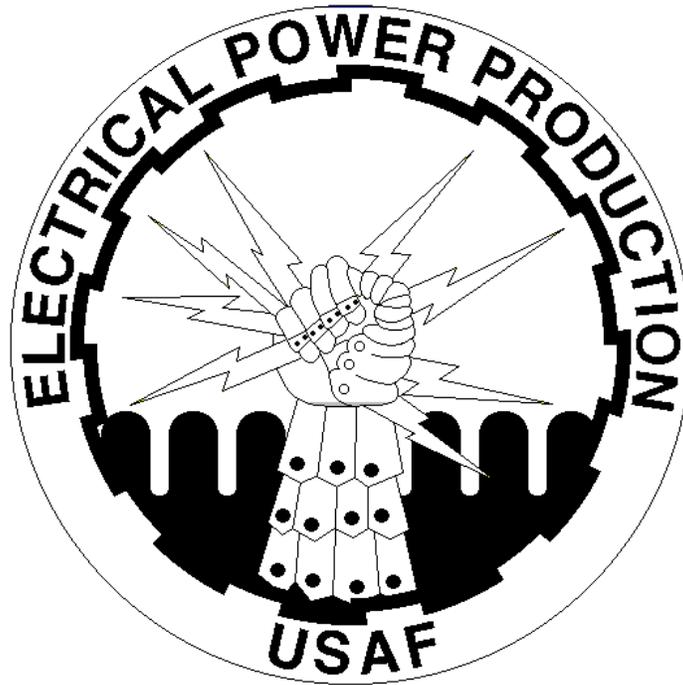
AFQTP completion  
CerTest completion (80% minimum to pass)

**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.

HQ AFCESA/CEOF  
139 Barnes Dr. Suite 1  
Tyndall AFB, FL 32403-5319  
DSN: 523-6392, Comm: (850) 283-6392  
Fax: DSN 523-6488  
E-mail: [ceof.helpdesk@tyndall.af.mil](mailto:ceof.helpdesk@tyndall.af.mil)

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## ENGINE DC ELECTRICAL SYSTEM

MODULE 18

AFQTP UNIT 2

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TROUBLESHOOT (18.2.)

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**TROUBLESHOOT ENGINE DC ELECTRICAL SYSTEM**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	18.2., Troubleshoot Engine DC Electrical System.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. <a href="#">35C2 series Technical Order (TO)</a>.</li> <li>2. Career Development Course (CDC) 3E052A, Vol. 2, Sect. 221: <i>Troubleshooting Procedures</i>.</li> <li>3. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Engine Start Systems</i>.</li> <li>4. Manufacturer's Manuals.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess, as a minimum 3E052 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. CDC 3E052A, Vol. 2, Sect. 221.</li> <li>2.2. Applicable TO and/or Manufacturer's Manuals.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1, Mar 00: <i>Engine Start Systems</i>.</li> <li>3.2. AFQTP 3E9X1 Module 13: <i>Electrical Power Production Tools and Test Equipment</i>.</li> <li>3.3. AFQTP 3E9X1 Module 15: <i>Electrical Fundamentals, Unit 11: Troubleshoot Electrical Circuits</i>.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Computer to support AFQTP CD-ROMs.</li> <li>2. General tool kit.</li> <li>3. Multimeter.</li> <li>4. Generator.</li> </ol>
<b>Learning Objective:</b>	The trainee will know the basic steps required to safely troubleshoot the electric start system.
<b>Samples of Behavior:</b>	<ol style="list-style-type: none"> <li>1. Isolate the components of the crank and start circuits.</li> <li>2. Inspect and eliminate common malfunctions associated with electric start systems.</li> </ol>
<b>Notes:</b>	
<ol style="list-style-type: none"> <li>1. To successfully complete this element, follow the steps outlined in the applicable technical manual exactly--no exceptions.</li> <li>2. The MEP-007B was used in this AFQTP to train the "concept of troubleshooting" and not the "right or wrong" procedures for troubleshooting. Knowledge of the circuitry and equipment you are working on is the key to isolating and correcting start circuit or any other electrical malfunctions.</li> <li>3. Prior to performing any maintenance, technician <b><u>MUST</u></b> isolate the starting system, and apply lockout and tag-out procedures</li> <li>4. Any safety violation is an automatic failure.</li> </ol>	

**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 ENGINE DC ELECTRICAL SYSTEM

**1. Background:** The Direct Current (DC) voltage required to start the generator and supply control voltage comes from the battery or batteries. This makes batteries one of the most crucial parts within the start circuit. Good maintenance and upkeep are essential to eliminating potential battery problems. Climatic conditions can affect the state of charge a battery will maintain. Cold weather starts drain batteries more quickly than in warmer climate conditions.

**1.1.** The crank and start circuit covered in this AFQTP is a 24-volt DC electrical circuit. The trainees will gain the critical knowledge and skills necessary from studying and tracing the circuitry to apply to other troubleshooting scenarios.

**1.2.** Since troubleshooting is a step-by-step procedure, the effectiveness depends on how much you know about the equipment and how much you think while working. The ability to troubleshoot depends on your capability to think and apply knowledge. To troubleshoot effectively, you must follow a systematic procedure. First, study the symptoms of the trouble thoroughly and ask yourself these questions:

**1.2.1.** What were the warning signs preceding the trouble?

**1.2.2.** What recent repair has been done?

**1.2.3.** Has a similar trouble occurred before?

**1.3.** Next, follow the basic troubleshooting procedures:

**1.3.1.** Perform an operational check.

**1.3.2.** Analyze the malfunction.

**1.3.3.** Locate the malfunction.

**1.3.4.** Perform corrective action.

**1.3.5.** Perform an operational check.

**2. Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Engine Start Systems. Upon completion of the above-mentioned CD-ROM properly troubleshoot an engine start system using the step-by-step procedures listed below.**

**NOTE:**

The review questions for this material are contained in the above-mentioned CD-ROM.

**NOTE TO TRAINER:**

1. This task requires a engine start system in need of maintenance. There is no feasible way to identify what specific type of start system.

2. If no malfunctioning equipment is available you must provide a training scenario to the trainee on the problem(s) you want him/her to solve.

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

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

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**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.

**Step 3: Document maintenance on AF Form719.**

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## TROUBLESHOOT ENGINE DC ELECTRICAL SYSTEM

### PERFORMANCE CHECKLIST

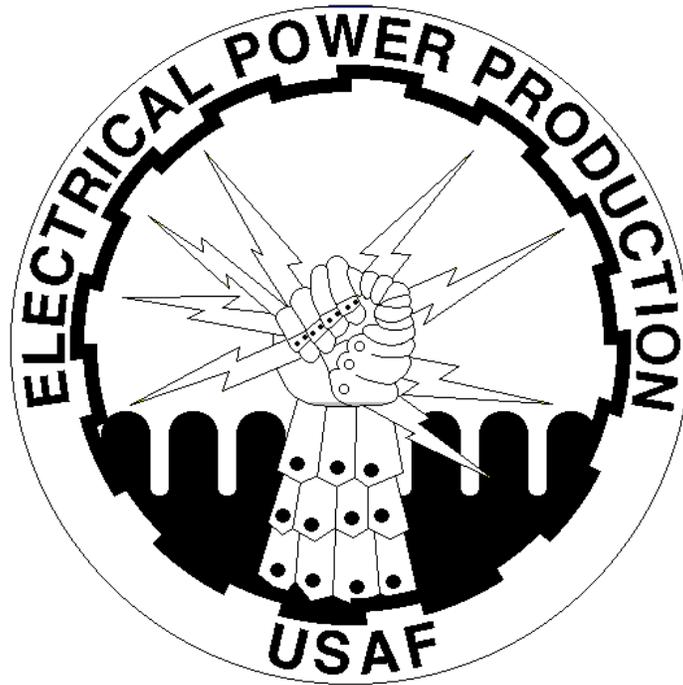
#### INSTRUCTIONS:

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

<b>DID THE TRAINEE....?</b>	<b>YES</b>	<b>NO</b>
1. Have equipment and scenario available 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		
7. Document maintenance action on AF Form 719		
8. Comply with all safety requirements		

**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.

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## ENGINE DC ELECTRICAL SYSTEM

### REPLACE

MODULE 18

AFQTP UNIT 4

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### BATTERY CHARGING-ALTERNATOR (18.4.1.)

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**REPLACE BATTERY-CHARGING ALTERNATOR**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	18.4.1., Replace battery-charging alternator.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. <a href="#">35C2 series Technical Order (TO)</a>.</li> <li>2. Career Development Course (CDC) 3E052B, Vol. 1, Sect. 007: <i>Types of Starting Systems</i>.</li> <li>3. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Engine Start Systems</i>.</li> <li>4. <a href="#">Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-45, Hazardous Energy Control and Mishap Prevention Signs and Tags</a>.</li> <li>5. <a href="#">AFI 32-1062, Electrical Power Plants and Generators</a>.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess, as a minimum, 3E032 AFSC.</b></li> <li>2. <b>Review the following:</b> <ol style="list-style-type: none"> <li>2.1. CDC 3E052B, Vol. 1, Sect. 007.</li> <li>2.2. Applicable TO and/or Manufacturer's Manual.</li> <li>2.3. AFOSHSTD 91-45 for lockout/tag-out procedures.</li> </ol> </li> <li>3. <b>Complete CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Engine Start Systems</i>.</b></li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Computer to support AFQTP CD-ROM.</li> <li>2. General tool kit.</li> <li>3. Personal safety equipment.</li> <li>4. MEP-007B.</li> </ol>
<b>Learning Objective:</b>	Replace battery-charging alternator.
<b>Samples of Behavior:</b>	<ol style="list-style-type: none"> <li>1. The trainee will ensure circuit has been de-energized prior to removal, and utilize the Lockout/Tag out procedures.</li> <li>2. Trainee will ensure the replacement component is the same specification as the original item.</li> <li>3. Trainee will remove and install a battery-charging alternator.</li> </ol>
<b>Notes:</b>	<ol style="list-style-type: none"> <li>1. To successfully complete this element follow the steps outlined in the applicable technical manual exactly--no exceptions.</li> <li>2. Prior to performing any maintenance, technician <b>MUST</b> isolate the starting system, and apply lockout and tag-out procedures.</li> <li>3. Any safety violation is an automatic failure.</li> </ol>

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## REPLACE BATTERY-CHARGING ALTERNATOR

**1. Background:** The battery provides power to start the engine, however, the alternator provides power to charge the battery as well as provides power to operate electrical systems. The charging system includes the battery, alternator, voltage regulator, connecting wires and cables and all associated electrical loads in the system. The charging system recharges the batteries as needed and also provides the current to power the electrical loads in the system. It does this by converting part of the engines mechanical energy into electrical energy.

**1.1.** As electrical loads drain the battery, its voltage drops. When the voltage falls below a certain level, an electrical switch called the voltage regulator turns on the alternator. The alternator produces electric current and sends it to the battery to restore voltage to the required levels. More specific operations of a MEP series battery-charging alternator are as follows: DC alternator G2 generates a DC voltage when the engine is operating. This voltage, applied through a regulator, which is part of G2, keeps both batteries in a fully charged state. The 24-volt field voltage for G2 is coupled through the contacts of relay K1 and steering diode CR6. Consequently, the G2 field disconnects when the engine is in the process of shutting down, thereby preventing possible alternator damage. Most alternators work on the same basic theory, however the electrical circuit will vary is design.

**1.2.** Sometimes when troubleshooting, the problem cannot be identified down to the component, but to the assembly. When in the field, you might change the component or the entire assembly. The availability of spare parts can be a major factor in determining your course of action. Prior to removing the component, tag your leads to ensure they are reconnected properly. Pay special attention to part numbers, model numbers, serial numbers, manufacturer's number, etc. This ensures the item being replaced is of the same specification as the defective part. This also saves heartache by ordering the wrong item through the supply system or wasting time trying to install an item that doesn't fit or function properly. Never modify generators or other equipment unless authorized by an approving authority. If you have a cost saving idea or a more efficient way of doing an operation, submit your suggestions on an AF Form 1000 for approval or an AFTO 22 for a TO correction.

**1.3.** This AFQTP has been developed using the MEP-007B as a model. Equipment may vary slightly, but the procedures are basically the same for replacing battery-charging alternators.

**2. Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Engine Start Systems. Upon completion of the above-mentioned CD-ROM properly replace battery-charging alternator using the step-by-step procedures listed below.**

### **SAFETY:**

**PRIOR TO REPLACING THE BATTERY-CHARGING ALTERNATOR, YOU MUST MAKE SURE THE UNIT WILL NOT START AUTOMATICALLY. YOU MUST ALSO DE-ENERGIZE THE DC CIRCUIT BREAKER AND PLACE THE BATTLE SHORT SWITCH IN THE RAISED POSITION. THESE ACTIONS ARE REQUIRED TO KEEP THE ENGINE FROM STARTING DURING REPLACEMENT.**

**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.

**NOTE TO TRAINER:**

1. This task requires a generator in need of battery-charging alternator maintenance.
2. If no malfunctioning equipment is available you must provide a training scenario to the trainee on the problem (battery-charging alternator) you want him/her to solve.

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

**Step 1: Isolate the engine from starting using lockout/tag-out procedures.**

- 1.1. Refer to AFOSH STD 91-45.

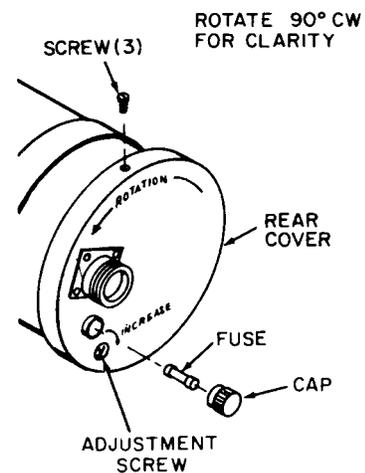
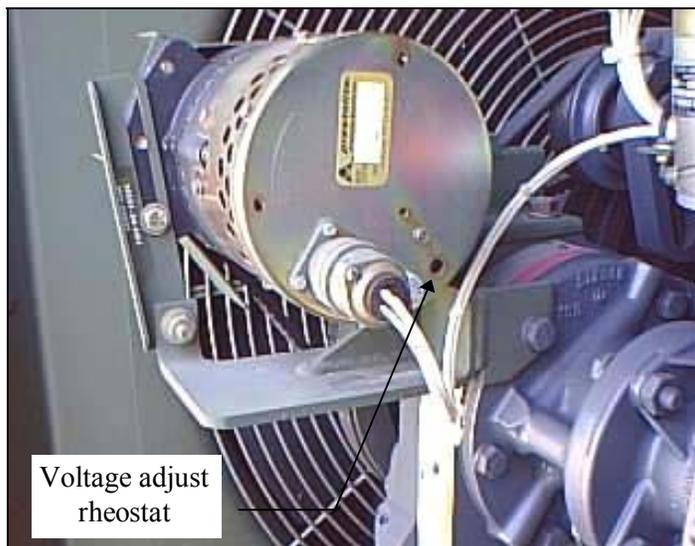
**Step 2: Replace battery-charging alternator**

- 2.1. Refer to applicable TO or manufacturer manual.

**Step 3: Reconfigure engine for operation.**

**Step 4: Perform a functional test.**

**Step 5: Document maintenance on AF Form 719.**



**Figure 1. Typical Battery-Charging Alternator**

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**REVIEW QUESTIONS  
FOR  
REPLACE BATTERY-CHARGING ALTERNATOR**

<b>QUESTION</b>	<b>ANSWER</b>
1. What component of the battery-charging system keeps the battery charged?	a. Voltage regulator. b. Starter. c. CR2. d. Alternator.
2. As electrical loads drain the battery, it's voltage does what?	a. Increase. b. Decreases. c. Stabilizes. d. Equalizes.
3. What method used by the alternator charges the batteries?	a. Turning electrical energy into mechanical energy. b. Atomization. c. Photosynthesis. d. Converting part of the engines mechanical energy into electrical energy.
4. Before removing a component, always tag the leads.	a. True. b. False.

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## REPLACE BATTERY-CHARGING ALTERNATOR

### PERFORMANCE CHECKLIST

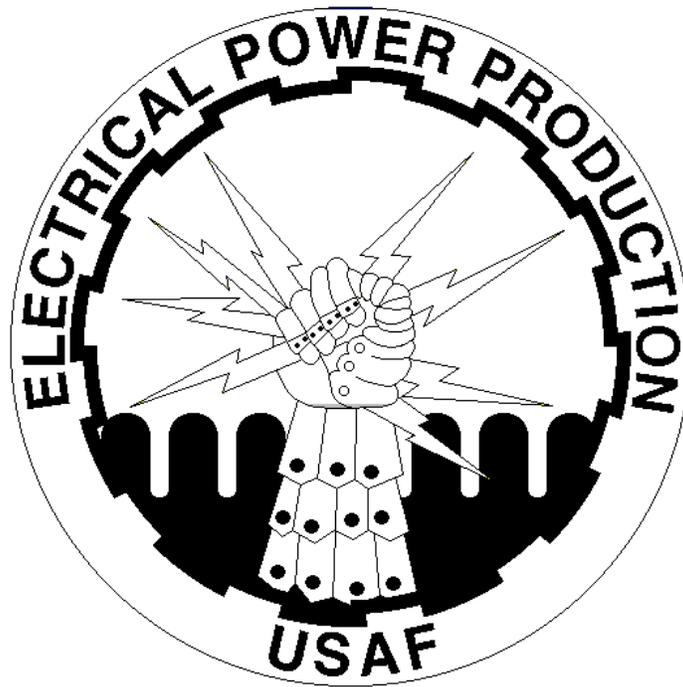
#### INSTRUCTIONS:

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 equipment and scenario available to perform task		
2. Isolate the engine from starting using lockout/tag-out procedures		
3. Replace battery charging alternator according to applicable TO or manufacturer manual		
4. Reconfigure engine for operation		
5. Perform a functional test		
6. Document maintenance action on AF Form 719		
7. Comply with all safety requirements		

**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.

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## ENGINE DC ELECTRICAL SYSTEM

### REPLACE

MODULE 18

AFQTP UNIT 4

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### STARTER MOTOR (18.4.2)

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**REPLACE STARTER MOTOR**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	18.4.2., Replace Starter Motor.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. <a href="#">35C2 series Technical Order (TO)</a>.</li> <li>2. Career Development Course (CDC) 3E052B, Vol. 1, Sect. 008: <i>Maintenance of Battery-Charging Systems</i>.</li> <li>3. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Engine Start Systems</i>.</li> <li>4. <a href="#">AFOSHSTD 91-45, Hazardous Energy Control and Mishap Prevention Signs and Tags</a>.</li> <li>5. <a href="#">AFI 32-1062, Electrical Power Plants and Generators</a>.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess, as a minimum, 3E032 AFSC.</b></li> <li>2. <b>Review the following:</b> <ol style="list-style-type: none"> <li>2.1. CDC 3E052B, Vol. 1, Sect. 008.</li> <li>2.2. Applicable TO and/or Manufacturer's Manual.</li> <li>2.3. AFOSHSTD 91-45 for lockout/tag-out procedures.</li> </ol> </li> <li>3. <b>Complete CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Engine Start Systems</i>.</b></li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Computer to support AFQTP CD-ROM.</li> <li>2. General tool kit.</li> <li>3. Personal safety equipment.</li> <li>4. MEP-007B.</li> </ol>
<b>Learning Objective:</b>	Replace starter motor.
<b>Samples of Behavior:</b>	<ol style="list-style-type: none"> <li>1. The trainee will ensure circuit has been de-energized prior to removal, and utilize their Lockout/Tag out procedures.</li> <li>2. Trainee will ensure the replacement component is the same specification as the original item.</li> <li>3. Trainee will remove and install a starter motor.</li> </ol>
<b>Notes:</b>	
<ol style="list-style-type: none"> <li>1. To successfully complete this element follow the steps outlined in the applicable technical manual exactly--no exceptions.</li> <li>2. Prior to performing any maintenance, technician <b>MUST</b> isolate the starting system, and apply lockout and tag-out procedures.</li> <li>3. Any safety violation is an automatic failure.</li> </ol>	

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## REPLACE STARTER MOTOR

**1. Background:** Sometimes when troubleshooting, the problem cannot be identified down to the component, but to the assembly. When in the field, you might change the component or the entire assembly. The availability of spare parts can be a major factor in determining your course of action. Prior to removing the component, tag your leads to ensure they are reconnected properly. Pay special attention to part numbers, model numbers, serial numbers, manufacturer's number, etc. This ensures the item being replaced is of the same specification as the defective part. This also saves heartache by ordering the wrong item through the supply system or wasting time trying to install an item that doesn't fit or function properly. Never modify generators or other equipment unless authorized by an approving authority. If you have a cost saving idea or a more efficient way of doing an operation, submit your suggestions on an AF Form 1000 for approval or an AFTO 22 for a TO correction.

**2. Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Engine Start Systems. Upon completion of the above-mentioned CD-ROM properly replace starter motor using the step-by-step procedures listed below.**

**NOTE:**

The review questions for this material are contained in the above-mentioned CD-ROM.

**NOTE TO TRAINER:**

1. This task requires a generator in need of starter motor maintenance.
2. If no malfunctioning equipment is available you must provide a training scenario to the trainee on the problem (starter motor) you want him/her to solve.

**SAFETY:**

**PRIOR TO REPLACING THE STARTER MOTOR, YOU MUST MAKE SURE THE UNIT WILL NOT START AUTOMATICALLY. YOU MUST ALSO DE-ENERGIZE THE DC CIRCUIT BREAKER AND PLACE THE BATTLE SHORT SWITCH IN THE RAISED POSITION. THESE ACTIONS ARE REQUIRED TO KEEP THE ENGINE FROM STARTING DURING REPLACEMENT.**

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

**Step 1: Isolate the engine from starting using lockout/tag-out procedures.**

- 1.1. Refer to AFOSH STD 91-45.

**Step 2: Replace starting motor according**

- 2.1. Refer to applicable TO or manufacturer manual.

**Step 3: Reconfigure engine for operation.**

**Step 4: Perform a functional test.**

**Step 5: Document maintenance on AF Form 719.**

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## REPLACE STARTER MOTOR

### PERFORMANCE CHECKLIST

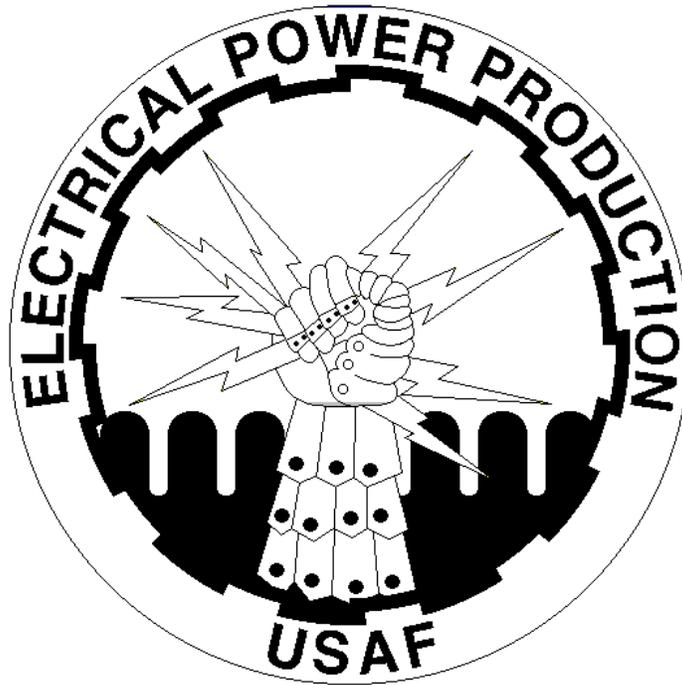
#### INSTRUCTIONS:

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 equipment and scenario available to perform task		
2. Isolate the engine from starting using lockout/tag-out procedures		
3. Replace starting motor according to T.O. or manufacturer manual		
4. Reconfigure engine for operation		
5. Perform a functional test		
6. Document maintenance action on AF Form 719		
7. Comply with all safety requirements		

**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.

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## ENGINE DC ELECTRICAL SYSTEM

### BATTERIES

MODULE 18

AFQTP UNIT 5

---

REPLACE (18.5.3.)

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**REPLACE BATTERIES**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	18.5.3., Replace batteries.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. <a href="#">35C2 series Technical Order (TO)</a>.</li> <li>2. Career Development Course (CDC) 3E052B, Vol. 1, Sect. 008: Maintenance of Battery-Charging System.</li> <li>3. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Engine Start Systems.</li> <li>4. <a href="#">AFOSHSTD 91-45, Hazardous Energy Control and Mishap Prevention Signs and Tags</a>.</li> <li>5. <a href="#">AFI 32-1062, Electrical Power Plants and Generators</a>.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess, as a minimum, 3E032 AFSC.</b></li> <li>2. <b>Review the following:</b> <ol style="list-style-type: none"> <li>2.1. CDC 3E052B, Vol. 1, Sect. 008.</li> <li>2.2. Applicable TO and/or Manufacturer's Manual.</li> <li>2.3. AFOSHSTD 91-45 for lockout/tag-out procedures.</li> </ol> </li> <li>3. <b>Complete CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Engine Start Systems.</b></li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Computer to support AFQTP CD-ROM.</li> <li>2. General tool kit.</li> <li>3. Personal safety equipment.</li> <li>4. Battery-start generator.</li> </ol>
<b>Learning Objective:</b>	Replace batteries.
<b>Samples of Behavior:</b>	<ol style="list-style-type: none"> <li>1. The trainee will ensure circuit has been de-energized prior to removal, and utilize their Lockout/Tag-out procedures.</li> <li>2. Trainee will ensure the replacement component is the same specification as the original item.</li> <li>3. Trainee will remove and install a battery.</li> </ol>
<b>Notes:</b>	
<ol style="list-style-type: none"> <li>1. To successfully complete this element follow the steps outlined in the applicable technical manual exactly--no exceptions.</li> <li>2. Prior to performing any maintenance, technician <b>MUST</b> isolate the starting system, and apply lockout and tag-out procedures.</li> <li>3. Any safety violation is an automatic failure.</li> </ol>	

**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.

## REPLACE BATTERIES

**1. Background:** Batteries are the heart of an electrical system, consisting of elements and cells. An element is a group of alternating positive and negative plates, which are welded to a post strap. A separator of insulating material such as porous fiberglass or polyethylene is placed between the plates. Each element is placed inside the battery case and immersed in an electrolyte solution. Once the element is placed in the electrolyte and becomes chemically active, it is called a cell. Cell connectors are used to join battery cells in series with one another. The battery has two external terminals that can be top mounted tapered post, threaded studs, or side mounted internally threaded connectors.

**1.1.** Replacing batteries can be a simple task if basic safety rules are followed. When the basic rules are violated, the battery transforms into a mini arc-welder, welding wrenches, screwdrivers and melting battery posts or what ever happens to short to ground or between posts. This can also cause the hydrogen gases in the battery to explode. Practice extreme caution when working around or on batteries.

### **1.2. Safety Rules:**

**1.2.1.** Always wear safety glasses when working with batteries. Eye injuries caused by splashing electrolyte are the most common accident that occurs when working on batteries.

**1.2.2.** Do not wear watches, rings, or other jewelry when working on or around batteries.

**1.2.3.** Always disconnect the battery's ground cable when working on the electrical system. This prevents sparks from short circuits or accidental starting

**1.2.4.** When removing a battery, disconnect the ground cable first and connect the ground cable last when installing.

**1.2.5.** Do not **short** across battery cables or battery terminals.

**2. Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Engine Start Systems. Upon completion of the above-mentioned CD-ROM properly replace batteries using the step-by-step procedures listed below.**

#### **NOTE:**

The review questions for this material are contained in the above-mentioned CD-ROM.

#### **NOTE TO TRAINER:**

1. This task requires a generator in need of battery maintenance.
2. If no malfunctioning equipment is available you must provide a training scenario to the trainee on the problem (battery) you want him/her to solve.

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**SAFETY:**

**PRIOR TO REPLACING THE BATTERIES, YOU MUST MAKE SURE THE UNIT WILL NOT START AUTOMATICALLY. YOU MUST ALSO DE-ENERGIZE THE DC CIRCUIT BREAKER AND PLACE THE BATTLE SHORT SWITCH IN THE RAISED POSITION. THESE ACTIONS ARE REQUIRED TO KEEP THE ENGINE FROM STARTING DURING REPLACEMENT.**

**NOTE TO TRAINER:**

The CD-ROM AFQTP refers to a MEP-007B generator for battery replacement. For simplicity sake, replacing a gel-cell in any battery-start generator will complete core task criteria.

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

**Step 1: Isolate the engine from starting using lockout/tag-out procedures.**

1.1. Refer to AFOSH STD 91-45.

**Step 2: Replace batteries according**

2.1. Refer to applicable TO or manufacturer manual.

**Step 3: Reconfigure engine for operation.**

**Step 4: Perform a functional test.**

**Step 5: Document maintenance on AF Form 719.**

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## REPLACE BATTERIES

### 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 equipment and scenario available to perform task		
2. Isolate the engine from starting using lockout/tag-out procedures		
3. Replace batteries according to applicable TO or manufacturer manual		
4. Reconfigure engine for operation		
5. Perform a functional test		
6. Document maintenance action on AF Form 719		
7. Comply with all safety requirements		

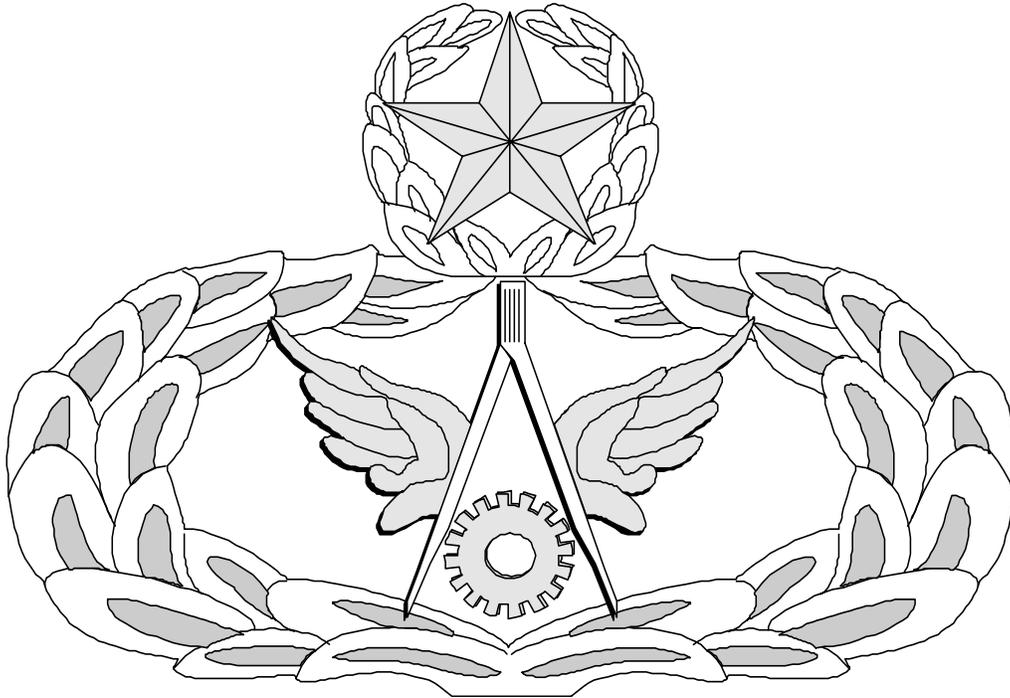
**FEEDBACK:** Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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# Air Force Civil Engineer

## QUALIFICATION TRAINING PACKAGE (QTP)

### REVIEW ANSWER KEY



FOR  
ELECTRICAL POWER PRODUCTION  
(3E0X2)

MODULE 18

ENGINE DC ELECTRICAL SYSTEM

**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.

**Key-1**

**REPLACE BATTERY-CHARGING ALTERNATOR**  
**(3E0X2-18.4.1)**

QUESTION	ANSWER
1. What component of the battery charging system keeps the battery charged?	d. Alternator.
2. As electrical loads drain the battery, it's voltage does what?	b. Decreases.
3. What method used by the alternator charges the batteries?	d. Converting part of the engines mechanical energy into electrical energy.
4. Before removing a component, always tag the leads.	a. True.

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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):

- |  |  |
|--|--|
| <input type="checkbox"/> STS Task Reference        | <input type="checkbox"/> Performance Checklist |
| <input type="checkbox"/> Training Reference        | <input type="checkbox"/> Feedback              |
| <input type="checkbox"/> Evaluation Instructions   | <input type="checkbox"/> Format                |
| <input type="checkbox"/> Performance Resources     | <input type="checkbox"/> Other                 |
| <input type="checkbox"/> Steps in Task Performance |  |

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

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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](mailto:ceof.helpdesk@tyndall.af.mil).

5. Thank you for your time and interest.

YOUR NAME, RANK, USAF  
Title/Position