

# AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)



FOR  
ELECTRICAL POWER PRODUCTION  
(3E0X2)

MODULE 22  
ENGINE GOVERNOR SYSTEMS

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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 3E0X2-20, 1 Oct 1999

Certified by: HQ AFCESA/CEO  
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Pages: 20/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:**

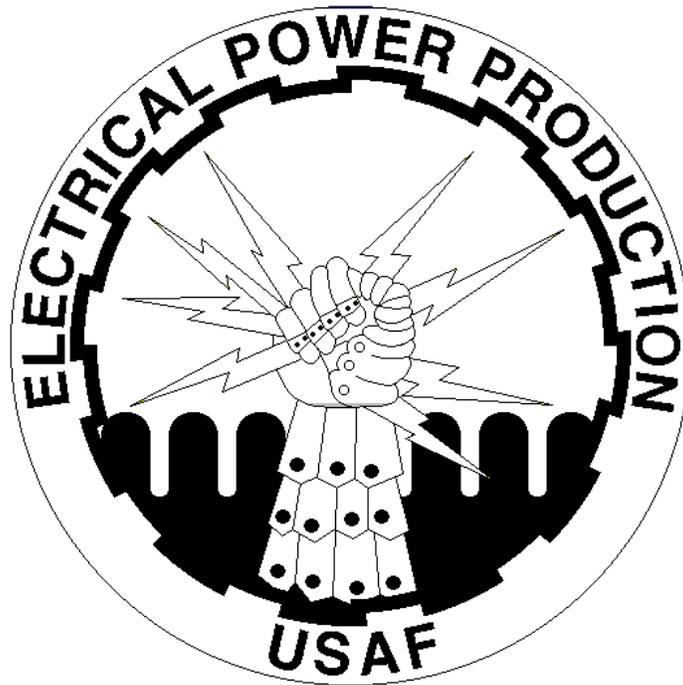
AFQTP completion  
CerTest completion (80% minimum to pass)

**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.

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## ELECTRONIC GOVERNORS

MODULE 22

AFQTP UNIT 2

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TROUBLESHOOT ELECTRONIC GOVERNORS (22.2.2.)

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**TROUBLESHOOT ELECTRONIC GOVERNORS**  
**Task Training Guide**

<b>STS Reference Number/Title:</b>	22.2.2., Troubleshoot Electronic Governors.
<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, Unit 4-2, Section 022: <i>Governor System Maintenance and Troubleshooting</i>.</li> <li>3. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Governor 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 a 3E052 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. 35C2 series TOs and/or manufacturer's manuals.</li> <li>2.2. CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Governor Systems</i>.</li> <li>2.3. CDC 3E052B, Vol. 1, Unit 4-1, Section 022.</li> </ol> </li> <li>3. <b>Complete AFQTP 3E9X1 Module 13: <i>Electrical Power Production Tools and Test Equipment</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. Multimeter.</li> <li>4. Clamp-on ammeter.</li> <li>5. Generator set with electronic governor system.</li> <li>6. TO or manufacturer's manual.</li> </ol>
<b>Learning Objective:</b>	<ol style="list-style-type: none"> <li>1. Know the basic steps required to safely troubleshoot the electronic governor system.</li> <li>2. Know the fundamental operation of an electronic governor.</li> </ol>
<b>Samples of Behavior:</b>	Trainee will be able to successfully troubleshoot basic electronic governor system faults and conditions.
<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. Any safety violation is an automatic failure.</li> <li>3. Trainer must develop an exercise scenario to validate ability of trainee to meet learning objective and samples of behavior.</li> </ol>	

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## TROUBLESHOOT ELECTRONIC GOVERNORS

### 1. Background:

**1.1.** Troubleshooting the Electronic Governor itself is a very limited scenario! More importantly, troubleshooting input and output readings to/from the module will lead you to a better understanding of the governor control system. The only function of the governor control system is to keep the generator running at a preset speed versus load on generator. When improper speed variations appear, check the load to be sure that the speed changes observed are not the transient result of continuing load changes. For training purposes, the governor control systems of the MEP-012A will be referred to, although the troubleshooting does cover most generator electronic governor control systems. Faults are revealed usually in speed variations of the engine, but it does not necessarily follow that all such speed variations indicate governor faults.

**1.2. System description & components:** The magnetic pickup measures the speed of the flywheel and sends that signal to the control module, which in turn measures that signal versus a predetermined set point. The control module then sends a signal to the fuel pump actuator; telling it to increase/decrease the amount of fuel to the engine. Brief descriptions are as follows:

**1.2.1.** A **magnetic pickup** is a sensor installed to measure engine speed by counting teeth on the flywheel as it turns, and relay that information to the governor control module.

**1.2.2.** A **fuel pump actuator** is in essence an electrically actuated flow control switch for fuel to the main fuel injection pump. The control module sends out a current that, in turn, rotates the actuator for more or less fuel.

**1.2.2.1.** MEP-012A (FZ series – normally open actuator). With these normally open actuator models, there is a chance when you lose power to your control module that the generator will go to the full fuel position and self-destruct.

**1.2.2.2.** MEP-012A (AW & D – normally closed actuator). With these normally closed actuator models, when you lose power to your control module your generator sets itself to run only at idle speed. This is the most prevalent symptom of a broken electronic governor control module!

**1.2.3.** An **electronic governor control module** is the brain of the fuel system; receiving and transmitting signals.

**1.2.3.1.** MEP-012A (FZ series – normally open control module) is identified by the Cummins part # 3037359. With these normally open actuator models, there is a chance when you lose power to your control module that the generator will go to the full fuel position and self-destruct.

**1.2.3.2.** MEP-012A (AW & D – normally closed control module) is identified by the Cummins part # 3062322. With these normally closed actuator models, when you lose power to your control module your generator sets itself to run only at idle speed. This is the most prevalent symptom of a broken electronic governor control module!

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2. As you can see, it's all about having the right signals, and for the control module to process them to do other work.

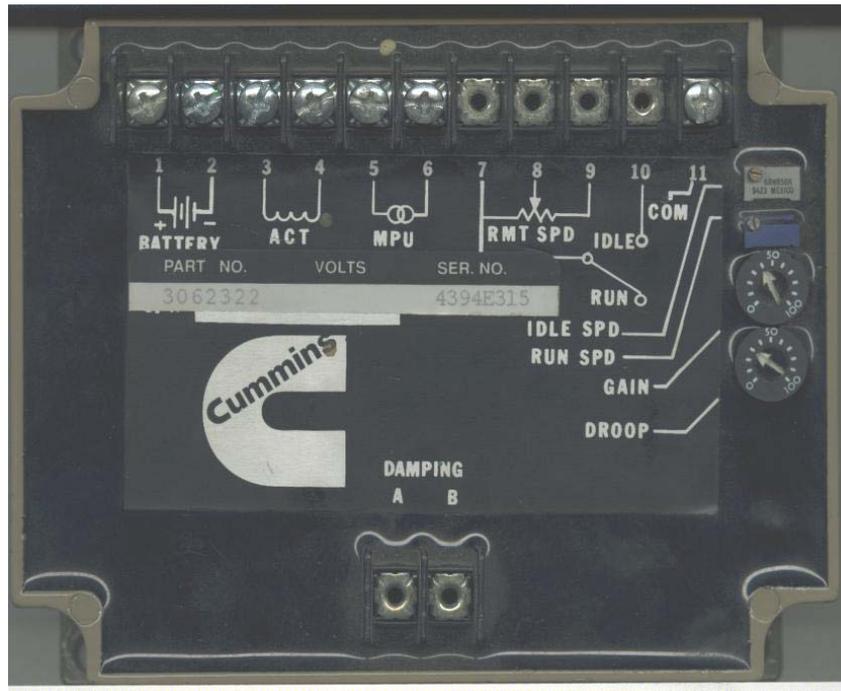


Figure 1a. MEP-012A Electronic Governor Module (AW & D models)  
Normally Closed & Additional Damping

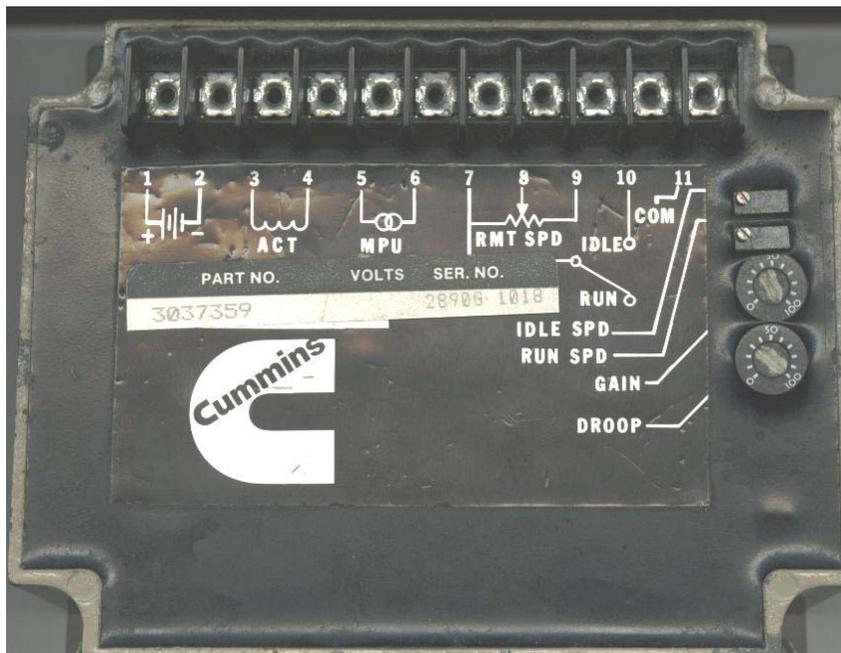


Figure 1b. MEP-012A Electronic Governor Module (FZ models)  
Normally Open & No Additional Damping

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ELECTRONIC GOVERNOR TROUBLESHOOTING CHART			
Component	Normal Reading	Abnormal Reading	Corrective Action
Magnetic pickup.  *The higher the AC volts, the further away the magnetic pickup is from the teeth on flywheel.	Startup – between 0.5 volts and 2 volts DC (term #5,6).	<0.5 volts, and > 2.0 volts.	Readjust or replace magnetic pickup.
	Running – between 2 volts and 30 volts DC (term #5,6).	<2 volts and >30 volts DC.	Readjust or replace magnetic pickup.
Control Module.	Battery voltage (terminals #1&2) $\geq$ 24 volts DC.	Battery voltage (terminals #1&2) < 20 volts DC.	Charge system control battery, or battery-charging alternator defective.
	Engine running speed at 61.5 Hz (no load)/ 60.0 Hz. (load)	< or > 61.5 or 60Hz.	Adjust gross running speed on module, or fine speed with variable potentiometer.
	Idle speed at 600 rpm's	< or > 600 rpm's.	Adjust idle speed on module with jumper installed between terminal 7, & 10.
	Gain set to 40.	Vary slightly with "different engine personalities".	Reset.
	Droop set to 30.	Vary slightly with "different engine personalities".	Reset.
Actuator –  *The higher the voltage to the actuator, the harder the control module is trying to get the actuator to work.	Normally open actuator - < 16 volt, <4 amps DC (FZ models). *Test1- 9.6 volts (term 3,4) @ 1.2 amps – no load. *Test2- 8.5 volts (term 3,4) @ 0.9 amps – 600kw. The closer the generator is to full fuel, the lower the volts and amps.	> 16 volts, >4 amps DC.	Replace actuator, or repair fuel pump. Control module working too hard to overcome binding.
		0 volts DC output to actuator.	Replace electronic governor module, if magnetic pickup, battery, and wiring check good.
	Normally closed actuator -< 19-20 volt, <4 amps DC. *The readings should be similar except reversed for the AW & D models. The closer the generator is to no fuel, the lower the volts and amps.	> 19-20 volts, >4 amps DC.	Replace actuator, or repair fuel pump. Control module working too hard to overcome binding.
		0 volts DC output to actuator.	Replace electronic governor module, if magnetic pickup, battery, and wiring check good.

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3. 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:

- 3.1. What were the warning signs preceding the trouble?
- 3.2. What recent repair has been done?
- 3.3. Has a similar trouble occurred before?

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

4.1. The first step is to **perform an operational check** to determine if an actual problem really exists. Follow step-by-step procedures in the technical manual for your particular item of equipment. Perform a visual inspection of the electrical components, check wiring harness for breaks, and check relays for loose connections, evidence of over heating, cracks, or any signs of damage.

4.2. The second step in troubleshooting is to **analyze the malfunction**. Detect the trouble by sight, sound, smell, or feel. Once you are aware of a malfunction, consult the proper technical manual for normal operation. This gives one a clearer understanding of how things should be working. One can also use the troubleshooting chart located in the proper technical manual. It is in this step that one determines the type of trouble in order to determine the type of test equipment to use.

4.3. The third step is **locating the malfunction**; this is the most difficult task. In this step, one will need to stay focused on the problem and not allow frustration to set in. This can cause one to resort back to the remove and replace technique. Perform the previous steps; determine type of test equipment needed to check the performance. Understanding the operation and knowing the “how, what, when and where” is the key to locating the malfunction.

4.4. The fourth step is to **perform corrective action**, once you have located the problem; a neat and permanent repair is a necessity. If possible, use original replacement parts to make repairs.

4.5. The last step is to **perform an operational check**; this is the most rewarding step in the troubleshooting process. If you do not prove your work, you will not know if the problem is solved. Remember, one malfunction can produce more than one problem.

**NOTE TO TRAINER:**

Trainer/Certifier must provide equipment and scenario for troubleshooting electronic governor systems in order to complete task. Use troubleshooting chart on the previous page for guidelines if needed.

**5. To perform troubleshooting of electronic governor systems, follow these steps:**

**Step 1: Trainee is provided equipment and governor problem 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 Form 719.**

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**REVIEW QUESTIONS  
FOR  
TROUBLESHOOT ELECTRONIC GOVERNORS**

QUESTION	ANSWER
1. What is the purpose of the magnetic pickup?	<ul style="list-style-type: none"> <li>a. Measure AC load on generator.</li> <li>b. Measure DC load on generator.</li> <li>c. Measure AC voltage of generator.</li> <li>d. Measure engine speed.</li> </ul>
2. On the FZ-series MEP-012A generator, what could happen when you lose power to your governor control module?	<ul style="list-style-type: none"> <li>a. Engine only runs at idle speed.</li> <li>b. Engine runs normally in battle short.</li> <li>c. Engine might self-destruct.</li> <li>d. Starts up next generator, automatically.</li> </ul>
3. What component of the electronic governor system is the brain of the system?	<ul style="list-style-type: none"> <li>a. Governor module.</li> <li>b. Normally open actuator.</li> <li>c. Normally closed actuator.</li> <li>d. Magnetic pickup.</li> </ul>
4. What is a typical reading for the magnetic pickup?	<ul style="list-style-type: none"> <li>a. 19-20 volts DC.</li> <li>b. 16 volts DC.</li> <li>c. 25 volts AC.</li> <li>d. 35 volts AC.</li> </ul>
5. What is the 3 <sup>rd</sup> step in troubleshooting process?	<ul style="list-style-type: none"> <li>a. Perform an operational check.</li> <li>b. Analyze the malfunction.</li> <li>c. Locate the malfunction.</li> <li>d. Perform corrective action.</li> </ul>

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## TROUBLESHOOT ELECTRONIC GOVERNORS

### PERFORMANCE CHECKLIST

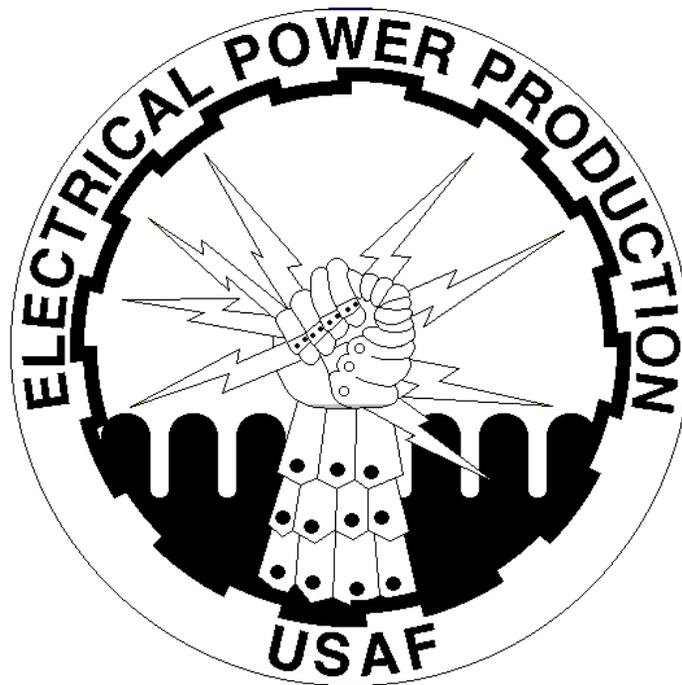
#### INSTRUCTIONS:

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. 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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## ELECTRONIC GOVERNORS

### ADJUST

MODULE 22

AFQTP UNIT 6

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DROOP (22.2.6.1.)

GAIN (22.2.6.2.)

IDLE (22.2.6.3.)

RUN (22.2.6.4.)

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**ADJUST ELECTRONIC GOVERNORS:  
DROOP; GAIN; IDLE; & RUN**

***Task Training Guide***

<b>STS Reference Number/Title:</b>	22.2.6.1., Adjust droop. 22.2.6.2., Adjust gain. 22.2.6.3., Adjust idle. 22.2.6.4., Adjust run.
<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, Unit 4-2, Section 022: <i>Governor System Maintenance and Troubleshooting</i>.</li> <li>3. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Governor Systems</i>.</li> <li>4. Manufacturer's Manuals.</li> <li>5. <a href="#">Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-45, Hazardous Energy Control and Mishap Prevention Signs and Tags</a>.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E052 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. 35C2 series TOs and/or manufacturer's manuals.</li> <li>2.2. CDC 3E052B, Vol. 1, Unit 4-1, Section 022.</li> <li>2.3. AFOSHSTD 91-45 for lockout/tag out procedures.</li> </ol> </li> <li>3. <b>Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Governor 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. Multimeter.</li> <li>4. Generator set with electronic governor system.</li> <li>5. TO or manufacturer's manual.</li> </ol>
<b>Learning Objective:</b>	Know when and how to adjust electronic governor controls.
<b>Samples of Behavior:</b>	Trainee must understand the purpose of adjusting governor controls and how to make all adjustments.
<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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## ADJUST ELECTRONIC GOVERNORS: DROOP; GAIN; IDLE; & RUN

### 1. Background:

**1.1.** The speed control system of the diesel engine used for power production is very important because it controls the frequency of the generator. A knowledge of the controls and operating principles of governor systems will help you understand the operation and maintenance of the speed control devices used on generator sets. Proper adjustment of the electronic governor control module is imperative to optimize performance of the generator set. Governor modules will vary, but the general adjustments are mostly identical for all generators. A governor from a MEP-12 series generator is used for our purpose of discussion.

**1.2.** The main adjustments on the electronic governor are the gain, droop, idle, and run. We will give a brief description of each.

**1.2.1. Gain:** The gain control is a one-turn potentiometer. It is used to adjust the sensitivity of the governor. A clockwise rotation of the potentiometer dial will shorten the response time of the governor to load changes.

**1.2.2. Droop:** The droop control is a one-turn potentiometer. It is adjustable for zero % (isochroous) to five % speed droop. Counterclockwise rotation will decrease the speed droop.

**1.2.3. Idle:** The idle speed control is a 20-turn potentiometer for adjusting the idle speed. A clockwise rotation will increase the idle speed.

**1.2.4. Run:** The run speed control is a 20-turn potentiometer for setting the desired no-load governed speed. A clockwise rotation will increase the run speed.

**2. Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Governor Systems. Upon completion of the above-mentioned CD-ROM properly adjust the droop, gain, idle, and run controls 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:**

The step has been developed using the MEP-007 as a model. Equipment may vary slightly, but the procedures are basically the same for adjusting electronic governor controls.

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

**Step 1: Isolate the engine from starting using lockout/tag out procedures.** Refer to AFOSHSTD 91-45.

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**Step 2: Adjust droop in accordance with (IAW) TO 35C2-3-474-2, Section VII, paragraph 5-46.**

**Step 3: Adjust gain IAW TO 35C2-3-474-2, Section VII, paragraph 5-46.**

**Step 4: Adjust idle IAW TO 35C2-3-474-2, Section VII, paragraph 5-46.**

**Step 5: Adjust run IAW TO 35C2-3-474-2, Section VII, paragraph 5-46.**

**Step 6: Document maintenance on AF Form 719.**

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**ADJUST ELECTRONIC GOVERNORS: DROOP; GAIN; IDLE; & RUN****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. Isolate the engine from starting using lockout/tag out procedures		
2. Gathered required equipment		
3. Make correct droop adjustments		
4. Make correct gain adjustments		
5. Make correct idle speed adjustments		
6. Make correct run adjustments		
7. Document maintenance actions on AF Form 719		
8. Comply with all safety requirements		

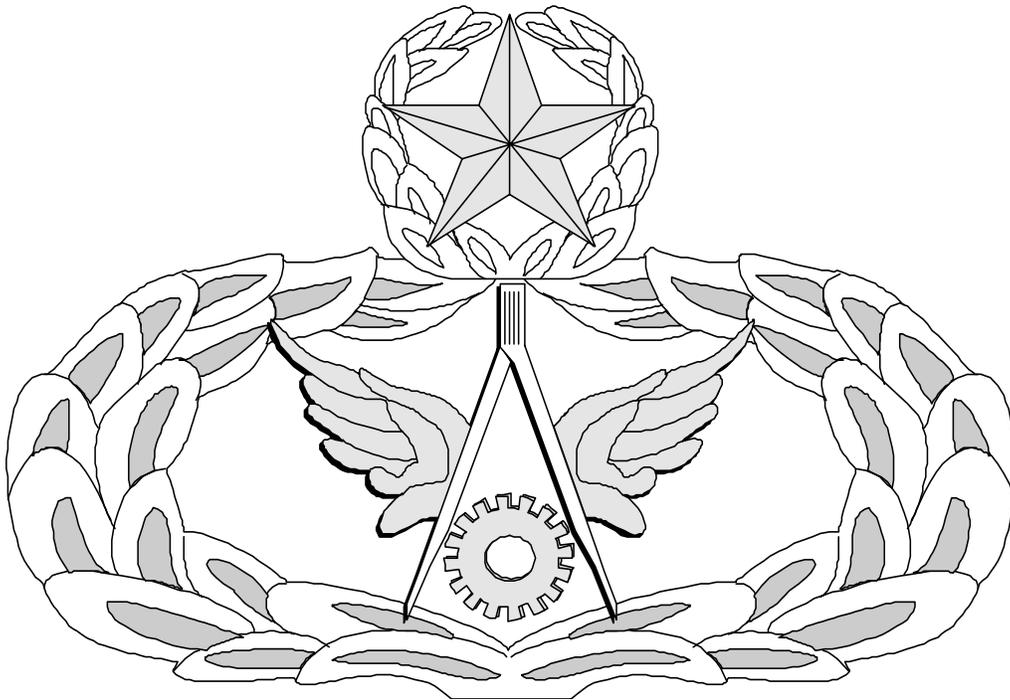
**FEEDBACK:** Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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# Air Force Civil Engineer

## QUALIFICATION TRAINING PACKAGE (QTP)

### REVIEW ANSWER KEY



FOR  
ELECTRICAL POWER PRODUCTION

(3E0X2)

MODULE 22

ENGINE GOVERNOR SYSTEMS

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**Key-1**

**TROUBLESHOOT ELECTRONIC GOVERNORS  
(3E0X2-22.2.2.)**

<b>QUESTION</b>	<b>ANSWER</b>
1. What is the purpose of the magnetic pickup?	d. Measure engine speed.
2. On the FZ-series MEP-012A generator, what could happen when you lose power to your governor control module?	c. Engine might self-destruct.
3. What component of the electronic governor system is the brain of the system?	a. Governor module.
4. What is a typical reading for the magnetic pickup?	c. 25 volts AC.
5. What is the 3 <sup>rd</sup> step in troubleshooting process?	c. Locate the malfunction.

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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):

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