

AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)



FOR
ELECTRICAL POWER PRODUCTION
(3E0X2)

MODULE 19
ENGINE LUBRICATION 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 3E0X2-17, 1 Oct 99

Certified by: HQ AFCESA/CEOF
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Pages: 17/Distribution F

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**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:

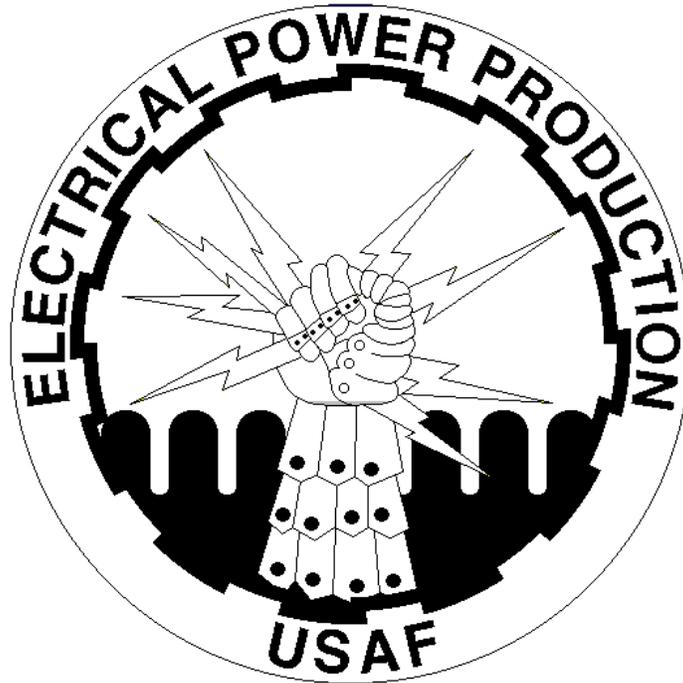
AFQTP completion
CerTest completion (80% minimum to pass)

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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ENGINE LUBRICATION SYSTEM

MODULE 19

AFQTP UNIT 2

TROUBLESHOOT (19.2.)

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TROUBLESHOOT ENGINE LUBRICATION SYSTEM
Task Training Guide

STS Reference Number/Title:	19.2., Troubleshoot Engine Lubrication System.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) 3E052B, Unit 3-2: <i>Lubricating System</i>. 2. CD-ROM Air Force Qualification Training Package (AFQTP) 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Lubricating Systems</i>. 3. 35C2 series Technical Orders (TOs), MEP Generators. 4. Manufacturer's manuals. 5. Local procedures.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E052 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC 3E052B, Vol. 1, Unit 3-2. 2.2. Applicable TO or manufacturer's manual. 2.3. CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Lubricating Systems</i>.
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Computer to support AFQTP CD-ROM. 2. General tool kit. 3. Personal safety gear. 4. Lubricating System. 5. Applicable TOs and/or manufacture's manuals.
Learning Objective:	Troubleshoot lubricating systems.
Samples of Behavior:	<ol style="list-style-type: none"> 1. Trainee will be able to explain lubricating system operation. 2. Trainee will be able to troubleshoot lubricating system.
Notes:	
<ol style="list-style-type: none"> 1. To successfully complete this task, follow the steps outlined in the applicable TO or manufacturer manual exactly—no exceptions. 2. Any safety violation is and automatic failure. 3. Trainer must develop an exercise scenario to validate ability of trainee to meet learning objective and samples of behavior. 	

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TROUBLESHOOT ENGINE LUBRICATION SYSTEM

1. Background: The lubrication system is vital to an engine's operation and extended service life. Any part that moves requires some sort of lubrication to reduce friction and remove heat. Without a lubrication system, moving parts would overheat and eventually stop. The proper operation of an engine's lubricating system is extremely important. The lubrication system assists the engine in the following ways:

- 1.1. Holds an adequate supply of oil for the engine.
- 1.2. Delivers oil to all necessary engine components.
- 1.3. Reduces friction between moving parts.
- 1.4. Absorbs and dissipates heat.
- 1.5. Cleans and flushes contaminants from moving parts.
- 1.6. Removes contaminants from the oil.

2. Operation principles in lubricating systems are basically the same but there may be slight differences. Refer to local TO or manufacturers manuals for your equipment.

2.1. Force-feed lubrication system: During normal operation, oil from the oil pan or the sump is drawn to the oil pump through the suction pick up tube. The pump sends oil to the oil cooler and to the oil filter. From the oil filter, oil travels to the galleries in the cylinder block. From the galleries, the oil takes several paths. In turbocharged engines, some of the oil travels through a supply line to the turbocharger. Oil from the turbocharger flows back through a return into the oil pan or sump. Oil is also sent through drilled passages in the block to the main and camshaft bearings. The oil travels from the main bearing journals through drilled holes in the camshaft. A small amount of oil is sent through the jet tubes to cool the pistons. Oil then travels to grooves in the camshaft bearings and into oil passages that lead to the valve lifter bores. These passages supply oil under pressure to lubricate the valve lifters. There are also passages that supply oil to rocker arm shafts and holes are provided to lubricate the valve train.

2.2. Splash lubricating system: Oil pump supplies oil to a splash pan located under the crankshaft. As the connecting rods revolve, scoops located on the rod caps dip into the splash pan troughs. The oil splashes, lubricating the moving parts nearby. Also, oil is splashed into collecting troughs and is gravity fed through channels or lines to lubricate moving parts that are further away. As the connecting rods revolve, an oil mist forms that lubricates the upper parts of the cylinders. It must be noted, that the splash system is found in smaller units or air compressors.

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?

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4. Next, follow the basic troubleshooting process:

- 4.1. Perform an operational check.
- 4.2. Analyze the malfunction.
- 4.3. Locate the malfunction.
- 4.4. Perform corrective action.
- 4.5. Perform an operational check.

NOTE TO TRAINER:

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

5. *To perform troubleshooting lubricating system, follow these steps:*

Step 1: Trainee is provided equipment and cooling problem 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.

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LUBRICATING SYSTEM TROUBLESHOOTING CHART	
<i>EXCESSIVE OIL CONSUMPTION</i>	
POSSIBLE CAUSE	CORRECTION
External oil leaks.	Check engine for visible signs of leaks. Replace defective parts.
Clogged crankcase breather pipe.	Remove obstruction.
Exhaust system restriction.	Inspect system piping and muffler. Perform exhaust back pressure test. Locate and correct source of any restriction.
Worn valve guides.	Replace valve guides.
Internal engine wear.	Overhaul engine.
<i>LOW LUBRICATING OIL PRESSURE</i>	
POSSIBLE CAUSE	CORRECTION
Oil leak and low oil level.	Check for leaks and add oil as needed.
Wrong oil viscosity.	Drain oil, replace filter, and fill with proper oil.
Defective pressure gauge.	Check gauge operation and replace as needed.
Plugged oil filter.	Replace filter. Clean or install new oil cooler core. Change oil.
Excessive clearance between crankshaft and bearings.	Overhaul engine.
Incorrect meshing of oil pump gears.	Check mounting arrangement. If the oil pump has been rebuilt, check for proper gear ratio combination. Check for correct oil pump cover gasket.
<i>BLUE EXHAUST SMOKE</i>	
POSSIBLE CAUSE	CORRECTION
Engine oil level too high.	Do not overfill crankcase. Check oil for dilution.
Worn or damaged pistons.	Check piston ring to groove clearance. Make sure return holes under oil control ring are open.
Damaged PCV valve.	Inspect for damage and replace as needed.
Worn valve guides.	Check for maximum permitted wear and service as needed.

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**REVIEW QUESTIONS
FOR
TROUBLESHOOT ENGINE LUBRICATION SYSTEM**

QUESTION	ANSWER
1. During normal operation in a force feed system, what draws oil from the oil pan?	a. Oil tube. b. Oil pump. c. Water pump.
2. What type of oil system uses scoops located on the rod caps?	a. Pressure feed type. b. Oil splash type.
3. The oil system is vital to unit operation.	a. True. b. False.
4. Oil from the turbocharger flows back to what?	a. Valve train. b. Oil pan. c. Crankshaft.
5. What is the final step in the troubleshooting procedure?	a. Perform an operational check. b. Analyze the malfunction. c. Locate the malfunction. d. Perform corrective action.

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SERVICE ENGINE LUBRICATION SYSTEM

PERFORMANCE CHECKLIST

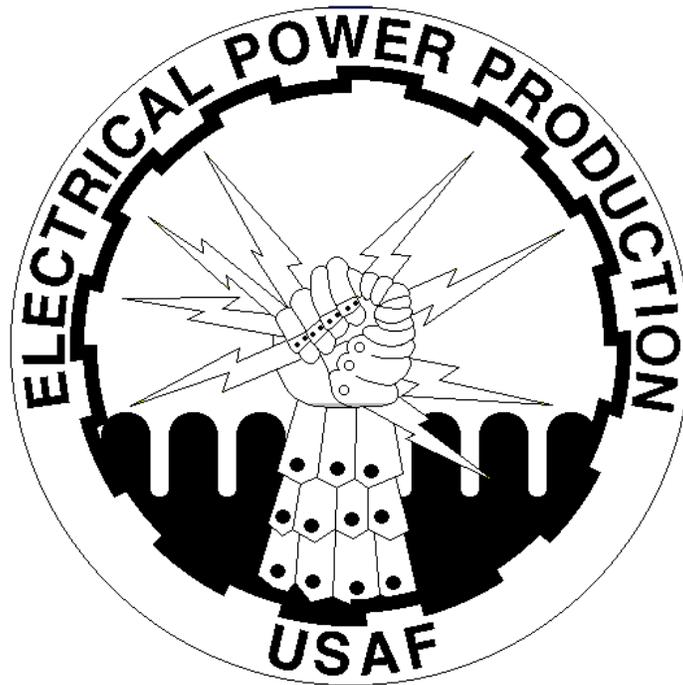
INSTRUCTIONS:

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 provided 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. 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 LUBRICATION SYSTEM

MODULE 19

AFQTP UNIT 5

SERVICE ENGINE LUBRICATION SYSTEM (19.5.)

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SERVICE ENGINE LUBRICATING SYSTEM
Task Training Guide

STS Reference Number/Title:	19.5., Service Engine Lubrication System.
Training References:	<ol style="list-style-type: none"> 1. 35C2 series Technical Orders (TOs), MEP Generators. 2. CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Lubricating Systems</i>. 3. Career Development Course (CDC) 3E052B, Vol. 1, Unit 3-2 4. AFOSHSTD 91-45, Hazardous Energy Control and Mishap Prevention Signs and Tags. 5. Military Specification MIL-C-10597. 6. Manufacturer's Manuals. 7. Local Procedures.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E032 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC 3E052B, Vol. 1, Unit 3-2. 2.2. AFOSHSTD 91-45. 2.3. Applicable TO or manufacturer's manual. 3. Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: <i>Lubricating Systems</i>.
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Computer to support AFQTP CD-ROM. 2. General tool kit. 3. Rags. 4. Applicable TO or manufacturer's manual. 5. Personal safety equipment. 6. MEP-007.
Learning Objective:	How to service an engine lubrication system.
Samples of Behavior:	Trainee will service the components of the lubricating oil system.
Notes:	
<ol style="list-style-type: none"> 1. To successfully complete this element follow the steps outlined in the applicable technical manual exactly--no exceptions. 2. Prior to performing any maintenance, technician MUST isolate the starting system, and apply lockout and tag-out procedures 3. Any safety violation is an automatic failure. 	

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SERVICE ENGINE LUBRICATION SYSTEM

1. Background: The oil is the lifeblood of the engine. Oil lubricates and protects the internal engine parts. The lubricating system should be drained and refilled periodically, as directed by local policy, to rid the lube oil system of contaminants. Small diesel engines used as standby units do not require oil changes at the same interval as continuously operating units (prime generators). Generally, on small units, lube oil is drained and discarded and new oil filters are installed at every oil change--annually. On large power units, the oil capacity and the need for continuous operation may require oil centrifuge and oil addition rather than short, periodic changes. In cold weather operations lube oil may need changing more often due to increased contamination and sludge.

1.1. Lubricating oil should always be drained while the engine is at normal operating temperature. This assures a better draining of the system and removes wax deposits and other impurities as they are suspended in the oil.

1.2. Oily rags, filters and waste oil must be contained and disposed of in accordance with local directives and policies. This waste is categorized as **hazardous material items**. Some local areas have an oil filter recycle program.

2. Complete the CD-ROM AFQTP 3E0X2 Electrical Power Production, Version 1.0, Mar 00: Lubricating System. Upon completion of the above-mentioned CD-ROM properly service engine lubricating 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:

The step has been developed using the MEP-007 as a model. Equipment may vary slightly, but the procedures are basically the same for servicing cooling systems.

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: Service the lubricating oil system.

2.1. Refer to applicable T.O. or manufacturer manual.

Step 3: Reconfigured engine for operation.

Step 4: Perform a functional test at operating temperature.

Step 5: Recheck the oil level after engine shut down.

Step 6: Document maintenance on AF Form 719.

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SERVICE ENGINE LUBRICATION SYSTEM

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. Isolated the engine from starting using lockout/tag-out procedures		
2. Properly test the lubricating oil in the engine		
3. Ensure the engine wasn't too hot to perform service		
4. Properly drain oil system		
5. Change all applicable filters		
6. Properly refilled the oil system		
7. Reconfigure engine for operation and remove lockout/tag-out devices		
8. Perform a functional test at operating temperature		
9. Re-check the oil level after engine shut down		
10. Document maintenance on AF Form 719		
11. Comply with all safety requirements		

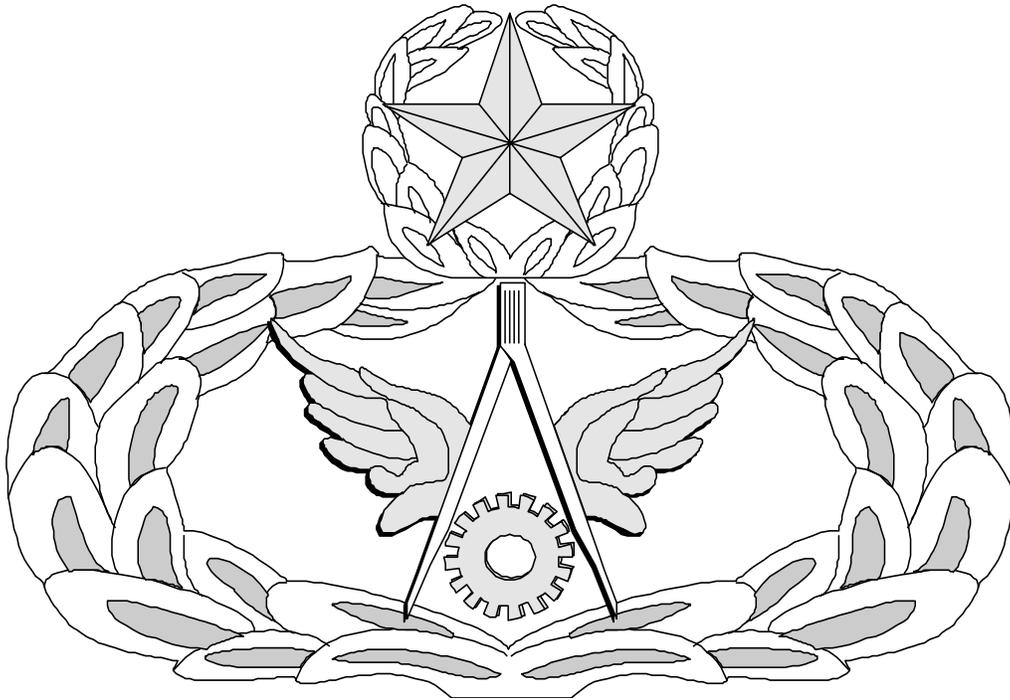
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Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



FOR
ELECTRICAL POWER PRODUCTION
(3E0X2)

MODULE 19

ENGINE LUBRICATION SYSTEM

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Key-1

**TROUBLESHOOT ENGINE LUBRICATION SYSTEM
(3E0X2-19.2.)**

QUESTION	ANSWER
1. During normal operation in a force feed system, what draws oil from the oil pan?	b. Oil Pump.
2. What type of oil system uses scoops located on the rod caps?	b. Oil splash type.
3. The oil system is vital to unit operation.	a. True.
4. Oil from the turbocharger flows back to what?	b. Oil pan.
5. What is the final step in the troubleshooting procedure?	a. Perform an operational check.

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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.

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