

# TOPIC OF THE MONTH SERIES – ENGINE MAINTENANCE & PERFORMANCE MONITORING

REV. 0 24 MARCH 2017

2017/03-28-104 (I) PP

## Engine Maintenance and Performance Monitoring

**Abstract:** Lasting 10 to 15 minutes, this presentation acquaints the audience with the benefits of working with mechanics to ensure that aircraft engines are maintained according to regulations, policy, and industry-accepted best practices. The value of flight data monitoring programs and technology is also discussed.

**Format:** Information Briefing - Power Point presentation

Required Personnel – FAAS Team Program Manager or designated FAAS Team Rep (s)

Optional Personnel – CFIs and DPEs who can speak on **Engine** Maintenance and Performance Monitoring

### AFS 850 Support:

In addition to these presenter notes, a guidance document, and a Power Point presentation that supports the program are provided. FPMs and presenters are encouraged to customize this presentation to reflect local area attributes and concerns.

## Appendix I – Equipment and Staging

### Equipment:

- Projection Screen & Video Projector suitable for expected audience
  - Remote computer/projector control available at lectern or presenter location
    - In lieu of remote – detail a Rep to computer/projector control.
- Presentation Computer
  - **Note:** It is strongly suggested that the entire program reside on this computer.
- Back up Projector/Computer/Media as available.
- PA system suitable for expected audience
  - Microphones for Moderator and Panel

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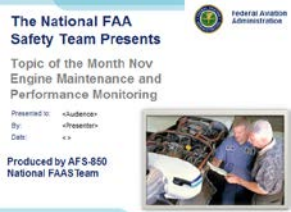
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- Optional Microphone (s) for audience
- Lectern (optional)

**Staging:**



- Arrange the projection screen for maximum visibility from the audience.
- Equip with PA microphones
- Place Lectern to one side of screen. This will be used by presenters and moderator

Slides	Script
	<p><b>Slide 1</b></p> <p><b>2017/03-28-104 (I) PP</b> Original Author: J. Steuernagle 24 March 2017; K CloverAFS-850 Operations Lead Office 562-888-2020.</p> <p><b>Presentation Note:</b> <i>This is the title slide for <b>Engine Maintenance and Performance Monitoring</b></i></p> <p><i>Presentation notes (stage direction and presentation suggestions) will be preceded by a <b>Bold header:</b> the notes themselves will be in Italic fonts.</i></p> <p><b>Program control instructions</b> will be in bold fonts and look like this: <b>(Click)</b> for building information within a slide; or this: <b>(Next Slide)</b> for slide advance.</p> <p><i>Some slides may contain background information that</i></p>

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
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	<p><i>supports the concepts presented in the program.</i></p> <p><i>Background information will always appear last and will be preceded by a bold <b>Background:</b> identification.</i></p> <p><i>We have included a script of suggested dialog with each slide. Presenters may read the script or modify it to suit their own presentation style.</i></p> <p><i>The production team hope you and your audience will enjoy the show. Break a leg!</i></p> <p><b>(Next Slide)</b></p>
<p><b>Welcome</b></p> <ul style="list-style-type: none"> <li>• Exits</li> <li>• Restrooms</li> <li>• Emergency Evacuation</li> <li>• Breaks</li> <li>• Sponsor Acknowledgment</li> <li>• Other information</li> </ul> 	<p><b><u>Slide 2</u></b></p> <p><b>Presentation Note:</b> <i>Here’s where you can discuss venue logistics, acknowledge sponsors, and deliver other information you want your audience to know in the beginning.</i></p> <p><i>You can add slides after this one to fit your situation.</i></p> <p><b>(Next Slide)</b></p>
<p><b>Overview</b></p> <ul style="list-style-type: none"> <li>• *GAJSC System/Component Failure Study</li> <li>• Best Practices for Engine Maintenance</li> <li>• Best Practices for Engine Operation</li> <li>• Safety Benefits of Flight Data Monitoring (FDM)</li> <li>• Present &amp; Future FDM Technologies</li> <li>• How GA pilots can use FDM today</li> </ul> <p><small>*General Aviation Joint Steering Committee</small></p> 	<p><b><u>Slide 3</u></b></p> <p>Recently, the GAJSC System/Component Failure Work Group identified released Safety Enhancements dealing with Engine Maintenance and Flight Data Monitoring.</p> <p>We want to take just a few minutes to talk about best practices for reciprocating engine maintenance and operation, and the safety benefits of Flight Data</p>

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	<p>Monitoring – a technology and process that’s now coming to General Aviation.</p> <p>We’ll look at present &amp; future FDM technologies, and we’ll talk about how to use FDM today.</p> <p><b>Presentation Note:</b> <i>If you’ll be discussing additional items, add them to this list (Next Slide)</i></p>
<p><b>Know your mechanic</b></p> <ul style="list-style-type: none"><li>• Take an active role</li><li>• Review inspection results</li><li>• Review ADS and Service Bulletins</li><li>• Assist with inspections</li></ul>  	<p><b>Slide 4</b></p> <p>Ideally, pilots and mechanics should work together to ensure the aircraft is operated and maintained properly. Pilots are encouraged to take an active role in maintenance; reviewing inspection results and discussing Airworthiness Directives and Service Bulletins.</p> <p>Assisting with inspections is a great way to get to know your mechanic and your aircraft.</p> <p><b>(Next Slide)</b></p>
<p><b>Service intervals</b></p> <ul style="list-style-type: none"><li>• <b>Oil &amp; Filter Change</b></li><li>- 50 Hrs. (30 Hrs. for Turbos)</li><li>• Filter Inspection – Immediate Results</li><li>• Oil Analysis – Multiple results over time for trending</li><li>- 100 Hrs. add</li><li>• Compression Check</li><li>• Magneto Timing</li><li>• Spark plug inspection &amp; maintenance</li><li>• Exhaust system check</li></ul>  	<p><b>Slide 5</b></p> <p>Comply with all manufacturer-recommended service intervals. Fifty-hour oil changes are recommended for most normally aspirated piston engines.</p> <p>Turbo-charged engines should undergo oil changes more frequently. Oil filter inspection with each oil change yields immediate feedback. If</p>

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	<p>metal particulate is discovered in the filter, it could be cause for concern.</p> <p>Oil analysis can reveal a lot about engine health as well but it works best when a trend can be identified over several samples. It's not a bad idea to do a compression check, Mag timing, Spark plug inspection and Exhaust system check every other oil change.</p> <p>It's also a good idea to check ADs &amp; Service Bulletins during regular service as well.</p> <p><b>(Next Slide)</b></p>
<p><b>Not just an oil change</b></p> <ul style="list-style-type: none"><li>• Opportunity for inspection<ul style="list-style-type: none"><li>- Leaks and stains</li><li>- Missing, broken, or loose hardware</li><li>- Tires</li><li>- Brakes</li><li>- Oleo struts</li></ul></li></ul>  	<p><b><u>Slide 6</u></b></p> <p>Whether you're assisting your mechanic or doing it yourself, every service interval is an opportunity to see things that are covered most of the time. While the oil is draining, take the time to give your aircraft a once-over. Look for leaks and stains in the engine compartment and wherever fuel or hydraulic fluid flows. Look for missing, broken or loose hardware. Check the condition of hoses, belts, and baffles. Tires, brakes, and oleo struts deserve your attention as well. It's a lot easier to identify and quicker to correct deficiencies while your bird is in the shop than to make another service appointment.</p> <p><b>(Next Slide)</b></p>

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<p><b>Engine Operation</b></p> <ul style="list-style-type: none"><li>• <b>Fly Often</b></li><li>• <b>Minimize thermal shock</b><ul style="list-style-type: none"><li>– Warm up before flying</li><li>– Smooth power application and reduction</li><li>– Be careful when operating lean of peak EGT</li><li>– Plan descents to avoid shock cooling<ul style="list-style-type: none"><li>• Especially important for Turbos</li><li>• And in cold weather</li></ul></li></ul></li><li>• <b>Monitor performance</b></li></ul>  <p><small>FAA Aviation Maintenance Technician Handbook</small></p>	<p><b><u>Slide 7</u></b></p> <p>How we operate our engines has a lot to do with how long they'll last.</p> <p>First of all – fly often. It's actually harder on an engine if the airplane is in a hangar – or worse - a ramp queen. Regular operation keeps your engine components lubricated - markedly reducing corrosion potential.</p> <p>Thermal shock can be very hard on engines so be sure yours has reached operating temperature before taking off.</p> <p>Smooth, steady power changes are good for engine longevity. This is especially true for turbo charged power plants.</p> <p>Be sure to strictly follow manufacturers' recommendations when operating on the lean side of peak Exhaust Gas Temperature. It's not worth saving a gallon or so per hour if your engine overheats in the process.</p> <p>Once again - especially for Turbos - plan your descents with some power to keep the engine warm.</p> <p>Finally, monitor engine performance from flight to flight. Small changes over time can forecast developing engine problems.</p>
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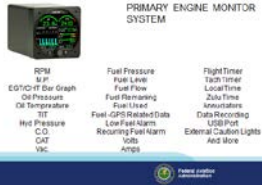
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	<p>We'll talk about monitoring in detail in the next slides.</p> <p><b>(Next Slide)</b></p>
<p>Flight Data Monitoring</p>  A slide titled "Flight Data Monitoring" featuring a photograph of a commercial airplane flying above a layer of clouds. The slide has a blue header and footer with a small logo.	<p><b>Slide 8</b></p> <p>Flight data monitoring has been around since before the jet age and modern airplanes make extensive use of the technology.</p> <p><b>(Next Slide)</b></p>
<p>Flight Data Monitoring</p>  A slide titled "Flight Data Monitoring" with the acronym "FOQA" in large letters. It includes two images: a cockpit instrument panel on the left and a red flight data recorder on the right. Text below the images lists "•Cockpit Voice Recorder (CVR)" and "•Flight Data Recorder (FDR)". The slide has a blue header and footer with a small logo.	<p><b>Slide 9</b></p> <p>In it's simplest form FDM consists of a cockpit voice recorder that records at least the most recent 15 minutes of crew conversations, and a flight data recorder that preserves such things as engine parameters, control position, heading, altitude, and airspeed data. <b>(Click)</b></p> <p>The equipment and processes to acquire and distribute the data are collectively known as Flight Operational Quality Assurance or <b>FOQA</b> (pronounced: <b>Fohqua</b>)</p> <p>But this equipment is only for the big guys right? General Aviation aircraft don't have anything like this ..... Or do they?</p> <p><b>(Next Slide)</b></p>

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<p><b>Flight Data Monitoring for GA</b></p>  <p>•Flight Data      •Flight Data + Visual</p>	<p><b><u>Slide 10</u></b></p> <p>While it's true that most GA aircraft don't have dedicated automatic flight data recording devices now; we will be able to enjoy the benefits of equipage in the future. In the meantime it's often surprising to see what we already have. <b>(Click)</b></p> <p>Manufacturers are already offering self-contained flight data and visual data recorders for GA airplanes and helicopters. Most operators of this equipment must periodically down load and analyze the recorded data – often with the aid of dedicated computer programs.</p> <p><b>(Next Slide)</b></p>
<p><b>Flight Data Monitoring for GA</b></p> 	<p><b><u>Slide 11</u></b></p> <p>Many data monitoring operations involve no automation at all. Flight engineers used to handle the monitoring and record keeping <b>(Click)</b></p> <p>And test pilots were expected to keep notes while flying.</p> <p><b>(Next Slide)</b></p>
<p><b>Sample of What's Available to the GA Community</b></p>  <p><b>PRIMARY ENGINE MONITOR SYSTEM</b></p> <ul style="list-style-type: none"> <li>RPM</li> <li>MP</li> <li>EGT/OT Air Graph</li> <li>Oil Pressure</li> <li>Oil Temperature</li> <li>TIT</li> <li>Hrd Pressure</li> <li>CO</li> <li>QAS</li> <li>VIC</li> <li>Fuel Pressure</li> <li>Fuel Level</li> <li>Fuel Flow</li> <li>Fuel Remaining</li> <li>Fuel Usage</li> <li>Fuel CPIS Related Data</li> <li>Low Fuel Alarm</li> <li>Resolving Fuel Alarm</li> <li>Wells</li> <li>AMPS</li> <li>Flight Timer</li> <li>Tach Timer</li> <li>Local Time</li> <li>Zulu Time</li> <li>Maneuvers</li> <li>Data Recording</li> <li>USB Port</li> <li>External Caution Lights</li> <li>And More</li> </ul>	<p><b><u>Slide 12</u></b></p> <p>Here's just one example of the information available in one small box. This example doesn't include recording capability but it's certainly one-stop shopping for engine information.</p>



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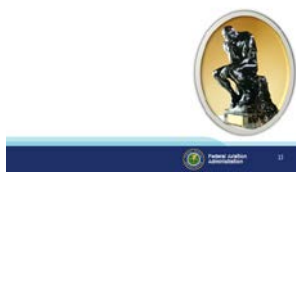
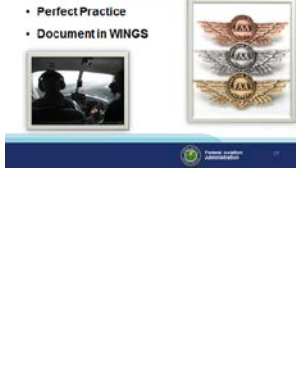
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	<p><b>(Next Slide)</b></p>
<p>Flight Data Monitoring for GA</p>  <p>January 2016 Topic of the Month Flight Data Monitoring</p>	<p><b><u>Slide 13</u></b></p> <p>Recip. pilots can do much the same thing by tracking engine power, fuel flow, oil temperature and pressure. Panel mounted GPS systems and many hand held units are already capable of recording position, heading, speed, and altitude. Some engine monitors have recording capability and many aircraft owners participate in oil analysis programs – a tool for gauging engine health and heading off expensive or, in some cases, disastrous problems. Some aircraft – particularly helicopters are equipped with metallic chip detectors that can forecast engine and transmission failures in time to make a safe landing.</p> <p><b>(Next Slide)</b></p>
<p>Flight Data Monitoring for GA</p>  <p>January 2016 Topic of the Month Flight Data Monitoring</p>	<p><b><u>Slide 14</u></b></p> <p>And don't forget basic instrumentation such as Air Speed Indicators, Attitude Indicators, Angle of Attack, Manifold Pressure, RPM, and G indicators – all of which give immediate feedback as to whether design limitations have or are about to be exceeded.</p> <p><b>(Next Slide)</b></p>

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<p><b>FDM Technology Cost</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%; text-align: center;">&lt; \$10K</th> <th style="width: 33%; text-align: center;">\$10K to \$20K</th> <th style="width: 33%; text-align: center;">&gt; \$20K</th> </tr> </thead> <tbody> <tr> <td style="font-size: small;">GA Low-cost FDM System</td> <td style="font-size: small;">Cockpit Voice Recorder (CVR)</td> <td style="font-size: small;">Flight Data Recorder (FDR)</td> </tr> <tr> <td style="font-size: small;">Cockpit Image Recorder (CIR) <small>(Low end)</small></td> <td style="font-size: small;">Cockpit Image Recorder (CIR) <small>(High end)</small></td> <td style="font-size: small;">Combined Recorder (FDR, CVR, CIR, DLC)</td> </tr> </tbody> </table> 	< \$10K	\$10K to \$20K	> \$20K	GA Low-cost FDM System	Cockpit Voice Recorder (CVR)	Flight Data Recorder (FDR)	Cockpit Image Recorder (CIR) <small>(Low end)</small>	Cockpit Image Recorder (CIR) <small>(High end)</small>	Combined Recorder (FDR, CVR, CIR, DLC)	<p><b><u>Slide 15</u></b></p> <p>At present FDM Technology from a little less than \$10,000.00 to more than \$20,000.00 but as competition and equipage increase, prices are expected to fall.</p> <p><b>(Next Slide)</b></p>
< \$10K	\$10K to \$20K	> \$20K								
GA Low-cost FDM System	Cockpit Voice Recorder (CVR)	Flight Data Recorder (FDR)								
Cockpit Image Recorder (CIR) <small>(Low end)</small>	Cockpit Image Recorder (CIR) <small>(High end)</small>	Combined Recorder (FDR, CVR, CIR, DLC)								
<p><b>Flight Data Monitoring for GA</b></p> 	<p><b><u>Slide 16</u></b></p> <p>In the meantime, we urge you to consider the information that's already available on every flight.</p> <p><b>(Next Slide)</b></p>									
<p><b>Questions?</b></p> 	<p><b><u>Slide 17</u></b></p> <p>Presentation Note: <i>You may wish to provide your contact information and main FSDO phone number here. Modify with Your information or leave blank.</i></p> <p><b>(Next Slide)</b></p>									
<p><b>Proficiency and Peace of Mind</b></p> <ul style="list-style-type: none"> <li>• Fly regularly with your CFI</li> <li>• Perfect Practice</li> <li>• Document in WINGS</li> </ul> 	<p><b><u>Slide 18</u></b></p> <p>There's nothing like the feeling you get when you know you're playing your A game and in order to do that you need a good coach <b>(Click)</b></p> <p>So fly regularly with a CFI who will challenge you to review what you know, explore new horizons, and to always do your best. Of course you'll have to dedicate time and money to your proficiency</p>									

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	<p>program but it's well worth it for the peace of mind that comes with confidence. <b>(Click)</b></p> <p>Vince Lombardi, the famous football coach said, "Practice does not make perfect. Only perfect practice makes perfect." For pilots that means flying with precision. On course, on altitude, on speed all the time. <b>(Click)</b></p> <p>And be sure to document your achievement in the Wings Proficiency Program. It's a great way to stay on top of your game and keep you flight review current.</p> <p><b>(Next Slide)</b></p>
	<p><b><u>Slide 19</u></b></p> <p>The AMT Awards program encourages AMTs and employers to take advantage of initial and recurrent training by issuing awards based on training received in one calendar year.</p> <p>The program has several levels, or phases, of recognition for both you and your employer. You can obtain an FAA Certificate of Training upon successful completion of the program requirements. Employers can obtain a Gold or Diamond Award of Excellence yearly depending on the percentage of their employees receiving awards.</p> <p>Training earned toward an AMT Award falls into one of two categories; Mandatory Core Training and Eligible Training.</p>

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	<p>Mandatory Core Training is one or more on-line training courses, depending on FAA evaluation of training needs. The Core Training course(s) can be located and completed in the Aviation Learning Center at FAASafety.gov.</p> <p>Eligible Training is the hourly training that can be credited toward an individual AMT Certificate of Training. This training must be aviation maintenance career related training.</p> <p>Be sure to document your achievement in the AMT Awards Program. It's a great way to stay on top of your game and keep stay proficient.</p> <p><b>(Next Slide)</b></p>
 <p>Thank you for attending • You are vital members of our GA safety community</p>	<p><b><u>Slide 20</u></b></p> <p>Your presence here shows that you are vital members of our General Aviation Safety Community. The high standards you keep and the examples you set are a great credit to you and to GA.</p> <p>Thank you for attending.</p> <p><b>(Next Slide)</b></p>
 <p>The National FAA Safety Team Presents Topic of the Month Nov Engine Maintenance and Performance Monitoring</p> <p>Presented to: &lt;&lt;audience&gt;&gt; By: &lt;&lt;presenter&gt;&gt; Date: &lt;&lt;&gt;&gt;</p> <p>Produced by AFS-850 National FAAS Team</p>	<p><b><u>Slide 21</u></b></p> <p><b>The End</b></p>

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