Perspective: The Importance of Aviation Engine Vibration Testing

A conversation with Rick Jones, President and CEO of MTI Instruments

Jet engine vibration is perhaps the worst enemy of an aircraft maintenance team. Out-of-balance parts can lead to cracked fan, turbine, and compressor components; general metal fatigue; and if unchecked, catastrophic engine failure. Overall vibration, however, is actually the summation of vibration contributions from any combination of moving parts within the engine, which makes analysis and balancing extremely complicated. Structural characteristics of individual aircraft compound the problem. Engine location on the airframe or type of engine mount, for example, can transmit or magnify vibration troubles. Rick Jones, President and CEO of MTI Instruments, addresses this industry-wide challenge to aviation safety and service.

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Q: What causes engine vibration?

A: The primary cause of engine vibration is imbalance. Rotating components with an asymmetrical mass distribution impose uneven centrifugal forces which result in vibration. Testing may determine that most of the vibration content is due to rotor imbalance, worn parts (for example, a pump or bearings), or some combination of the two. Our equipment is used for two main tasks—to check vibration levels and to balance rotors.

Q: How does an aircraft engine become unbalanced in the first place?

A: The causes for out-of-balance conditions vary widely. Imbalances can result when rotating engine parts such as fan blades are replaced. Damage from bird strikes or other impacts may cause out-of-balance conditions. Natural wear and corrosion, of course, will also lead to a redistribution of mass over time.

Q: When should an aircraft engine be tested for vibration, and how often?

A: Engine manufacturers specify a maintenance schedule that must be adhered to for their engines. Additionally, the FAA will on occasion issue directives related to engine safety. Included in these recommendations and mandates are specific testing requirements and allowable vibration limits. Some airlines or other aircraft owners may require a stricter schedule and tougher limits than the engine manufacturer. In general, the engine should be tested when the schedule requires, when an impact event occurs, or with any increase in the overall vibration level.

Q: Who is responsible for performing routine engine vibration analysis and balancing?

A: Ultimately the aircraft operator is responsible for ensuring the entire aircraft is safe and meets standards. But commercial airlines tend to use one of several options as it relates to engine maintenance. An airline might have its own in-house maintenance crew that's responsible for the maintenance of the fleet's aircraft and its engines. It may also use maintenance through the engine's OEM as part of a maintenance contract, or contract a third-party maintenance crew to manage and conduct a fleet's maintenance needs. These MRO (Maintenance, Repair, and Overhaul) providers—companies such as Lufthansa Technik, HAECO, and Delta Tech Ops– may specialize in specific maintenance operations such as engine vibration analysis and balancing.

The military has their own crews to conduct maintenance and repair operations, but they too will leverage contracted services that provide resources, equipment, and expertise.

Q: What role does vibration analysis and balancing play in an engine lifecycle management plan?

A: All turbine engines have OEM-specified vibration limits, and all airframe and engine manufacturers provide procedures for addressing an out-of-specification vibration condition. These procedures vary in effectiveness, depending on the test equipment specified and/or the skill level of available personnel. With the right tooling and training, these procedures can be used on an emergent basis to bring an engine within limits and save the need for an engine change.

It's important to note that dramatic cost savings are possible with the latest vibration analysis and trim balance procedures. Traditional methods of fan-only balancing such as the "three shot plot" method, for example, require a minimum of four engine runs to complete. MTI Instruments' precision balancing system, in comparison, can lower vibration to the minimum possible in one run with consistent, well documented and accurate results.

In addition, significant savings can be realized through early analysis of turbine vibration. An advanced portable system can eliminate the need for engine removal and replacement.

Q: How long has MTI Instruments been involved with aviation MRO?

A: The original vibration analysis and precision balancing systems, which we call our PBS, came about in the early 1980s as the result of valuable relationships with the USAF, NASA, General Electric, Rolls Royce, and Pratt & Whitney. Some engine OEMs specified the MTI Instruments' PBS in maintenance documentation, and soon thereafter aircraft operators and MROs began to purchase it.

It wasn't long before word spread about the power and simplicity of our vibration testing and balancing systems and it penetrated almost all corners of the large-frame engine MRO market. Since then, MTI Instruments has consistently adopted new advances in technology to improve the functionality of our PBS, making it more compact and easier to use.

About MTI Instruments

MTI Instruments is a US-based manufacturer of highly-advanced balancing and vibration analysis systems. Specifically designed for aircraft engine/turbine manufacturers, our portable and test cell balancing solutions are backed by 50 years of industry service. Every day, leading names from commercial aviation, as well as the US Air Force and foreign militaries, use our systems to solve engine vibration problems. At MTI, we're obsessed with precision and with providing innovative vibration/balancing expertise to maintenance, repair and overhaul (MRO) organizations worldwide. MTI Instruments is also proud to be an ISO 9001:2015 certified company.

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