# Diesel Technology in Aviation… Again: Exploring Line Maintenance of the Diesel Engine

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*Abstract*— **Diesel engine technology has arrived into the general aviation market and its benefits and advancements are changing the way aviation technicians must look at Line Maintenance and troubleshooting. Computer controlled engines need computers for diagnostics and maintenance.**

***Keywords-Diesel; Technology; FADEC; Aviation***

## I. INTRODUCTION

Diesel technology has been around for a very long time in many different industries and has been a proven technology in many of those fields. Diesel engines operate differently than the traditional gasoline combustion engine. In fact they are commonly referred to as "Compression Ignition" engines as they compress fuels until they explode within the combustion chamber, as opposed to burning in conventional gasoline engines [2]. This paper will take a glimpse into the Aviation Diesel engine and the differences in Line Maintenance of the Aviation Diesel engine.

## II. HISTORY

Diesels have been around a long time, even in aviation. The founder of the Diesel engine Rudolf Diesel, hence the name "Diesel" first ran his diesel engine in 1897. Diesel engines in the beginning were for heavy machinery and the marine industry [2]. Diesel's first arrived in the aviation industry in the early 1900's. The first aircraft designed diesel engine was the "Junkers Jumo 4" which began flight testing in 1913 and was revised again and again over the next nearly twenty years. The Jumo engine although very efficient, never gained widespread popularity, due in part to cheap gasoline fuels at the time [3].

## III. FUEL

Diesel fuels typically have better lubricating properties than gasoline based fuels. The chemical composition of diesel fuel with compounds such as sulfur that acts as a lubricant on the engines internal parts reduces component wear rates. In the aviation industry Jet A is widely used in place of diesel fuel, as it shares similar properties. The low sulfur content of Jet A makes its lubricity value lower and the fuel must be supplemented with additives to prevent excessive engine component wear [4] and [6].

The global availability of jet fuel over aviation gasoline has sparked new interest in diesel technology. In many parts of the world aviation gasoline is extremely expensive or nearly impossible to obtain [5].

## IV. DIESELS IN AVIATION

In recent years diesels have arrived back into the aviation market. Several aircraft manufactures are now producing and have diesel engines offered as an optional engine package on several production models. Though usage of diesel engines on aircraft is widespread in Europe, it has not fully caught on in North American [1].

## V. FADEC

Full Authority Digital Engine Control (FADEC) has changed the Diesel engine, making it more efficient and much easier to operate. The use of single power lever operation for the pilot reduces workload in terms of engine management. The pilot of a FADEC diesel engine powered aircraft no longer has to manage manifold pressure and prop loading [1]. Control of the engine is simply a variable of the software that is running the engine in regards to the percent power the pilot has selected. Redundancy is built into the system with dual channels of sensors, run by separate computers and an aircraft

DOI: 10.5176/0000-0004_1.1.5

backup battery to run the computers in the event of an electrical system failure.

## VI. Line Maintenance/Troubleshooting

Line Maintenance and troubleshooting is very different on the FADEC Diesel engine, compared to the traditional gasoline engine, as the engine is now computer controlled. Aviation technicians must use laptops and tablets to interface with the operating systems that are controlling the engine to read faults and engine parameters when troubleshooting. Faults codes or descriptions must then be interpreted to determine the proper course of action. Data logging, Event, and Fault records are some of the files that may be accessed to enhance troubleshooting. Some diesel engine manufactures have incorporated diagnostics that can be viewed live while the technician attempts to duplicate the discrepancy. Some types of files are raw data that must be sorted within additional software such as Excel and some are Windows based point and click type applications. These data files provide detail information on what was and is happening to the engine, technicians no longer need to rely on pilots to inform them of engine parameters during the time of the discrepancy. Some Diesel engines require a "Software Key" to interface with laptops/tablets to access these files, thus requiring factory training to obtain possession of the software key. In the event the technician is unable to diagnose the engine discrepancy, these files may be downloaded and emailed to the engine manufacturer technical support staff for assistance.

Performing inspection items, such as the Compression test, require the use of test equipment that is slightly different than what is used on a gasoline engine. Diesel engines typically have very high compression ratios, due to the inherent design of the engine, thus making most gasoline compression tester units incompatible. The technician must make certain to use a compression tester that has a pressure range high enough to read the diesel engines compression. These testers are of the Direct Compression type and require access to a fuel injector or glow plug port for testing.

Static power checks are performed more like a turbine engine than a reciprocating engine on the FADEC controlled diesel engine. The technician must compare the percent output or load to the prescribed chart to assess engine performance. The FADEC computer will compensate for most non-standard atmospheric conditions and the technician simply verifies the percent output of the engine.

## VII. Conclusion

The diesel engine or should I say "Compression Ignition" engine is back in the forefront of the aviation market. This resurgence of the diesel engine is due in part to computers and FADEC technology making engine management simpler for the flight crew and cheaper to operate with better fuel consumption than previous models. Aviation technicians must be knowledgeable of all related systems and sensors. The complete understanding of which sensors are critical for the engine and which ones are considered non-critical is paramount to troubleshooting. Computer based diagnostics and troubleshooting has now arrived to the general aviation market.

## References


[1] FADEC: Making a piston engine act like a turbine. (2007). Aviation Maintenance, 26(7), 0. Retrieved from Http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/228256725?accountid=27203

[2] Mollenhauer, K., & Tschoke, H. (2010). *Handbook of diesel engines*. Berlin,London: Springer.

[3] Wilkinson, P. H. (1942). *Diesel aviation engines*. New York: National Aeronautics Council.

[4] Anastopoulos, G., Lois, E., Karonis, D., Kalligeros, S., & Zannikos, F. (2005). Impact of oxygen and nitrogen compounds on the lubrication properties of low sulfer diesel fuels. *Energy*, *30*(2-4), 415-426. Retrieved from http://dx.doi.org/10.1016/j.energy.2004.04.026

[5] Dalton, C. P. (1977). The availability of jet fuel over the next two decades. *Aircraft Engineering and Aerospace Technology*, *49*(12), 8-14.

[6] Goodger, E. M. (1996). Jet fuels. *Aircraft Engineering and Aerospace Technology*, *68*(5), 3-6.


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