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MEASURING PARAMETERS OF PHOENIX-100 GAS-GENERATOR

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1. Introduction

In development of Phoenix family of turbo engines there was a need for a satisfying measuring installation in order to control and monitor engine parameters.

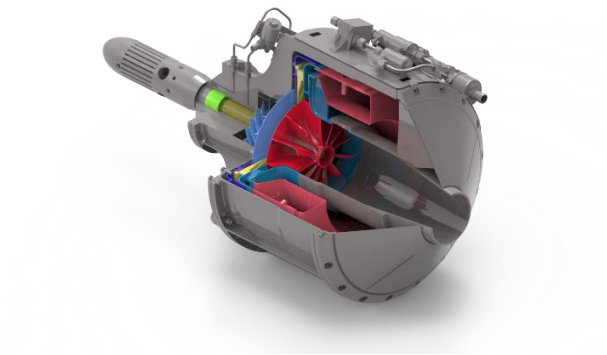

Fig. 1. Phoenix-100 gas-generator

As testing installation does not have enough measuring channels, we need to select a few parameters which will satisfy the need for control as well as to provide us with enough information of behavior of engine operation. The problem was the same as in case monitoring the engine parameters on gas-generator on tip-jet helicopter [1]. Because the generator was placed on the top of helicopter, above the blades, it was necessary to reduce a number of sensors for effective operation of tip-jet propulsion system [2].

2. Acquisition system

Acquisition system for engine, gas generator [3] Phoenix-100, testing consists of the following sensors: flow meter, accelerometer, two thermocouple probes, two pressure transducers, inductive sensor and load cell (Fig.2).

The flow meter device is installed on the fuel pump and it is used to measure the mass flow rate of fuel for ignition main fuel supply system. It is a part of engine monitoring and control system.

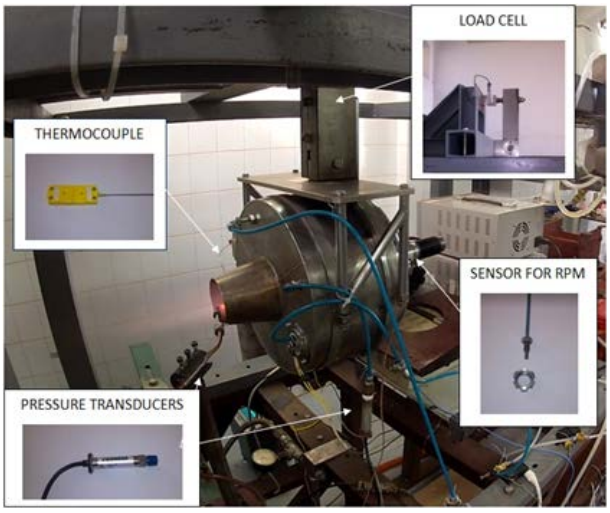

Fig. 2. Acquisition system for engine testing and monitoring

The accelerometer, placed near the bearing, is used to monitor the engine behavior during tests, also it can determine resonant areas or some damage appearance.

Two thermocouple probes, OMEGA K-type thermo couple CH+ AL-, are installed. One reads the temperature of more loaded bearing. The other one measures the temperature of operating fluid, mixture of combustion products, placed on the nozzle near its exit section (Fig.2).

Pressure transducer measures maximum static pressure in the gas-generator, in the area behind the diffuser and before the combustion chamber entrance. Therefore, it gives the information of compressor pressure ratio during testing. The sensor that is used is OMEGA PX602-150GV with the following characteristics: span 150 psig, accuracy 1%, input voltage 5-10Vdc, output signal 10mV/V, maximum pressure 300 psig, and etc. (Fig.2). The same sensor is used for measuring the total pressure on the nozzle exit. As the gas temperature is around 700°C there is a pipe system from copper pipes installed between the pitot sonde and the transducer, in order to cool down the

combustion products mixture to an appropriate level so sensor cannot be damaged (Fig.2).

For determining the engine rpm, the inductive sensor DW-AD-405-04-290 is used. Its characteristics are: diameter of stainless housing 4mm, operating distance of 0.8mm, supply voltage 5-30Vdc, output current ≤1/≥2.2 A, switching frequency ≤10000Hz, ambient temperature range -25 - +70°C etc. The measuring is done over the toothed distant bush located between the bearings on the shaft with previously explained probe (Fig.2).

OMEGA S shaped load cell LC111-250 is used to measure engine thrust during testing together with appropriate level system [4] installed on test bench (see Fig.3). It has the following characteristics: range 0-250 lb, output current 3mV/V, supply voltage 10Vdc, with linear errors ±0.03%, repeatability 0.01%, hysteresis ±0.02 of the full range, operating temperature from -40 to 93°C etc.

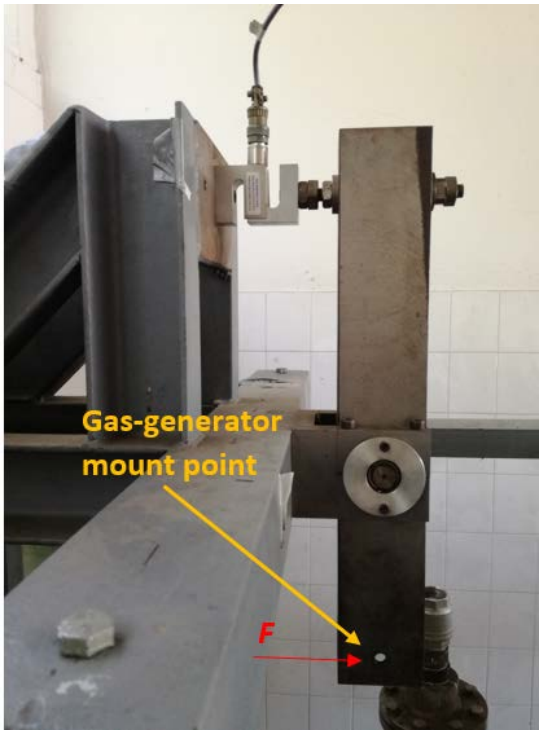

Fig. 3. Level mechanism with S-shaped load cell for measuring the thrust force

The following Figure 4 presents a diagram with measured values of these basic generator parameters at 55,000 rpm during testing. During testing, values of ambient pressure and temperature were measured independently.

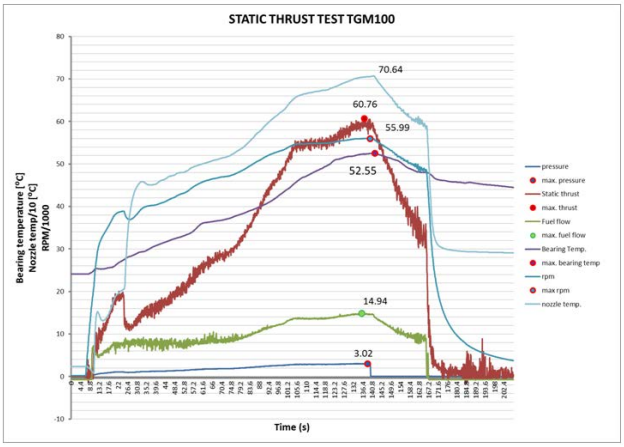

Fig. 4. Static test results for Phoenix-100 gas-generator

3. Remarks

The presented acquisition system proved to be useful for determining, monitoring and controlling the gas-generator operation and behavior. With a few presented sensors and their output result, we later managed to simulate the flow in gas-generator with Computation Fluid Dynamic software. The paper also presents a verified idea for the way of force measuring, with appropriate level system and sensor as in the Fig.3, and solution for measuring with simple conventional pressure transducer a total pressure of hot combustion products.

Acknowledgements

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References

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