

## ANALYSIS OF PRESSURE RATIO IN THE INTAKE IN DEPENDENCE ON HIGH-VOLTAGE BEHAVIOURS

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### Introduction

The intake air together with fuel creates burnt fuel mixture and combustion process takes place in the combustion chamber of engine in the cylinder. Correct composition of fuel mixture is the main requirement to get the maximum desired engine torque, the lowest possible fuel consumption and also the lowest volume of emissions in the exhaust.

Control unit regulates the composition of the mixture with aim to control the throttle opening and regulate opening of the injection valves. Throttle regulates the amount of incoming air. Control unit needs to obtain information about air pressure in the intake manifold through the pressure sensors for appropriate setting of throttle.

### Experimental measuring of pressure conditions

Operating condition of engine was diagnosed in auto electric Laboratory at the University of Žilina (Fig.1). Experimental measurements of pressure ratios were performed in the interval between idling and full load.

Idling we can monitor and measure without difficulties, but the condition of full engine load can be adequately monitored only if laboratory is specified (on a roller brake).



Fig.1. Autodiagnosics laboratory at the University of Žilina

In the Fig.2 the speed and pressure of motor obtained by the oscilloscope OBD KTS 520, which allows obtaining the values directly from the control unit is shown.

When idling stabilizes the pressure in the intake channel, achieved value is influenced by the tightness of the intake manifold behind throttle and regulation of idle through the bypass channel around the throttle.

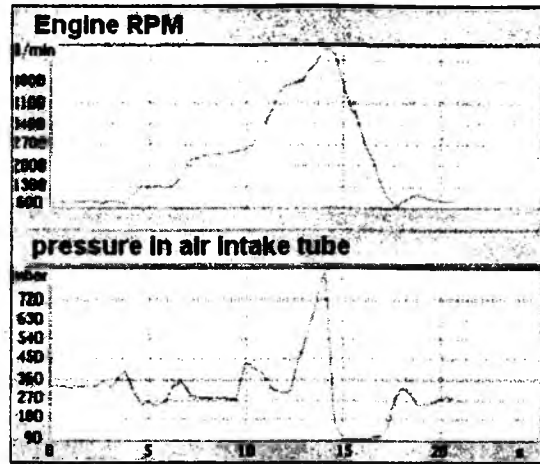


Fig.2. The speed and pressure obtained from the control unit

As the result of idling big losses strangulation occurs because the throttle is almost closed (there is a large vacuum, which act against the engine run).

Conversely mechanical friction causes losses of moving parts such as engine friction, piston rings on cylinder walls, friction in the crankshaft system, friction in the auxiliary aggregates (alternator, oil pump, fuel pump), or loss of swirling air in the crankcase (they are relatively low).

Idling is also characterized by low thermal efficiency of the engine due to a small ignition advance. A small advance to achieve good levels of emissions, mainly hydrocarbons, whose concentration increases with the increase of the ignition advance is needed.

Another negative influence exerted on the engine at idling is worse function manifold pressure that is set to provide optimal timing in areas where the highest torque moment is needed.

### The pressure in the intake and sparking voltage

Pressure in intake has a dominant influence on the size of the over voltage, when idling gets the size of voltage peaks about 8 to 11 kV (the secondary voltage of transformer) in Fig.3.

Shortly after reaching full throttle opening, the cylinder receives large amount of air. At that point engine is almost fully loaded, because it overcomes the moments of inertia of rotating parts.

When the air is compressed, a high pressure in cylinder occurs. This corresponds to an increase over voltage to about 15 kV (Fig.4).

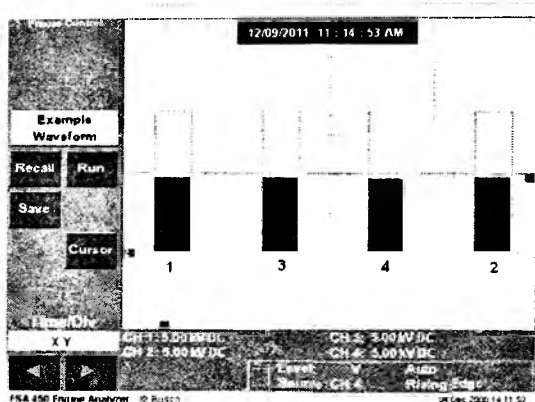


Fig.3. Graph of secondary voltage for each cylinder at idle

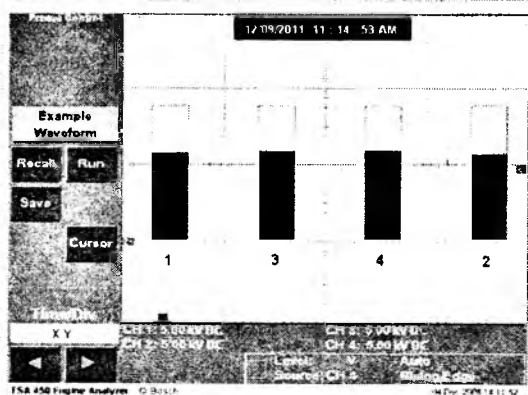


Fig.4. Graph of secondary voltage for each cylinder at higher engine speeds

This high engine load is only momentary, when is the engine accelerated to a higher speed, the load in the cylinder declines, there is the smaller amount of compressed air resulting in a lower pressure in the cylinder - below the transformer secondary voltage.

In addition, shortly after stepping on the gas pedal as soon as the motor starts spinning from idle to maximum speed, ignition advance is increasing by jump. This is obviously reflected in the pressure in the cylinder at the moment of jump-spark.

#### Conclusion

A more detailed analysis over the manifold pressure in various situations with oscilloscope

system KTS 520 is investigated. The system is connected to the terminals of the pressure sensor which allow us to measure and diagnose the voltage on the sensor, therefore, manifold pressure.

For different application methods of engine load is clear that in slow rotate of non-loaded engine a low pressure in the intake in the whole course of acceleration occurs. The pressure was sharply increased at the value of the maximum engine speed, when the throttle was fully opened.

When the sharp in engine speed increases, the engine is exposed to high moment of rotating parts inertia, which translates on the pressure in the intake. Pressure rises sharply with increasing speed. After closing the throttle is pressure plummeted to the lowest value. It follows that the suction pressure is proportional to the load engine, and so is adapted also to the throttle.

When the changes of pressure in the combustion chamber on to size of over voltage are analyzed, the over voltage increase connected with increase of pressure can be seen.

This effect is also related to the ignition advance, because in the bigger ignition advance the pressure in the cylinder is lower. Over voltage is bigger in a richer mixture, which has a lower electrical resistance. Among other effects can be the voltage polarity, electrode distance, the wear and temperature.

Based on the height of columns (size over voltage) can be analyzed the ratios of the pressures of the engine cylinders, where the change in ratios of pressures is proportional to the size of the over voltage.

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