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ADVANCED METHODS TO REDUCE THERMAL LOSSES IN THE INTAKE SYSTEM

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ABSTRACT: This paper presents three methods for reduce thermal losses in the intake system whit improvement of airflow and thermal protection. In the experiment are involved two patented devices conceived by the author conceived by the author and one PhD theme device: 1, Dynamic device for air transfer, 2, Integrated thermal deflector, and, 3, Advanced thermal protection. The tests were carried on different vehicle running in real traffic and in the Internal Combustion Engines Laboratory, within the specialization "Road automotives" belonging to the Faculty of Engineering Hunedoara, component of "Politehnica" University of Timişoara. The results have been processed and compared whit the ones obtained whitout these devices.
Keywords: thermal losses, intake, engine, integrated thermal deflector

1. INTRODUCTION

A cold air intake (CAI) is an assembly of parts used to bring relatively cool air into a car's internal-combustion engine. Most vehicles manufactured from the mid-1970s until the mid-1990s have thermostatic air intake systems that regulate the temperature of the air entering the engine's intake tract, providing warm air when the engine is cold and cold air when the engine is warm to maximize performance, efficiency, and fuel economy. With the advent of advanced emission controls and more advanced fuel injection methods modern vehicles do not have a thermostatic air intake system and the factory installed air intake draws unregulated cold air. Aftermarket cold air intake systems are marketed with claims of increased engine efficiency and performance. The putative principle behind a cold air intake is that cooler air has a higher density, thus containing more oxygen per volume unit than warmer air [1].

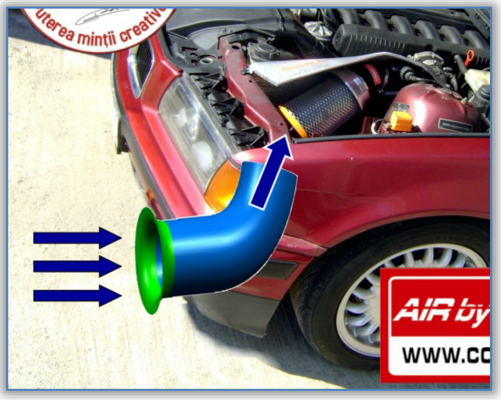
2. PRESENTATION OF THE METHODS AND DEVICES

2.1. Dynamic Device for Air Transfer (DDAT)

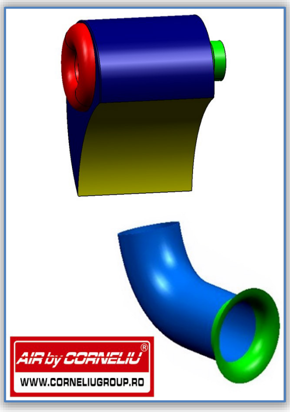
Dynamic device for air transfer (Figure 1) refers to a device designed to collect and transfer air from outside the engine compartment on tha air filter, to make a laminar, concentrated flow of air and lowering its temperature for increase the volumetric efficiency of internal combustion engine. The Dynamic Air Transfer Device consists of: external collection diffusers (one or several), connection joints and external axial collector (one or two passages).

Advantages

» the air transfer to the filter has a concentrated laminar flow;
» the low air allows a more efficient internal cooling of the ICE;
» a slight effect of overfeeding is created, which is proportional to the speed of the car;
» an increased volumetric efficiency;
» a higher burning yield of the combustion mix;
» lower levels of polluting emissions;
» dynamic admission;
» makes possible to shorten the distance between the filter and admission gallery.



a)



b)

Figure 1.Dynamic device for air transfer; a – operation principle, b – virtual model, made Catia V5

2.2. Integrated thermal deflector

The integrated thermal deflector (Figure 3) it's designed to protect the air filter area from the thermal radiations generated by the cooling radiator and combustion engine. The integrated deflector has the form of a separating wall between air filter area and rest of engine compartment.

The usage of the integrated thermal deflector has the following advantages:

- » the air flow generated by cooling radiator (i.e. thermal radiations) is deflected outside the air filter area
- » the temperature of the air filter is maintained at an optimum level (i.e. their over-heating is avoided)

Temperature variation measurements (Figure 4) have been carried out at different speeds both in the area of the air filter and outside the area of the air filter whit the integrated thermal deflector mounted on the site [2].

2.3. Advanced thermal protection

Because of the position in the engine compartment the intake (Figure 5) is highly expose to thermal radiations from the cooling radiator, exhaust pipe and

Pressure variation measurements (Figure 2) have been carried out at different speeds both in the area where the air is transferred from the DDAT to the filter and the area where the air is absorbed by the filter (left and right side) without the DDAT. The measurements were performed with the digital manometer TESTO 510 (0-100hPa)

A significantly higher air collection and transfer effect is observed with DDAT than in the case of the simple absorption performed by the super-absorbing filter [2].

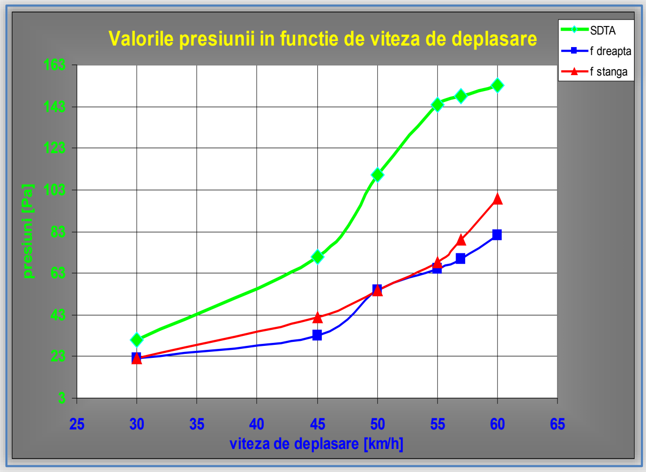
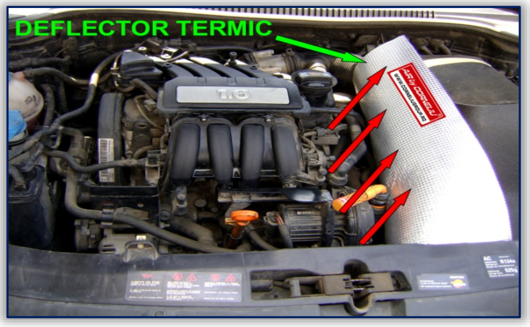


Figure 2. Intake pressure values

a)



b)

Figure 3. Integrated thermal deflector; a – real model, b - operation principle

engine itself which is a disadvantage, the intake air it heated and the result is a lower density, thus containing less oxygen per volume unit than cold air.

One method of reducing thermal losses is to insulate the intake whit a new kind of material.

The principal scope is to resource and development a new insulates material from composite, natural and organic materials based from recycling materials.

Early comparative tests were carried out on sections (Figure 6) of intake with or without layers of insulation materials. The tests were performed with various layers (Figure 7) of insulation materials such as silicone, carbon fiber, cork and various mixtures.

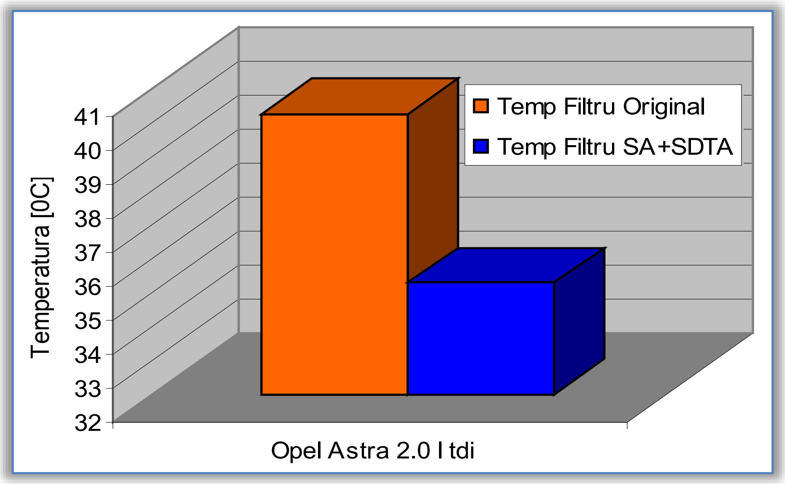


Figure 4. Intake air temperature values

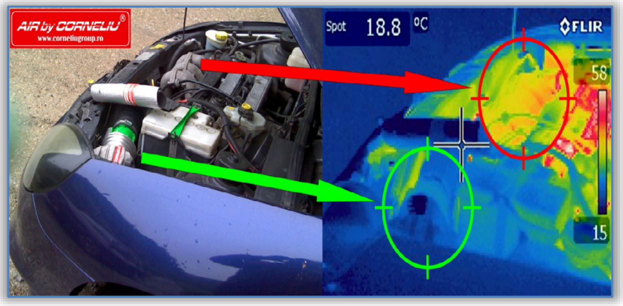


Figure 5. Intake temperature - Thermal imager

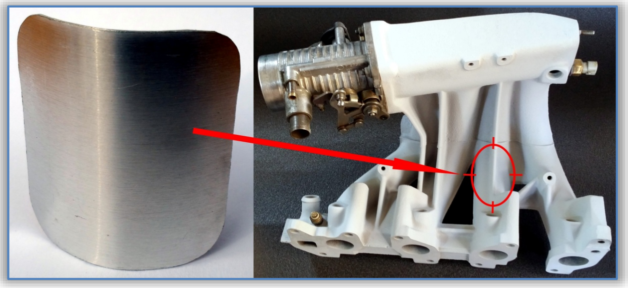


Figure 6. Intake sections probe

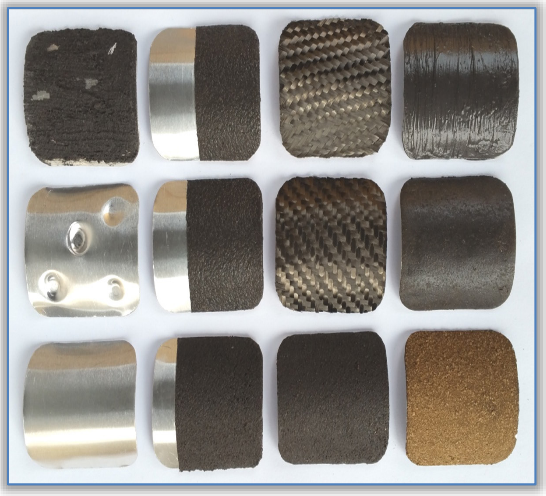
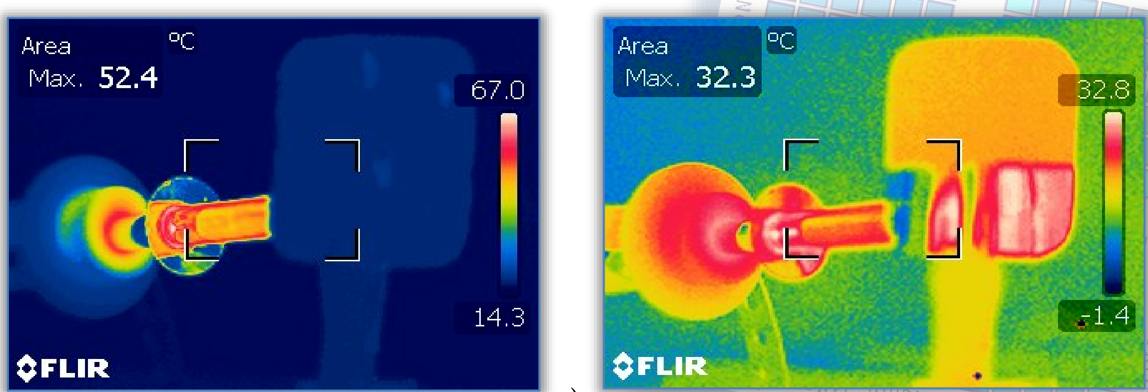


Figure 7. Intake sections coated

Comparative tests (Figure 8) on sections from intake coated with an insulating layer revealed a significant improvement regarding thermal losses.



a) b)

Figure 8. Comparative Thermal imager tests; a – coated intake section probe,
b – no coated intake section probe

3. CONCLUSIONS

In conclusions, we can say that these methods can reduce thermal losses in the intake system by providing a higher pressure air flow while maintaining a low temperature along intake system, contributing to increasing the filling efficiency η_v of the engine cylinders.

Also improving the filling efficiency η_v means a lower specific fuel consumption and lower exhausts pollutants.

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