ANNALS of Faculty Engineering Hunedoara
– International Journal of Engineering
Tome XV [2017] – Fascicule 4 [November]

ISSN: 1584-2665 [print; online]
ISSN: 1584-2673 [CD-Rom; online]
a free-access multidisciplinary publication
of the Faculty of Engineering Hunedoara

[1.]Corneliu BIRTOK-BĂNEASĂ

THE DISPERSION OF THE HEAT FLOW IN THE ENGINE COMPARTMENT. CASE STUDY FIAT PANDA 1.2i

[1.]University Politehnica Timişoara, Faculty of Engineering Hunedoara, Hunedoara, ROMANIA

Abstract: This paper presents a study concerning the influence of the dispersion of the heat upon the air filter and the intake manifold. The data was registered in real time with the help of thermal imaging camera at different operating regimes on a FIAT Panda vehicle, equipped with a gasoline engine with a cylindrical capacity of 1.2l. The propeller group is placed across a constructive solution everything in front. The gas circulation is a cross flow type with the intake manifold placed behind the engine and the exhaust manifold in front of the engine. The air filter is placed in the upper part of the engine, the frame is made out of plastic in a prismatic shape. The air circulation through the filter is offset cross flow going from the front to the back. The results obtained after the tests allow us to determine the optimum parameters on the efficiency of the heat transfer on the air filter and of the intake manifold of the internal combustion engine.
Keywords: intake manifold, air filter, cross flow, heat transfer

1. INTRODUCTION

The measurement were made on a FIAT Panda vehicle, equipped with an engine displacement of 1.2l (figure 1), gasoline multipoint injection. The propeller group is placed across, a constructive solution everything in front. The gas circulation is a cross flow type with the intake manifold placed behind the engine and the exhaust manifold in front of the engine. The air filter is placed in the upper part of the engine, the frame is made out of plastic in a prismatic shape. The air circulation through the filter is offset cross flow going from the front to the back.

Figure 1. Fiat Panda [1]

The thermal radiations and the hot air from the exhaust manifold, engine, the cooling radiator and the location of the air filter, in the case of this type of engine promotes excessive heating of the air filter and of the intake manifold (figure 2). The absorbed air is heated shrinking in this way its density, and the engine's performance drops in the warm season. The temperatures of the air filter and of the intake manifold vary, in this case, between 60-85˚C depending on the speed of vehicle [2].

2. CONDITIONS AND MEASUREMENTS

Comparative measurements were made at the level of the engine compartment, mainly on the exterior surfaces of the air filter, of the intake manifold and of on the heat sources (exhaust manifold, engine and the cooling radiator of the engine). The temperatures were studied depending on the ambient temperature, functioning regime (normal or heavy traffic) and road (altitude difference, ramp, slope).

- **The air filter** (figure 2) has a panel type filter element (from micro porous cardboard) placed vertically, and on the upper part of the engine, with a plastic frame in a prismatic shape. The air circulation through the air filter is offset cross flow from front to back [2].
- **The intake manifold** (figure 3) is positioned in the rear of the engine. On the intake manifold there is placed throttle-little engine module step by step and the multipoint injection ramp [4]. The material used in the construction of the intake manifold is PA66 GF35.

Figure 2. The air circulation through the air filter [3]

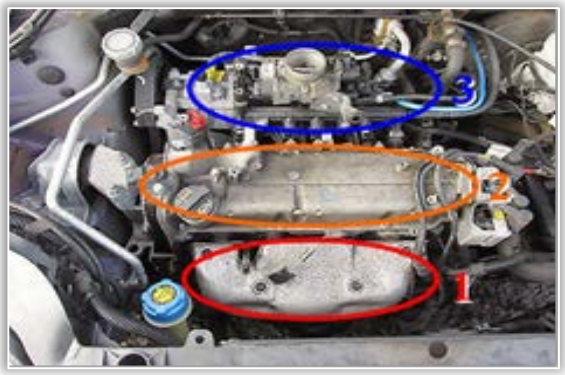

Figure 3. Overview of the engine. 1-exhaust manifold; 2-engine; 3-intake manifold [5]

- **The heat sources** of the air filter and of the intake manifold in the case of the Fiat vehicle are as follows (figure 3): exhaust manifold, engine and cooling radiator

3. THERMAL IMAGING MEASUREMENT OF THE HEAT FLOW DISPERSION

In the following paragraph there are presented comparative temperature measurements from the engine compartment (overview), from the exterior surface of the air filter and of the intake manifold for the above mentioned situations. Using the thermal imaging camera one can emphasize the areas which were influenced by the heat transfer, as a result of the heat dispersion through the engine compartment. The measurements done with a cold engine are presented in figures 4, 5, 6, 7 and 8.

Figure 4. Thermal field in the engine compartment

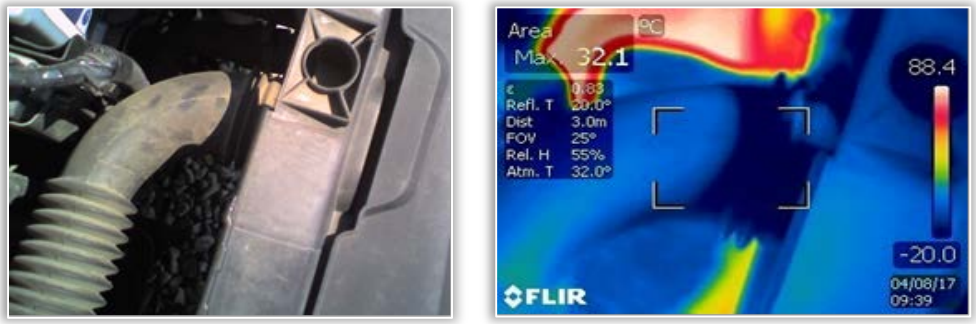

Figure 5. The thermal fied on the surface of the connection inlet of the air filter

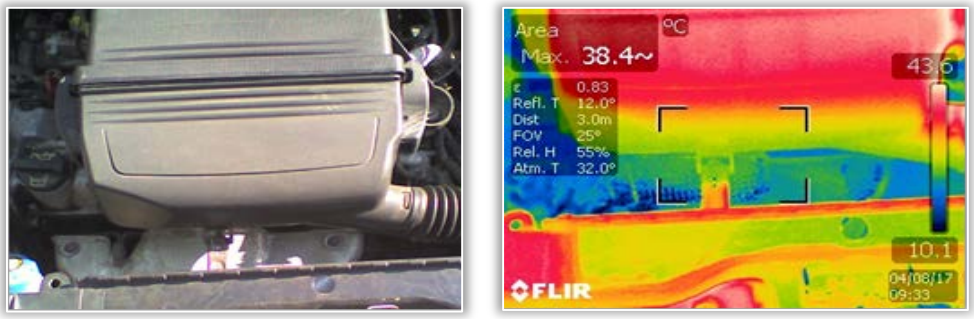

Figure 6. Thermal field in the exhaust manifold area

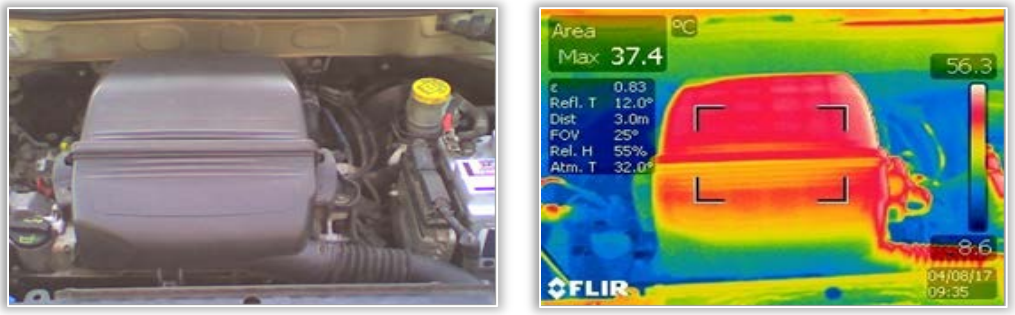

Figure 7. Thermal field on the frame of the air filter

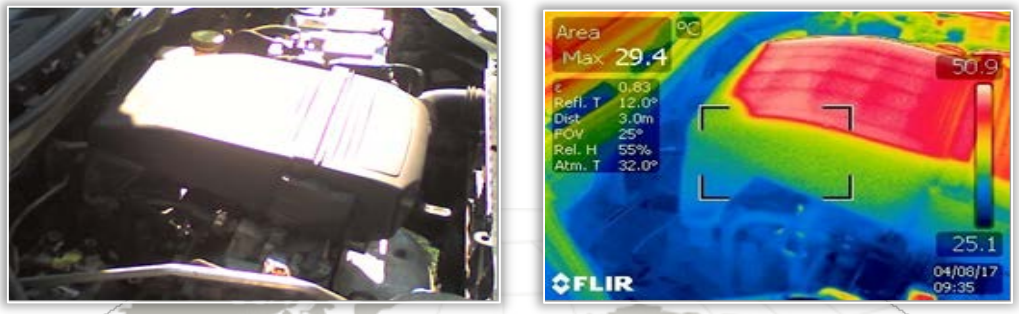

Figure 8. Thermal field in the intake manifold area

Measurements done with a warm engine in city traffic are presented in figures 9, 10, 11, 12, 13 and 14.

Figure 9. Thermal field in the engine compartment

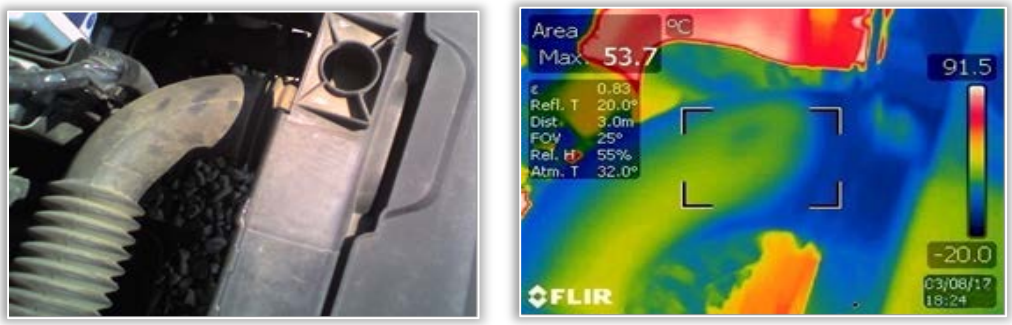

Figure 10. The thermal field on the inlet connection area of the air filters

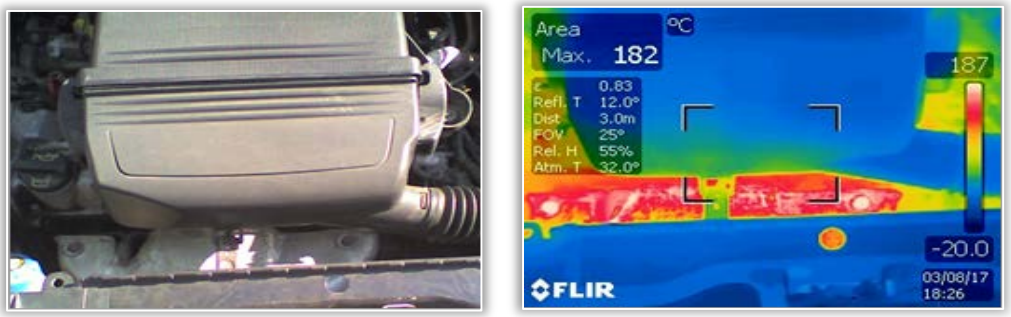

Figure 11. Thermal field in the exhaust manifold area

Figure 12. Thermal field on the air filter frame

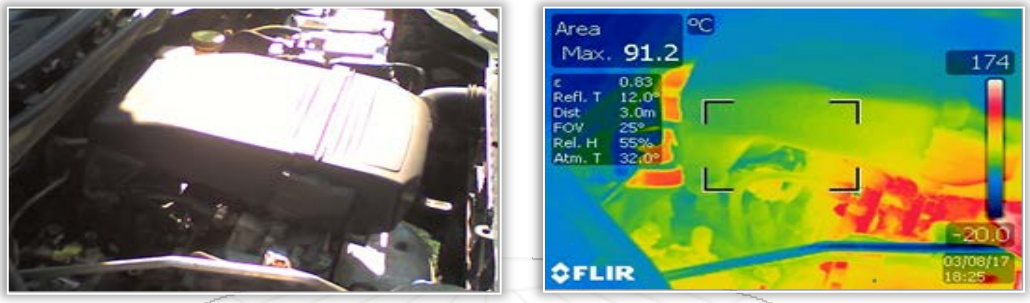

Figure 13. Thermal field in the intake manifold area

Figure 14. Thermal field in the upper part of the engine

The absorbed air is heated, shrinking its density, and the engine's performance decreasing in the warm season, the registered power loss being up to 20%. The temperatures of the air filter and of the intake manifold vary, in this case, between 60…92°C, depending on the speed of the vehicle [6]. The heat dispersion is dependent on the next constructive parameters of the air filter and of the intake manifold:

- the used materials
- the exterior architecture and surface

The obtained results are presented graphically in figure 15.

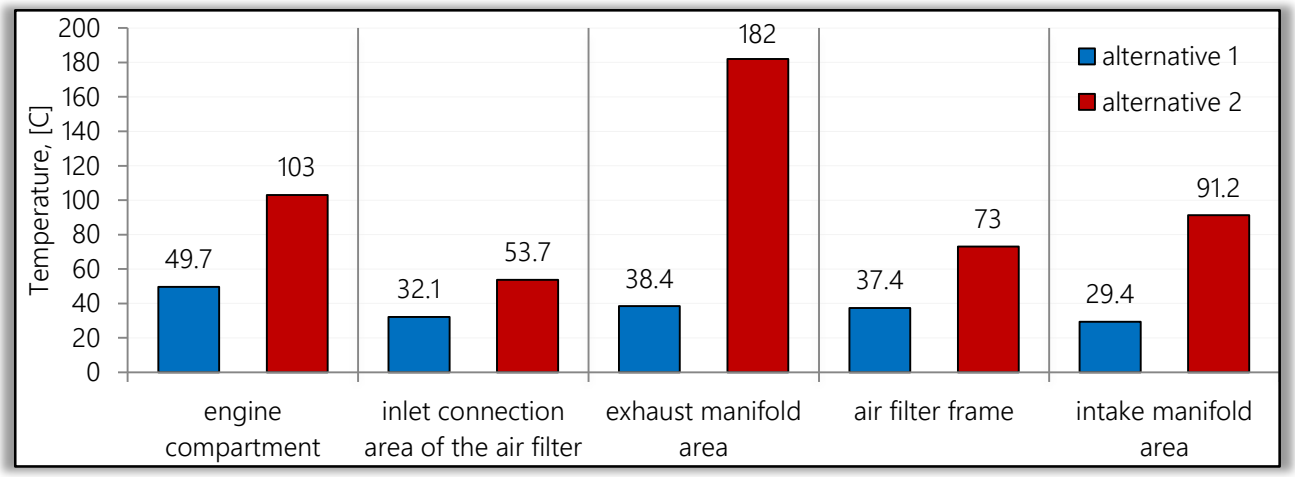

Figure 15. Graphic representation of maximum temperatures in the two situations: alternative 1 – cold engine; alternative 2 – warm engine in city traffic. a) engine compartment; b) inlet connection area of the air filter; c) exhaust manifold area; d) air filter frame; e) intake manifold area

4. FINAL RESULTS AND CONCLUTIONS

When the measurements were finished one can emphasize the fact that the constructive solution chosen for the vehicle FIAT Panda 1.2l, and the positioning of the air filter over the engine leads to an additional heating of the air destined for the functioning of the engine, promoting in this way to the appearance of engine overheating phenomena, of detonation, abnormal wear, etc. and having some influences upon the reduction of the coefficient of filling the engine cylinder resulting also a direct effect over the fuel consumption and emissions.

References

[1] http://www.shop.s-tuning.eu/fiat-c-34.html
[2] Birtok–Băneasă, C., Raţiu, S., Admisia aerului în motoare cu ardere internă – Filtre supraaspirante – Sisteme dinamice de transfer, Editura Politehnica, Timişoara,2011;
[3] https://www.fiatforum.com/members-motors/287318-mums-had-panda.html
[4] Raţiu, S., Motoare cu ardere internă pentru autovehicule rutiere – Procese şi caracteristici, Experimente de laborator, Mirton, Timişoara, 2009;
[5] https://www.partsgateway.co.uk/fiat-parts/panda/engine
[6] Raţiu, S., Birtok-Băneasã, C., Alic, C., Mihon, L., New concepts in modeling air filters for internal combustion engines, 20th International DAAAM SYMPOSIUM "Intelligent Manufacturing & Automation: Theory, Practice & Education", Vienna, Austria, 2009, ISSN 1726-9679;
[7] www.corneliugroup.ro.