RESEARCH REGARDING THE USE OF ADVANCED MATERIALS FOR OPTIMIZING THE INTAKE PROCESS FOR INTERNAL COMBUSTION ENGINES

Thesis – Resume
for obtaining the scientific title of doctor of philosophy at
Politehnica Timișoara University
in the Material's Engineering domain

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INTRODUCTION

Quality standards in vehicles need to improve the properties of materials used in their construction, the development of new materials and processing technologies. The choice of material and manufacturing processes influence the performance and costs of vehicles. Currently, in the automotive industry, the share of metallic materials is decreasing compared to various composite materials, plastics, shape memory materials because of the advantages they present of which may be remembered most significant: increase uptime, size reduction, noise and vibration absorption and uptake kinetic energy shock accident. Relatively new models come onto the market, there is a diversification of the use of unconventional materials while increasing quality.

This thesis is a contribution in Materials Engineering because of the results on the influence of different materials used in the construction of air filters super-aspirant, dynamical systems for air transfer and deflectors heating - own design, the efficiency of air intake engines internal combustion. Also, the results of its implementation on different engines, air filters super-aspirant, dynamic systems that transfer air baffles and heat conducting laboratory tests and monitoring in real traffic. The research is experimental and the results and conclusions contained in the paper are effective solutions on the route of intake.

Thesis has proposed discussing three lines of research:

- Design and development of components of the intake system;
- Influence of material characteristics on the dispersion of the components of the heat flow in the engine compartment of the vehicle;
- Experimental research on the influence of the intake manifold material on thermodynamic processes in internal combustion engines.

The thesis has predominantly applicative results which are implemented in practice: FSU super-aspirant filters for passenger cars, filters super-aspirant for buses, filters for powertrain super-aspirant YXV drift collectors' axial aerodynamic deflectors for trucks and heating for vehicles.

CHAPTER 1

ACTUAL STATUS REGARDING THE MATERIAL USED IN THE CONSTRUCTION OF VEHICLES

At the beginning era of the construction of vehicles, the customer expectations regarding performance and quality of the cars were relatively low. The cars were made of conventional materials of that time. About 80% of the vehicle's weight was made up of components made of cast iron and steel. The situation changed completely; Modern vehicles must meet the vast variety of additional requirements. Of these, the most important are [1/1] safety, vehicle impact on the environment, conserve resources, namely comfort favorable price.

Modern materials' technology plays a very important role in the development of the vehicle domain. Numerous examples (bodywork, suspension components Powertrain) shows that low weight technologies directed to reduce the weight, to increase comfort and to increase the recyclability can be achieved by using advanced materials solutions based on [1/1].

The first generation of Corvette was launched on January 17, 1953 (Figure 1 / 1.1.) at the Motorama exhibition organized by General Motors at the Waldorf Astoria in New York. At its launch, Corvette C1 was the first production car with a body entirely of fiberglass, and all versions of this generation were convertibles. Copies were made in the first two years were powered by the Chevrolet six-cylinder, and from the third year of production it was chosen the legendary V8 Small Block. The third generation was the longest-running, C3 Corvette was launched in 1968 (Figure 12 / 1.2.). In 1975, for the making body of this generation it was chosen a new composite laminate called Sheet Molding Compound (SMC).

Figure 1. Corvette C1 1953

Figure 2. Corvette C3 1968

Proper filtering of the air entering into the cylinder of an internal combustion engine, is essential to extend the operation thereof. Preventing air intake with different impurities from the atmosphere, significantly reduces the wear over time, relative to the moving parts of the engine [2/13].

A major disadvantage, in addition to the filtering function of the sucked air in the air, the air filter - as a separate part in the composition of the engine - is a gas-dynamic resistance material, interposed on the path of the inlet. If it is not cleaned periodically, and the vehicle travels more frequently in areas with dust, the intake pressure is reduced and the filling factor suffers substantial penalties [2/13].

Air filters for filtering the intake air, necessary for the operation of internal combustion engines, are carried out in several variants which differ according to the principle of filtration [2/13]

-filters with filtering element;

- filter inertia;

-combined filters

The materials used in the manufacture of the first drafts of air filters have been from rolled steel quality filter housing, stainless steel for filtering element, aluminum alloys for elements to connect it to the path of the inlet (Figure 3 / 1.5.) [3 / 14]. The filter element was made of the site overlay from 5 to 10 layers, and the shape thereof, respectively of the air filter was cylindrical in most cases (Figure 3 / 1.5.). In the case of the engines of competition, having carburetors mounted on each cylinder, tit was found out that there was no air filter, the engine was drawing air directly from the engine compartment, achieving only a coarse filter through a single website.

After 1950, the filter element becomes a consumable, replacing every rolling set by each manufacturer, the air suction is performed depending on the season: in summer the outside of the engine compartment, and in winter in the exhaust manifold (figurile14 / 1.12.) with a positive effect on the coefficient of filling performance respectively of consumption and emissions' performance [2/13]. The filter element currently used in the form of microporous cardboard or textile, appears much later in a variety of forms, the most common being the panel (Figure 5 / 1.13.) [2/13].

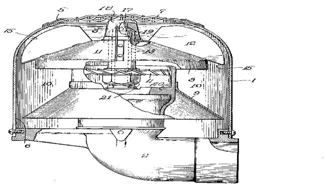


Figure 3. Air filter Ford T brevet US1438553/1922 inventor James P. Guam

Figure 4. Ford Mustang 1994

Figure 5. Panel type air filter

The architecture of the air filter has changed over time, from the original shape (cylindrical) to a prismatic shape as a result of experience. Changing the shape has been determined by considerations as: the filtration area, size, location, etc. The materials used in the preparation of the joints of the carcasses concerned are mainly air filter plastic (polyethylene, polypropylene, polyamide).

The main function of the intake manifold is the distribution of fresh fluid in a uniform manner (mixture of air, fuel or air), for each cylinder of the internal combustion engine [4/15].

Uniform distribution is important to optimize the efficiency and engine performance. The inlet manifold can provide support for the carburetor, throttle body, fuel injectors and other engine components [4/15].

Depending on the material, semi or manufacturing technology, there are five main galleries of admission available on the market:

- cast aluminum alloy (Aluminum 319F);
- tin alloy;
- bars of aluminum alloy (All-Billet intake);
- hybrid plate and rod, aluminum alloy;
- Composite / plastic (PA6 or PA66).

CHAPTER 2

HEAT TRANSMISSION.
BASIC NOTIONS, CHARACTERISTICAL MEASURES

The heat transfer is the transfer of internal energy within a single thermodynamic system, in areas with higher temperature to the areas with lower temperatures, or between different systems at different temperatures of the system with higher temperature to the lower temperature.

Accordingly, heat can be identified only at the border between interacting systems, and exists only as long as there is a temperature difference between them. As a size process and not a status one there is not an exact differential.

Heat transfer is a phenomenon irreversible and a time dependent phenomenon that follows the principles of thermodynamics. The I principle is respected in that the internal energy transferred by warmer system is equal to the internal energy received by the colder system. The II principle is observed also in view of the formulation of the Clausius on the heat transfer purposes spontaneous "heat flows spontaneously (by itself) only at high temperatures to low temperatures".

Simple phenomena, fundamentally different of heat transfer are [5/37]:

- thermal conduction;
- heat convection;
- thermal radiation

The conduction of thermal energy - heat is transported from one point to another through the medium by interaction between the atoms and molecules of matter without being involved in the whole of its movement.

The heat convection is transfer mode by which heat is transported by a moving fluid, the fluid acting like particles of heat carriers.

Thermal radiation: heat is transmitted through electromagnetic waves and does not require a material medium, on the contrary, as the environment in which the transfer takes place by radiation is close to absolute vacuum, the thermal radiation is stronger.

In most cases the actual heat transfer phenomena attending all three simple [5/37]

CHAPTER 3

COMPONENTS OF THE INTAKE SYSTEM.
OWN CONCEPTIONS

Developing in an exponential pace of information technology has made possible the application of new technical concepts and optimize engine management, the research being directed towards reducing fuel consumption and widest possible use of unconventional fuels. The main purpose of the research mentioned above, is to reduce emissions, to reduce the use of materials shortages, increase reliability and lower the noise.

The experience gained by monitoring the operation of the functional parameters of internal combustion engines, imposed the optimization of the intake system components, focusing on features and advanced materials used in manufacturing the air filter. The studies presented in this chapter focused on implementing new own concepts regarding multifunctional filters called super-aspiring, of air transfer dynamic systems and thermal deflectors.

Materials used in the construction of air filters over-aspiring, of dynamical systems transfer heat and air deflectors must ensure proper operation and maintenance of technical characteristics and resistance to specific requests.

From the technical considerations mentioned above, the implementation of the components of the over-aspiring filters, of the dynamic systems for the transfer of air and the thermal deflectors have provided the following materials:

- the filter element - carton microporous (average efficiency of the filter 97%) with a duration of use between 10 000-25 000km depending on the engine cylindrical capacity;
- a perforated casing - MR16x7 code flattened expanded metal, steel DC01 (EN 10130) electrolytic galvanized, 66% open area, thickness 0.8 mm;
- internal diffuser - 0.7mm thick DC01 steel sheet, electrolytic galvanized and painted in electrostatic field (SR EN ISO1460 / 2002); The aluminum alloy 6061 (AlMg1SiCu) EN AW-6061, glass and carbon fibers;
- lid - 0.7mm thick DC01 steel sheet, electrolytic galvanized and painted in electrostatic field;
- front speaker - aluminum alloy Al 6061 (AlMg1SiCu) EN AW-6061; glass and carbon fibers;
- internal aerodynamic element - polyol-isocyanate;
- connection elements (threaded rods and screw nuts) - SREN10083-1,2 galvanized steel 1C45;
- connecting cylinder - DC01 steel; The aluminum alloy 6061 (AlMg1SiCu)
- connection fittings - plastic (PVC);
- heat insulation - ROFLEX expanded polyethylene insulated, respectively RadiantX.

Compared with conventional air filters, that are aimed at filtering the air or noise reduction over-aspiring filters (Figure 6./3.7.) fulfill the following functions [2 / 13,6 / 41,7 / 42,8 / 43]:

- capture the air;
- increase the intake air flow rate;
- pre-cool the air;
- turn the flow of air 180 °;
- regain a quantity of air;
- reduce the resistances of gas dynamics;
- increase the filling factor.

a b

Figure 6. Reversed over-aspiring filters:
a – prototype; b – reversed filter W

It has been designed an intake system for internal combustion engines effectively called dynamic air transfer system (SDTA) (Figure 8 / 3.22), with the role of improving the circulation of air towards the air filter [2/13, 6 / 41.7 / 42.8 / 43.9 / 44.10 / 45.11 / 49].

The novelty SDTA (figure 9 / 3.26) in the longitudinal mounting as against to the axis of the motor vehicle, of some intake external speakers to the front (in front of the radiator and in the front bumper area). These lead the intake air out of the engine compartment through fitting to the external axial collector, where the air transfer is made to the filter [2/13, 6 / 41.7 / 42.8 / 43.9 / 44.10 / 45.11 / 49].

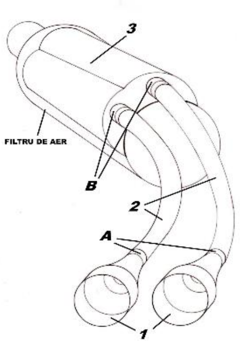


Figure 8. The dynamic system of the air transfer:
1 – intake external speaker; 2 – connection fitting; 3 – external axial intake;

Figure 9. Implementation of SDTA – air circulation

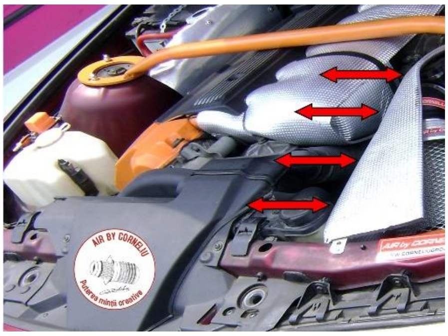
The aim of the heat deflector is to protect the air filter and the intake manifold, directing the downward flow of hot air coming from the engine cooling radiator [2/13, 6 / 41.7 / 42.8 / 43.9 / 44.10 / 45.12 / 50].

Depending on the areas of the protected components, the heat deflector has the following applications [2/13, 6 / 41.7 / 42.8 / 43.9 / 44.10 / 45.12 / 50].

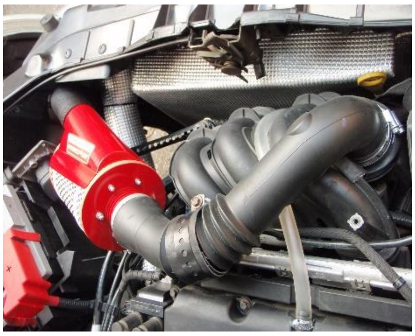
- positioning the fan radiator in order to direct the air flow in the intake manifold (Figure 10 / 3.38.b, d);
- positioning the filter in the air in order to maintain a relatively low temperature (Figure 10 / 3.38.a;);
- positioning on the surface of the intake manifold (Figure 10 / 3.38.c).

a.

b.



c.



d.

Figure 10. Thermal deflector:
a – integrated deflector for the air filter, b – integrated radiator deflector, c – positioning the thermal deflector in the intake are; d - positioning the thermal deflector on the cooling radiator

CHAPTER 4

DISPERSION OF THE HEAT FLOW IN THE ENGINE COMPARTMENT OF THE VEHICLES. CASE STUDIES

This chapter shows the results of the experimental researches aimed at determining the influence of the heat flow dispersion from the engine compartment upon the path of the intake i.c.e. (internal combustion engine). The data were collected with a thermal imaging camera in real time with different modes of operation of the vehicle.

The intakes of the studied powertrain systems contain the following materials: aluminum alloys (AL319F), plastics (polyamide PA66, foamed polyethylene), composite materials (fiber glass).

The research was conducted on two types of engines:

a. vehicles:
   - Fiat Panda 1.4l;
   - Ford Fiesta 1.4l;

b. competition vehicles:
   - Nissan 350Z 3.5l;
   - Nissan Silvia 4.0l;
   - Toyota Celica 2.0l;
   - BMW E36 4.0l;
   - BMW E46 3.2l;
   - BMW E 36 4.4l.

The car studied in this case is Fiat Panda which is equipped with a cylinder capacity of 1.2L engine, petrol multi-point injection.

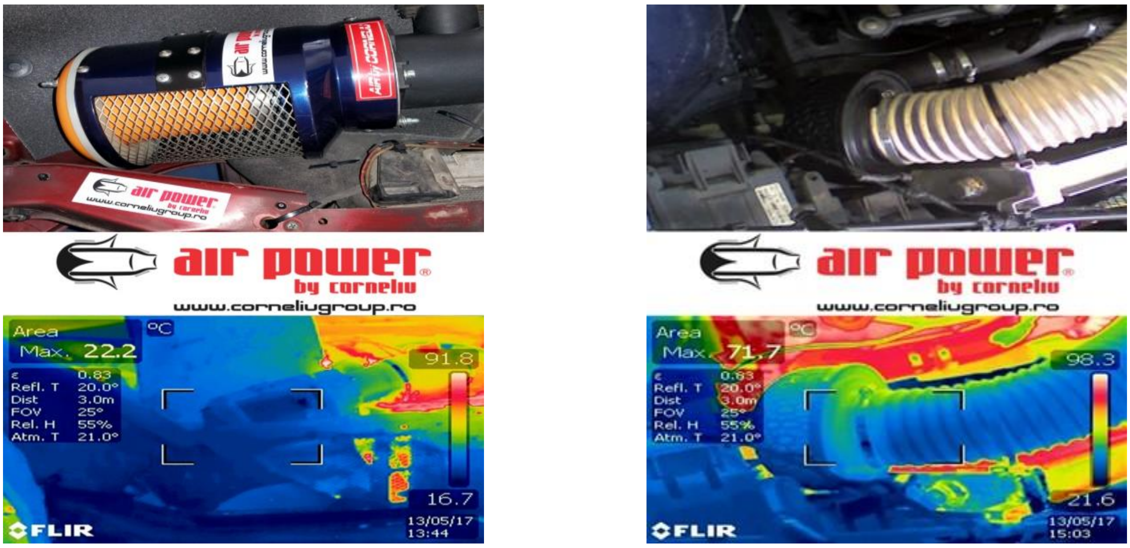
Comparative measurements were made on the engine compartment, particularly to the outer surfaces of the air filter (Figure 11 / 4.12.), the intake manifold and the heat source (exhaust manifold, the engine and the radiator for cooling the engine) [13 / 57].

Figure 11. Thermal field on the shell of the air filter

On the basis of thermal measurements it is highlighted the fact that the constructive solution chosen for the 1.2L Fiat Panda and positioning of the air cleaner above the engine, lead to additional heating of air for the operation of the engine, thus contributing to the occurrence of overheating phenomena, of detonation, abnormal wear etc. with influences on reducing the coefficient of filling the engine cylinder, with consequences in terms of increased fuel consumption and emissions.

Two cars were monitored with the same engine cylinder capacity of 4.4l V8, with the following equipment [2/13]:

- Variant 1 (Figure 12.a / 4.44.) YXV over-aspiring air filter, dynamic system of air transfer (SDTA) and integrated heat deflector;
- Variant 2 (Figure 12.b / 4.44.) sport air filter [14/65].



a. b.

Figure 12. Thermal field in the air filter area captured with a thermal imaging camera :
a - variant 1; b – variant 2

As a result of the measurements it is shown that for the same value of temperature in the engine compartment (109^{0}C) (Figure 13 / 4.46.) it is emphasizes a temperature difference on the surfaces of the intake gallery due to the difference of the intake air temperature. This is explained by maintaining a relatively low temperature of the air in the filter in the first variant, due to the intake and transfer of an additional flow of air from outside the engine compartment (using SDTA) respectively YXV protection filter area (integrated heat deflector).

In conclusion, the solutions implemented in the case of variant 1, the air aspired in has a temperature up to 69% lower compared to version 2 with a direct effect on the temperature difference on the surface of the intake manifold up to 44% (Figure 13 / 4.46.). The effect of reducing the intake air temperature improves the filling efficiency of the engine cylinder, thus avoiding the phenomenon of overheating the engine, frequently encountered in the case of powertrain drift cars.

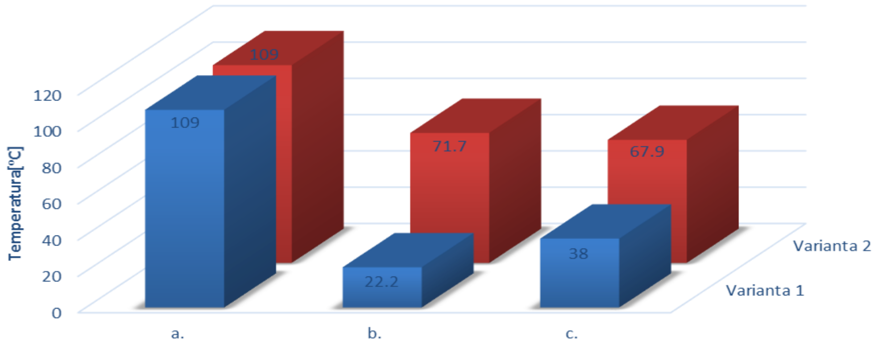


Figure 13. Graphic representation of the maximum temperature:
1 – version equipped with YXV, SDTA, deflector, 2 – version equipped with sport filter
a- engine compartment ; b) intake air filter area; c) intake gallery surface

CHAPTER 5

RESEARCH REGARDING THE INFLUENCE OF THE INTAKE MANIFOLD MATERIAL UPON THE THERMODYNAMIC PROCESSES IN THE INTERNAL COMBUSTION ENGINES

This chapter presents the results obtained regarding the influence of the material of the intake manifold on thermodynamic processes in internal combustion engines, process simulation and validation of experimental results.

The research was conducted on an experimental stand designed to study the influence of material intake manifold on the heat transfer process during the engine air intake. To this end, the stand allows temperature measurement at various points characteristic of the intake manifold of different materials.

For experimental research two variants have been taken into account:

- an intake manifold made of aluminum alloy (Ford Puma 1.7);
- an intake manifold of the polyamide (Ford Puma 1.4).

The experimental data obtained in both cases were processed and analyzed. These were used to generate the numerical model simulation of airflow through the intake manifold. Following results conclusions were formulated on the material influence upon processes characteristic to the intake manifold of internal combustion engines.

In terms of reducing the heat transfer path of the intake manifold mainly in the case of aluminum alloy, there has been adopted, implemented and tested a number of solutions for the reduction of thermal losses. These consist of custom designing a thermal deflector to insulate the admission with a new type of composite material with insulating capacities, which composition contains natural, organic and recycled elements. An additional property of this is that the material can be easily applied by brush or spray onto the outer surface of the manifold. Also, to include the new developed materials in the insulators category, values were determined using the thermal transfer coefficient of the heat flux plate.

To achieve the thermodynamic study of the material's influence of the intake manifold influence upon the process of heat transfer and gas-dynamic during air intake in i.c.e., it was designed and executed the experimental stand RIMS (Resource Intake Manifolds Stand) own design (Figure 14 / 5.3.). The stand allows realizing temperature and pressure measurements at various characteristic points for the intake manifold of the same or different geometric point of view, made from different materials (aluminum alloy, polyamide, fiberglass, carbon fiber, etc.) [15 / 75].

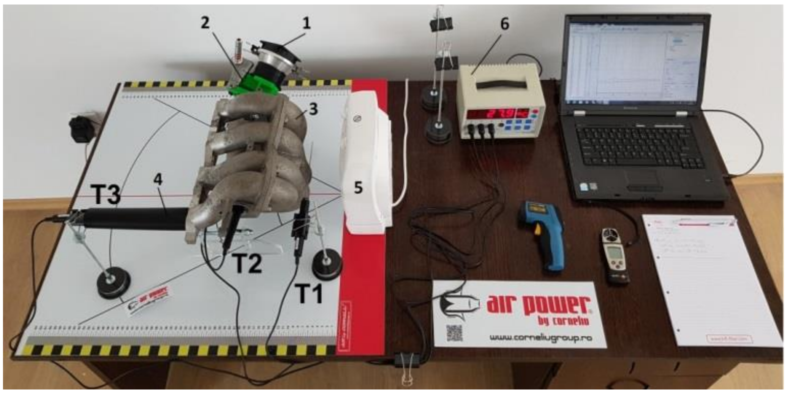
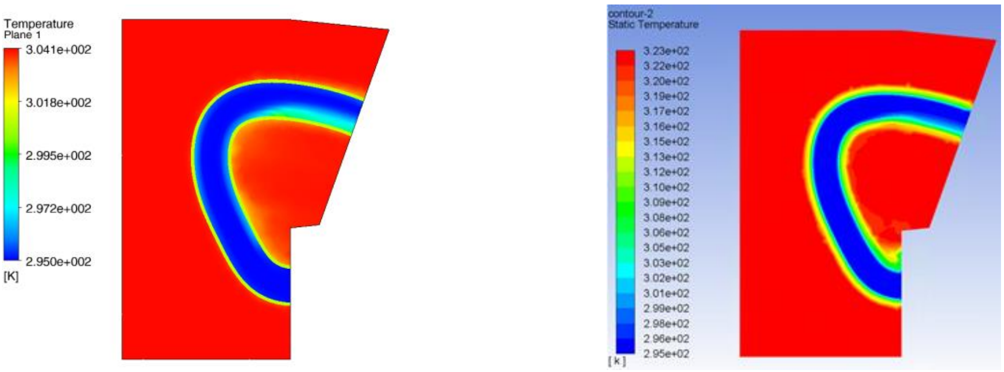


Figure 14. Experimental stand RIMS:
1 – ventilator, 2 – throttle flap, 3 – intake gallery, 4 –pipe,
5 – heating source, 6 – temperature monitoring device

The results of the simulation in CFD (Computational Fluid Dynamics) for the gallery of the aluminum alloy and of polyamide were: temperature field on a median plan of the section of aluminum alloy (Figure 15 / 5.17.a), polyamide (Figure 15 / 5.17 .b) gallery.



a. b.

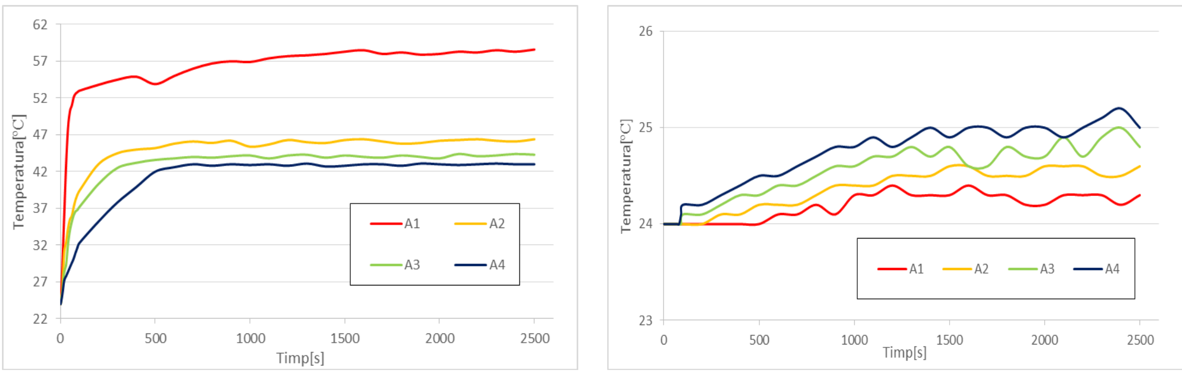
Figure 15. Temperature and the power lines:
a, b – temperature fields in median plan (aluminium alloy / polyamide gallery);

In order to reduce heat losses to the intake gallery made of aluminum alloy, it is recommended to implement a heat deflector (Figures 16 / 5.25.) Multilayer expanded polyethylene ROFLEX [2 / 13,12 / 50],

a. b. c.

Figure 16. Mounting of the heat deflector on the intake aluminium alloy gallery
a-c – 100% protection,

The values of the temperature of the outer surface (corresponding to the measuring point T1) of the studied deflectors vary depending on their area (Figure 17 / 5.28.a). The variation of the point temperature T1 of the four types of areas (A1, A2, A3, A4) is approximately 27% and the measuring point T3 of 3% (Figure 17 / 5.28.b).



a. b.

Figure 17. Comparing values of the four deflector categories' temperature:
a –T_1 point, b –T_3 point

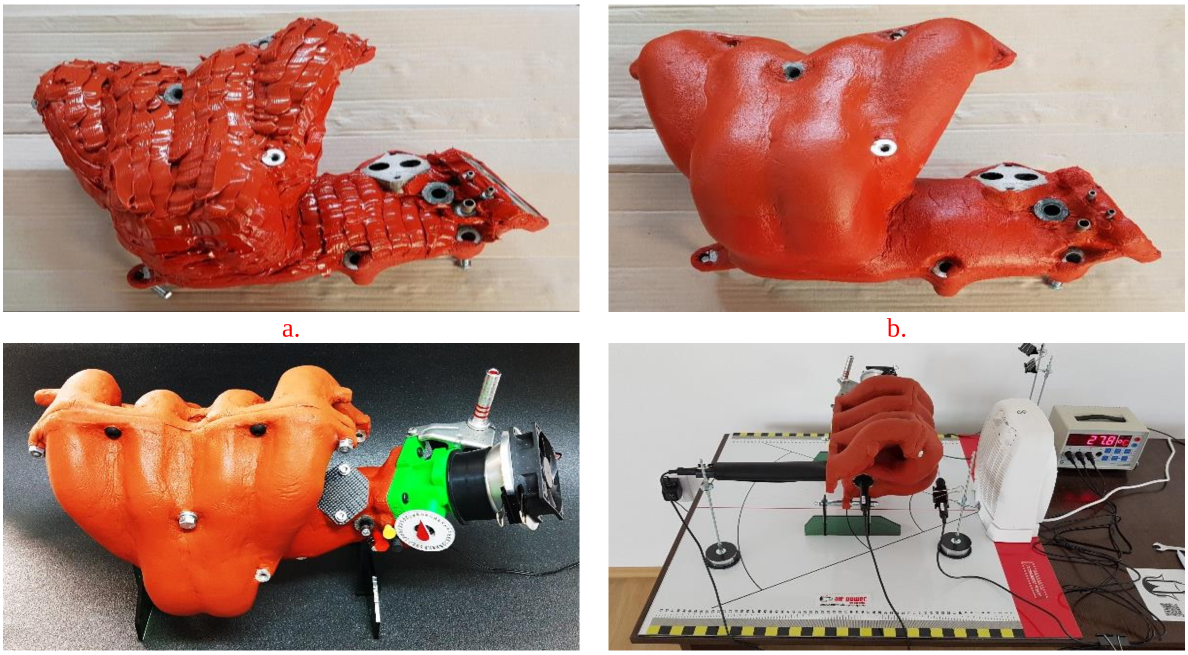
The insulating layer called SPTI (Thermo-Silicone Insulating Polyurethane), provides protection to thermally solicited assemblies (convection, conduction and radiation) of the internal combustion engine, such as intake manifolds made of aluminum alloy.

The insulating layer was applied by brushing the outer surface of the manifold (Figure 18 / 5.34.a, b) in several stages to give an average coating thickness of 4mm.

The gallery protected with SPTI layer (Figure 18 / 5.34.c) was mounted on the RIMS stand (Figure 18 / 5.34.d) and tested under the same conditions.

Figure 19 / 5.35. presents the variation of the temperatures in the three data points (T1, T2, T3) from which their maximum values thereof are found, being the following:

- in the outer surface of the manifold 48,1^{0}C;
- on the inner wall surface 26,7^{0}C
- intake air outlet of 23,1^{0}C



a. b. c. d.

Figure 18. SPTI insulated aluminium alloy intake gallery:
a – deposit of insulating layer, b – finishing the deposit layer, c – the gallery's components assembly, d – testing on RIMS stand

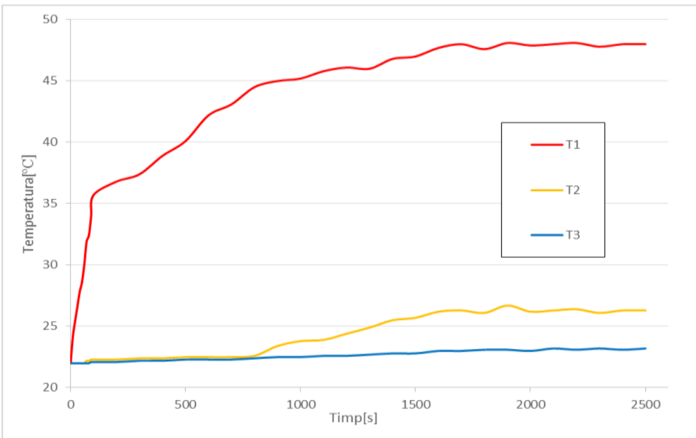


Figure 19. Variation of temperatures in T_1, T_2, T_3 points, in the case of aluminium alloy SPTI insulated gallery

In the measurement points T_2 and T_3 the recorded temperatures for the SPTI insulated aluminum alloy gallery, shows a decrease of 5.96% and 8.33% as against the bare aluminum alloy gallery.

CHAPTER 6

CONCLUSIONS. OWN CONTRIBUTIONS.
DIRECTIONS FOR FURTHER RESEARCHES

Based on studies of specialized literature and own researches outlined in the thesis the following significant conclusions are revealed:

- Steel and cast iron, in addition to other metals and non-ferrous alloys, were the basic materials for the automotive industry;
- At present, there is an extension of share of metals and non-ferrous alloys, and in particular those of metal: composite materials, plastics and shape memory materials, long-term trend is to use lighter materials, stronger and more durable, keeping in mind the efficient use of raw materials;
- To reduce fuel consumption and service costs, a series of air filters were designed for internal combustion engines multifunctional for internal combustion engines;
- Over-aspiring filters compared with conventional filters, allow the diversification of functions, such as: capture, pre-cool, increase the intake air flow rate, 180 ° reverse the air flow's positive effect on the coefficient of filling of the engine cylinders;
- The materials used for the over-aspiring air filter are: DC01 steel (sheet, pipe), microporous cardboard, flattened expanded metal, aluminum alloy Al6061;
- The over-aspiring filter components universal (FSU): diffuser, perforated cover, cap, connecting elements are made of steel (sheet pressed respectively expanded) which requires a large amount of machining operations and other additional effect on the costs (U.S. Patent Nos. 126019 / 12.28.2012, RAR-OPC Certificate product no. 3937 / 10.24.2012);
- Following the implementation of the above mentioned filters, and monitoring them over a period of two years, it was decided the manufacture of the over-aspiring filter components using different composites: glass fibers, carbon fibers, plastics;
- The adopted solution has the following significant advantages: relatively high productivity, low costs, reducing the number of components (all-steel: three parts speaker, perforated cover, cap, connecting elements; variant composite materials: speaker, cover) and the use of composite materials which enable the obtaining of complex structural shapes, which are an advantage in optimizing fuel consumption (decrease of up to 4%);
- In order to improve the air flow circulation to the air filter a system for dynamic air transfer was designed (SDTA) - Utility Model no. .EN 2009 00028;
- For the protection of the over-aspiring air filter and of the hot air intake manifold coming from the cooling radiator it was designed and implemented an Integrated Thermal Radiation Deflector, the materials used in its manufacturing being steel DC01 (board) and insulation expanded polyethylene (Utility Model Nr. 00026 EN 2010);
- Using over-aspiring filters, the air transfer dynamic system and integrated thermal deflector the following benefits are obtained: increase of the pressure of the intake of the fresh air fluid, temperature decrease, with positive effects on reducing fuel consumption;
- Monitoring, for various engines of the dispersion of heat in the engine compartment, was performed using a thermal imaging cameras;
- Using SDTA and protecting the YXV over-aspiring filter with the heat deflector in the case of motoring the E36 BMW car drift, lead to the reduction of intake air temperature averaged 69% compared with the version fitted with sport filters;
- To determine material influence on the intake manifold and gas-dynamic thermal transfer process it was designed and executed the experimental stand RIMS (Resource Intake Manifolds Stand);

- On the RIMS stand there have been tested two intake galleries, made from different materials: aluminum alloy and polyamide, observing that the temperature's value on the outside of the gallery in the polyamide is higher by about 40% compared to the gallery aluminum alloy;

-The data obtained on the RIMS stand were input data for achieving the simulation using the software ANSYS, and the results indicated that, for the same value of temperature (50^0C), the temperature of the inner wall of the manifold made of aluminum alloy has an increase of 35% and 30% of the air at the exit of gallery compared to the gallery polyamide;

- By implementing the thermal deflector plate in the case of aluminum alloy manifold, it is found that the maximum temperature on the outside has an average of $58,6^0$C and the intake air temperature about $24,3^0$C, compared to unprotected gallery, values were of 30^0C and $25,2^0$C, which represents a reduction in temperature to about 3.57% of the air exit;

- In order to optimize the thermal protection, there have been developed five different types of material for which coefficient values of the heat transfer were determined, chosing the convenient variant in terms of the coefficient and of the specific qualities application and of adhesion;

- The SPTI insulated aluminum alloy gallery (Silicone Polyurethane Thermo-Insulating) was tested on the RIMS stand in the same conditions, leading to the following conclusions:

- The temperature at the measuring point on the surface of the outer gallery protected with the insulation material, has an increasing of 35% compared to the bare aluminum alloy gallery;

- The recorded temperature of the intake are for the SPTI insulated aluminum alloy gallery, shows a decrease of about 8.33% as against the bare aluminum alloy gallery.

The most significant original contributions are the following:

- Making a summary of the specialized literature on the materials used to manufacture the components of the air intake system of internal combustion engines;

- Monitoring the exploatation of the air filters of internal combustion engines composition, highlighting various drawbacks (low filtration surface strength, high gas dynamics, etc.);

- Developing new concepts, own concepts, regarding the multifunctional filters called over-aspiring, of heat transfer dynamical systems and air deflectors;

- The choice of materials, based on the qualitative characteristics for making over-aspiring filter, heat transfer dynamical systems and air deflectors;

- Manufacturing the over-aspiring air filters, the air transfer dynamic systems and heat deflectors;

- Achieving experimentation stands to test over-aspiring air filters, heat transfer dynamic systems and air deflectors under laboratory conditions;

- Testing over-aspiring air filters, the air transfer dynamic systems and thermal deflectors by implementing various engines (cars, trucks, buses, cars competition);

- The study of the dispersion of heat in the engine compartment of the intake system;

- Determining the influence of the material used to make the intake manifold upon the heat transfer according to the specific thermal stress;

- Carrying out the experimental RIMS stand for the analysis of thermal losses on the heat transfer coefficient of the material of the intake manifold;

- The analysis, by MEF method using specialized software ANSYS, of the influence thermal stresses on the process of admission for the studied galleries;

- Selection of optimal solutions in order to reduce heat losses in the case of aluminum alloy manifold;

- Heat deflector custom implementation for the intake manifold made of aluminum alloy;

- Obtaining new insulating materials for the protection of the intake manifold made of aluminum alloy;
- Determination of the coefficients of obtained thermal transfer materials;
- Selection of the insulating material called SPTI based on qualitative characteristics and determining the optimum technology of application on the surface of the intake manifold.

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