

Contents of Work Package 3-WP12: Optimized Design and Operation of Special Vehicle

3-WP12: Optimized Design and Operation of Special Vehicle

Coordinator of the WP

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Participants of the WP

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Main Goal of the WP

Strength optimization of the supporting frame of a specialized vehicle (made of high-strength steel) by non-destructive inspection of weld joints, which significantly reduce fatigue strength if performed poorly.

Energy optimization of the special vehicle's thermal system to ensure the highest possible efficiency.

Partial Goals for the Current Period

The introduction of non-destructive inspection of welds and their surroundings in the production process of the frame of a special vehicle, manufactured from high-strength steel.

Solution of energy losses in the intake and exhaust pipes of the power unit, optimization of the cooling system of a special vehicle.

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Official 3-WP12 Deliverables:

- 3-WP12-001 | **The procedure of non-destructive control of internal stresses of welded components by the principle of magnetic response**, Ztech, VI./2026, SVOS 0.8; UPa 0.2
- 3-WP12-002 | **Functional sample of the Energy Optimized of Special Vehicle Cooling System**, G-funk, VI./2026, SVOS 0.8; UPa 0.2

Activities in 3-WP12: Optimized Design and Operation of Special Vehicle

The solution to the V50 result in 2023 consisted in studying the possibilities of technological procedures for non-destructive detection of the internal stresses of the weld joints of the supporting frame of a special vehicle based on the magnetic response of the material after welding. The magnetic method MMM (Metal Magnetic Memory - Magnetic Memory of the Material) is a non-destructive method (NDT) based on sensing the intensity of the magnetic field H_p in the form of residual magnetization on the surface of the material using one or more probes, each of which senses the magnetic field in three mutually perpendicular planes. The residual magnetization of the material is influenced by the production process (in our case, welding). The special sensor on which the probes are placed is moved over the surface of the measured place and the signal from the individual channels is recorded in digital form in the memory of the device and is displayed on the display in graphic form either directly as H_p or as a gradient dH_p/dx depending on the path along which the probe is moving. The data stored in the memory can be transferred to a PC with the help of the appropriate software and analyzed here using special software, or printed in the form of a graph - a so-called magnetogram. Based on the evaluation, we can determine zones with increased stress concentration SCZ (Stress Concentration Zones), where there are defects after welding. The voltage concentration is proportional to the measured magnitude of the magnetic field strength gradient around the given location. The essential advantage of this NDT method is the ease of measurement as well as high sensitivity.

Activities in 3-WP12: Optimized Design and Operation of Special Vehicle



Fig. -Tester of Stress Concentration TSC-3M-12

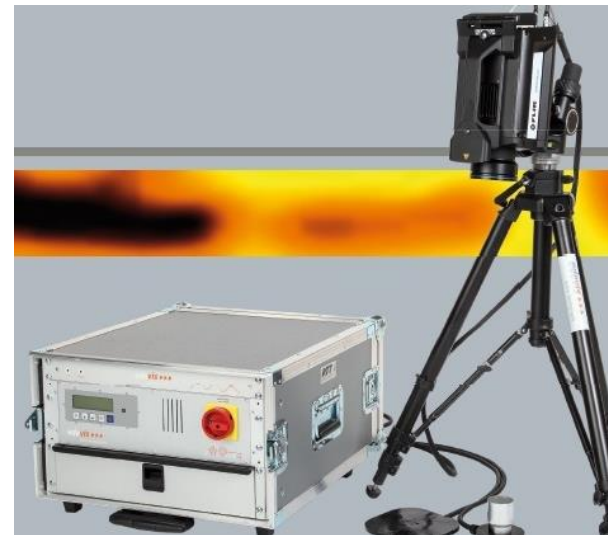


Fig. - Edevis ITvis

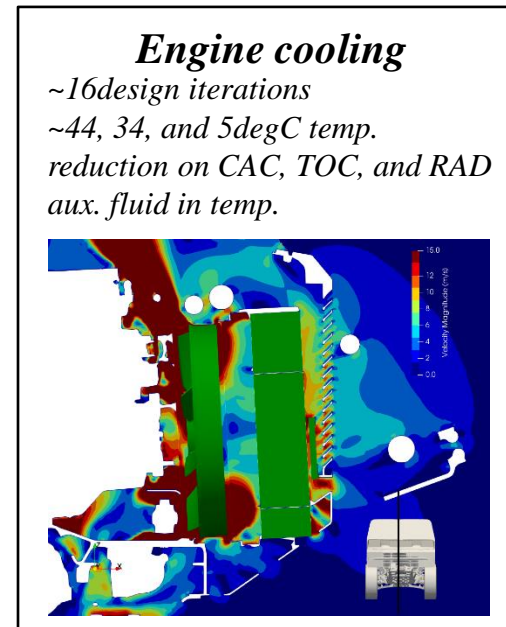
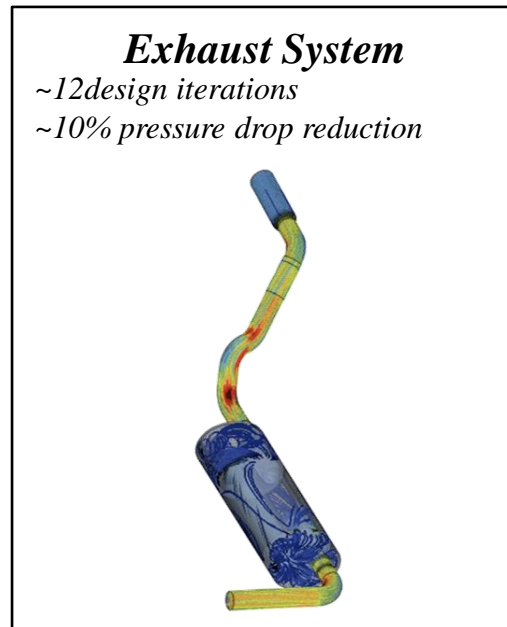
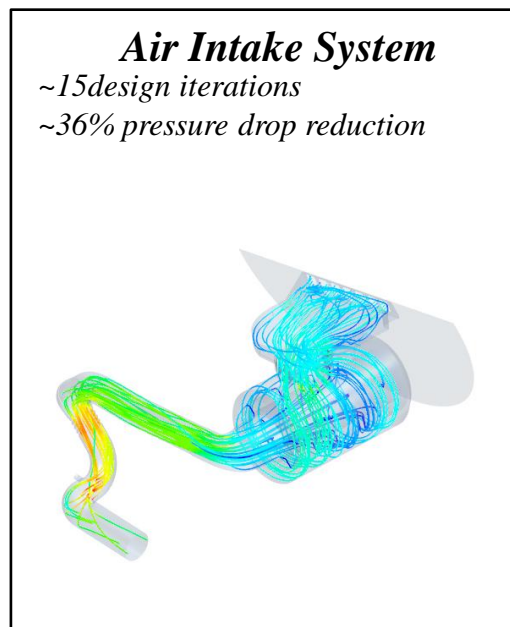
An alternative method theoretically considered in 2023 to ensure the inspection of welds is the use of the active thermography method. A high-quality thermal camera with the required temperature range according to the available documents will show the temperature interface in any weld defects with sufficient sensitivity. An example is a thermographic imaging camera with the appropriate software. It is a method of active thermography, which is not subject to environmental influences, but is unfortunately many times more expensive than the magnetic method.

Activities in 3-WP12: Optimized Design and Operation of Special Vehicle

Activities in 3-WP12-002:

The following optimizations were performed using 3D simulations :

- Air intake pressure drop reduction
- Exhaust pressure drop reduction
- Engine cooling optimizations (engine bay flow optimization)



Fulfillment of goals and deliverables of 3-WP12: Optimized Design and Operation of Special Vehicle

Current State of Deliverables, Milestones and Fulfillment of Goals

3-WP12-001 | The procedure of non-destructive control of internal stresses of welded components by the principle of magnetic response, Ztech, VI./2026, SVOS 0.8; UPa 0.2

- The MMM (Metal Magnetic Memory) system was chosen for non-destructive inspection of weld joints.
- At the same time, the use of an active thermographic method was examined as another option for checking welds.
- The achievement of the goal - The creation of a proven technology for the inspection of welded joints - is not in jeopardy.

3-WP12-002 | Functional sample of the Energy Optimized of Special Vehicle Cooling System, G-funk, VI./2026, SVOS 0.8; UPa 0.2

- Air intake, exhaust and flow in the engine compartment have been optimized.
- In the next part, the development of a new AC-condenser model was started.
- The achievement of the goal - The production of a functional sample of an energy-optimized cooling system - is not in jeopardy..

Fulfillment of goals and deliverables of 3-WP12: Optimized Design and Operation of Special Vehicle

List of Due Deliverables and Their Added Value

3-WP12-001 | The procedure of non-destructive control of internal stresses of welded components by the principle of magnetic response, Ztech, VI./2026, SVOS 0.8; UPa 0.2

Non-destructive inspection of welds will lead to higher strength quality of the supporting frame of a special vehicle and thus to its greater competitiveness.

3-WP12-002 | Functional sample of the Energy Optimized of Special Vehicle Cooling System, G-funk, VI./2026, SVOS 0.8; UPa 0.2

An optimized cooling system will lead to a lower energy demand of a specialized vehicle and thus to its lower operating costs and thus to a lower negative impact on the environment.

Current contribution of 3-WP12: Optimized Design and Operation of Special Vehicle

Assessment of the Contribution of Deliverables

- Non-destructive inspection of weld joints is applicable to all welded structures, the connection can be to: 3-WP10, 4-WP05, 4-WP9, 4-WP10 and potential for other projects is in Transport 2030, Horizon-CL4.
- Energy optimization of the cooling system of a special vehicle, possible connection to: 1-WP02 and potential to other project is in Transport 2030.

Current contribution of 3-WP12: Optimized Design and Operation of Special Vehicle

Assessment of the Formal/Administrative Goals of the Work Package

Assessment of formal and economic tasks in 2023 is not at risk. Both the University of Pardubice and the company SVOS are proceeding according to plan.

Current contribution of 3-WP12: Optimized Design and Operation of Special Vehicle

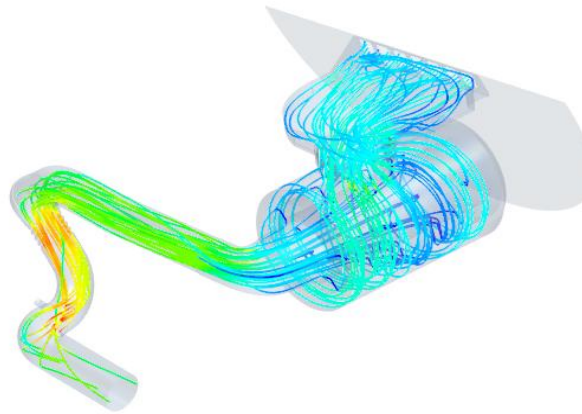
Acknowledgment

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Current contribution of 3-WP12: Optimized Design and Operation of Special Vehicle



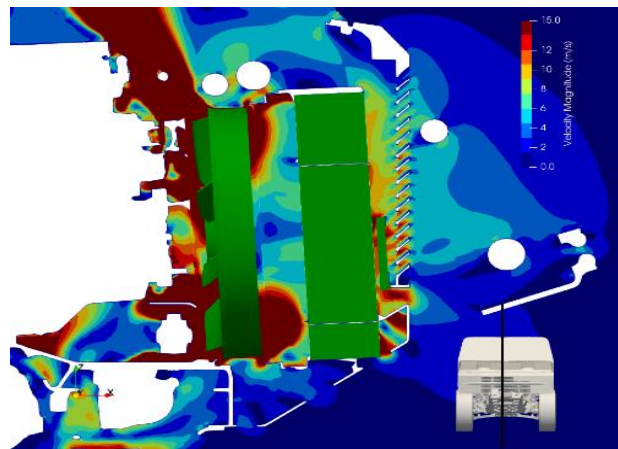
Tester koncentrátoru mechanického napětí TSC-3M-12



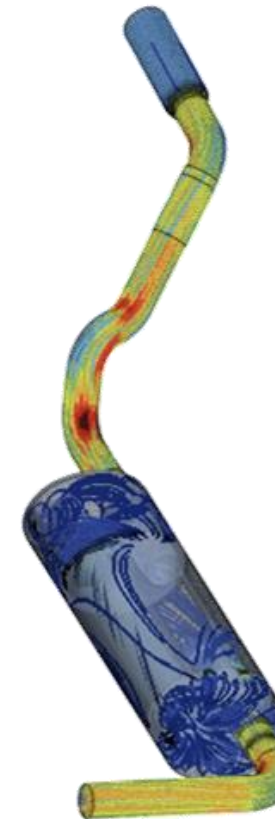
Optimalizace nasávání vzduchu, snížení poklesu tlaku o 36%



Měřicí sestava pro aplikaci aktivní termografické metody pro zjišťování defektů svarů



Optimalizace chlazení motoru

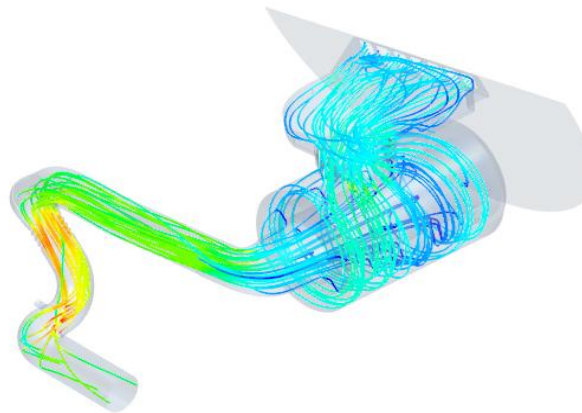


Optimalizace výfukového systému, snížení poklesu tlaku o 10%

Current contribution of 3-WP12: Optimized Design and Operation of Special Vehicle



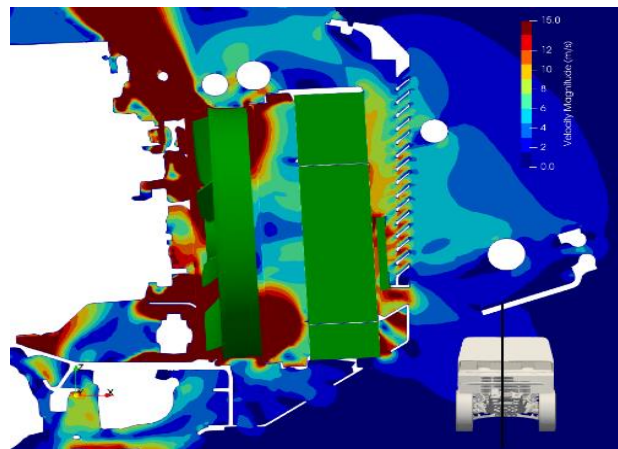
Tester of concentration of mechanical stresses TSC-3M-12



Optimizing air intake, reducing pressure drop by 36%



Measuring setup for the application of the active thermographic method for detecting weld defects



Engine cooling optimization



Optimizing the exhaust system, reducing the pressure drop by 10%