ATPI

High performance damping technology for Aircraft vibration attenuation and Thermo-Phonic Insulation

Contract EC AST4- CT-2004-516057

PUBLISHABLE FINAL ACTIVITY REPORT

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Coordinator:	Mr Philippe VERDUN **ARTEC AEROSPACE**
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Diffusion List

Name	Company
ARTEC Aerospace	**ARTEC**
Groupe Vibroacoustique du LRMA	**LRMA**
Amorim	**AMR**
Catherineau SA	**CAT**
Lièges HPK SAS	**HPK**
Université de Liège	**UL**
Optrion	**OPT**
Euro Inter	**EI**

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Executive Publishable Summary

1. ATPI objectives

From a feasibility study, ATPI has a global objective to identify an innovating solution to increase the comfort of aircraft passengers by reducing the impact of external noise. Thus, the project is broken down in six operational objectives:

- To adapt the SPADD® technology to the aeronautic constraints and requirements;
- To use or develop new materials (visco elastic material, cork compounds) able to provide the expected damping and stiffness performances at low temperature;
- To modify the existing design (or find new shapes) accommodating the new materials while keeping the improved performances;
- To simulate the new damping compound technology, called SPADD®-ATPI for vibration and acoustic characteristics;
- To estimate its performances in operational conditions;
- To prototype and validate by testing, the acquired principles.

2. ATPI partnership

Coordinator: **ARTEC Aerospace**, **France:** RTD Performer

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Partnership:
Groupe Vibroacoustique du LRMA, France, Partner 2
Amorim, Portugal, Partner 3
Catherineau SA, France, Partner 4
Lièges HPK SAS, France, Partner 5
Université de Liège, Belgium, Partner 6
Optrion, Belgium, Partner 7
Euro Inter, France, Partner 8

3. Work performed

ATPI comprises 6 major Work Packages, without counting WP6, which deals with management.

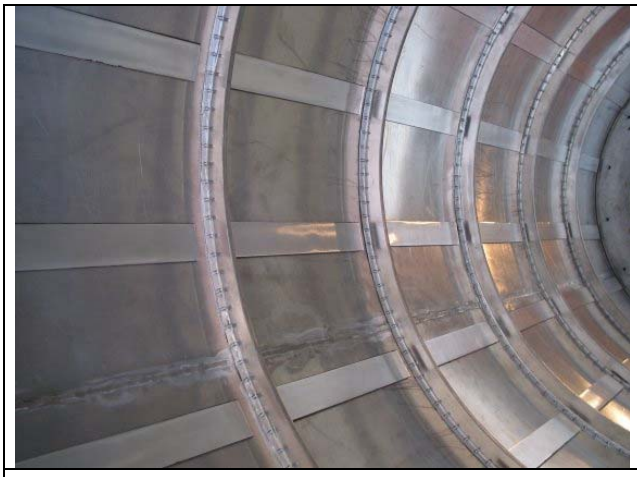
WP1: To set-up a detailed vibration/acoustic attenuation specification
Status: closed
Main results: Various types of noise excitation, resulting from vibroacoustic phenomena are transmitted inside fuselage by solid or air propagation. The air propagation, is identified as a main contributor for turbofan (flow turbulence) or turbopropeller (propeller noise). The performance of the damping ATPI technology should be characterised by its capacity to reduce level of these twofold operating vibration on a representative mock up and to improve the noise reduction (NR).

WP2: Numerical assessment and optimisation the vibro-acoustic performance.
Status: closed
Main results: A complete optimisation and design process is performed to adapt the SPADD® technology to the ATPI specifications, with a twofold target: SPADD-skin configuration for the flow turbulence noise issue and SPADD-frame configuration dedicated for the propeller noise issue. This iterative process includes:
- A numerical topological and parameters optimisation to attenuate the vibration response of the fuselage skin and frames,
- Accurate CAD design of the dedicated ATPI solutions
- Final validation of the damping design methodology and vibration performance by comparison with the experimental vibration and acoustic tests campaigns (see WP5)
- By experimental feedback, updating and validation of the analytical acoustic model by comparison with the experimental vibroacoustic tests campaign (see WP5)

WP3: Material study
Status: closed
Main results: More than 40 materials have been characterised (among which 10 new developments for ATPI purpose). A final panel has been selected for their compliance with the operating specifications (dynamic and dissipative properties, low density) at component scale:
- 2 polymers material based on silicones providing damping and thermal properties
- 4 cork compounds and 2 synthetic foam offering, for a low mass added, the expected dynamic stiffness at low temperature and a efficient thermal protection for the above visco-elastic material.

WP4: Prototype manufacturing
Status: closed
Main result: Several reference mock ups (from WP1 definition) and damping treatments (as defined in WP2, WP3) have been manufactured for testing.

- 6 configurations of SPADD-skin treatments (applied on the cylindrical mock ups, with or without glass wool covers)
- 1 cylindrical mock up integrating a new design of softens damped frame, SPADD-frame.



A SPADD- skin product

SPADD-frame concept

WP5: To validate the global vibroacoustic performance
Status: closed
Main result: Large vibroacoustic characterisation campaigns have been performed on the SPADD-skin and SPADD-frame configuration of damping treatment.
In terms of performance, these experimental validations show that:
- The SPADD-skin product, in association with glass wool blankets, allows to exceed the technical objective with a 12dB vibration attenuation and a Noise Reduction improvement of 3 to 5dB on the wide frequency band [300-12KHz].
- The SPADD-frame concept treatment allows to exceed the technical objective, with a vibration attenuation of the frame modes contribution higher than 20Bd, inducing a Noise Reduction improvement higher than 3dB on propeller noise peak frequencies, while saving 40% of mass compared to the standard DVA solution.

WP7: Dissemination of the obtained results in order to pave the way to the exploitation plan.
Status: closed
Main result: General agreement on the final issue of PUDK, implying all the ATPI partners.

4. ATPI achievements compared with expected results

The ATPI design methodologies, vibroacoustic performance assessments and experimental validation have demonstrated that a high increase of structural damping, from light technologies, can have a drastic impact in terms of reduction of the acoustic level.

Beyond this very promising acknowledgement of performance, the experimental analysis validates the numerical process of sizing, from the vibration optimisation to the acoustic impact and finally, pave the way for an evolution of the analytical approaches in terms of damping, complex stiffness contributions in the Noise Reduction.

At last, thank to the pragmatic approach “identification of a witness configuration at ambient temperature” and “selection of the constitutive materials for their equivalent properties at low temperature”, this validation offers a selection of SPADD-skin products, ready for manufacturing at prototype scale, for testing in real aircraft conditions and with the best confidence in its capacity for certification.

5. Intentions for use and impact

AIRBUS, as ATPI project end user, is involved in the general requirement (including the definition of the representative structure), design constraints and finally, in the evaluation of the vibroacoustic improvement. Face to these very promising experimental results, AIRBUS has shown a clear interest in the ATPI technology, engages the consortium to continue its effort, for a rapid product certification, and refers to the possibility, in the next few months, to perform a complete validation on real life structure.

6. Main elements of publishable results of the PUDK

A general agreement have been approved by the consortium in terms of :

- scientific and commercial dissemination
- encouraging the implementation of the developed technologies/materials in agreement with the ATPI consortium
- prospecting new market (inside and outside the aeronautical field)
- components and final product manufacturing
- development of manufacturing process
- Product distribution and integration, inside and outside the aeronautic field of activity.