

REPORT DOCUMENTATION PAGE

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Title: Effective Heat Exchanger Performance

Technology Area: Area 5 – Advanced Propulsion Technologies

Objective: To develop a high effectiveness heat exchanger for the AMPV while maintaining unit cost equivalence with the current military production heat exchanger. The heat exchanger needs to maintain acceptable durability and reliability targets of the current military production heat exchanger.

Description: The military is upgrading their fleets to increase vehicle power and/or to add more capabilities (communication, control, and sensing equipment) to aid in completing the mission. Future military combat vehicles are focused on increasing the overall power-pack power density; these changes increase the cooling demand on military vehicles. However, as the power-pack increases in power, the allocated space claim for the cooling system has not increased, resulting in an overburdened cooling system. This results in a platform that is unable to meet its mobility requirements. One possible solution is to increase the heat exchanger effectiveness; allowing for an increase in heat rejection while minimizing impact on space, weight, and cost allocation.

The objective of this topic is to assess, develop, and evaluate a more effective heat exchanger technology that increases thermal and aerodynamic performance while minimizing the impact on weight, cost, and durability. Table 1 in the example military heat exchanger performance shows the space claim, boundary conditions and performance requirements for (3) typical heat exchangers that would be configured into a heat exchanger pack. Chart 1 in the example military heat exchanger performance shows the typical air flow sensitivity to heat exchanger air-side restriction. TARDEC wants to investigate heat exchanger technologies that meet or exceed the thermal and aerodynamics performance targets shown in Table 1 by 5%.

Phase I:

Identify and assess possible heat exchanger technologies that are plausible under the conditions described in the description section and reference section. Such effort should include any necessary analysis to support the selection of the heat exchanger technology. The outcome of this phase: 1. should be the selection of a heat exchanger technology solution for evaluation in Phase II, 2. Complete analysis of the heat exchanger pack mentioned above, 3. Durability and reliability predictions, 4. Cost analysis, 5. Plans to setup an agile manufacturing process to enable updating the current Army vehicle fleet.

Phase II:

Design, build, demonstrate, and validate the performance of the heat exchanger technology selected in Phase I under the conditions mentioned in the description. This demonstration should focus on the heat exchanger aerodynamic performance, the impact of fouling on the performance of the heat exchanger, and the heat exchanger durability in the relevant environment described in the description section and reference section. In addition, update to the agile manufacturing plan and set-up trial run to prove manufacturing readiness.

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Phase III

Develop the heat exchanger technology for an agile manufacturing process to aid in getting this technology onto current military vehicles. Also prove that the manufacturing is agile to produce various size heat exchanger packs in a relatively short period of time. It is envisioned that this technology should benefit the cooling capabilities across various platforms, which in turn increase the vehicle mobility conditions.

References:

The following documents will be directly applicable to this topic:

Example Military Heat Exchanger Performance

Kays, W. M., and A. L. London. Compact Heat Exchangers. McGraw-Hill Book Co., 1964.

MIL-STD-1472F, Department of Defense Design Criteria Standard: Human Engineering (23 Aug 1999).

AR 70-38 Research, Development, Test and Evaluation of Material for Extreme Climatic Conditions.”

MIL-STD-810G, Department of Defense Test Method Standard: Environmental Engineering Considerations and Laboratory Tests (312 OCT 2008).

FM 3-11 (ArmyStudyGuide.com).

ATPD 2404A, Section 5.2.7, Interface Standard, Environmental Conditions for the Heavy Brigade Combat Team Tracked Vehicle Systems.

ASTM D6210-17, ASTM International –Standards Worldwide, ASTM International.

Keywords:

Compact Heat Exchangers

Radiator

Heat Exchanger

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Is this topic linked to a Science and Technology Objective (STO), Army Capability Enabler, Technology Maturation Initiative or ManTech Project:

Yes. This topic is has direct applicability to the AMPV, Advanced Powertrain Demonstrator (APD), AMEP, NGCV.

Would this topic have PEO interest/benefit?

Yes. This topic is endorsed by the AMPV Mobility Lead Mr. David Williams and LTC Howell.

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Does this topic support the Army Modernization Priorities?

Yes. This topic directly impacts the APD, CVP, NGCV and AMPV programs by providing more effective heat exchanger increasing vehicle mobility.

Does this Topic Support the TARDEC 30-Year Strategy and the Director's Priorities?

Yes. This project address TARDEC's long term strategy toward improving propulsion power density, and improving tracked vehicle mobility.