



SURFACE VEHICLE RECOMMENDED PRACTICE

J1542™

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Laboratory Testing of Vehicle and Industrial Heat Exchangers for Thermal Cycle Durability

RATIONALE

SAE Five-Year Review.

1. SCOPE

This SAE Recommended Practice is applicable to all liquid-to-air, liquid-to-liquid, air-to-liquid, and air-to-air heat exchangers used in vehicle and industrial cooling systems.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (U.S. and Canada only) or +1 724-776-4970 (Outside U.S. and Canada), www.sae.org.

SAE J1597 Laboratory Testing of Vehicle and Industrial Heat Exchangers for Pressure-Cycle Durability

SAE J1598 Laboratory Testing of Vehicle and Industrial Heat Exchangers for Durability Under Vibration-Induced Loading

SAE J1726 Charge Air Cooler Internal Cleanliness, Leakage, and Nomenclature

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3. OBJECTIVE

The objective of this document is to establish a guideline for the thermal cycle durability testing of heat exchangers. The thermal cycle durability test is intended to simulate thermal expansion and contraction that occurs during the typical duty cycle of a heat exchanger and is accomplished by alternating the flow of hot and cold fluid through the heat exchanger. The cycling is designed to induce a high but reasonable level of thermal strain damage to the heat exchanger, and the target number of cycles may be historically or empirically correlated back to a vehicle level durability target. Thermal cycling can result in fatigue fractures in the fluid-carrying components (tube, plates, etc.) of the heat exchanger, resulting in leaks. The likelihood of thermal fatigue fractures resulting in leaks is affected by material thickness, material strength, high temperature, magnitude of temperature differentials, and number of cycles. The pass/fail criteria should be “no leaks,” but it may also include other undesirable damage associated with the testing. The test temperatures, pressures, flow rates, number of cycles, and pass/fail criteria may be different for each type of heat exchanger and application; therefore, the test specification is determined and agreed between the heat exchanger manufacturer and their customer.

4. FACILITY REQUIREMENT

The test facility should provide a system that provides a source of “hot” and “cold” process fluids that are:

- 4.1 Of the type used in the application, or acceptable substitute.
- 4.2 Supplied at the specified temperature(s) and pressure(s), as agreed.
- 4.3 Supplied at the specified fluid flow rate range, as agreed.

The system may include:

- 4.4 Safety features as specified by regulatory codes and common practices, such as pressure relief, automatic shutdown in case of fluid leaks, and an enclosure to contain fluids.
- 4.5 Automated data logging and cycle counting.
- 4.6 Filters to maintain fluid quality.

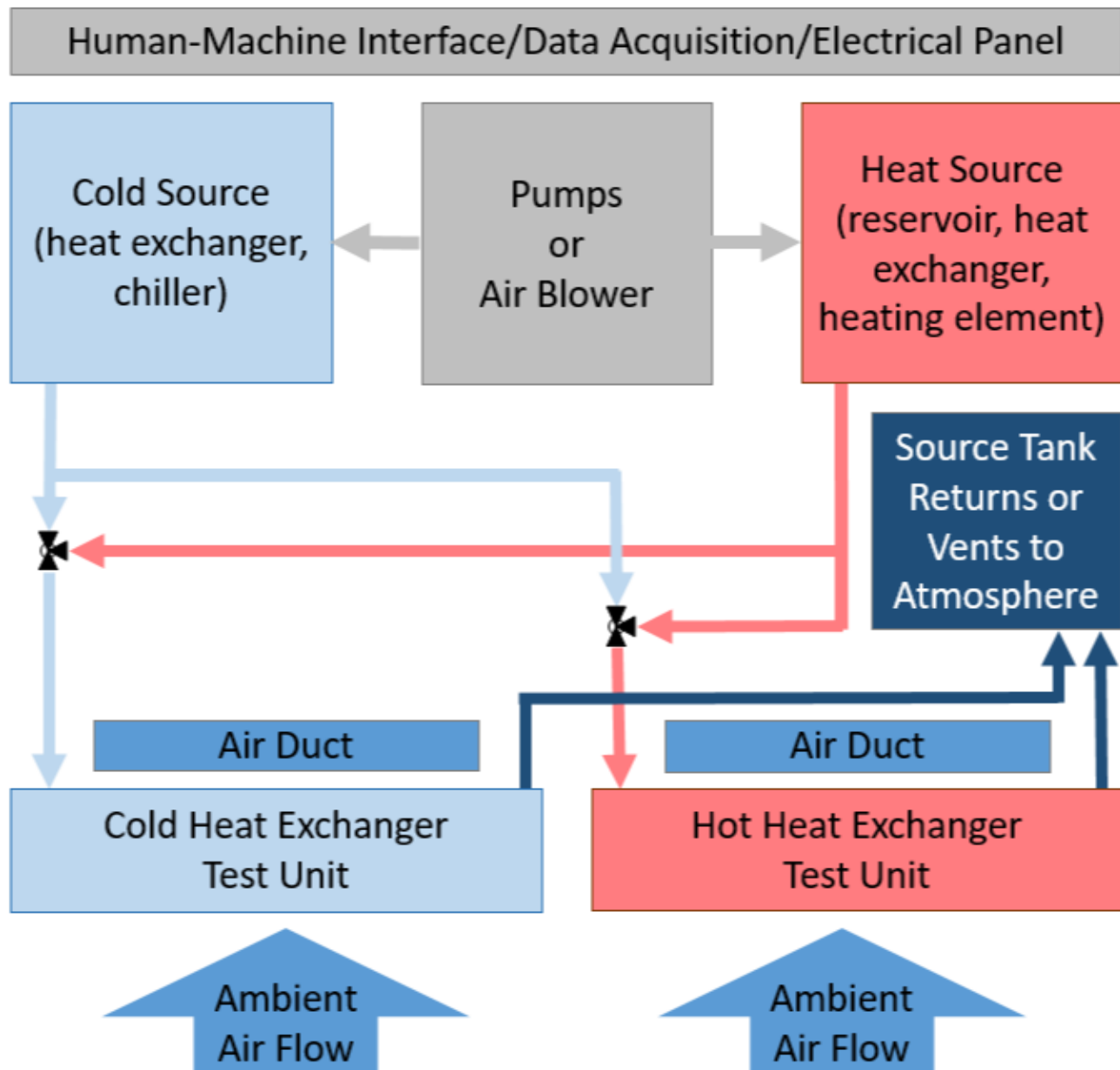


Figure 1 - Typical thermal cycle test system

5. TESTING

- 5.1 Prior to starting the test, check the heat exchanger for integrity. This is generally a leak test. For charge air coolers, use the methods described in SAE J1726 to verify that leakage does not exceed acceptable levels.
- 5.2 Install test heat exchanger(s) as specified by the vehicle manufacturer and the heat exchanger supplier (orientation and support as in service, if possible) in a safe manner. It is very important that the heat exchanger mounting hardware and method replicate that intended to be used in the production application. A test setup that does not constrain the heat exchanger as installed can result in unintended stresses that may lead to a non-representative and possibly premature failure.