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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1542

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

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. This document outlines the tests to determine durability characteristics of the heat exchanger under thermal cycling.

1.1 **Purpose—**This document is to provide a test guideline for determining the durability of a heat exchanger under thermal cycle conditions.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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

3. ***Objective—***To verify compliance with established criteria that insures durability in a specific application. This document describes a system to thermally induce stresses into a heat exchanger at specified rates and temperatures. The process is accomplished by heating and cooling the unit in a specified manner.

4. ***Facility Requirement—***The facility should provide the following as required:

4.1 Source of “HOT” fluid capable of delivering the fluid to the test unit at specified temperature and pressure.

4.2 Source of “COLD” fluid capable of delivering the fluid to the test unit at specified temperature and pressure.

4.3 Compressed air at specified pressure and temperature.

4.3.1 Charge air cooler test media.

4.3.2 Determination of product integrity.

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4.3.3 Evacuation of steam condensate after heating cycle if required.

4.4 Means of moving these fluids to and from the test unit in a specified manner.

4.5 Means of checking heat exchanger integrity.

4.6 A control system adequate to control the thermal cycle as specified. It may include the following:

a. Flow measuring devices
b. Pressure gauges
c. Pressure switches
d. Fluid filters
e. Temperature indicators
f. Pressure regulators for each fluid
g. Relief and back pressure regulators
h. Automatic energy shut-downs
i. Electrical relays, timers, switches, indicator lights, and related items as required
j. Thermal cycle counters
k. Safety features as specified by regulatory codes and common practices
l. Heaters and controls
m. Automatic data logging equipment

(See Figure 1 for typical control system for reference.)

5. Testing

5.1 Check heat exchanger for integrity.

5.2 Install test unit as specified (orientation as in service, if possible) in a safe manner.

5.3 Set up control system to obtain specified cycle (see Figure 2 for typical thermal cycle).

5.3.1 TYPICAL THERMAL CYCLE TEST TEMPERATURE DIFFERENTIAL—(See Table 1.)

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TABLE 1—

Type of Heat Exchanger	Temperature Differential[1]
Radiator (Liquid-to-Air)	80 °C (144 °F)
Air Cooled Oil Cooler (Oil-to-Air)	110 °C (198 °F)
Liquid Cooled Oil Cooler (Oil-to-Liquid)	110 °C (198 °F)
Air Cooled Charge Air Cooler (Air-to-Air)	175 °C (315 °F)
Liquid Cooled Charge Air Cooler (Air-to-Liquid)	140 °C (252 °F)

1. Differential temperatures are typically modified and agreed to in accordance with customer's reliability targets.

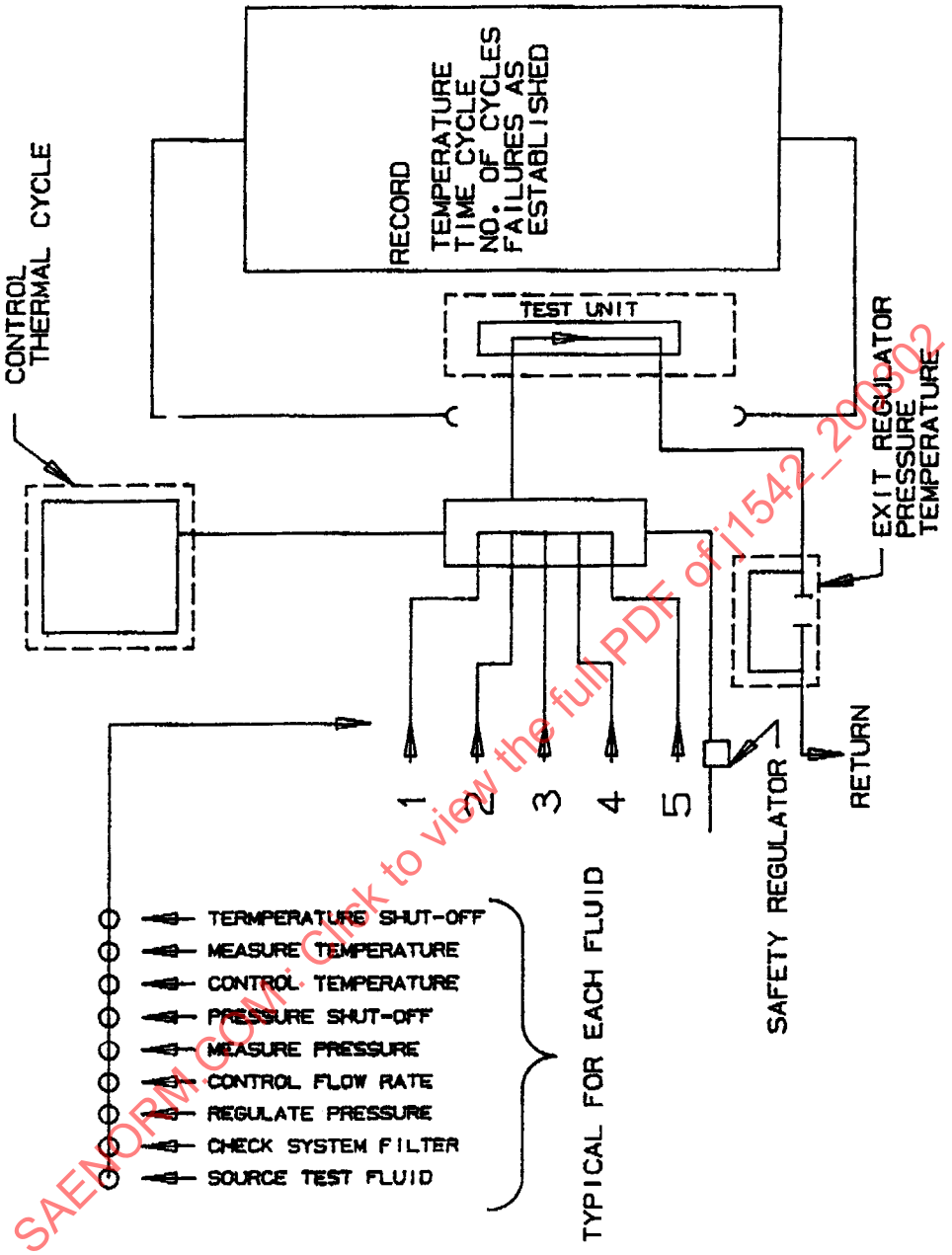

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FIGURE 1—TYPICAL CONTROL SYSTEM

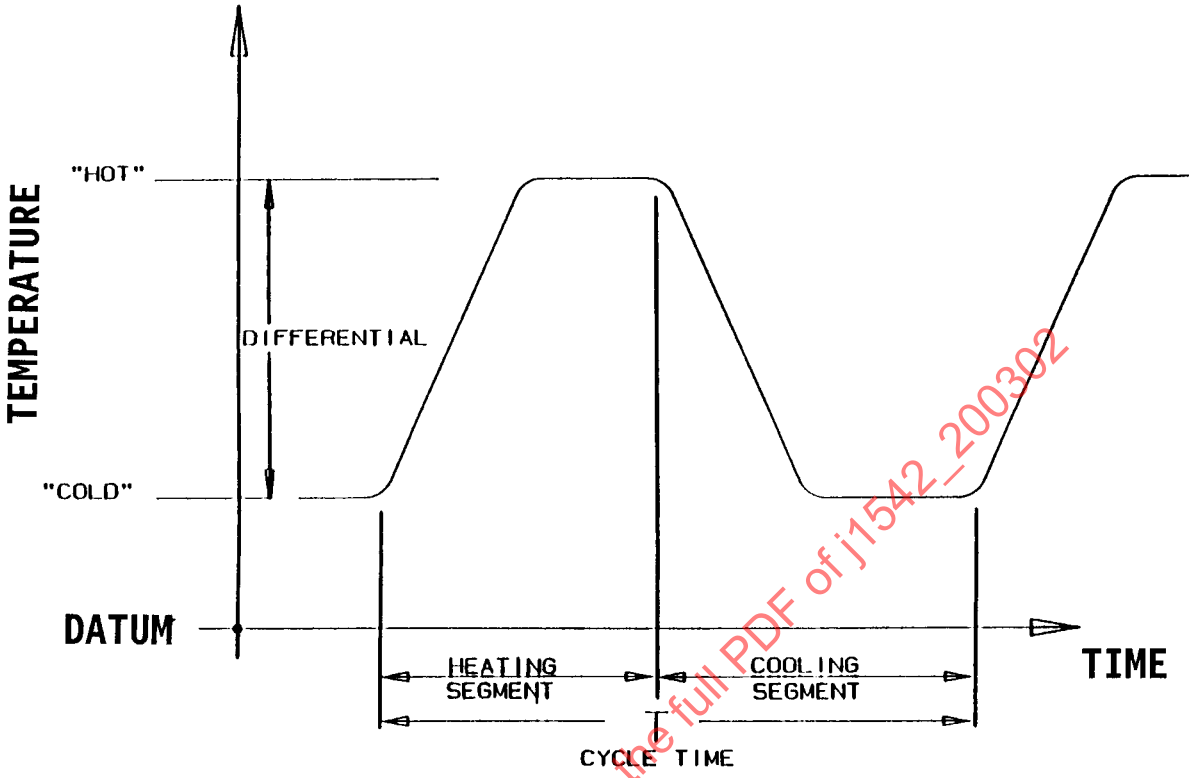

FIGURE 2—TYPICAL THERMAL CYCLE

5.3.2 "HOT"—temperature is specified based on specific application. This temperature to be at least equal to normal operating conditions. The system shall be capable of maintaining this temperature.

5.3.3 "HOT-COLD"—test temperature differential is based on individual application. A controlled temperature should be maintained within ±6 °C (±11 °F) by controlling either hot or cold source to take advantage of available resources.

5.3.4 "COLD"—temperature is established by test temperature differential.

5.3.5 The test cycle and its segments are to be based on specific application and are measured in seconds. The transition time from HOT to COLD will vary depending on test media, test equipment, and test method. One cycle consists of a heating segment and a cooling segment. A segment is that time required to bring the outlet temperature to within 5% of inlet temperature. It is desirable to minimize segment duration in order to expedite testing and maximize thermal cycle loading. To this end, and to insure compliance with outlet temperature goals, it may be required to circulate ambient media.

5.3.6 Test ambient temperature is to be specified based on specific application.

5.3.7 Nominal pressures and pressure ranges observed within the test should be recorded and maintained.

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