



SURFACE VEHICLE INFORMATION REPORT

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Glossary of Engine Cooling System Terms

RATIONALE

Five-Year Review. The terms “Auxiliary Pumps,” “Logarithmic Mean Temperature Difference,” and “Rotary Valves” have been added.

1. SCOPE

The objective of this glossary is to establish uniform definitions of parts and terminology for engine cooling systems. Components included are all those through which engine coolant is circulated: water pump, engine oil cooler, transmission and other coolant-oil coolers, charge air coolers, core engine, thermostat, radiator, external coolant tanks, and lines connecting them.

2. REFERENCES

2.1 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.1.1 SAE Publications

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

SAE J151	Pressure Relief for Cooling System
SAE J164	Cooling System Metallic Caps and Filler Necks
SAE J631	Radiator Nomenclature
SAE J814	Coolants for Internal Combustion Engines
SAE J1393	Heavy-Duty Vehicle Cooling Test Procedures
SAE J1436	Requirements for Engine Cooling System Filling, Deaeration, and Drawdown Tests

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Documents

Document Sharing Hub

SAE J1468	Oil Cooler Application Testing and Nomenclature
SAE J1726	Charge Air Cooler Internal Cleanliness, Leakage, and Nomenclature
SAE J2914	Exhaust Gas Recirculation (EGR) Cooler Nomenclature and Application
SAE J3136	Low-Temperature Coolant Circuit Nomenclature and Applications
SAE J3142	Thermal Flow Control Valve Nomenclature and Application

3. DEFINITIONS

3.1 AERATION

The entrainment of gas (air, combustion gas, or both) in the coolant.

3.2 AFTERBOIL

Boiling of the coolant after engine shutdown. It is caused by an engine's local metal surface heat flux into adjacent coolant. Heated coolant would reach a superheated state for its local additive concentration and pressure.

3.3 AFTERBOIL VOLUME

The quantity of coolant forced from the engine by afterboil. The volume is a combination of liquid coolant and coolant vapor created by high heat flux from the engine liner and cylinder head reaching boiling point at the lower pressure seen locally after engine shutdown. This may or may not be displaced from the system, depending upon the system design, coolant level, or both.

3.4 AIR-TO-BOIL (ATB) TEMPERATURE

The ambient air temperature (°C or °F) at which the coolant at the radiator inlet reaches its boiling point. The coolant boiling point is a function of the absolute pressure and the characteristics of the coolant. However, the term is also quite commonly used without consideration for the absolute pressure or the coolant characteristics. In the case of an open radiator at sea level pressure with water as coolant, a boiling point of 100 °C (212 °F) is assumed.

3.4.1 Air-to-Boil Temperature = Boiling temperature of the system coolant - highest coolant temperature during specified test + ambient temperature.

3.5 AIR RECIRCULATION - FAN

The recycling of air already discharged by the fan back to the fan inlet. Recirculation raises air-fan temperature and reduces air mass flow.

3.6 AIR RECIRCULATION - RADIATOR

The recycling of hot air already passed through the radiator, usually caused by engine enclosure pressure. Recirculation can be minimized with well-placed recirculation baffles.

3.7 AMBIENT CAPABILITY

Similar to ATB temperature (see 3.4) but refers to an air ambient temperature at which any of the fluids being cooled exceed their design temperature limits under a specified operating cycle. For example, if four fluids are being cooled, the ambient temperature at which the first fluid reaches its design limit determines the ambient capability of the entire system.

3.8 AMBIENT TEMPERATURE

The environmental air temperature (°C or °F) in which a unit is operating. In general, the temperature is measured in the shade (no solar radiation) and represents the air temperature for engine cooling system performance measurement purposes. Air entering the radiator will usually be above ambient temperature due to the heat gained passing by hot surfaces on its way to the core or from recirculation.

3.9 APPROACH TEMPERATURE DIFFERENTIAL

The temperature difference between hot-side fluid (coolant, oil, or charge air) and cold-side fluid (air or coolant) entering the heat exchanger. This is a quantity indicating the temperature potential driving heat transfer in data supplied by the heat exchanger supplier along with the heat transfer capacity of the heat exchanger (see 3.48).

3.9.1 Supplier data usually comes in the form: $q' = (U \times A) \times \Delta T$

where:

q' = heat transferred (kW or Btu/min)

U = overall heat transfer coefficient (kW/m²/°C or Btu/min/ft²/°F)

A = effective core heat transfer area (m² or ft²)

ΔT = temperature difference (°C or °F) expressed as either entering temperature difference or temperature potential (common definition for radiator performance)

3.10 AUXILIARY PUMPS

Typically run on 12 V electric power, may be used to supply coolant flow for heater cores flow during stop/start, for low temperature loops, and for charge air coolers and for electrification components.

3.11 AUXILIARY TANK

A separate tank in the cooling system provided to perform one or more of the following functions:

- a. Filling
- b. Coolant reservoir
- c. Deaeration
- d. Retention of coolant expelled from radiator by expansion, afterboil, or both
- e. Visible fluid level indication, including add and full markings
- f. A warning of low coolant level, either by an electronic fluid level indicator or low coolant warning sensor

The terms “burp bottle” and “overflow bottle” are sometimes used synonymously with this type of recovery system, which is non-pressurized.

3.12 BLOCKED OPEN THERMOSTAT

A thermostat mechanically blocked open to the position representing its maximum open position; usually used during cooling tests.

3.13 BLOWER FAN MODE

A cooling system configuration where the fan is positioned such that the air passes through the fan before entering the heat exchanger(s). This configuration is sometimes called a forced air, blower, blow through, or pusher system.

3.14 COOLANT

In the context of this standard, coolant is the fluid circulated through a cooling system by the pump that absorbs heat from the hot surfaces of heat exchangers from the hot side fluid, as well as absorbing engine heat rejection from hot internal surfaces as a result of fuel combustion at high temperatures. The heat is then dissipated to ambient air circulated through the core of the radiator by the fan. The coolant has other purposes in the case of engine cooling systems. At a minimum, the coolant consists of water plus a rust inhibitor, which protects iron parts of the engine and cooling system from oxidation. Antifreeze is most commonly added to water, either ethylene glycol or propylene glycol, to provide additional cooling system protection by:

- Lowering the freezing point temperature for low ambient temperature conditions when the engine is off.
- Raising the boiling point temperature to prevent localized boiling in areas of high temperature and low pressure inside the engine when operating a high load, high ambient temperature, or both.
- Adding galvanic corrosion protection for protection of cooling system parts containing copper, brass, and solder; and a surface coating on aluminum parts of the system to prevent oxidation.
- Providing added lubrication for seals in the coolant pump.

3.15 COOLANT RECOVERY SYSTEM

A subsystem for the purpose of containing the coolant which is expelled from the system when it expands due to an increase in the coolant's bulk temperature. The recovery system consists of a tank that is partially filled and attached using a vent line to the vent on a filler neck of a full and pressurized radiator. As the coolant heats and expands, it forces the radiator cap to open and allow fluid flow into the auxiliary tank. When the coolant cools, a vacuum is created, forcing the radiator cap to open, and that draws fluid from the tank back into the radiator. A pressure-vacuum cap is required for this type of system.

3.16 COOLING SYSTEM

A group of interrelated components that effectively transfer heat for the purpose of keeping components and cooling fluids below specified design temperature limits.

3.17 COOLING SYSTEM CAP

Device that seals the opening used to add coolant to the pressurized section of the engine cooling system and regulate the cooling system's pressure level. A relief spring will move enough to open the seal above a specified pressure, allowing coolant or pressurized air to flow out of the opening (either to the environment or an auxiliary tank), and prevent over-pressurization of the system that would cause structural damage or leakage elsewhere in the system. The opening system pressure is determined by the OEM. Note that once the cap is installed and sealed, pressure is only created when either (1) the coolant temperature rises above the value when the cap is sealed, (2) the volume expands thermally as in coolant recovery systems, or (3) there is another source of gas entering the coolant circuit. Simply installing and sealing a cap does not create pressure. In the case of recovery tank systems, a second spring reacting to vacuum will also be included in the cap to allow flow to return to the cooling system from the auxiliary tank when the coolant cools and contracts and reaches a specified negative pressure below ambient atmospheric pressure.

3.18 COOLING SYSTEM CAPACITY (VOLUME)

The amount of coolant designated (liters or quarts) to completely fill a cooling system to its designated cold full level mark. This includes filling all heat exchangers, lines, and a dry engine.