SAE International	SURFACE VEHICLE RECOMMENDED PRACTICE	SAE **J1148 APR2010**
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Engine Charge Air Cooler (CAC) Nomenclature

RATIONALE

This document is cancelled because its content is now included in SAE J1726 (February 2010).

1. SCOPE

This SAE Recommended Practice is intended to outline basic nomenclature and terminology in common use for engine charge air coolers, related charge air cooling system components, and charge air cooling system operational performance parameters.

1.1 Description

An engine charge air cooler is a heat exchanger used to cool the charge air of an internal combustion engine after it has been compressed by an exhaust gas driven turbocharger or a mechanically or electrically driven blower (supercharger). The use of a charge air cooler offers increased engine horsepower output, reduced exhaust emission levels, and improved fuel economy through a more complete combustion process due to increased intake air density. Typical cooling media include the engine's coolant, ambient air, or an external coolant source.

2. REFERENCES

There are no referenced publications specified herein.

3. DEFINITIONS

For purposes of this SAE Recommended Practice, charge air may be referred to as a fluid when in fact it is a gas. The cooling medium may be referred to as a fluid when in fact either liquids or gases can be employed.

3.1 Hardware

3.1.1 Aftercooler

A charge air heat exchanger located after the compressor (see Intercooler).

3.1.2 Air-to-Air Cooler

A charge air heat exchanger that uses ambient air as the cooling medium.

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3.1.3 Core

The portion of the heat exchanger that includes the principal heat transfer surface areas. The main core components include the tubes, external fins, internal fins, and oftentimes, the header. Some designs include the header as part of the inlet and outlet tanks. The core components are either brazed or mechanically fastened together. Mechanically fastened core components are connected with expanded joints, sealants or interference fit elastomeric gaskets. These gaskets are sometimes called resilient grommets. Some cores have brazed tube-to-fin joints in combination with elastomeric gaskets between the tubes and headers. Most OEM cores are brazed with one of the following manufacturing processes:

3.1.3.1 Air Braze

Brazing the heat transfer components of the core in an air atmosphere and typically employing a corrosive type flux.

3.1.3.2 Vacuum Braze

Brazing the heat transfer components of the core in a nearly zero atmosphere and typically without the use of liquid flux.

3.1.3.3 Controlled Atmosphere Braze (C.A.B.)

Brazing the heat transfer components of the core in a controlled atmosphere and typically employing a non-corrosive flux. Typical examples of this brazing process include aluminum alloy brazing by the NOCOLOK® process and copper alloy brazing by the CUPROBRAZE® process, which typically employ a nitrogen atmosphere.

3.1.3.4 Dip Braze

Brazing the heat transfer components of the core in a molten metal or salt bath.

3.1.3.5 Exothermic Braze

Brazing the heat transfer components of the core through the employment of an exothermic compound sufficient to reach the brazing temperature of the filler metal.

3.1.3.6 Torch Braze

The heat transfer components of the core are joined mechanically by expanding the tubes. The tube-to-header joints are torch brazed.

3.1.4 External Fins

Secondary surfaces that increase the area to transfer heat to the cold fluid.

3.1.5 Header

The portion of the core that connects the inlet and outlet tanks to the core matrix. The ferrules are typically formed or pierced.

3.1.6 Inlet Ducts

The portions of the cooling system that direct the fluids into the inlet tanks of the heat exchanger.

3.1.7 Inlet Tanks

The portions of the heat exchanger located between the compressor and the intake manifold or between series compressors that direct the fluids into the core matrix.

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3.1.8 Intercooler

A charge air heat exchanger located between the compressor and the intake manifold or between series compressors.

3.1.9 Internal Fins

Secondary surfaces that increase the area that is to transfer heat from the hot fluid.

3.1.10 Air-to-Coolant Cooler

A charge air heat exchanger that uses the engine coolant or other external liquid coolant as the cooling medium.

3.1.11 Multipass

A charge air heat exchanger that passes the fluids through the core matrix more than once.

3.1.12 Outlet Ducts

The portions of the cooling system that direct the fluids out of the outlet tanks of the heat exchanger.

3.1.13 Outlet Tank

The portion of the heat exchanger that direct the fluids out of the core matrix.

3.1.14 Remote Mounted

A charge air heat exchanger that is located (mounted) in an area not normally associated with or convenient to the cooling medium.

3.1.15 Single Pass

A charge air heat exchanger that passes the fluids through the core only once.

3.1.16 Tubes

The portions of the heat exchanger core matrix that are used to separate the fluids and are also the primary heat transfer surface areas. (See Figure 1 for typical tube types.)

3.1.17 Turbulator

Secondary surfaces that increase the turbulence and mixing of the cold or hot fluids.

3.2 Operating and Performance Parameters

3.2.1 Ambient Temperature

The temperature of the air surrounding the engine or vehicle before such air is influenced by heat or work energy from the engine or vehicle.

3.2.2 Boost Pressure

The pressure of the charge air as it leaves the turbocharger, supercharger, or other compressor.

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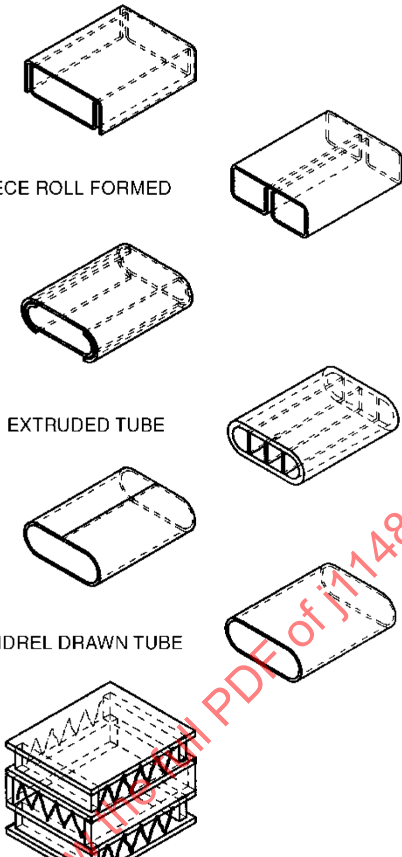

FIGURE 1 - CHARGE AIR COOLER TUBES

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3.2.3 Density Recovery Efficiency

The ratio of the charge air density increase achieved from cooling the charged air, to the density decrease due to the temperature rise in the process of compressing the charge air.

3.2.4 Density Recovery Ratio

The ratio of the charge air density at the engine intake manifold to the air density at conditions of ambient temperature and boost pressure.

3.2.5 Inlet Pressure

The pressure of the charge air as it enters the heat exchanger.

3.2.6 Inlet Temperature

The temperature of the fluids as they enter the heat exchanger.

3.2.7 Inlet Temperature Differential (ITD)

The inlet temperature difference between the hot and cold fluids.

3.2.8 Intake Manifold Pressure

The charge air pressure in the intake manifold.

3.2.9 Intake Manifold Temperature

The charge air temperature in the intake manifold.

3.2.10 Intake Manifold Temperature Differential (IMTD)

The difference between the charge air temperature in the intake manifold and the ambient temperature.

3.2.11 Mass Flow Rate

The rate of flow of the hot and cold fluids through the heat exchanging system expressed in terms of mass units per unit time.

3.2.12 Operating Conditions

The conditions under which the heat exchanger must operate; usually determined or set as the most severe conditions the heat exchanger will operate under continuously.

3.2.13 Outlet Pressure

The pressure of the fluids as they exit the heat exchanger.

3.2.14 Outlet Temperature

The temperature of the fluids as they exit the heat exchanger.

3.2.15 Pressure Drop

The difference in fluid pressures as measured between the inlet and outlet of the heat exchanger or heat exchanging system.

3.2.16 Temperature Drop

The difference in the fluid temperatures as measured between the inlet and outlet of the heat exchanger or heat exchanging system.

3.2.17 Temperature Effectiveness

The ratio of the inlet charge air temperature minus the outlet charge air temperature divided by the inlet temperature differential.

3.2.18 Test Conditions

The conditions under which the heat exchanger is tested to determine its effectiveness and pressure drop, usually the same as the operating conditions.

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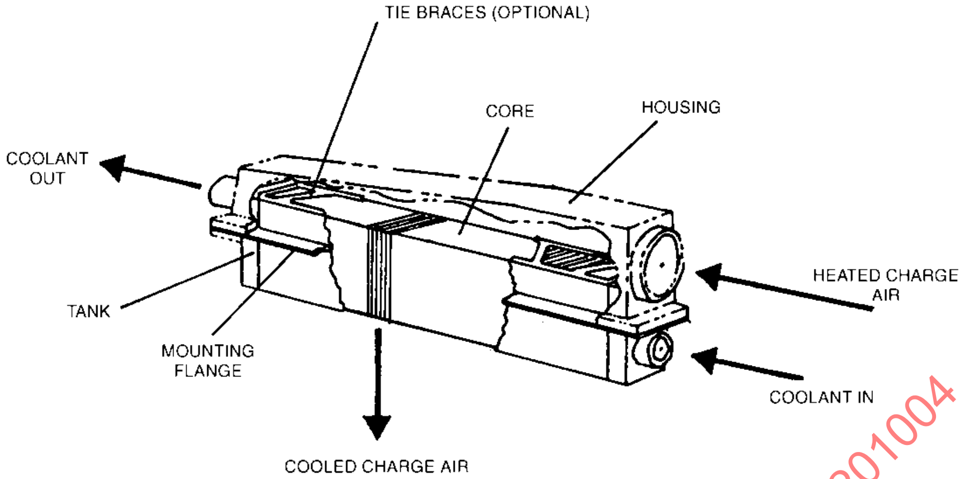
4. SCHEMATICS OF TYPICAL CHARGE AIR COOLERS

4.1 Air-to-Coolant Heat Exchangers

a. Mounted in the intake manifold (see Figures 2 and 3)

b. Mounted remotely (see Figures 4 and 5)



NOTE—Coolant sources can be varied.
Materials have to be compatible with the type of coolant and environment.

FIGURE 2 - AIR-TO-COOLANT - MOUNTED IN INTAKE MANIFOLD

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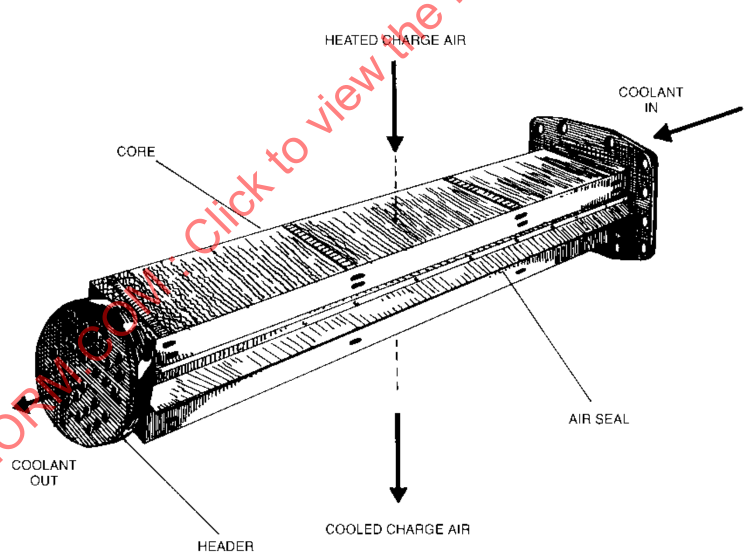
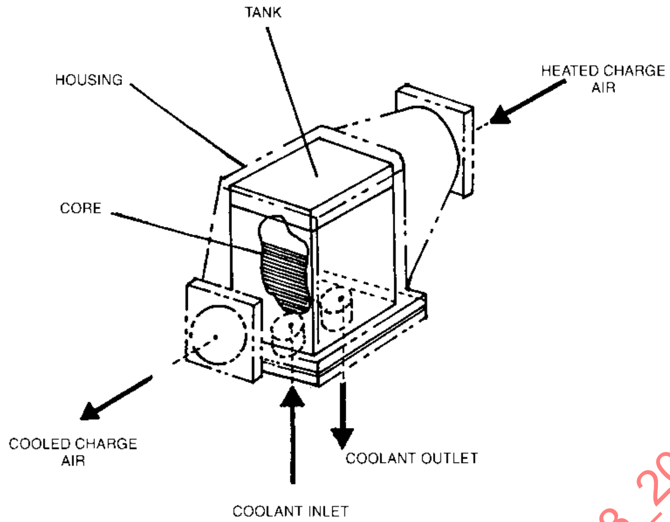


NOTE—Coolant sources can be varied.
Materials have to be compatible with the type of coolant and environment.

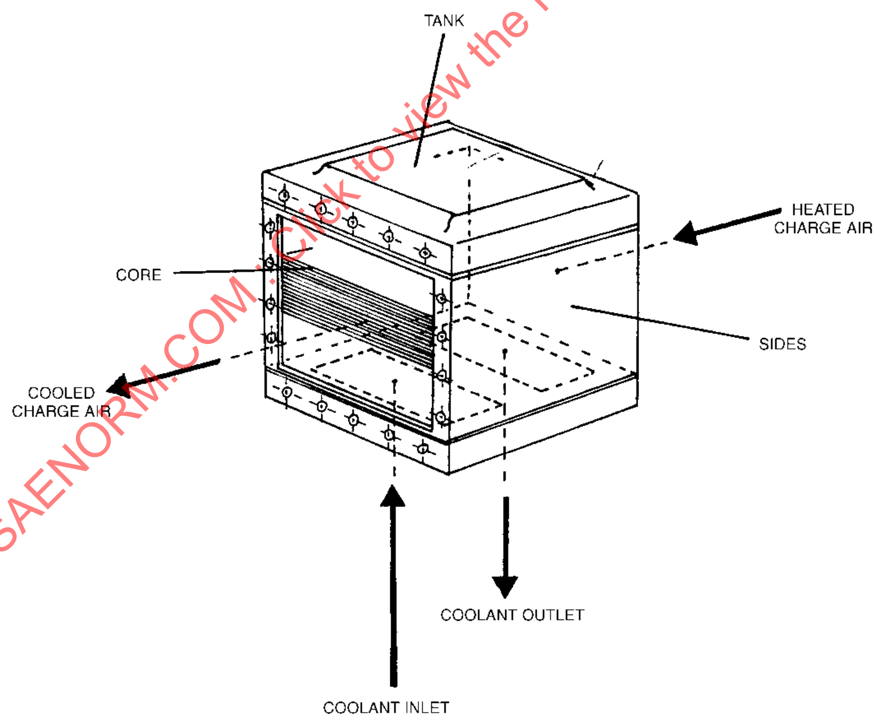
Coolant traverses may be a single pass or a multipass arrangement.

FIGURE 3 - AIR-TO-COOLANT - MOUNTED IN INTAKE MANIFOLD



NOTE—Coolant sources can be varied.
Materials have to be compatible with the type of coolant and environment.

FIGURE 4 - AIR-TO-COOLANT - MOUNTED REMOTELY



NOTE—Coolant sources can be varied.
Materials have to be compatible with the type of coolant and environment.

Coolant traverses may be a single pass or a multipass arrangement.

FIGURE 5 - AIR-TO-COOLANT - MOUNTED REMOTELY

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