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SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) ENGINE CHARGE AIR COOLER NOMENCLATURE

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 operating and 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, an engine driven turbocharger, or a mechanically or electrically driven blower. The use of a charge air cooler allows increased engine horsepower output, and may reduce emission levels and improve fuel economy through a more complete combustion due to the increased air density available. Typical cooling media include the engine's coolant, ambient air, or an external water or coolant source.

2. *References*—There are no referenced publications specified herein.

3. *Definitions*

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.

3.1.3 CORE—The portion of the heat exchanger that includes the principal heat transfer surface areas. Typical core manufacturing processes include the following:

3.1.3.1 *Air Braze*—Atmosphere brazing employing a corrosive flux. Components need to be washed after brazing.

3.1.3.2 *Vacuum Braze*—Nearly zero atmosphere brazing without the requirement of an added flux except for the components requirement of residual magnesium when brazing aluminum.

3.1.3.3 *CAB Brazing*—Controlled atmosphere brazing employing a non-corrosive flux. A typical example is the Nocolok process with a nitrogen atmosphere.

3.1.3.4 *Mechanically Expanded*—Where a tube to header seal is accomplished by mechanically expanding the tube into the header at the tube/header interface. No brazed joints are used.

3.1.3.5 *Dip Braze*—Brazing in a hot liquid. Liquid residue must be removed.

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.

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 that direct the fluids into the core matrix.

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 area surrounding the heat exchanger.

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

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.

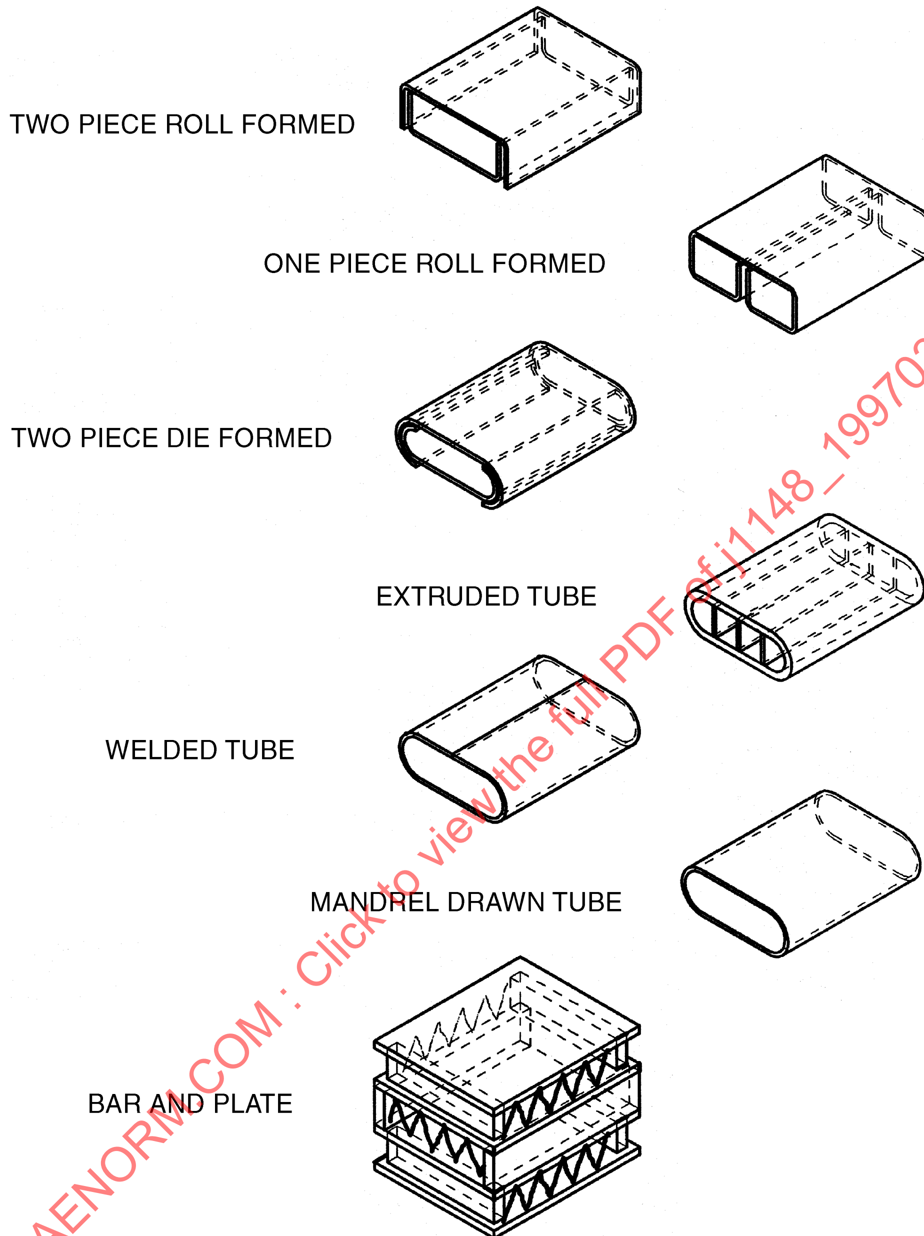


FIGURE 1—CHARGE AIR COOLER TUBES

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 MASS FLOW RATE—The rate of flow of the hot and cold fluids through the heat exchanging system expressed in terms of mass units.

3.2.11 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.

3.2.12 OUTLET PRESSURE—The pressure of the fluids as they exit the heat exchanger.

3.2.13 OUTLET TEMPERATURE—The temperature of the fluids as they exit the heat exchanger.

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

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

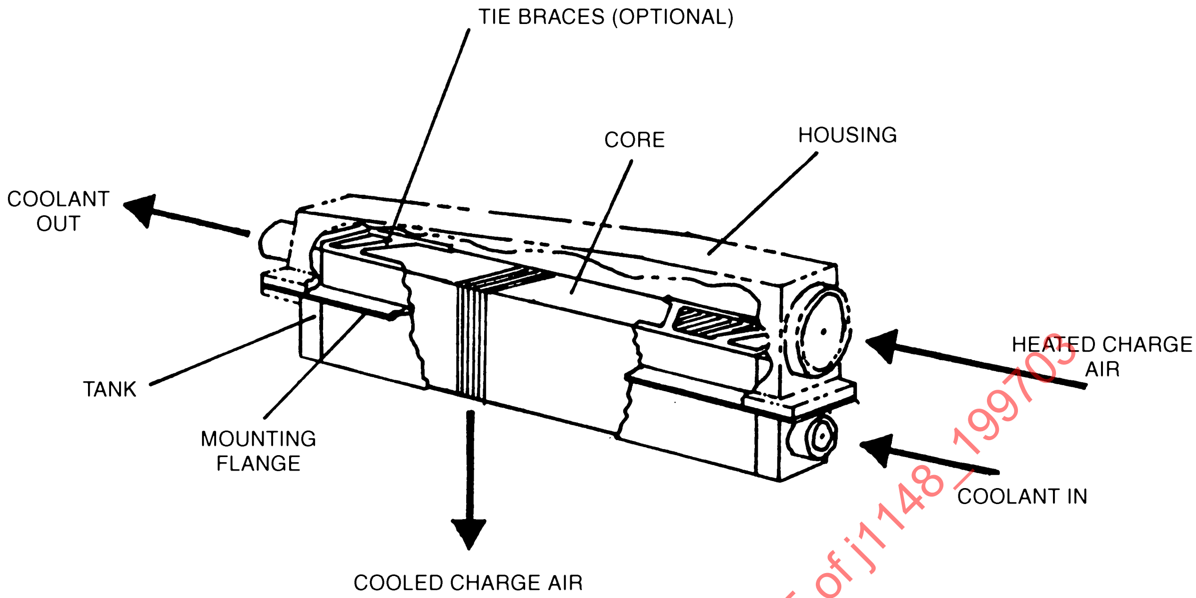
3.2.16 TEMPERATURE EFFECTIVENESS—The ratio of the hot fluid temperature drop to the inlet temperature differential.

3.2.17 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.

4. Schematics of Typical Charge Air Coolers

4.1 Air to Coolant Heat Exchangers

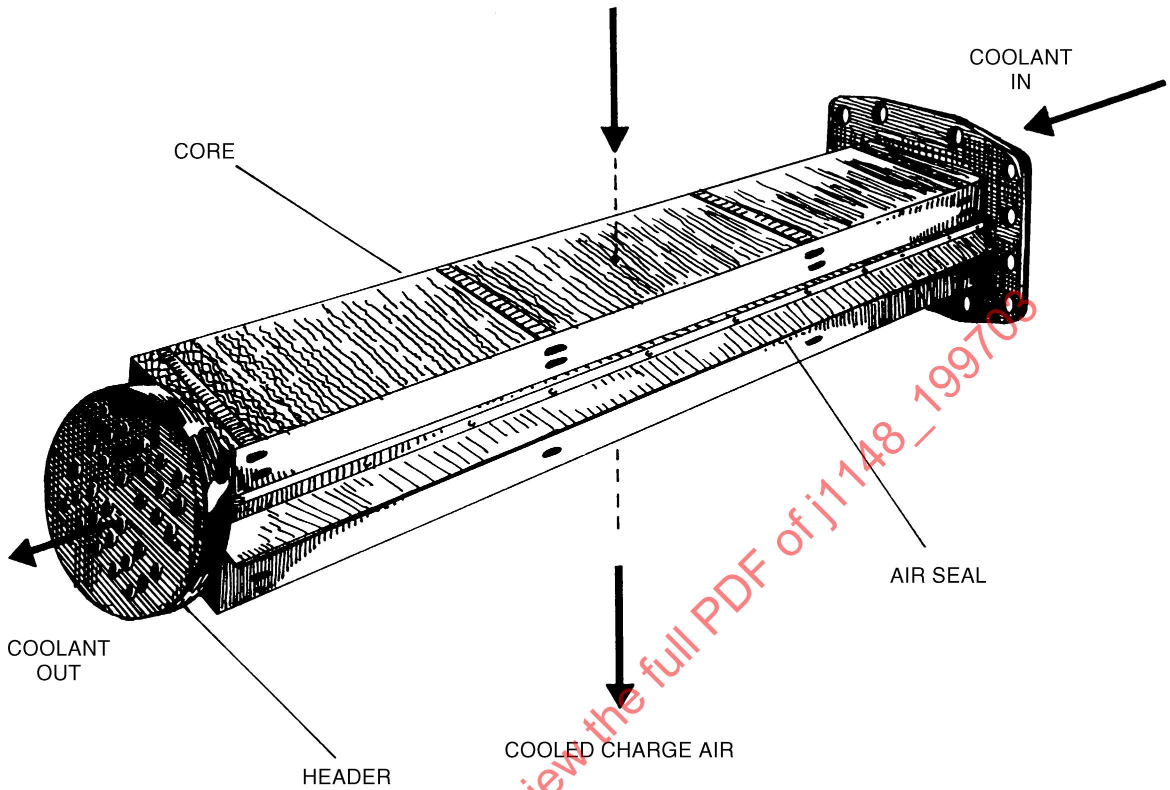
a. Mounted in the intake manifold (see Figures 2 and 3)
b. Mounted remotely (see Figures 4 and 5)



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

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

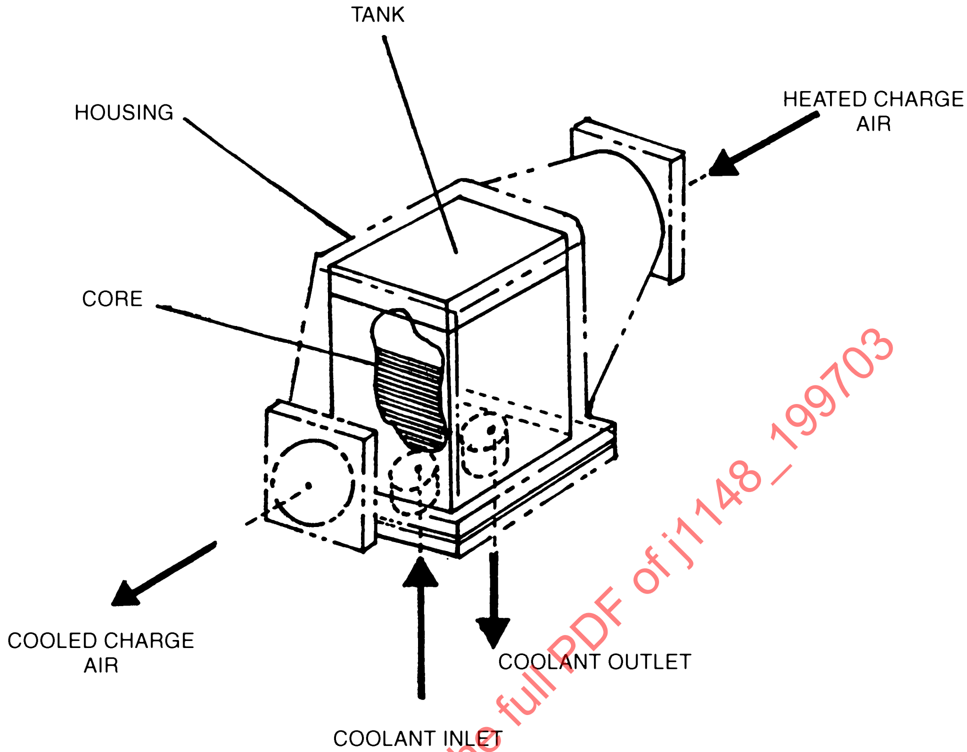
FIGURE 2—AIR TO COOLANT—MOUNTED IN INTAKE MANIFOLD



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

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

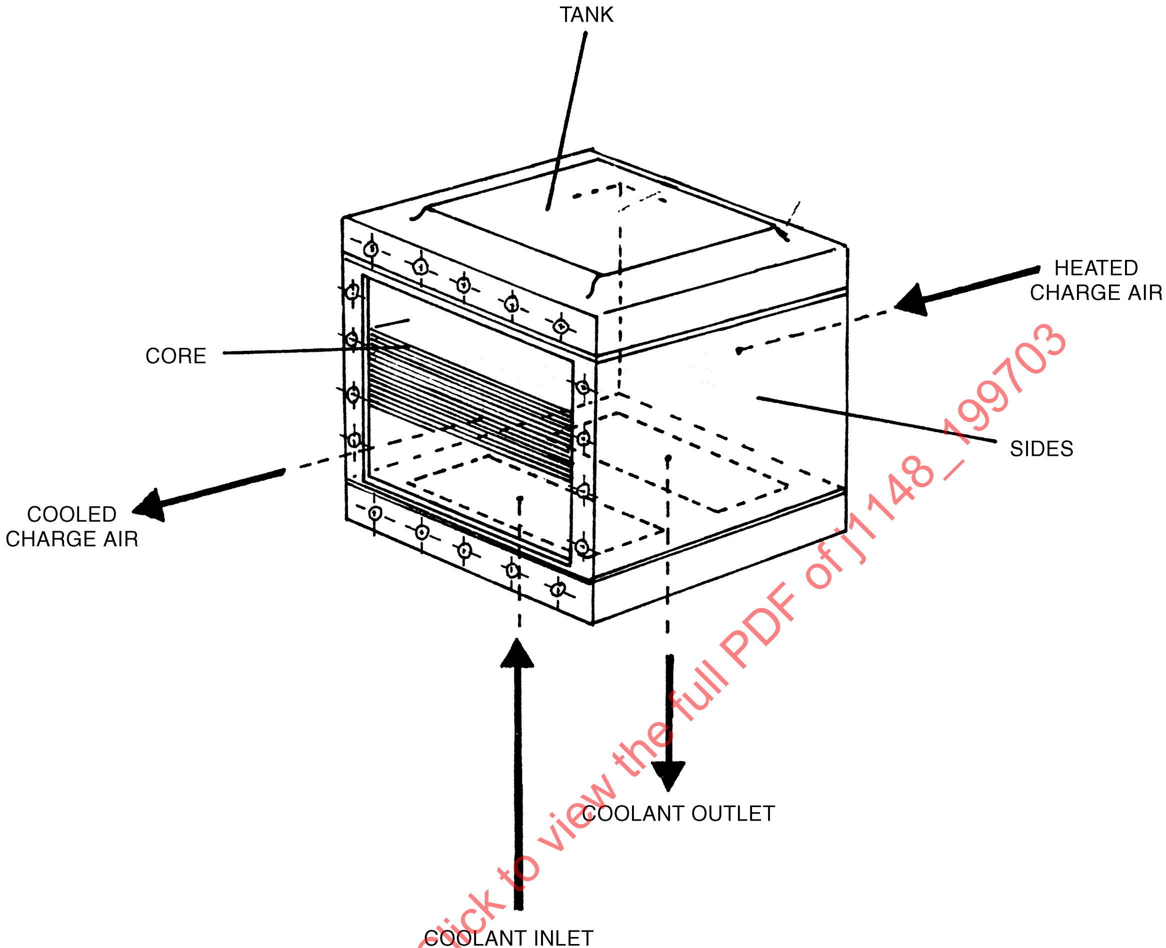
FIGURE 3—AIR TO COOLANT—MOUNTED IN INTAKE MANIFOLD



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

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

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

4.2 Air to Air Heat Exchangers

a. Engine fan cooled (see Figure 6)
b. Auxiliary blower cooled (see Figure 7)