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TESTING YOUR COOL, Maintaining Charge Air Coolers,

by: F. Larry LePrevost, Executive Vice President, Johnson Mfg. Co.

Whenever the subject of charge air cooler (CAC) repair comes up, it is invariably associated with heavy duty radiator shops that are equipped to handle large OTR radiators, industrial heat exchangers, tube and shell units, generator sets and the like. Ever since air-to-air coolers were developed by Mack back in the late '70's, and later put into use by the other prominent equipment makers, their numbers have steadily grown. Heavy-duty repair now represents the fastest growing segment of the radiator industry. One of the main reasons for its growth of more than five percent this past year is due largely to the rapid proliferation of CACs. Yet another bright spot for HD shops may result from stiffer EPA regulations effecting diesel emissions. These new rules should bring in many additional exhaust gas recirculation (EGR), radiator and CAC service opportunities.

Recently, smaller CACs have been showing up on high performance cars like BMW's new Mini Cooper S, as well as turbocharged products from Diahatsu, Subaru and VW. Based on our ever-increasing need for speed, these smaller, lighter, more powerful engines represent a market dynamic that is likely to continue for years to come. Historically speaking, service industries trail the introduction of new products by only a couple of years, so there may still be enough time for shops who are not already servicing CACs to get in on the action, providing they act quickly.

Many radiator shops are alive and well today only because they have positioned themselves on the leading edge of the changes in their marketplace. Others may have resisted change, or failed to take advantage of market trends such as the aluminum/plastic revolution. My point is not to lecture, but to observe through hindsight, that the next great wave of opportunity for the cooling system service industry may already be upon us. That is, testing and servicing of charge air coolers!

Heat and Pressure

Charge air cooleres are made from aluminum alloys primarily because they offer excellent heat rejection, corrosion resistance, strength and lightness. However, when one considers all the forces acting upon a CAC simultaneously, (harsh environment, thermal cycling, vibration, internal pressure change) one surely has to reason that sooner or later, every CAC in use will require testing, servicing, recoring, or replacement. The typical in-service temperatures of a CAC can reach 400-500 F, yet new units provide temperature reduction to 110 F - quite remarkable. Even so, it has been estimated that as many as 100,000 units fail in the US annually. One source says that CACs usually require servicing or replacement every 3 to 5 years, while another states 300,000 to 500,000 miles depending on the severity of duty. Consider this; every time a turbocharger kicks in, internal air pressure can increase by as much as 50% and that's usually when the temperature peaks, Is it any wonder this potent combination of heat, vibration and pressure can initiate stress cracking?

Although it has been said that roughly 50% of all CAC failures are the direct result of failed turbochargers, most of the remaining units require service either because of cracks running down the tubes, or fractures adjacent to the tube-to-header joints. Such cracks don't usually occur as a sudden catastrophic failure, but as tiny hairline fractures that are nearly impossible to see. These can almost always be detected with soapy water. At this early stage cracks will permit some loss of pressure, yet the unit may still remain well within manufacturers operating specifications. As time goes on these cracks grow in size until reaching the point at which pressure loss exceeds specifications. Then both engine performance and fuel economy are noticeably reduced, while emissions levels soar above permissible limits. Loss of power is the most common complaint, but perhaps you've also heard that whistling sound often associated with a leaky CAC.

Pressure loss has a greater impact on boost density than does operating temperature, which means a leaking charge air cooler may play a more significant role in loss of power, failure of the turbocharger or shortened engine life. Therefore, it seems that every owner/operator should opt for the inspection of the CAC at regular maintenance intervals rather than facing the expense, inconvenience and downtime resulting from failures on the road. Testing should be an easy sell if you can get in touch with the right person!

Testing charge air coolers is easy, as well as safe when you use the right equipment. Johnson is just one of several suppliers offering a kit for this purpose.

Pressure Check

Every CAC test kit comes with instructions; follow them carefully. Make certain plugs and equipment are easy to use, well-secured and clamped in place. We take this part very seriously because we don't want anyone getting hurt. Have you ever seen a four-inch test plug weighing over two pounds go ballistic? During an actual test conducted at Johnson, we blew one an estimated 125 feet in the air and back to earth again in seven seconds, giving us a calculated velocity of over 75 mph. If the same plug had been launched horizontally, it would have traveled nearly 100 feet.

Pressure the unit, usually with a standard air chuck, watch the pressure gauge for 15 seconds to determine whether the pressure drop has exceeded the manufacturer's specifications. While it is true some charge air coolers leak a little even when new, manufacturers of other units claim zero leakage. Leaking ductwork, or loose clamps may also contribute to lower boost, so if you're testing a CAC on the vehicle be sure to inspect for these problems as well.

MAXIMUM OEM SERVICE BLEED RATE SPECIFICATIONS:

Caterpillar	5 PSI Within 15 Seconds @ 30 PSI
Cummins	7 PSI Within 15 Seconds @ 30 PSI
Detroit Diesel	5 PSI Within 15 Seconds @ 25 PSI
Mack Truck	5 PSI Within 15 Seconds @ 30 PSI
Volvo Trucks	7 PSI Within 15 Seconds @ 30 PSI

Repair or Replace?

So you've found a leak! Always begin by precleaning, which at times may be very difficult though not impossible. When cleaning, be sure to use only chemicals that are designed for aluminum. Do not use caustic, high pH solutions, or ammonia as it will quickly attack the aluminum. It will start with the fins and depending on the length of exposure, it can even eat into the tubes, Bead blasting with a medium grit is one of the most effective methods for cleaning, providing that your blasting media can get into the area to be cleaned.

Assuming this is one of those cases where failure was caused by a failed turbo, the best thing to do, according to one industry professional, is to recore or replace it, rather than doing a clean and repair. Any repair process begins with cleaning, but removing the baked-in contamination from inside this unit could be a tough chore. If the failure is due to stress cracking, again it would probably be best to recore or replace the unit. Chasing split tubes can be an endless job, according to another industry professional. If however, the crack runs next to the tube-to-header joints, your options may include epoxies, brazing or welding.

For certain repairs, a section of the tank may be sawed away, or the tanks may have to be removed totally. Circular saws are used for this purpose however, be careful not to leave behind any of the shavings, as they will almost certainly damage the turbo-charger. It is also recommended that you save your tanks as new CAC tanks are not sold separately. Maybe yours will come in handy for a recore job down the road.

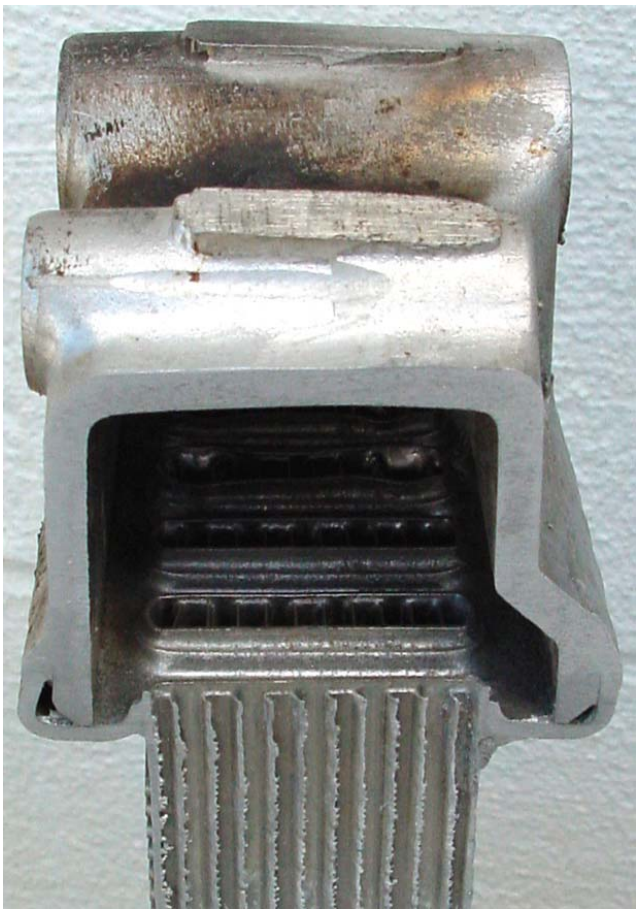
As you would imagine, there is more than one type of charge air cooler construction available in the aftermarket. One type is referred to as a bar-and-plate design that seems beefy and quite adequate for the task. It is my understanding these are sold both as complete units or cores and they advertise an impressive warranty. Most other types include heavy gage tube-and-fin designs. Most units are either controlled atmosphere brazed (CAB) or vacuum brazed with welded tanks, while at least one brand has silicone tube-to-header grommets. I haven't done an actual survey of CAC manufacturers, but I see warranties ranging from 1 to 7 years advertised in trade journals.

Be Smart, Be First

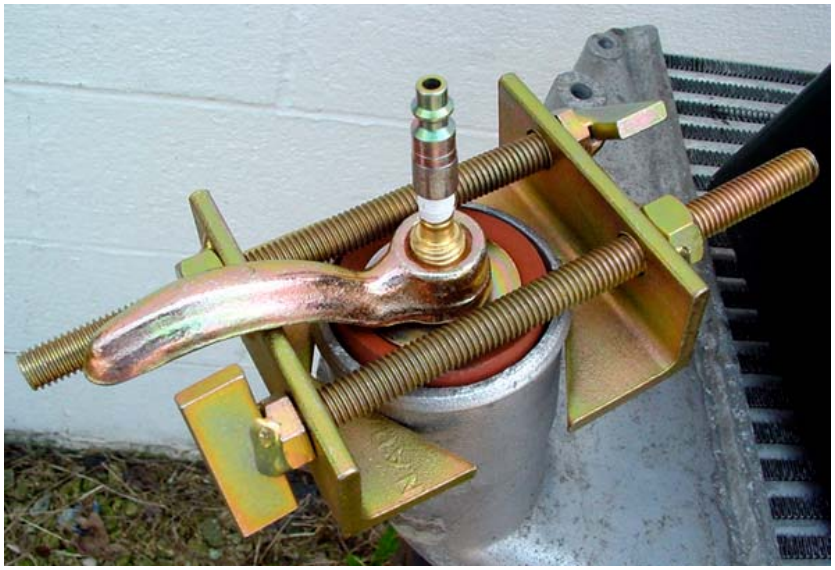
Shops have a wide selection of different makes and models to choose from so it would be wise to shop around. When ordering an OEM replacement charge air cooler from a dealer, it is always best to have the VIN or an original part number handy. However, when ordering an aftermarket unit or core, there is nothing like having one or more good CAC catalogs for reference. Trust me, manufacturers will be happy to oblige when you call them.

Obviously there is a lot more to know about this rapidly growing segment of the industry. I leave you with just one thought: put yourself in the drivers seat by being the first shop to test every charge air cooler you can put your hands on. By doing so, you will be creating the opportunity to select the best option - replacing, recoring or repairing- for your customer. It all starts with your ability to test them properly.

Pressure loss will occur through almost invisible cracks.



Stress cracking tends to occur in the lighter gage components. Here's an actual crack in the tube-to-header joint. Hint: look on the right side.



Make certain the plugs are properly retained before pressure testing.

Use a gage and wristwatch to measure pressure loss over time.

P.N. 351-CAS JOHNSON'S CHARGE AIR COOLER TEST KIT

Rugged components will make your testing easier

Johnson Manufacturing Company of Princeton, Iowa, was established in 1909. The company supplies solders, fluxes, tools and supplies to the cooling system service industry. For more information, telephone (563) 289-5123 or go to www.johnsonmfg.com