Ceramic Coating of Headers

by Michael Link

Stainless steel tubular headers for the Stag. *Image: Rimmer Bros. catalogue*

Have you ever considered getting your exhaust manifold or header ceramic coated? Why would you want to bear the expense of having this done? Does the benefit justify the cost?

Originally the coating technology was developed for the military with applications in marine, aeronautical and land based machinery. The technology of ceramic coating began in the early 1980's as a solution to metal corrosion and thermal management and began to become noticed and utilized in the automotive track world in the 1990's. When the benefits began to be seen at the race track, the technology caught on with a wider automotive audience.

There are many interest areas where people have their exhausts coated: classic cars, hot rods, off-road vehicles, tractors, boats and more. The reason is to get the most out of the parts—to perform better and last longer, to improve an engine's efficiency, and to gather any more horsepower that can be gained. Horsepower gains of up to 3% have been claimed by coating an entire exhaust system.

LHS ceramic coated stainless tubular exhaust header. *Image: Michael Link*

Generally, when automotive exhaust systems are coated they are done both inside and out. Exhaust gases are extremely corrosive, causing erosion, pitting of the metal and thermal oxidation; getting your manifold or header coated prevents these from occurring. Studies have shown that exhaust parts can last four times longer when coated.

Some of the performance benefits of ceramic coating are reduced under-hood temperature, improved thermal efficiency and uniform temperatures, leading to improved horsepower. Higher under-hood temperatures tend to reduce engine inlet air density translating to a drop in power and reducing the durability of surrounding electrical (especially the coil), hydraulic and mechanical components and can, in the case of the Stag and other carbureted engines, lead to fuel vaporization.

Studies show that engine efficiency improves 1% for every 10 degree F drop in under-hood temperature, and the average under-hood temperature drop is in the 100 degree F range. For the Stag engine, that could mean a 14.5 horsepower increase, although I suspect we would realize much less than that since those studies were done on modern vehicle engines. Keeping the heat in the exhaust manifold or headers has the beneficial effect of better exhaust gas velocity, which means reduced cylinder backpressure from the exhaust system, in any engine, old or new.

Something else to consider is that headers made of relatively thin tubing have different properties than cast iron manifolds. Header tubes uncoated run much hotter than cast iron manifolds. Many uncoated headers, when observed at night, glow an orange-red color, something very unusual for cast iron manifolds.

I just replaced the 1998 Rimmer Bros. headers on my Stag with a set of new tubular stainless steel headers, purchased from Robsport in the UK which are manufactured by Phoenix Performance Exhausts Ltd., based in Cullompton, Devon [*also available from Rimmer Bros* ***- Ed.***] None of the suppliers I could find had headers specifically designed for left-hand-drive cars; so I had to modify the rear most tube on the left-side header to clear the steering shaft. I am not especially happy with the result, but the header is functional. I figure I'll address redoing the tube modification at some future point, for now it will have to do. The modified left rear header tube is not as smooth inside as the original manufacture and the tube is now 1/8 inch smaller diameter for the #8 cylinder. I had the headers and the 90 degree pipes that fit to them coated by Jet-Hot (based in Oklahoma City, OK and Burlington, NC), in "Light Silver Pearlescent." They offer over 80 colors, and after many photos and e-mails exchanged with Jet-Hot,

RHS header - Michael had to modify the LHS header to fit his LHD Stag. Image: Michael Link

this one looks to me to be the closest to the correct silver color of the original Triumph manifolds. [*Canadian members contemplating ceramic coating might consider Fireball Performance Coatings located in Erin, ON or High Tech Coatings in Ruscom, ON or Impact Coatings, in Edmonton, AB* – ***Ed***.]

The older headers I just replaced had also been Jet-Hot coated, so I cannot quantify the heat reduction from the original cast-iron manifolds and I have no way to measure ambient under-hood temperatures.

After driving my Stag on the freeway for 35 minutes at full running temperature in an 85 degree F ambient air temp environment, the measurements all in Fahrenheit are shown in the following tables. Terence McKillen kindly took some measurements on his Stag to provide some comparison. Terence's numbers are taken on an original Stanpart uncoated cast iron manifold, in a 45 degree F ambient air temperature environment, with similar drive time and speed. Terence's findings are the red numbers in the table below.

The header tube temperature measurements were taken about five inches from their respective exhaust port for the left side, and as near to that as I could for the right, though the measurements are each closer to their port on the right side.

In the first table, the first number is with the engine still running, the second is with engine shut off for ten minutes, the third number is with the engine shut off for 25 total minutes.

Location	0 min	-10 mins	-25 mins
#2 cylinder	427 500	172 320	123 182
#8 cylinder	411 300	152 250	122 134
Left collector	360	128	106
#1 cylinder	430 470	147 190	115 112
#7 cylinder	458 500	140 300	117 142
Right collector	503	159	125

In the following table, heads measured adjacent to the studs (side toward the center of the engine), first with the engine still running, second number after the engine was shut off for 25 minutes.

Location	0 min	-25 min
Left front	187	166
Right front	174	154
Left rear	190	166
Right rear	189	160

In the table following, radiator temperature readings, first with the engine still running, second number after the engine was shut off for 25 total minutes.

Location	0 min	-25 min
Upper left	172	167
Upper right	169	151
Lower left	178	154
Lower right lower hose adjacent to the fan shroud	164	147

Notice that the coated headers consistently cooled down about 60-65% between shut off and 10 minutes and were down by 70-74% in 25 minutes. For Terence's original cast iron manifolds, the right manifold was down 40-60% in 10 minutes and down by 72-76% in 25 minutes (which is comparable) **but** the left manifold only cooled by 20-40% in 10 minutes and was down by 55-64% after 25 minutes.

Michigan resident, Chris Holbrook, upgraded his original cast iron headers for stainless steel four branch exhaust manifolds but did not go the ceramic coating route. He coupled them to a straight through stainless steel exhaust system. He reports that they cool down very quickly when the engine is switched off which would seem to confirm a low heat sink potential. According to Chris, "*Getting the hot exhaust gases out of the head quickly, proved to be the single most effective measure in the quest for a reduction in under-hood temperatures.*"

Canadian member, Robin Searle, had his OEM headers ceramic coated (by Fireball Performance) and commented that "*Ceramic coating of the original cast iron exhaust headers made the engine bay less hot, and certainly it eliminates any issue of rust on the manifolds, so for me it has been a positive move.*" Robin noted that the cost of coating his headers was around CDN$300 (US$225).

Each reader has to decide for themselves if the benefit justifies the cost. For those with the original cast iron manifolds, erosion isn't likely much concern though thermal oxidation can become an issue in cast iron manifolds. For the cast iron manifolds, the improved exhaust gas velocity would reduce the effect, in part, of their inherent back pressure; and being coated would add to the life of the manifolds by reducing or eliminating the thermal oxidation. For those who change to headers, there is the improved exhaust gas flow and velocity, plus the reduction of the heat into the engine bay that would likely otherwise be added, all of which should improve the horsepower output.

For many of us, getting a little more efficiency and the added horsepower from improved exhaust gas management is worth the price, since coating doesn't have any real drawbacks beyond its cost. Plus, there is the added benefit of the coated parts lasting longer and they look good too. **SN**