

EXHAUST BUILDING BLOCKS:

HEADERS, MERGE

ADVANCES in race exhausts tend to be more evolutionary than revolutionary, and the development of new components can be dictated—and limited—by several factors, including type of racing, track sound rules, engine requirements, and more.

However, when given freedom within applications, the industry often manages to find performance gains through exhaust system components. “Professional race teams and engine manufacturers with the budget to perform comprehensive testing in search of a competitive advantage are the leaders in finding exhaust related

developments,” said Gary Donahoe of Coast Fabrication, Huntington Beach, California. “There is still room for dedicated and intelligent individuals to find new advances.”

While performance improvements can take many forms, Donahoe reminded that the exhaust system must be very specific to each aspect of the powertrain, as well as the conditions in which the vehicle will be used. “The exhaust system needs to be designed so the power band fits the application in every way,” he said.

Newer materials like titanium and Inconel alloys also have spurred development of exhaust components for racing applications, according to Alejandro Antonellini from Conformia in Venado Tuerto, Argentina. “The less weight with the same or higher resistance is one of the main improvements you obtain with them,” Antonellini said. “Also, some fluid dynamic considerations that involve temperature and density of gas must be considered in the analysis.”

Chris Stepp from Burnsville, Minnesota-based Stainless Headers Mfg. said new—and more challenging—exhaust configurations appear all the time. For example, “with the popularity of high-horsepower, side-exit designs, trying to get every bit of performance coupled with the limited real estate found in that design area keeps our team developing creative solutions every day,” he explained. “That configuration gets even more complicated when builders need a muffler in the system to satisfy track rules. We face these challenges on a regular basis, and custom fabricate components for each individual application.”

Stepp further pointed to Pro Street and Pro Touring builds that tend to follow high-horsepower configurations with low ground clearance. “Because of the ground clearance issue, builders tend to opt for a smaller tube size than what performs optimally,” he said. “We see some of these builds with engines that can exceed well over the \$50,000 mark and run a system with smaller than optimal



COLLECTORS & BENDS

BY NICK GAGALA

size. There is a considerable amount of horsepower left on the table with this type of design. The answer is oval tubing. With oval tubing, the fabricator can obtain the optimal tube cross sectional area for the given height restriction the design calls out for. Oval tubing requires extensive tooling, but we feel the high-end, high-horsepower market drives this decision to make the investment.”

Speaking to developments in new exhaust components, David Borla of Borla Performance in Oxnard, California, stressed that his company pays close attention to racers’ needs and objectives for their systems. As housing developments continue to encroach upon race tracks nationwide, Borla noted that noise restrictions are a constant concern. However, he added, when it comes to product innovation, “sound can be a critical factor or it can be of no significance whatsoever.”

“Sound can drive a lot of what we do in racing applications, but other issues might be weight or durability,” Borla continued. “Even in circumstances where there may not be a decibel

level limit that has to be met, we do find in all types of different racing the driver wants to attenuate the sound.”

Borla further listed benefits of a quieter exhaust system as decreased driver fatigue, better ability to hear inside the cockpit, and even greater stealth on the race track.

All Systems Go

Viewing race headers, merge collectors, bends and other exhaust components as a complete system is paramount, according to the majority of our contacts. “It is of the utmost importance that the exhaust system be designed as a total system,” said Donahoe of Coast Fabrication. “A significant performance advantage can be gained by saving weight on the exhaust system; however, if it fails before the end of the race, all is lost. Also, an exhaust system that is perfectly suited to make the best lap time will be of no use if it is out of compliance

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A quieter exhaust system offers several benefits, including decreased driver fatigue, better ability to hear inside the cockpit, and even the ability to move stealth-like on the race track. Indeed, while sound is one of the driving forces in race exhaust system components, other factors manufacturers consider include weight and durability, reported one company representative.

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with sound regulations.”

Vince Roman of Burns Stainless in Costa Mesa, California, agreed that exhaust systems must be designed in a holistic fashion to ensure maximum performance. “Looking in a catalog and finding a cam that will increase power by 10 hp, an intake that increases power by 10 hp, and an exhaust header that increases power by seven hp will likely put you 10 hp down,”



When putting together an exhaust system, racers should consult both their engine builders and chassis builders. One supplier explained, “Knowing optimal header, primary, collector, merge and secondary sizes supplied by the engine builder helps the chassis builder develop a strategy to bring his project together.”

he said, adding that Burns Stainless strives to help customers design systems that correspond to their specific engine builds and applications. “The use of the Burns Race Engine Specification form makes this an easy and quick process for retailers and engine builders willing to give their customers an extra level of services,” he said.

When designing exhaust assemblies for a race vehicle, it is important to note that the amount of exhaust coming from the engine affects both the tube OD and wall size, said David Canada of Woolf Aircraft Products, Romulus, Michigan. “Also, the temperature of the exhaust is going to impact the minimum wall of the tube. Thus, this should play a part in the design of the tubing,” he said. “The heat coming from the engine creates stress on the tube, which will fatigue the part, and the thicker the wall, the less stress there will be on the tube. The thinner the wall, the more stress on the tube. Therefore, some may choose to sacrifice the wall thickness for the longevity of the part.”

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according to Antonellini of Conforma, but, after that, "it is necessary to build a good dyno system with the possibility to test different lengths and diameters to arrive at the best arrangement of exhaust for the range of rpm of the engine," he told us.

Conforma built a new exhaust system for the Turismo Carretera (TC) in Argentina, where Oreste Berta SA has developed all of its engines using new heads with multivalve systems.

Meantime, the race exhaust product lines at Stainless Headers Mfg. require a sophisticated relationship between engine builder and chassis builder. "Knowing optimal header, primary, collector, merge and secondary sizes supplied by the engine builder helps the chassis builder develop a strategy to bring his project together," Stepp said.

Exhaust Developments

Considering race headers, merge collectors, bends and other exhaust products from an interrelated system perspective, following are some of the latest offerings on the market.

Holley Performance Products in Bowling Green, Kentucky, recently introduced its new Hooker Blackheart catback and axleback exhaust systems for the 2015 Ford Mustang GT equipped with the 5.0L Coyote V8—both systems are available with or without mufflers. Also now available from Holley Blackheart are complete exhaust solutions for 2010-2015 Camaro applications.

"Thick water jet flanges, long transition collectors with integrated merge collector spears, true mitered merge collectors, and lightweight 18 gauge 304 stainless steel are just some of the exhaust components today's marketplace demands, and Blackheart has answered that call," Blane Burnett said. "All Hooker Blackheart products are not only focused on fitment, packaging and reliability, but countless hours of dyno testing is performed to ensure increased power and performance for each application."

Hooker Blackheart offers products for both street applications and race-only complete systems. "Blackheart is not trying to reinvent the wheel. However, [it]



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is continually pushing the envelope and extracting as much power and performance with each product while maintaining precise fitment, packaging and long lasting reliability," said Jehan Tetango, a Hooker Blackheart exhaust engineer.

Coleman Machine in Menominee, Michigan, currently offers a 6-inch diameter, 2-into-1 muffler that will meet the 90 decibel rule for most Late Model and other racing applications. The body is 14 inches long with a high-temperature fiberglass core and features a removable end cap, "so the muffler can be easily rebuilt, if needed; and it also includes a clamp-on mounting bracket," Glenn Myers said. "Its compact design makes it easy to mount in confined spaces."

These mufflers are most commonly used for asphalt racing such as limited late models and super late models, and road racing applications that require the use of a muffler and must meet a maximum decibel rule, Myers told us.

Burns Stainless develops new components to help racers achieve greater power, Roman said. "Most recently, we have found that many customers want turnkey solutions for their race cars, and we have been developing bolt-on systems with modular components, so systems can be tailored for specific needs," he explained. "For example, we have released muffler systems for the Corvette C6 Z06, and soon for the Porsche 987 Cayman models that have interchangeable mufflers or straight pipes, depending on the track sound and performance levels that need to be met."

Merge collectors are consistently strong movers for SPD in Rancho Cordova, California, and the company is eager to meet demand, according to Chris Hill. "Generally, it doesn't take us any more than a couple, two or three days to be able to get through collectors if it is something we don't have in stock," he said.

SPD has built exhaust system components out of various materials, including Inconel, titanium, mild steel and stainless. "You name it, we've probably done it," Hill said. "We've even done some stuff in aluminum, believe it or not. Some people

like trial and error."

Coast Fabrication's Donahoe mentioned how racing exhaust system products are becoming more refined. "At Coast Fabrication, we work closely with customers to understand their goals,



While performance improvements can take many forms, the exhaust system must be very specific to each aspect of the powertrain, as well as the conditions in which the vehicle will be used. One supplier noted that the exhaust system should be designed so the power band fits the application in every way.

and then custom build systems with all of those details in mind," he explained. "We specialize in using our years of experience to solve difficult packaging and reliability problems."

Ground clearance is a fairly universal consideration for racers' exhaust systems, Borla told us, and the ability to fit mufflers into a particular space envelope is critical, too. And Borla Performance has introduced new end cap designs that build on the company's core structure.

"We also have a relatively new patented technology, which we've named ATAK (Acoustically Tuned Applied Kinetics), and that's just an evolution of my father's multi-core design, which originally we called the XR-1," Borla said. "Our multi-core design allows us to increase the internal diameter of the muffler, which obviously provides significant improvements in flow while still being able to attenuate the sound."

Performance Tube Bending (PTB) in Irwindale, California, private labels exhaust systems for its customers. PTB's Jim Renella stressed that his racing clients desire horsepower and sound, as well as high-quality fit and finish. Because the company private labels, Renella said, "We are the door that leads to their manufacturing facility, so we know what to

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give them in order to make them happy and successful in selling their product. Naturally, with everything they supply us, we try to eliminate as much engineering as possible. We'll guide them through some of the aspects of making the system and help them out with certain problems, but when it comes to engineering they have to supply their tested part.

"The component aspect of this business caters to their needs because they aren't going to make 25 systems at a time—because every car is different, every job they get is different," he continued. "So, they are custom making each set, and that's where we come in. We try to be the one-stop shop where they can take up all of these components at a very affordable price."

Kooks Custom Headers in Statesville, North Carolina, works closely with top engine builders in order to improve horsepower/torque numbers in spec style motors. "We've been making a couple hundred strictly engine dyno runs with different configurations of primary lengths and expansion joints and everything else, where we can find horsepower/torque throughout the rpm band," Chris Clark said. "It lets us know if we can get out of a corner faster or even get better fuel efficiency for the overall race."

"We've also been doing a good bit of testing with some of these Pro Mod guys for the blower cars in the NHRA, and our zoomie headers are on some of the fastest blower cars in the country," he continued. "The biggest thing was how long are the pipes lasting? Do they have to weld in between runs? Do they have to go into the pits and have them welded?"

According to Clark, the main challenge was headers cracking and falling short in durability or reliability. "So that's something that we really worked on and figured out a real strong solution for zoomie kits that we produce, where they are not cracking and not breaking," he said, adding that an adjustment to header design solved the problem.

Stapp of Stainless Headers Mfg. said that with more tracks requiring some type of muffler, his company fields requests for

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zoomie mufflers, which help racers pass tech inspection.

With lighter racing components that decrease vehicle weight being highly sought after, Woolf Aircraft bends thin-walled tubing in stainless, aluminum and steel, Canada told us. "We can also fabricate exotic materials, like Inconel or titanium, which can be designed even thinner," he said. "Having components that are easily replaceable is also desired by many of our customers. Woolf Aircraft is capable of designing components that are easy to replace, such as welding flanges on the ends of tubing, which allows for quick replacement of the part.



Advances in race exhausts tend to be evolutionary, and the development of new components can be dictated—and limited—by several factors, including type of racing, track sound rules and engine requirements. However, when given freedom within applications, the industry often finds performance gains through exhaust system components. And one manufacturer reported, "There is still room for dedicated and intelligent individuals to find new advances."

"Easily replaceable parts...also allow for quicker testing on various designs of racing vehicles," he added.

Litchfield, Minnesota-based Heartthrob Exhaust Accessories bends all the way up to five-inch tubing in all different kinds of metals, said John Forbes, who credited the PRI Trade Show with helping disseminate information about his company's capabilities. "We have a lot of race shops across the nation that understand now that we water jet, and we can mandrel bend... We have a merge collector kit that if a person is building their own headers, they can buy this merge collector that they can weld up real quickly and put it into the headers that they are going to make," Forbes said. "We don't make headers, but we sell a tremendous

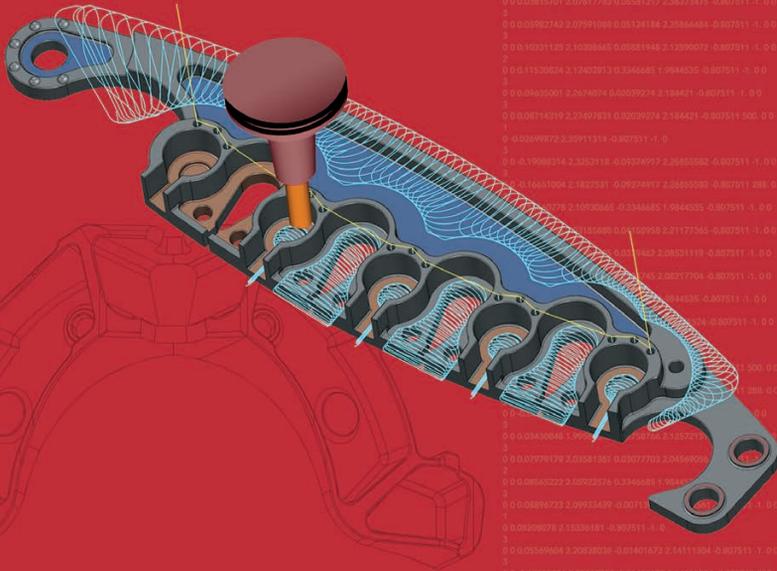


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amount to guys who go to PRI that make headers, and we water jet out the flanges going on the heads; we mandrel bend the tubing. They can buy bends or a complete header type kit and the collectors or whatever. We have all the components for people that are making headers to buy the parts from us. It's the same thing with mufflers. We'll make mufflers, but again a lot of it is driven by what exactly they want. We make thousands of different types of mufflers every year."

Evolving to the Future

Though most of our contacts agreed that advances for motorsports-specific exhaust systems tended to be more gradual in nature, they do firmly believe these products are improving.

"Brilliant people have been performing intense testing for decades, so advancements are normally small; however, every year improvements are found," Donahoe of Coast Fabrication said. "There is a never-ending quest for more power, more usable power, lighter weight, and now with the sound restrictions being more prevalent, this complication must be added to the equation as well."

While Roman of Burns Stainless agrees that exhaust system advances are evolutionary, he did cite "the ever-improving technology of metal 3D printing," as creating revolutionary possibilities.

And Borla said that while most of the exhaust technology in use today was developed almost a century ago, there is always room for improvement in racing. "The science has been understood for a long time. Like anything else physics related, applying the science is a different story," he said. "When you get into racing, sometimes the difference between first place and even 10th place can be fractions of a second. So, really squeezing the most out of your exhaust system, getting it in the right places, understanding your race strategy, where you want to make power, how you want to make power, how important sound is, and integrating all of those things into a package that's going to help you gain that fraction of a second, that is really where the challenges are."



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