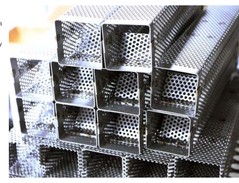
BBE
BILLY BOAT EXHAUST

MUFFLER DESIGN

There are as many different theories and designs of mufflers as there are companies making them. The science of muffler design revolves around three major areas: 1) sound, 2) flow, 3) and durability. For the team at Billy Boat Exhaust, we have taken our 25 years of experience, our racing background, and our practical approach to design a product that has a signature tone and provides a lifetime of driving enjoyment.

There are two basic ways to muffle an internal combustion engine. First, through absorption, in which the sounds waves are absorbed through a perforated core into some kind of packing material, and second, reflection, in which the sound waves are bounced off an internal baffle or back at each other in order to cancel the sound waves. We have built thousands of exhaust systems over the years and have found that each design theory has strengths and weaknesses. Our goal when we prototype a new exhaust is to create a deeper, throatier tone for the exhaust, increase the volume at idle and while under acceleration, but keep the interior volume quiet while at cruise and free of any "drone". In order to meet these criteria, we use a combination of each design style in our exhaust systems. We do not use "off the shelf" mufflers in our exhaust systems- each application is evaluated, and we build what is the optimal solution for each vehicle. This provides us with the opportunity to achieve the ultimate sound and performance.

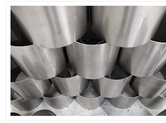


While most muffler companies use a standard round tube design, Billy Boat Exhaust uses a square tube design. This tube design allows for more volume in the muffler tube and also allows for more perforated surface area inside the tube. More volume means better flow and less restriction, while the increased surface area means more perforated material to absorb sound waves. We also use perforated arrows inside the tubes to direct the exhaust flow in a lazy S pattern, helping to increase the efficiency of the absorption side of the muffler.

The packing material around these perforated square tubes is equally as important as the design, as different materials have different acoustic properties. These materials must be durable and provide a lifetime of enjoyment, yet also emit the deep tones which create our signature tone. We use two different types of packing materials in our mufflers, a stainless steel mesh material and an extremely high temperature ceramic material. The stainless steel mesh is wrapped around all muffler cores to add a layer of durability to each muffler, while the ceramic material is used as a blanket around the core or as a void fill inside the muffler chamber. The combination of these two materials is unique in the exhaust industry and is the foundation for our deep, throaty muscle car tone.

Each of the mufflers in a Billy Boat Exhaust system also has a reflection component to it. We use internal Helmholtz chambers in each muffler, which are dead-end tubes branched off of the main muffler core. The name comes from a device created in the 1850s by Hermann von Helmholtz, which he used to identify various frequencies and sound waves. As the exhaust flows by these tubes, pressure is reduced and the sound waves reflect back in the opposite direction. We use these internal tubes to reflect and cancel the high pitched sound waves which cause "drone" in the exhaust.

Durability is also an important component of each muffler. We use only 18 or 20 gauge 304 stainless steel for our muffler cases, and the muffler endplates are all 14 gauge 304 stainless steel. Each muffler is hand built according to exact design specifications for each application, and then either hand TIG welded or welded in our robotic welding cell. Our goal at Billy Boat Exhaust is to build the best performing, best sounding and highest quality exhaust systems on the market. Our manufacturing techniques and our signature tone is unique in the industry in order to provide our customers with a "moment of adrenaline and a lifetime of performance."



MANUFACTURING PROCESS

Each Billy Boat Performance Exhaust system incorporates 3-generations of fabrication skill and racing talent. Every system starts with T-304 stainless steel, known throughout the industry as the highest quality material practical for after-cat exhaust applications. All exhaust tubing is mandrel bent on sophisticated CNC machinery for a precise fit and uninterrupted exhaust flow. What's more, the use of T-304 stainless steel flanges offers high strength and complete resistance to harsh elements. All hangers, resonators, and tips are T-304 stainless steel as well.

PRT NO-DRONE TECHNOLOGY

NO-DRONE
Performance & Resonance Control Technology

The Billy Boat Performance Exhaust PRT after-cat system employs exhaust tech-nology unique to the aftermarket So unique, in fact, it doesn't use a muffler at all. The Billy Boat Performance Exhaust PRT system is simple in design, though more complex in theory, which suggests that you can have a mellow sound at cruising speeds and a sport note when you're tearing up the streets. It allows true straight through exhaust passage under aggressive driving conditions.

How a Dyno Works

We're going to quote DynoJet directly to explain how the machine works, since paraphrasing would only do you an injustice. "Power, in mechanical terms, is the ability to accomplish a specified amount of work in a given amount of time. By definition, one horsepower is equal to applying a 550-pound force through a distance of one foot in one second. In everyday terms, it would take one HP to raise a 550-pound weight up one foot in one second. So to measure horsepower, we need to know force (in pounds) and velocity (in feet per second). DynoJet's inertia-dynamometer measures power just in this way. The dyno calculates velocity by measuring the time it takes to rotate the heavy steel drum one turn. The dyno measures force at the surface of the drum by indirectly measuring the drum's acceleration. Acceleration is simply the difference in velocity at the surface of the drum from one revolution to the next. The force applied to the drum is calculated from acceleration using Newton's 2nd law, F=MA. (Force equals (Mass times (A)cceleration. Power is coupled to the drum by friction developed between the driving tire of the vehicle and the knurled steel surface on the drum of the dynamometer."

Calculating Torque

"When an object rotates around a point, the object's speed of rotation depends on both an applied force and the moment arm. The moment arm is the distance from the point of rotation to where the force is being applied. Torque is the product of the force and the moment arm. For example, think about trying to spin a drum by wrapping a rope around the drum and then pulling on the rope. If the rope is wrapped around a drum of one-foot radius and pulled with 550 pounds of force, the resulting torque is 550 foot-pounds. The torque on the dyno's drum can be calculated by multiplying the force applied by the drum's radius. However, engine torque is not equal to the dyno's drum torque because the gearing through the drivetrain changes the moment arm. The change in the moment arm is proportional to the ratio of engine speed to drum speed. Therefore, tachometer readings are necessary to calculate and display engine torque."

RPM	Stock Horsepower	BBE Horsepower	Gains
3000	156	**163**	+7
3500	190	**196**	+6
4000	219	**227**	+8
4500	252	**265**	+13
5000	280	**299**	+19
5500	311	**332**	+21
6000	320	**345**	+25
6500	314	**344**	+30

RPM	Stock Torque	BBE Torque	Gains
3000	274	**285**	+11
3500	286	**294**	+8
4000	284	**298**	+11
4500	295	**309**	+14
5000	295	**314**	+19
5500	297	**317**	+20
6000	280	**302**	+22
6500	254	**278**	+24

Check out an excellent selection of performance exhaust systems on our website.