Intelligent Performance, Part 2 - Exhausts

How to spend the least to get the best

By Julian Edgar

One of the most cost-effective mods on almost any car is an upgraded exhaust. While it depends on the car and what else has been done to it, a good rule of thumb is to expect about a 10 per cent gain in peak power - enough to make a noticeable difference to real-life on-road performance.

Material

Exhausts are made from a number of materials - stainless steel, mild steel, or aluminised mild steel. The latter is never used on other than factory systems, so we'll ignore it from here on. Mild steel and stainless steel pipes flow the same (the differences sometimes quoted in regard to internal surface finishes can be ignored if the pipe is made big enough in the first place). In actual use, the pipe materials have little to differentiate them, except for durability.

Good stainless steel will last forever; mild steel piping will typically last 5 - 10 years. If you expect to keep your car for a long time, consider stainless. Otherwise, pocket the substantial savings and go for mild steel. (Of course, if your's is a show car and you wanna polish the system, you'll be happy to spend the extra money. But this series isn't directed towards you, cos show cars aren't budget cars!)

Bends

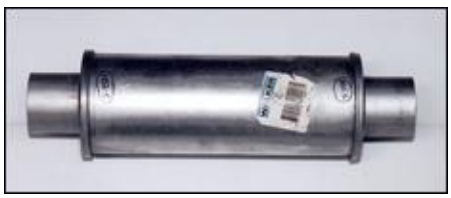
Exhaust pipes can be bent using either mandrel or press bending. Press bending machines are common - every exhaust shop has one. Mandrel bending machines are much rarer, usually being found only in manufacturing exhaust shops. Press bends are slightly flattened, while mandrel bends maintain a similar diameter to the inner diameter of the tube right around the bend. Making the issue more complex, most exhaust shops that build a 'mandrel exhaust' just get a box of mandrel bends and weld them together. This means that there are 'steps' and often penetrated welding beads at each join - not good for flow. In fact, given the cost difference between the two types of exhaust, it's often best to get a press-bent exhaust in a pipe **one size larger** than is required. That way, it's cheap and effective. Note that the difference in flow rates for the two types of bend really only becomes noticeable with bends tighter than 45 degrees.

Cat Converters

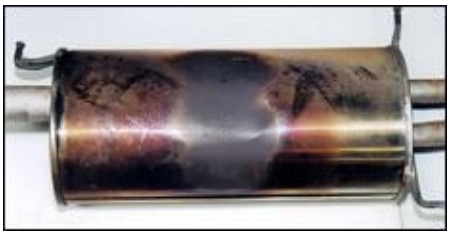
In all the factory cat converters I have flow tested, the cat has been the single most restrictive part of a standard exhaust system. This means that replacing the exhaust but leaving the factory cat in place isn't the best approach. In fact, it makes sense to actually have a cat installed that's larger than the nominal pipe size. For example, a 3-inch cat on a 2.5-inch exhaust will give better results than a 2.5-inch cat on a 2.5-inch exhaust. Testing has even shown that expanding a 2.5-inch aftermarket cat's nipples to 3 inches results in a good improvement in flow. However, shallow angled cones should then be used to adapt one pipe size to the other, reducing the restriction across the transitions in pipe size. Note that emissions compliance goes straight out of the window with a change in cat converter or even a change in the piping ahead of the standard converter (which then alters cat light-off time).

Mufflers

The best mufflers to fit are large body, straight-through designs. I could write a lot here, but some of the evidence on both flow and noise can be found in the conclusions of the AutoSpeed's giant muffler comparison at "Giant Muffler Comparison - Summary of Results" Simply put, straight-thru mufflers have nearly zero flow restriction, and good straight-throughs have the best noise suppression as well. Note also that the larger the muffler, the more likely that a given design is to be quiet.



The fitting of resonators (small additional straight-thru mufflers) is worthwhile to keep noise down. If you are unsure as to whether a resonator will be needed, ask the exhaust shop to make a straight section of pipe within the exhaust system, so that it's cheap and easy to insert the ressy later, should one prove to be needed. The arguments for and against mild and stainless steel mufflers are the same as for the pipework - long-term durability and appearance, versus cost.



If you are on a really tight budget and have a small car, make friends with the local high performance exhaust shop. Once you've done that, you'll be rather surprised by how many near-new exhaust systems from cars like WRXs and HSV Holdens are thrown away. Some of these exhausts - when bought new from the maker - are worth thousands of dollars and include (relatively) high-flow mufflers and cat converters. The components from these systems are ideal for cars up to about 120kW (160hp), and the cost of the materials can be near zero - chrome tips and all!

Extractors

In most (but not all) cars, extractors are worthwhile. These replace the cast iron exhaust manifold, with individual pipes going to each exhaust port. However, you need to be a little careful, in that if the cast iron manifold looks good with long runners and (say) a 4-2-1 design, it probably **is** good. Tight, short pipes from each cylinder are very likely to flow as poorly as they look. In a naturally aspirated car with a poor manifold design, about half of the power gain of a full system comes from the extractors.

When extractors are fitted, the oxygen sensor is usually relocated. In its new location it can both take longer to warm up (unheated versions) and also sample the output of only one cylinder. Both scenarios can have implications for how well the car runs.

To be most frugal, always visually assess the quality of the standard manifold before spending the money on extractors. They can always be added later if the new exhaust doesn't give quite the performance gain that you expected.

Back-Pressure

In all but one test I have ever performed, the bigger the pipe, the better the power. That exception was on a Celica 2.2 FWD, where I'm willing to bet that if the management system had been slightly retuned (eg low rpm ignition timing advanced) the power at low revs would have picked up over standard as well (it was already improved over standard at high revs). Thus, after the tuned length section of the pipe is finished (ie after the first muffler/resonator/cat converter), in a naturally aspirated engine you should go for a large pipe. In turbo cars, go for a large pipe straight off the turbo. Incidentally, note that over the last 40 years, the pipe size regarded by some as "too big" has been getting larger and larger every year! The following table, extracted from the book 21st Century Performance*****, is my recommendation for pipe size:

Maximum Power (kW)	**Pipe Diameter** (inches)
75	2
120	2.5
165	3
230	3.5
375	4

Incidentally, measuring exhaust backpressure is as simple as brazing a copper pipe to the start of the exhaust tube and then running a pressure gauge to it. (In some cars it's easier to temporarily remove the oxygen sensor and use the resulting tapping hole as a pressure measuring port.) Doing this is **highly** worthwhile if you wish to see whether it's actually worth replacing the exhaust.

Costs

Some people lose sight of the fact that an exhaust is just a bit of bent pipe. If you want performance at the lowest cost, shop around, inspect the work being done, and do some bargaining. This AutoSpeed article has lotsa pics of a good and bad exhaust to help you in your assessments: "Exhausted Performance"

Conclusion

You want good exhaust system performance at low cost?

1. Use mild steel not stainless steel.
2. Always upgrade the cat converter to a larger size.
3. Fit a straight-thru, large body muffler.
4. Inspect the standard manifold(s) before specifying the use of extractors.
5. Use a large tube size.
6. Shop around and bargain.

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