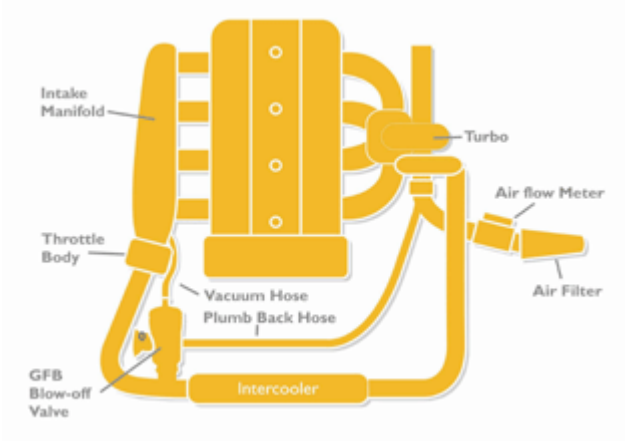
How does a blow off valve work ?

What is a blow off valve ?



A blow-off valve is an air pressure bypass valve that is placed between the turbo compressor and the throttle.

When your turbocharged car is on boost, the entire intake system is filled with pressurized air; from the turbo compressor, through the throttle body and inlet manifold and into the combustion chambers. When the throttle is closed, this pressured air can no longer enter the engine. The only path available for the air is to try to flow back the way it came, through the turbo compressor the wrong way. This creates a fluttering noise on the blades of the still-spinning turbo compressor.

In addition to making this fluttering noise, a noise that is probably unwanted in a nice new turbo car (though actually extremely popular amongst modified-car enthusiasts!) it is often claimed that the load placed on the turbocharger from this pressurized air flowing through it the wrong way can cause premature wear or damage. The jury is still out on this, as it's quite difficult to directly attribute a turbo failure to not having a blow-off valve fitted. For that matter, we are yet to see a spectacularly damaged turbo from a street-driven car; they usually just plain wear out.

There are many other reasons car manufacturers fit blow-off valves to their cars, mainly to do with emissions, fuel economy and drivability. In aftermarket applications though, the main reasons for fitting a BOV are to hold higher-than-standard boost levels, to give better throttle response (than a factory BOV) by staying closed whenever it's not venting, and of course to make noise!

A blow-off valve (also called a compressor bypass valve or diverter valve) is a valve, generally a piston type, which is placed between the turbo compressor and the throttle to bypass the pressurized air on a closed throttle, either plumbing it back into the turbo inlet for silent operation, or to the atmosphere to make the signature blow-off valve whoosh.

How a blow off valve works

A blow-off valve is vacuum/pressure actuated piston-type valve. It uses vacuum/pressure signals to tell the piston when to open and close.

At idle there is engine vacuum on the top of the BOV piston trying to suck it open, and no vacuum or pressure on the bottom of the piston. Since a vent-to-atmosphere BOV needs to be shut at idle to avoid air being drawn in through it, there is a spring inside a BOV with the job of holding the piston closed. The spring preload adjustment is to allow for differences in engine vacuum from car to car, and variations in atmospheric pressure at different elevations.

On airflow metered cars the air drawn in through an open vent-to-atmosphere BOV at idle would confuse the ECU and cause over-fuelling and stalling and in any case, the air drawn in is unfiltered.

Under cruise conditions (off boost) the BOV is experiencing similar conditions to when the car is at idle, but there is less vacuum present on top of the piston because the throttle is partly open. If the BOV spring has been adjusted to keep the piston closed at idle, it will also be closed at cruise.

On boost there is boost pressure on both top and bottom of the BOV, the forces from which counteract each other, so the BOV remains closed.

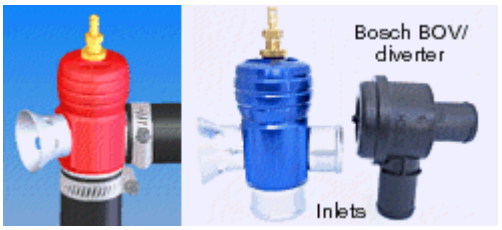
Immediately after the throttle is closed under boost there is vacuum on the top of the piston and boost pressure on the bottom of the piston, which together, quickly open the BOV to release the pressure. When the pressure has been released, the BOV closes.

How to fit a blow off valve

The simplest way to fit a blow off valve is to buy a GFB ‘bolt-on' blow off valve kit. Bolt-on kits are available for many vehicles including Audi 1.8T, Ford Falcon XR6 Turbo, Mitsubishi Lancer GSR and EVO, Mitsubishi Galant VR4, Nissan Skyline, Nissan 200SX, Subaru WRX & STi, Subaru Liberty/Legacy GT and Volkswagen 1.8T.

If there isn't a bolt-on kit available, don't worry, you can still fit a GFB BOV to almost any turbo car. Using the standard adaptors supplied with a Go Fast Bits blow-off valve you can…

1. Hose mount



Many OEM bypass/diverter valves use rubber hoses, which makes it very easy to replace them with a GFB unit as shown. A range of hose adaptors are available from GFB to suit all of the common hose sizes used.

Be careful about the orientation of the valve when the factory inlet and outlet hose are the same diameter. The majority of European manufacturers install their diverter valves in the opposite orientation to the way a GFB valve should be installed. Boost should always enter the bottom of a GFB valve, and dump through the side outlet(s).

2. Pipe mount

Two sizes of pipe mount bases are available – 1” or 1.5” (25.4mm or 38mm), and short lengths of pipe in these diameters are available in stainless steel or alloy.

Select a suitable location on the factory inlet plumbing (somewhere between the turbo and the throttle), and weld the suitable pipe into position. The GFB BOV then pushes onto this pipe and is sealed by the supplied o-ring that sits in a groove inside the base. The BOV secures on the pipe with grub screws and locking nuts (also supplied).

3. Vehicle specific adaptor

Some OEM valves bolt up to a flange, and GFB has a range of vehicle specific flange adaptors to suit many cars. The GFB blow-off valve then mounts onto the adaptor in the same way as the pipe mount described above.

Note that some GFB flange adaptors screw directly into the bottom of the GFB valve, thereby replacing the original base entirely.

Which type of blow-off valve makes the fluttering or ‘pigeon' noise?

The short answer is that there is no blow-off valve that makes this noise. Read on to find out why.

Without a BOV, the pressurized air being pumped into the engine by the turbo will have only one path when the throttle is closed: back through the turbo compressor. The fluttering sound is the sound of this air against the blades of the spinning turbo compressor as it tries to flow through it the wrong way.

Car manufacturers fit recalculating (plumb back) BOVs to give the pressurized air an alternate path when the throttle is closed: back into the turbo compressor inlet. This eliminates the ‘undesirable in a brand-new car' fluttering noise.

Aftermarket BOVs typically vent the pressurized air into the atmosphere for the purpose of making noise, and are characterized by the 'standard trumpet' sounds. Some other brands do different things with the air to make different noises, but this is not to be confused with the fluttering noise. Our own ‘whistling trumpet' is one example of this.

In some cases, aftermarket BOVs do not flow enough air either as a result of their design, or the way that they are adjusted. In this case, fitting an aftermarket blow-off valve *will* result in the fluttering noise being emitted *from the turbo*. While this is extremely popular, it is worth noting that if this is your objective, then simply removing the factory BOV and replacing it with a pair of hose plugs would have been more cost-effective!

Incidentally, fitting a pod air filter can make any fluttering noise that was already present more audible. Also, large front-mounted intercoolers can increase the likelihood of ‘flutter' for any given BOV, due to the larger volume of air present in the intake system. If the BOV is any good, some adjustment of the spring preload would be all that is necessary to once again eliminate the flutter.

Finally, it is possible to set up your GFB blow-off valve to cause some ‘pigeon' noise by increasing the spring preload slightly (turning the spring preload adjustment clockwise). The aim is to have the flutter occur at low rpm and boost, while allowing the BOV to vent freely at higher rpm and boost levels. Experiment with it; you can't do any harm!

What makes the GFB Mach 1 and Deceptor Pro blow-off valves different to other blow-off valves on the market?

Other manufacturers will claim that their valves allow the noise to be adjusted, but none can do it to the extent, or with the ease, that the GFB Mach 1 and Deceptor Pro can. Furthermore, no manufacturer will be able to offer a product with this degree of adjustability, since this technology is patented.

Neither of these blow-off valves change the noise by muffling the air vented to the atmosphere. They change the ratio of air that is vented to either the inlet or the atmosphere. This way the noise can be completely silent like a factory valve, or as loud as you want.

In cars that suffer from backfiring or throw the check engine light with a vent-to-atmosphere valve, the GFB Mach 1 and Deceptor Pro blow-off valves can be tuned to vent as much air as possible to the atmosphere before the problem occurs, so that having the noise is still possible.

So whether it is the Mach 1 hand-adjustable blow-off valve, or the Deceptor Pro in-car electronically adjustable blow-off valve, you're getting the best and most adjustable BOV on the market!

What boost level can I use with a GFB blow-off valve?

Any level you like! The design of all GFB blow-off valves means that you can run boost levels that will more likely blow up hoses before the valve will leak. Because of the acetal seat the piston makes a perfect seal, and our valves have been tested in the factory to pressures of 110psi (if you can blow up one of our valves on a car we'd like to hear about it!).

How do I adjust the spring pressure to suit different boost levels?
You don't need to! At full throttle there is equal boost pressure on both sides of the piston, so it doesn't matter what boost level you are running, the pressure balances itself out. It then requires very little spring pressure to stay shut. The spring adjustment is used to match the VACUUM signal of the car. The idea is to adjust the valve so that the piston remains just closed at idle. This way, when you lift off the pedal, the spring will be neutralized so that the boost is free to push the piston open.

I want my BOV to be noisy, but I've been told that I can't vent a blow-off valve to the atmosphere. What's the deal?
There are many people who will say that if your car has a MAF (Mass Air Flow) sensor (which is most modern turbo cars), you can't vent a BOV to atmosphere. This is not entirely true. In most cases you can, but it pays to be aware of the possible side effects. Quite often you may find the side effects are so minimal that they are not really a concern. This section describes in detail what happens when you vent to atmosphere.

Most factory turbo cars run some form of MAF sensor (usually found directly after the air filter box), some use a MAP (manifold absolute pressure) sensor or even a combination of both. These sensors are used to determine the amount of air the engine is using so it can deliver the appropriate amount of fuel. In a car with a MAF sensor, when a BOV vents, air is escaping from a closed system. This air has already passed through the MAF sensor and has been measured, and the computer doesn't know that this air never made it to the engine. This will cause a brief rich mixture as the computer will still deliver the correct amount fuel dosage based on the amount of vented air.

There are two stages to a BOV venting, as initially it is evacuating the pressure from the inlet pipes and intercooler, which usually takes less than a second (depending on your inlet system). Then once the pressure is released, the valve stays open to allow the turbo to freewheel, thus reducing compressor surge and the associated thrust and torsion loads. It is mainly during this free-wheeling stage that causes the over-fuelling problems, since the turbo is basically pumping air through the MAF sensor and out to the atmosphere through the BOV, which accounts for the majority of air that escapes the system. The resulting rich mixture is what can sometimes cause backfiring and a puff of smoke in some cars. The severity of these effects usually depend on the state of tune of the engine. In cars that are modified (say with full exhaust, pod filter, a little extra boost etc) but still using the factory tuning, it is not uncommon for the ECU to compensate for the extra airflow it sees by running rich for engine protection. On a WRX for example, mildly modded engines can be running as rich as 10:1 with the factory ECU. It is this poor state of tune that can cause backfiring when an atmosphere-venting BOV is added.

Stalling is another common problem, many people have had bad experiences with atmosphere-venting valves causing stalling problems. However, with the correct spring adjustment this is never a problem. As long as the valve closes properly before the engine reaches idle, the ECU will have no problem maintaining a smooth idle. Most complaints of stalling actually come from people using certain Japanese brand valves, which often do not have the range of spring adjustment to compensate.

Some cars are affected by backfiring when venting to atmosphere, and some are not. Even two identical cars with slightly different mods can react differently. The bottom line is if you vent to atmosphere with a MAF sensor you MAY use fractionally more fuel (depending on the kind of driving you do) and there is a chance you may hear some popping in the exhaust. For people who just want the maximum noise from the valve this is usually not a worry.

Are GFB blow off valves adjustable?
Yes, all of the GFB blow off valves feature spring pre-load adjustment.
This should not be confused with the noise adjustability of the Mach 1 and Deceptor Pro, which have a second system to for this purpose. Spring pre-load is used to keep the piston shut at idle, and therefore should be adjusted to suit the idle VACUUM, not full throttle boost (it has no effect on the boost holding ability of the valve). The adjustment of the valve should be made so that the piston will shut just before idle every time.

Is there a possibility that dirt could enter the engine through the trumpets?
No. A blow off valve is a one-way device, air will only ever flow OUT of it.
The turbo piping before the throttle body will only ever be at atmospheric or positive pressure, except for a very brief period when you rapidly open the throttle from off boost conditions.
In such a situation, if the valve is open, it will immediately close as soon as the throttle is opened, because the manifold vacuum no longer holds the piston open, and any vacuum in the turbo piping will also tend to pull the valve shut. Therefore there is no way unfiltered air can ever enter the engine through the valve.