Wastegates - True or False

The more powerful the engine, the bigger the wastegate you need.
False. This is one of the more popular misconceptions. A wastegate is possibly the only component in your whole engine package that can actually be made smaller as you increase your boost/horsepower output. Use this simple guide:

Big Turbo/Low Boost = Bigger Wastegate
Big Turbo/High Boost = Smaller Wastegate
Small Turbo/High Boost = Smaller Wastegate
Small Turbo/Low Boost = Bigger Wastegate

Wastegates don't operate in high temperatures.
False. Contrary to the popular belief, external wastegates are usually mounted at the hottest part of the exhaust. It's the place where all the exhaust gases meet, creating extra heat. This, combined with the late combustion of unburnt fuel (due to rich mixtures, retarded timing and high octane fuels) significantly raises the exhaust temperature.

Larger wastegate valve diameter = better flow.
True – sort of. While the valve diameter is without a doubt an important part of the flow rate, equally important, but often misunderstood, is the importance of the flow path. When comparing wastegates with similar valve size, it is important to have a balanced body/valve/spring combination that is designed to work together to allow for maximum boost control. All Turbosmart wastegates are designed with this in mind.

BOVs True or False

BOVs are only for high performance cars
False. All turbo-charged cars can benefit from having a BOV installed, both as a performance modification, and to prolong the life of the turbo.

BOVs don't work on automatic cars
False. All the benefits of a BOV still apply to cars with an auto transmission. Getting on and off the gas pedal has the same effect on turbo lag regardless of the transmission type.

Bigger is always better
There are two factors that will determine the type and size of a BOV for your car.

1. Boost/Horsepower. The higher the boost/horsepower combination, the higher flowing BOV will be required.

2. Engine type. Engine bays with a restrictive layout will only accommodate a small BOV, or BOVs specifically made for that particular engine.

"Flutter" is bad for the turbo
True! The "flutter" occurs when upon shutting the throttle, air caught between the turbo and the shut throttle. The consequent back pressure forces the air back through the turbine blades. This process, more commonly called "cavitation" places enormous loads on the turbo and can lead to premature wear of the turbo bearings and other load-bearing components. The cavitation or "flutter" can be fixed by either fitting a BOV onto a system that hasn't got one, or making sure the BOV is matched to the output of the turbo and is not working outside its flow capacity and ensuring the BOV is set up correctly. In short, this "flutter" no matter how nice it may sound, is a sign of a problem, and if left uncorrected, might result in a rather expensive turbo rebuild.

What is a turbocharger

A turbocharger is an air compressor driven by exhaust gases.

How a turbocharger works

By forcing air into the engine, a turbocharger increases the volumetric efficiency of the engine allowing for an increase in the amount of fuel that can be burnt. More air and more fuel results in more power.

A typical turbocharger is divided in to two parts – the hot (exhaust) part and the cold (air pump) part. The main part of the exhaust side is the turbine. Powered by the exhaust gases from the engine the turbine can spin at speeds of up to 200,000rpm. It is connected via a shaft to the Air Pump, which spins at the same speed, compressing the air into the intake, creating Boost Pressure. An average turbocharger, with 6-8psi boost can provide up to 40% increase in power.

Turbocharger vs Supercharger

Turbocharging and supercharging are two different methods of increasing the power output of an engine through forced induction.

Superchargers create boost via a step-up mechanism (gears, belts or pulleys) connected to the engine drive belt, drawing its power from the crank. The boost delivery is directly linked to the engine speed, increasing and decreasing with the engine RPM, for example a 12psi centrifugal supercharger kit might produce 12psi at 7000rpm but only 2psi at 2000rpm.

Because superchargers are powered directly by the engine crank, they need engine power to create boost, the power lost to run a supercharger can be up to 10-20%. Boost adjustment involves changing the gears or pullies to alter the rpm ratio. The main advantage of centrifugal superchargers is the ease of install, while the benefit of a positive diplacement supercharger lies in its immediate boost response.

Turbochargers create boost using the engine exhaust gases' flow and heat as their power source. The boost is not available immediately, like in superchargers, but a properly sized turbo will spool up quickly and provide full boost at a much lower RPM than a centrifugal supercharger.

The fact that turbochargers develop their power from waste energy is their main advantage. Another is their versatility; the boost pressure can be adjusted on the fly through a boost controller giving the driver full control over how much and when the boost is used.

Upgrading a turbocharger is also a much simpler proposition, most turbo components, including the compressor itself are available as bolt-ons.

What is a wastegate

Internal or external, a wastegate is a boost-controlling device that operates by limiting exhaust gases going through the turbocharger, controlling the maximum boost pressure produced by the turbocharger itself. A wastegate consists of an inlet and outlet port, a valve and a pressure actuator.

How a wastegate works

A pressure actuator, controlled by boost pressure determines whether the wastegate is open or shut. In its resting position, a wastegate is shut, and as the boost pressure builds, force is applied to the actuator. When the boost pressure exceeds the spring value, the actuator will progressively open the wastegate, bypassing some of the exhaust gases therefore maintaining the boost pressure at the set level. To put it simply – a wastegate prevents the boost pressure from climbing indefinitely and consequently blowing the engine.

When is an external wastegate needed

Most of the factory turbo systems feature an internal wastegate made to handle stock boost levels. The most common reason for investing in an external wastegate is fitting an after-market turbo or better control of the boost and consequently the power output of your engine. Additionally, most large frame turbochargers are not equipped with internal wastegate systems.

Most tuners will recommend an external wastegate for any engine producing 400hp or more, as running high boost through a factory internal wastegate can overpower the actuator spring, limiting maximum boost level. Aftermarket external wastegates feature bigger inlet and outlet ports, higher pressure springs and bigger actuator diaphragms to effectively control high boost pressure.

What is a BOV (blow-off-valve)

A blow off valve, also referred to as a dump, bypass, or a pop off valve, is a vacuum-activated pressure relief valve. A typical BOV consists of an inlet and outlet port, a piston, a spring and a vacuum connection point.

What a BOV does

A BOVs' function is to release excess boost pressure from the intake system when the throttle is closed. A perfect example of this is during on boost gear changes. Without a BOV, upon shutting the throttle, the pressurised air caught between the free-spinning turbo and the shut throttle is forced back through the turbine blades, this, in turn, forces the turbine to slow down or stall. This phenomenon is often referred to as "compressor surge" or "cavitation" and it places undue load on the turbocharger bearings, significantly shortening the lifespan of the turbo or even causing serious damage.

The secondary function of a BOV is to reduce the "turbo lag" effect between gear changes. Without a BOV, the compressor surge slows the turbine down, which then takes longer to spool up again when the throttle is opened. With a BOV, the excess boost pressure is released, keeping the turbine spinning and thus reducing the turbo lag effect.

How a BOV works

A BOV is usually mounted on the intercooler pipework between the turbocharger compressor and the throttle body, ideally on the throttle body side of the intercooler. A vacuum line connects the upper chamber of the BOV with a vacuum/boost source from the intake manifold. In its resting position, a spring holds the piston shut against the intake port.

Under boost with the throttle open, the blow-off valve remains shut. Upon shutting the throttle, vacuum is created in the inlet manifold, this vacuum combined with the pressure in the intercooler pipe forces the piston to open, releasing excess boost pressure in the intake system.

Different types of BOVs

There are two main types of BOVs; atmospheric (or VTA – vent to atmosphere) and recirculating (Plumb Back). The difference between the two types is in how they dispose of the vented boost pressure. Atmospheric BOVs vent the excess boost pressure out of the system into the atmosphere – hence the "atmospheric" name. These BOVs usually produce the much sought-after "whoosh" sound. The recirculating or "Plumb-back" type BOV vents the pressure back into the intake system before the turbocharger inlet. They are practically silent compared to their atmospheric counterparts and are recommended for applications where the car needs to comply with noise or emission restrictions. They are also a good choice for off-road or rally applications where a sealed BOV system offers superior reliability and protection against damage caused by dirt, mud, sand etc. Turbosmart's Dual Port is a combination of the two – equipped with both a trumpet and a plumb-back attachment giving the user a choice of three BOV options: atmo, plumback, or both. The staged ports on these BOVs make them an ideal choice for vehicles with sensitive air flow metered management systems.

How a boost controller works

A boost controller controls the amount of manifold pressure by changing the amount of pressure going to the wastegate. A boost controller limits the supply of boost pressure to the wastegate actuator. For example; if you wish to increase your boost pressure above your standard wastegate actuator pressure (typically 7psi), the boost controller must acurately modify the pressure signal the wastegate actuator receives by venting an adjustable amount of pressure, forcing the turbo to produce the new, increased boost level.

There are two types of boost controllers; mechanical and electronic. Mechanical (gated) boost controllers offer up to two boost settings set by the driver and controlled via a switch. They are easy to fit, simple in operation and require little maintenance.

Electronic boost controllers are a far more sophisticated solution offering a host of boost settings mapped against different triggers like gear change, time, rpm or a manual switch. Electronic boost controllers require a higher level of technical knowledge to be fitted but offer a greater flexibility and countless features.

What is an Fual Pressure Regulator?

A FPR (fuel pressure regulator) is a device which controls the pressure of fuel supplied to the fuel injectors of your engine. The FPR controls the fuel pressure supplied to the injectors by returning a portion of the fuel provided to the rail by the pump to the fuel tank.

How does it work?

The FPR maintains constant fuel pressure by using a spring and valve to control the return of fuel through an orifice. The spring force applied on the valve will determine the base fuel pressure at zero manifold pressure. The top of the valve has manifold pressure acting on it while the bottom of the valve has fuel pressure acting on it. As the manifold pressure increases, the fuel pressure increases to maintain a pressure ratio between the inlet manifold and the fuel pressure.

What is the pressure ratio?

The pressure ratio is the ratio of increase of manifold pressure vs fuel pressure. For fuel to be sprayed into the combustion chamber, there must be a pressure difference between the inlet of the injector and the outlet of the injector.
Different injectors will only actuate in their designed pressure rating. The Turbosmart FPR series are designed to have a pressure ratio of 1:1. For every 1 PSI increase in boost pressure, there is a 1 PSI increase in fuel pressure. This maintains the pressure differential between the inlet manifold and the fuel source.

What is important when looking for a FPR?

Flow capabilities: The FPR must be able to flow enough fuel from the fuel pump to keep the fuel pressure in the working range of the fuel injectors. This is especially important on cars equipped with mechanical pumps as it is common to see the engine RPM high while the engine is not consuming high amounts of fuel e.g. a drag car at the end of a run will back off the throttle but the engine RPM is still very high. If the FPR cannot flow enough fuel, the pressure will increase dramatically which can result in a fuel system malfunction. Turbosmart FPR's are capable of flowing enough fuel for engines producing the amount of horsepower stated in the series, e.g FPR3000 = 3000 HP.

Fuel compatibility: With a wide variety of high octane fuels on the market, it is important that the diaphragm in the FPR is able to withstand the fuel provided to the engine. The FPR800 is designed to be suitable for street cars running pump gas or leaded race fuels. The FPR1200 – FPR3000 are designed to handle all types of fuel which makes it suitable for race cars.

Stable pressure ratio: Make sure when choosing an FPR that the product increases fuel pressure at its design ratio, i.e. a FPR with a 1:1 ratio increases fuel pressure by 1 PSI for every 1 PSI of boost pressure.

E-Boost 2

Simple Setup guide

1) Set the SP Value: The SP value determines the duty cycle the solenoid will operate at when the gate pressure is reached. This is a value between 0 – 99. The larger the value, the higher the duty cycle, the more air the solenoid will bleed off from signal to the wastegate, the more boost the turbocharger will produce. Start the setup by increasing the SP value to 10. Bring the car onto boost and see what the maximum boost pressure is. Increase the values in increments of 10 until the boost achieved is close to the value desired. Then increase or decrease the SP value in small increments until the desired boost level is achieved. The SP value can also be adjusted while the car is on boost however, instead of the SP value being shown, the boost pressure will be displayed.

2) Gate pressure setup: The gate pressure is the pressure at which boost pressure begins to act on the wastegate. This changes the response of the turbocharger and the rate at which boost increases to the desired boost pressure. The gate pressure will always be lower than the desired boost pressure as the wastegate needs time to open and control the flow of exhaust gas. Start by setting the gate pressure 5 PSI below the boost pressure achieved with the corresponding SP value. Bring the car onto boost and check whether there is a boost spike. If there is no boost spike and you want to increase the response of the turbocharger you can increase the gate pressure until you get a spike, then reduce the gate pressure until the spike is gone. Alternatively, you can lower the gate pressure to change the ramp rate of boost. This can be used in situations where the rise in boost is too aggressive and causes undesirable wheel spin.

3) Sensitivity setup: The sensitivity is how sensitive the E-Boost 2 is to changes in the boost curve. Under normal circumstances, the sensitivity is left at the factory set level of 20. If your boost curve is wavy through the rev range, change the sensitivity to 15. If your boost curve drops off at the end of the rev range, change the sensitivity to 25.

Repeat these steps in all of the boost groups you have selected.

EMI (Eletromagnetic Interference) and RFI (Radio Frequency Interference)

There seems to be a cloud of mystique surrounding the EMI issue, with some people calling it a fantasy and others blaming it for all of their car's ills.

The truth is, while EMI may not be the source of all evil, it is very real and it does have an adverse effect on sensitive electronic devices.

The source of EMI is any object that carries rapidly changing electrical currents, in cars, the most common source of EMI is an aftermarket ignition system.

It is a proven fact that the ignition system, especially solid core plug wires can transmit EMI into the vehicle's electrical system causing erratic behaviour in electronic devices like ECUs or electronic boost controllers.

Solutions

The first and the most important step in reducing EMI is to follow the ignition system installation instructions EXACTLY to ensure all the electronic devices are wired properly. Using helically wound spark plug wires can reduce EMI transmission as does shielding any sensitive electronic devices and their wiring, but the simplest and often most effective way of avoiding EMI is careful planning and routing of the entire ignition system away from all other wiring.

Aftermarket ignition systems, especially CDI, can create large amounts of electrical noise. Noise filters such as the MSD noise capacitor (#8830) can be wired into the power supply of the ignition system to eliminate large voltage fluctuations in the vehicles electrical system.

Connecting the ground wires of the e-Boost2 directly to the negative terminal of the car battery can also reduce the effects of EMI. This is especially important when the battery has been relocated to the boot or trunk of the vehicle.

Installing diodes into the ground wires of the e-Boost2 loom can effectively reduce the risk of EMI affecting the functionality of the e-Boost2. The diodes will restrict the flow of current in one direction.

The diodes only need to be installed on the ground wires that are being used e.g. diodes only need to be placed on the trigger wires if external triggering is used.

The diodes need to be wired in so that the flow of current is away from the head unit, i.e. the cathode is away from the head unit (As per wiring diagram). The diode models that can be used are 1N4001 or 1N4002.

Use only resistor type relays when connecting the E-Boost2 to an auxiliary device. Normal relays can cause voltage spikes to the e-Boost2.