Turbo

Q. How much shaft play should my dual ball bearing turbo have?
A. The Garrett full ball-bearing turbo is designed to have clearance between the bearing cartridge and center housing for hydrodynamic damping in addition to the internal clearances of the bearing cartridge itself. Hydrodynamic damping uses the incompressible properties of a liquid (oil in this case) and the space around the bearing cartridge to dampen the shaft motion of the rotating assembly. When the turbo is new, or has not operated for a long period of time allowing most of the oil to drain out, the rotating assembly will move more in the radial direction than a typical journal-bearing turbo because there is no oil in the center housing. This condition is normal. As long as the shaft wheel spins freely and the wheels don't contact their respective housings, the assembly will function properly.

Q. Does my turbo require an oil restrictor?
A. Oil requirements depend on the turbo's bearing system type. Garrett has two types of bearing systems; traditional journal bearing; and ball bearing. The journal bearing system in a turbo functions very similarly to the rod or crank bearings in an engine. These bearings require enough oil pressure to keep the components separated by a hydrodynamic film. If the oil pressure is too low, the metal components will come in contact causing premature wear and ultimately failure. If the oil pressure is too high, leakage may occur from the turbocharger seals. With that as background, an oil restrictor is generally not needed for a journal-bearing turbocharger except for those applications with oil-pressure-induced seal leakage. Remember to address all other potential causes of leakage first (e.g., inadequate/improper oil drain out of the turbocharger, excessive crankcase pressure, turbocharger past its useful service life, etc.) and use a restrictor as a last resort. Garrett distributors can tell you the recommended range of acceptable oil pressures for your particular turbo. Restrictor size will always depend on how much oil pressure your engine is generating-there is no single restrictor size suited for all engines. Ball-bearing turbochargers can benefit from the addition of an oil restrictor, as most engines deliver more pressure than a ball bearing turbo requires. The benefit is seen in improved boost response due to less windage of oil in the bearing. In addition, lower oil flow further reduces the risk of oil leakage compared to journal-bearing turbochargers. Oil pressure entering a ball-bearing turbocharger needs to be between 40 psi and 45 psi at the maximum engine operating speed. For many common passenger vehicle engines, this generally translates into a restrictor with a minimum of 0.040" diameter orifice upstream of the oil inlet on the turbocharger center section. Again, it is imperative that the restrictor be sized according to the oil pressure characteristics of the engine to which the turbo is attached. Always verify that the appropriate oil pressure is reaching the turbo. The use of an oil restrictor can (but not always) help ensure that you have the proper oil flow/pressure entering the turbocharger, as well as extract the maximum performance.

Q. I want to make x horsepower, which turbo kit should I get? or Which turbo is best?
A. Select a turbocharger to achieve desired performance. Performance includes boost response, peak power and total area under the power curve. Further decision factors will include the intended application. The best turbo kit dictated by how well it meets your needs. Kits that bolt on without any modification are best if you don't have fabrication capabilities. Less refined kits can be cost effective if you access to fabrication capabilities. For more information on the right Garrett turbocharger for you, please visit the Turbo Application Search Engine

Q. What is causing my turbo to sound like a sewing machine's whistle?
A. The "sewing machine whistle" is a distinct cyclic noise cause by unstable compressor operating conditions known as compressor surge. This aerodynamic instability is the most noticeable during a rapid lift of the throttle, following operation at full boost.

Q. What is/causes Shaft Play?
A. Shaft play is caused by the bearings in the center section of the turbo wearing out over time. When a bearing is worn, shaft play, a side to side wiggling motion of the shaft occurs. This in turn causes the shaft to scrape against the inside of the turbo and often produces a high-pitched whine or

whizzing noise. This is a potentially serious condition that can lead to internal damage or complete failure of the turbine wheel or the turbo itself.

Q. How should I break in a turbo?
A. A properly assembled and balanced turbo requires no specific break-in procedure. However, for new installations a close inspection is recommended to insure proper installation and function. Common problems are generally associated with leaks (oil, water, inlet or exhaust).

Q. What is the difference between a BOV and a Bypass Valve? How do they work, and are they necessary?
A. A Blow Off Valve (BOV) is a valve that is mounted on the intake pipe after the turbo but before the throttle body. A BOV's purpose is to prevent compressor surge. When the throttle valve is closed, the vacuum generated in the intake manifold acts on the actuator to open the valve, venting boost pressure in order to keep the compressor out of surge. Bypass valves are also referred to as compressor bypass valves, anti-surge valves, or recirculating valves. The bypass valve serves the same function as a BOV, but recirculates the vented air back to the compressor inlet, rather than to the atmosphere as with a BOV.

Q. How does a Wastegate work?
A. A Wastegate is simply a turbine bypass valve. It works by diverting some portion of the exhaust gas around, instead of through, the turbine. This limits the amount of power that the turbine can deliver to the compressor, thereby limiting the turbo speed and boost level that the compressor provides.

- The Wastegate valve can be "internal" or "external". For internal Wastegates, the valve itself is integrated into the turbine housing and is opened by a turbo-mounted boost-referenced actuator.
-An external Wastegate is a self-contained valve and actuator unit that is completely separate from the turbocharger.
-In either case, the actuator is calibrated (or set electronically with an electronic boost controller) by internal spring pressure to begin opening the Wastegate valve at a predetermined boost level.
-When this boost level is reached, the valve will open and begin to bypass exhaust gas, preventing boost from increasing.

Q. What is compressor surge?
A. The surge region, located on the left-hand side of the compressor map (known as the surge line), is an area of flow instability typically caused by compressor inducer stall. The turbo should be sized so that the engine does not operate in the surge range. When turbochargers operate in surge for long periods of time, bearing failures may occur. When referencing a compressor map, the surge line is the line bordering the islands on their far left side. Compressor surge is when the air pressure after the compressor is actually higher than what the compressor itself can physically maintain. This condition causes the airflow in the compressor wheel to back up, build pressure, and sometimes stall. In cases of extreme surge, the thrust bearings of the turbo can be destroyed, and will sometimes even lead to mechanical failure of the compressor wheel itself. Common conditions that result in compressor surge on turbocharger gasoline engines are:

-A compressor bypass valve is not integrated into the intake plumbing between the compressor outlet and throttle body
-The outlet plumbing for the bypass valve is too small or restrictive
-The turbo is too big for the application

Q. What is boost creep?
A. Boost creep is a condition of rising boost levels past what the predetermined level has been set at. Boost creep is caused by a fully opened Wastegates not being able to flow enough exhaust to bypass the housing via the Wastegates itself. For example, if your boost is set to 12psi, and you go into full boost, you will see a quick rise to 12 or 13psi, but as the rpm's increase, the boost levels also increase beyond what the boost controller or stock settings were. Boost creep is typically more

pronounced at higher rpm's since there is more exhaust flow present for the Wastegates to bypass. Effective methods of avoiding or eliminating boost creep include porting the internal Wastegates opening to allow more airflow out of the turbine, or to use an external Wastegates.

Q. What is boost spike?
A. A boost spike is a brief period of uncontrolled boost, usually encountered in lower gears during the onset of boost. Typically spikes occur when the boost controller cannot keep up with the rapidly changing engine conditions.

Q. How can I adjust the turbo boost?
A. Adjusting the boost is straightforward. However, it depends on the type of boost controller. For a standard Wastegates actuator, simply recalibrate the actuator to open (more or less) for a given pressure. Changing the length of the rod that attaches to the Wastegates lever accomplishes this adjustment. For mechanical boost control systems, adjustments may involve changing the setting on a regulator valve(s). For electronic boost control systems, adjustments may need to be made to the vehicle's engine management system. For an external Wastegates, adjusting the boost often requires turning the adjustment screw (when equipped) to increase/decrease spring load, changing Wastegates springs, or shimming Wastegates springs.
IMPORTANT: WHILE ADJUSTING THE BOOST IS STRAIGHTFORWARD, OFTEN THIS CHANGE REQUIRES MODIFICATIONS TO THE ENGINE FUEL MANAGEMENT SYSTEM!

Q. What is a boost leak?
A. A boost leak means that somewhere in the turbo or intake, there is an area where the air (boost) is escaping. Typically a boost leak is caused by a loose or bad seal, cracked housing, etc. When a boost leak is present, the turbo will be able to generate boost, but it may not be able to hold it at a constant level and pressure will drop off proportionally to the size of the leak.

Q. What is Boost Threshold?
A. Boost threshold is the engine speed at which there is sufficient exhaust gas flow to generate positive manifold pressure, or boost.

Q. What is Turbo Lag?
A. Turbo lag is the time delay of boost response after the throttle is opened when operating above the boost threshold engine speed. Turbo lag is determined by many factors, including turbo size relative to engine size, the state of tuning of the engine, the inertia of the turbo's rotating group, turbine efficiency, intake plumbing losses, exhaust backpressure, etc.

Q. What are the main differences between a Single and Twin Turbo setup?
A. A single turbo receives exhaust flow from and supplies air to all cylinders.
The most common type of twin turbo setup is the parallel system where each turbo is fed by ½ of the engine's cylinders. Here, both compressors supply air to the intake manifold simultaneously.
There are also sequential twin turbo systems, which run on one small turbo at low engine speeds and switch to two parallel turbos at a predetermined engine speed and/or load. Furthermore, there are series twin turbo systems where one turbo feeds the other turbo. These are primarily used on diesel engines due to the extremely high boost levels that can be generated.
For this FAQ, we will just refer to the first two setups identified above.
Choosing between a single or parallel twin turbo setup is primarily based on packaging constraints in the engine bay, or a personal choice by the tuner. In most cases, for top performance, a single turbo is preferable because larger turbos are generally more efficient than smaller turbos. However, often there is not room for one large single, or the tuner wants the visual impact of twin turbos. The notion that two smaller turbos will build boost faster than one large turbo is not always accurate because even though the turbos are smaller, each one is only getting half of the exhaust flow. Sequential systems seem to have the capacity to support big power. In theory, the sequential twin turbo setup is a potent combination. A few O.E.s have produced systems of this type but control issues have proven significant, making them challenging to function seamlessly. One slight draw back to a sequential twin turbo system is that sometimes during daily driving (specifically, in cornering) if the

driver is not constantly aware, the second turbo will spool and result in a lot of unpredicted power.

Q. What are the main tuning problems when dealing with Turbos?
A. Engine calibration - fueling and ignition timing. Under boost, it is crucial that there is no engine-killing detonation occurring within the cylinder. This is done by fine tuning the air/fuel ratio a bit rich to help cool the combustion gas, and by tuning the ignition advance curve to ensure that combustion chamber pressures stay below the level that causes unburned fuel to ignite ahead of the advancing flame front.

- end of content

Intercooler

Back To Top

Q. Is there any maintenance required for my intercooler? Are there any special things to do to keep it working longer?
A. In a water-to-air intercooler, check the water level often as this is crucial for the intercooler to operate properly. In cold weather, just like a car, it will need antifreeze in order to function effectively and properly. With an air-to-air intercooler, there really is no maintenance that needs to be done other than just the routine checking of hoses and clamps to make sure everything is tight. Additionally, the intercooler fins may be picked-out or de-smashed to ensure maximum cooling. Every 20,000 miles or so it is recommended that the intercooler core be inspected, and if necessary, flushed/washed out to remove any accumulated oil or buildup.

Q. I want my car to remain a sleeper/stealth. Can I paint or anodize my intercooler so it is not easily visible?
A. Yes! It is not uncommon at all for an intercooler and endtanks to be anodized black to keep attention away from the car and help it maintain a sleeper appearance. A very light coat of paint on the core and endtanks is also another option, usually much cheaper and easier than anodizing, with a negligible performance loss.

Q How significant is a leak in my intercooler?
A. For an air-to-air intercooler, a leak, as long as it is not a significantly large one, will not hinder performance at all. However, if an air-to-water intercooler develops a leak in the main core, it could lead to other more significant problems with the engine itself. Be sure to fix these problems as soon as they occur to prevent other damage.

Q. Is there a maximum amount of boost I can run on my intercooler?
A. While it is possible that an intercooler can fail from boost levels being too high, it is a very rare scenario. However, if not properly designed to handle high boost, cracking along seams and of the endtanks can occur.

Q. I want to turn up my boost, is a larger intercooler necessary?
A. Usually, it is not necessary to upgrade the intercooler when raising boost levels. The pressure drop contributed by the intercooler is proportional to it's flow (CFM) squared. This relationship shows that it is highly unlikely the change resulting in loss from higher boost levels will require a larger intercooler. If there is a significant change however, such as 40% or 50%, then a larger intercooler may be necessary.

Q. What exactly is 'pressure drop/loss' / 'flow loss' and how are they measured?
A. Pressure loss, or pressure drop, refers to the change in pressure when comparing the air entering the intercooler with the exiting air. This change is mostly affected by the internal flow area of the intercooler. Flow loss, however, is measured not just with pressure loss but with how much restriction to airflow exists. Maximum performance can be obtained if the pressure loss is kept below 1.0 to 1.5 psi. Anything in excess of these numbers, especially higher than 3.8 psi, and the intercooler is not properly fitted for the application which results in hindered performance and dramatically decreased functionality of the intercooler system itself.

Q. What is intercooler effectiveness and how do I measure it?
A. Effectiveness is defined as the ratio of how many degrees of temperature that were removed from the charge air by the intercooler to the original temperature that is put into the charge air by the turbo. Example: If the turbo compresses the charge air to a temperature of 140° F, but after passing through the intercooler the air is 115° cooler (resulting in a 25° F charge air temperature), the efficiency would be: Effectiveness: 115/140 = 0.82 or 82% efficiency Typically, air-to-air intercoolers for normal street applications range between 60% and 70% efficiency. Often, liquid-to-air intercoolers have effectiveness ratings from 75% to 95%. One common method of improving the cooling of the charge air dramatically in an air-to-water intercooler is the inclusion of ice as a coolant.

Q. Will a FMIC block flow to my radiator?
A. No. Since the intercooler allows air to pass through it, airflow to the radiator will not be blocked. However, using an intercooler core that is too thick and does not allow air to pass through it quickly or completely and airflow to the radiator can be restricted which can lead to potential overheating problems.

Q. What is the best placement of my intercooler?
A. The best place for your intercooler is directly in the path of the inflow of ambient air. Traditionally this has been right in front of the radiator in the front of the car, hence the term Front Mount Intercooler.

Q. How do I select the proper intercooler core size?
A. A major limiting factor in choosing an intercooler size is space constraints within the engine bay. If there is not enough room for an intercooler with adequate flow, then often a water-to-air intercooler is used instead to maximize the cooling capability of the surface area of the core. You want to make sure that the intercooler you choose is large enough to effectively handle the air. Too small of a core, and you will restrict the potential of the turbo by not allowing the charge air to be cooled adequately.

Q. What is the difference between an air-to-air intercooler and a water-to-air (liquid-to-air) intercooler?
A. An Air-to-Air intercooler uses ambient air flowing over the fins to cool the charge air, while an Air-to-Water intercooler uses coolant (water) with a system similar to that of a radiator's cooling system. Traditionally, air-to-air intercoolers are used for street applications because of their lower cost and reduced complexity, while air-to-water intercoolers are used in race and packaging-constrained applications.

Q. Will an intercooler help make more horsepower?
A. Yes, although it is only indirectly responsible for helping make more power. Since the intercooler increases the charge air density, an intercooled engine will typically make more power than a non-intercooled engine with the same setup by allowing more air to be crammed into each cylinder

Q. FMIC, TMIC, SMIC - what do they mean?
A. (Front Mounted Intercooler, Top Mounted Intercooler, Side Mounted Intercooler) terms which refer to the placement of the charge air cooler in the engine bay and in reference to the engine. Typically FMICs provide the best cooling capability, as they are located in front of the radiator for optimum airflow. SMICs and TMICs are commonly found on factory-turbo'd cars. TMICs are more prone to heatsoak as they are placed over the engine directly in the path of the rising heat and very close to the hood. However, when a TMIC is used in conjunction with a hood scoop, they can provide adequate cooling.

Q. What is the purpose of an Intercooler?
A. An intercooler's primary function is to cool the charge air after it has been heated due to boosting and the heat that is produced by the turbo before sending the air into the engine. As the air is cooled, it becomes denser, and denser air makes for better combustion (more power). Additionally, the

denser, cooler air helps reduce the chances of knock.

Q. What is intercooler heat soak?
A. Heat soak is when the intercooler can't dissipate the heat that it absorbs from the turbo fast enough. When an intercooler can't cool the charge air by removing the heat from it, it loses its effectiveness. This explains why turbo cars tend to run slower or have slightly less power when the weather is warm.

- end of content

Other

Back To Top

Q. How is boost measured? (Bar, mmHg, PSI) and How do you convert from one to another?
A. Boost is measured as the pressure that the turbo creates above atmospheric pressure. Normal Atmospheric Pressure (1 atm) = 14.7 psi = 760 mm Hg 1 Bar is not actually equal to 14.7 psi, but rather it is equal to 14.5 psi, = 0.9869 atm = 750.062 mm Hg

Q. What is the Exducer?
A. Looking at a compressor wheel, the exducer is the "major" diameter. For a turbine wheel, the exducer is the "minor" diameter. The exducer, in either case, is where flow exits the wheel. Compressor wheel exducer diameter is incorporated into Garrett GT-series nomenclature: The "60" in the GT2860RS for example, has a 60mm compressor wheel exducer diameter.

Q. What is the Inducer?
A. Looking at a compressor wheel, the inducer is the "minor" diameter. For a turbine wheel, the inducer is the "major" diameter. The inducer, in either case, is where flow enters the wheel.

Q. How fast will my car go with xyz?
A. This question cannot be answered as how fast any given car will go depends on the unique individual setup, road/weather conditions, and of course, the driver's skill.

Q. Are oil deposits indicative of impending turbo failure? There is blue/black smoke, is my turbo going bad?
A. Blue/black smoke can be caused by numerous conditions, and one of them could be a turbocharger worn past its useful service life. The following are potential reasons that blue/black smoke could occur:
 * Clogged air filter element or obstructed air intake duct. This condition creates a vacuum due to high differential pressure resulting in oil drawn into the compressor and subsequently burned during engine combustion.
 * Engine component problems; i.e. worn piston rings or liners, valve seals, fuel pump, fuel injectors, etc.
 * Obstructed oil drain on turbocharger resulting in pressure building inside the center housing and forcing oil past the turbocharger seals
 * Damaged turbocharger or turbocharger worn past its useful service life
 * Black smoke is also sometimes indicative of too rich an air/fuel mixture.

Q. What should I look out for when buying a turbo?
A. 1. Condition of the turbine housing - inspect for cracks on the exterior and inside the inlet of the housing. If the housing has cracks then the housing needs to be replaced.
 2. Condition of the turbine and compressor wheels - inspect for cracks and damaged blades. If either of the wheels are damaged then the wheel (s) need to be replaced and the center section balanced.
 3. Condition of the bearings - spin the turbocharger shaft and check for roughness. If roughness is detected then the turbocharger needs to be disassembled and the internal components inspected and replaced if necessary.
 4. The most important factor is to make sure the turbo is the proper one for your application. A

properly matched turbo will provide better performance and more reliable operation. A properly matched turbo includes matched turbine and compressor wheel sizes and appropriate housings.

Q. Should my turbo/exhaust manifold glow red after driving?
A. Yes, the turbo/exhaust manifold can glow red under certain driving conditions. The exhaust gas temperature can reach over 1600F under high load operating conditions; i.e. towing, extended uphill driving, or extended high rpm/boost conditions.

Q. How do I adjust my compression ratio?
A. The easiest and most effective way to accomplish this is through the use of either higher/lower compression pistons, and/or using a head gasket of a different thickness.

Q. What compression ratio should I run with my turbo engine?
A. Allowable compression ratio depends on many factors, and there is no one right answer for every application. Generally, compression ratio should be set as high as feasible without encountering detonation at the maximum load condition. Setting the compression ratio too low will result in an engine that is a bit sluggish in off-boost operation. Setting it too high however, can lead to serious engine problems due to knock. Factors that influence the compression ratio can include: fuel anti-knock properties (octane rating), boost pressure, intake air temperature, combustion chamber design, ignition timing, and exhaust backpressure. Many modern engines have well designed combustion chambers that will allow modest boost levels with no change to compression ratio, assuming appropriate tuning. For higher power targets with more boost, compression ratios should be adjusted to compensate.

Q. What additional maintenance is required for the turbo?
A. Good, clean oil is extremely important to the turbocharger. It is best to change the oil and filter at least as often as the automobile manufacturer recommends. FRAM produces replacement oil filters for all levels of server use. Visit www.FRAM.com to select the right filter for your application! Turbo performance is sensitive to turbo inlet conditions. A clogged air filter can drastically affect the turbo inlet. Air filters should be inspected at every oil change and replaced at 12,000 to 15,000 mile intervals. FRAM produces replacement air filters including a new performance filter the FRAM AirHog. NOTE: Never exceed the vehicle manufacturer's recommended filter change intervals.

Q. What is the purpose of an oil catch can?
A. An oil catch can's purpose is to catch oil blow-by gasses that can eventually create a carbon and oil sludge build-up in the intake and turbo.

Q. How can I remove and clean the oil condensation box/oil catch can?
A. The oil condensation box, or catch can, can be cleaned once it is removed with any cleaning solvent. Simply fill the box with a cleaner and slosh it around until oil deposits are gone. Removing the oil condensation box can be a challenge and varies by vehicle. NOTE: some vehicles are not equipped with an oil condensation box.

Q. Do I really need the cool down procedure on my turbo?
A. The need for a cool down procedure depends on how hard the turbo and engine is used, and whether or not the turbo is water-cooled. All Garrett turbochargers must pass a heat soak test and the introduction of water-cooling has virtually eliminated the need for a cool down procedure. Garrett is one of the few turbocharger manufactures that subjects their turbos to several OE qualification tests. When you buy a Garrett turbo you can be sure it's a reliable one!

Q. Should I run a Turbo Timer?
A. A turbo timer enables the engine to run at idle for a specified time after the ignition has been turned off. The purpose is to allow the turbo to cool down thus avoiding "coking" ("coking" is burned oil that deposits on surfaces and can lead to blocked passages). The need for a turbo timer depends on how hard the turbo and engine is used. Running at full speed and full load then immediately

shutting down (heat soak) can be extremely hard on a turbo. Water-cooling of the turbocharger's center housing has essentially eliminated the need for turbo timers or extended idling periods.

Q. What is Knock/Detonation?
A. Knock is a condition caused by abnormal combustion of the air/fuel mixture and can result in damage to an engine. The three factors that result in engine knock are: 1) knock resistance characteristics (knock limit) of the engine, 2) ambient air conditions, and 3) octane rating of the fuel being used.

1. Since every engine is vastly different when it comes to knock resistance, there is no single answer to "how much." Design features such as combustion chamber shape, spark plug location, bore size and compression ratio affects the knock characteristics of an engine. In addition, engine calibration of fuel and spark plays an enormous role in dictating knock behavior.
2. For the turbocharger application, both ambient air conditions and engine inlet conditions affect maximum boost. Hot air and high cylinder pressure increases the tendency of an engine to knock. When an engine is boosted, the intake air temperature increases thus increasing the tendency to knock. Charge air cooling (e.g. an intercooler) addresses this concern by cooling the compressed air produced by the turbocharger.
3. The octane rating of fuel is a measure of a fuel's ability to resist knock. The octane rating for pump gas ranges from 85 to 94 while racing fuel would be well above 100. The higher the octane rating of the fuel, the more resistant it is to knock. Since knock can be damaging to an engine, it is important to use fuel of sufficient octane for your application. Generally speaking, the more boost you run, the higher the octane requirement.

Q. How much boost can I run on pump gas?
A. The primary limitation to maximum boost is engine knock. It is also not advisable to run the maximum amount of boost your car can handle on a daily driven basis as a precaution against if the boost spikes.

Q. Which boost controller should I get? (Manual or Electronic)
A. Boost controllers vary widely in performance, price, and functionality. For a comprehensive breakdown of some of the more popular options, see the July 2002 issue of Sport Compact Car Magazine.

Q. What is a boost controller?
A. A boost controller is a device that bleeds or blocks the boost pressure signal entering the Wastegates actuator. The idea is to keep the Wastegates closed to allow higher boost pressures than the actuator would otherwise allow. These can be simple mechanical or sophisticated electronic devices, with price tags to match.

Q. What other systems are affected by turbocharging? (Fuel, Oil, Cooling, Drivetrain, etc)
A. There are several factors that must be addressed when deciding to turbocharge a previously naturally aspirated engine, such as: Is the current fuel delivery system capable of providing increased, adequate amounts of fuel? Is the cooling/oiling system capable of handling the extra power and consequently, extra heat that is generated by the turbo? Is the clutch/transmission/drivetrain up to the task of handling the extra power? Etc

Q. The turbo gauges measures turbine speed, right?
A. The "turbo gauge", commonly called a boost gauge, does not measure turbine speed. It measures the intake manifold pressure. Under light loads the boost gauge will indicate a vacuum due to the turbocharger shaft not rotating fast enough to create positive pressure (boost). Once load (throttle position) increases, the boost gauge will indicate a positive pressure.