Let's Go Turbo

Don't worry, this piece is not too technical. In fact, the history of turbo-charging has interesting beginnings.

After the Second World War, there were two schools of thought on automotive development - European and American. Post-war Europe had suffered a great deal of damage, and as car makers limped back to making automobiles, the impetus was on saving whatever resources they had. Cars, therefore, had to be cheap to buy and run, and fuel was still available only at a premium. Countries like France, for instance, stipulated engine capacities for the cars produced so that the government could ensure minimum consumption of fuel. It was different in America however, but we will come to that later.

The economic situation in Europe improved as time passed by, but stringent restrictions continued in various forms. In their effort to make more powerful sports cars out of the existing engine capacity rules, European car makers went on a technology hunt. Thus overhead valves and push-rod engines gave way to overhead cam engines; engineers worked on overdrive to make the small 1,500 cc-engine-powered cars go faster. Fuel feed systems also changed and the good ol' carburetor gave way to the fuel-injection system.

Along with fuel injection, the concept of turbo-charging came into reckoning. What is turbo-charging?

Turbo-charging, simply, is a method of increasing the output of the engine without increasing its size. The basic principle was simple and was already being used in big diesel engines. European car makers installed small turbines turned by the exhaust gases of the same engine. This turbine compressed the air that went on to the combustion chamber, thus ensuring a bigger explosion and an incremental boost in power. The fuel-injection system, on its part, made sure that only a definite quantity of fuel went into the combustion chamber.

Therefore, what the turbo-charger was doing was simply increasing the volumetric efficiency of the engine. To give you an example: a 1,500 cc engine that produced, say, 60 bhp when it was normally aspirated, benefited at times with a 10- to 20-per cent power boost depending on the kind of turbo-charger used. Normally, the manufacturer would have had to resort to a bigger displacement in the engine, or design and develop an all-new engine to get more power from the same unit. BMW was the first to use turbo-charging in a production passenger car when they launched the 2002 in 1973. The car was brilliantly packaged too and paved the way for a simply magnificent 'Turbo Era' in the automotive world. Swedish giant Saab took its cue from this, and its ensuing 900 series was one of the most characteristic turbo cars of its time.

Basic turbo-chargers had their merits and a few quirks. Early turbo-charged cars suffered from what was known was turbo-lag. The turbo fans of these cars needed a particular exhaust boost pressure for them to spin at a speed that was enough to compress air and get the additional power out, and that meant a sudden burst of acceleration. While purists considered this unrefined technology, enthusiasts hailed it and accepted it as a quirk that made turbo-charged cars very special.

Across the Atlantic, however, things were a bit different. After the World War, the American economy was growing fast, fuel was not expensive and roads were straighter and broader. That meant big cars with even bigger engines. Whenever American auto engineers were pressed to improve performance, they went for the sure-shot way of increasing the engine capacity. So even today we have big V-8s that displace nothing less than 5,000 cc and race cars that still use push-rod engines to make lots of power.

However, turbo technology was spreading its wings in Europe and Formula One was its center stage as F1 constructors and engine makers discovered the power of turbo. Renault was the first engine maker to bring turbo-charged engines to Formula One tracks. Regulations allowed either 1,500 cc turbo engines or a 3,000 cc normally aspirated engine and soon the teams realized the difficulty of racing against turbo cars. In fact, in the 1985 Dutch GP, all the cars that started from the row were turbo-charged. In the 'qualifying boost' settings, these cars produced 1,000 bhp-plus and in the 'race-boost' settings cars had around 700 bhp on tap.

Even motorcycling was not spared the turbo zing that was typical of the late '70s and early '80s. Some of the Japanese Big Four thought it would bring back the performance edge that they had lost with the demise of big-engined two-stroke bikes. As far as performance went, the turbo stickers splashed across big Suzuki's did nothing more than prove a good marketing tool. Turbo bikes were complicated, needed fuel-injection systems, and were too expensive to build and buy.

But soon the world realized other ways of getting more power out of road car engines. Multiple valves and double-overhead camshaft designs developed reasonable performance without the complication of turbo-charging, and these methods were politically correct too since they consumed less fuel. Consequently today there are only a few petrol-powered road cars that still use turbo-chargers for enhanced performance.

Computers soon started playing an even bigger role in cars. Engine management systems linked to fuel-injection systems meant getting more out of the engine was even easier. For example, one can buy chips that can boost power by 100 bhp for some Japanese cars, such as the Nissan Skyline. Moreover, on-road speeds were being restricted all over the world. Though most of the sports cars today are capable of doing more, they are restricted electronically not to exceed 250 kmph even in autobahn-blessed Germany.

Turbo-charging lost its edge towards the end of the '80s and today this technology is used only in select performance cars. Porsche, for example, is all set to build a turbo-charged version of its all-new 911 (water-cooled) with added performance. Turbo engines were banned in Formula One too with the idea of restricting the performance of the cars (and thereby making them safer too). There are many who consider this a backward step in the world of Formula One, which is considered to represent the 'tomorrow' of automotive technology. But if one analyses the performance of normally aspirated cars in F1 today, (3,500 cc non-turbo), they perform as well, if not better, than the turbo cars of the early '80s.

So, there are no full stops in technology. While road cars and even sports and racing cars are going in for more efficient engines, better metallurgy and wilder-than-ever electronics to get their engines to perform at an optimum level without sacrificing the performance edge, turbo-chargers still continue to serve the same purpose they were invented for... albeit more so with diesel engines.

Why more in diesels than petrols?

Simple facts first. Diesel engines are lethargic to start with but they produce all their power and torque at lower engine speeds as compared to their petrol counterparts with similar engine sizes. A turbo-charger can be effective when coupled to a diesel engine and can make it quicker and faster. And since the diesel engines churn the power out early, the turbo-chargers also get to work early and hence negate the biggest drawback of a diesel engine - slow acceleration.

And as discussed earlier, diesels always came with some sort of fuel-injection system or other much before it became the norm with petrol cars. So development of turbo-charged diesels was under way for a longer time. Turbo-charging, like having multiple valves and electronic fuel injection, ensures complete combustion thus resulting in less toxic emissions. In the direct-injection 'common-rail' engines (that can be as powerful and refined as some of the most modern petrol engines), though, there is a new threat for turbo-charged diesel engines. But for now, turbo-charging remains a sure-shot way to boost the performance of a diesel automobile, and is widely used by sports utility vehicles and even passenger cars.

What is an 'Intercooler Turbo'?

You have seen the monikers on the flanks of Mitsubishi Pajeros, right? It usually reads: 2,800 cc intercooled turbo-charged. Intercoolers are used by most of today's turbo-diesel engines to make the compressed air denser. It works like this - on starting, exhaust gases spin the turbine and thus activate a compressor that pressurizes the air. This pressurized air from the turbo-charger is then sent through a duct to an air-cooled intercooler, which lowers the temperature of the intake charge and thus increases its density. The air-cooled intercoolers receive air through separate intakes and that explains the small scoops and louvers usually found on the hoods of turbo-charged cars.

Modern turbo-diesel engines also make use of a temperature-sensitive, motor-driven fan which boosts airflow at low engine speeds or when the intake air temperature is high. Though there are diesel engines that 'earn' a turbo-charger mid-way through their life, the usual practice is to design and develop an engine with a turbo-charger in mind. Then, as and when a turbo-charged model is added to the stable, the engine can adapt to it without any additional strengthening and cooling of engine parts. A well-engineered, turbo-charged diesel engine offers better fuel efficiency (at times by 15 per cent), better overall performance (better torque and high-end power), reduced noise (compared to normally aspirated diesel engines) and minimum engine maintenance (owing to better combustion of diesel fuel).

Now, that wasn't too bad, was it?