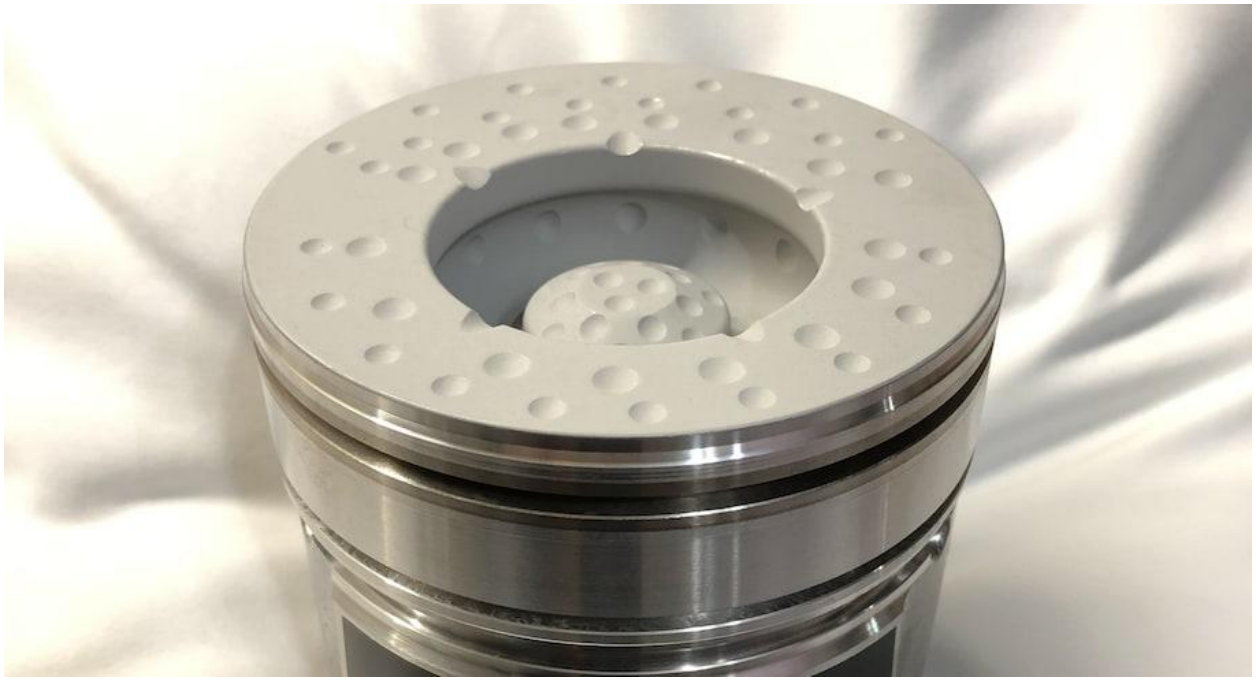
# Diesel Engines Steal a Power-Adding Trick From ... Golf Balls?

**Speed of Air claims their dimpled pistons improve power and efficiency, and it has the data to back it up.**



While the world is trying to go EV, heavy duty diesel trucks like the Ford F-250 are still the rage for those who do big jobs (or want to look like they do). Many truck owners are always on the lookout for a way to make more power, reduce fuel consumption, and even reduce particulate emissions to reduce the cost of filling up their Diesel Exhaust Fluid (DEF) tanks. That's why the claims that Speed of Air (SoA) makes about their pistons are so enticing to those looking to rebuild their engines. But do these dimples actually work? They sent us the data to show us that it's not just for show.

## Why Does A Golf Ball Have Dimples?

A golf ball's dimples have a reason to exist: they create a boundary layer of air that reduces the drag by creating turbulence at the surface of the ball. While this doesn't totally explain how a golf ball can increase its altitude (that's thanks to the Magnus Effect of a sphere spinning in a fluid), it doesn't lose as much speed due to drag thanks

to the turbulence created by the dimples. That turbulent layer delays the separation of the air on the backside (relative to its direction of travel) of the golf ball and reduces the size of the drag-inducing wake when compared to the smooth ball.

Of course, you're probably saying to yourself, "Yeah, great, but a piston isn't a ball." When it comes to how fluids act (and the air you and your engine breath are fluids), creating a boundary layer still plays a critical role in your combustion chamber, especially when it comes to keeping the fuel in suspension with the air. If you're able to create a well-attached boundary layer in the combustion chamber, the air and fuel charge will remain in suspension longer. That will also help the flame front advance farther through the charge, which leads to more of the air fuel mixture to be used to force the piston down as it expands within the cylinder. When the air fuel mixture isn't able to burn completely, you get carbon buildup within the combustion chamber, valves, and piston.

## How Do They Know It Works?

That was one of the ways that Speed of Air determined if their dimpling worked in the combustion chamber. "During the early phase testing," said Chris Parkhurst, Speed of Air CEO and managing director, "SoA used various flow bench techniques to determine fuel wash areas on the piston crowns that were indicated by excess carbon build-up." Dimpling wasn't necessarily the first on their list, either. They tried many other texturing techniques to try and keep the air fuel mixture in suspension for longer, but found that

the golf ball-like dimpling of the piston worked the best. Today, they rely on computational fluid dynamics (CFD) to better optimize their designs for Powerstroke, Duramax, and Cummins engine pistons for medium-duty vehicles. Another design improvement made to these pistons are pressure release slots machined into the crowns of these pistons. "They are applied to our piston designs to unload the pressure in the bowl area and accelerate the burn of the fuel air mixture," said Parkhurst, and these cuts lead to a quieter running engine when compared to even the OE piston design.

## Heavy-Duty Testing

SoA also sent their pistons to independent testers as early as 2014, where a SoA piston was used during a rebuild of a Caterpillar 3516 engine used in a 793D mining truck for Newmont North America and rebuilt by a Cat dealer. That engine was removed with 44,842 hours on it and reconditioned with SoA pistons being the only change from the engine rebuild's normal parts. That engine went from being used for 16.30 hours per day on the Cat pistons to 18.34 hours per day on the SoA pistons by the time it was removed for servicing once more in 2017 after 915 days in service. The reasoning for the shorter period of time was due to the engine rebuilder reusing the head bolts, a practice that was reasonable and predictable by the rebuilder at the time.

Unfortunately, the reused head bolts were the reason the engine was pulled again as Newmont North America stated in its report "Had it not been for the risk of equipment downtime and possible further damage, caused by additional head bolt breakage, it is reasonable the engine would have stayed in service for a longer, but unknown, period of time." Parkhurst also noted that this particular dealer has stopped this ill-advised practice.

Despite those head bolt issues, Newmont noted that the cylinder packs, pistons, rings, and liners "indicated significant useful life remained" and the low amount of carbon build up on the pistons as well as the very low crankcase deposits versus other rebuilds. Other significant findings in the report was its exhaust emissions, which testing showed a significant reduction and improvement versus "the comparative engine." "Given that only approximately 40 percent (piston crown modification and thermal coating) of the available SoA technology was applied," the report finished, "the considered opinion is that operational improvement (is) applicable to the SoA technology was achieved." SoA also supplied us with a report from Olsen Ecologic Lab in Fullerton, California that compared a stock Cummins 5.9 liter engine to one with only a set of Speed of Air pistons installed. In that report, there was a 15.5 percent increase in horsepower and a 15.2 percent increase in torque. That's not where the good news stops, either, as this report found that the Brake-Specific Fuel Consumption was reduced by 3.2 percent, the opacity of the exhaust was reduced (meaning less particulate matter) by 77.6 percent, NOx levels reduced by 61 percent, exhaust hydrocarbons dropped by 32.5 percent, and CO2 levels dropped by 41.4 percent.

## Why Just Pistons, Though?

Considering that there are more areas that flow air and fuel, why are pistons the only items that SoA have released with their dimple design? "Our patents cover every space that air flows through the internal combustion engine (ICE), including intake and exhaust ports and manifolds, heads, turbos, etcetera," said Parkhurst, "We have done everything you can do to an ICE regarding dimpling; however, our testing has shown that the pistons provide the vast majority of the benefit with the turbo at the next tier." When it comes to commercial rebuilds, manifolds (both intake and exhaust) and heads aren't considered as consumable as the pistons and turbochargers are. "So, for those two reasons we have focused on commercializing something we can actually sell without us turning into just a machine shop," Parkhurst continued.

## Why Haven't OEMs Caught On?

That is a great question, but one that can only be answered with hypotheticals. It could come down to a cost versus benefit question that the aftermarket doesn't typically need to answer. When building in such mass quantities, speed and cost are huge factors even when both are minuscule at the individual level. It's why more parts snap on rather than bolt on for the vehicles you are driving today. The extra time cost of machining a piston with these features potentially outweighs the benefits of how a piston performs without them. Again, that's just speculation, but goes to a reason why the aftermarket exists.

They don't need to balance their sheets and justify time like an OEM does as their primary goal is to fulfill niche and specific markets.

One of those specific markets SoA is looking to service is California commercial diesel truck owners and operators. For engines older than 2010 (or chassis not refitted with an engine newer than that) and operating in heavy-duty vehicles weighing over 14,000 pounds, California has prohibited them from operating in and registering within the state. The issue comes down to the emissions of these particular engines, but the emissions improvements SoA has shown with just their pistons could become their saving grace.

"We are still in development on that and it will likely take at least 2,500 hours of durability testing," said Parkhurst, "but we'll see when we get a test letter issued from CARB. We think we will target either CAT C-series (9/12/15/18 liter) engine families or possibly the Detroit 12.7 and 14L 60 series, first." The kit Parkhurst described to us would be a complete kit that a rebuilder can do with the engine still mounted to the vehicle's frame and would not only include SoA's pistons but also a turbocharger, new ECM flash, and "a reasonably light substrate," he said, "We are pretty sure our substrate would be limited to DOC and we would not need DPF, SCR or EGR. There is much work to be done in that regard but that appears to be the achievable path."

For now, SoA is concentrating on the commercialization of their medium-duty diesel engine lineup. But, their work will also spread into racing and gasoline engines in the near future—all using the same aerodynamic principle that makes a golf ball fly through the air. Who knew that the lowly golf ball had so much to offer an internal combustion engine?