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Title: Evaluating the Impact of Speed of Air Pistons on Performance, Efficiency, and Thermal Characteristics in a 2015 VW Golf TDI

Abstract

This study by Fisher Motor Works evaluates the effects of Speed of Air pistons on performance, fuel efficiency, and thermal management in the 2015 Volkswagen Golf TDI engine. The stock Golf TDI engine, rated at 150 horsepower (hp) and 236 foot-pounds (ft-lbs) of torque, was first tested for baseline performance. Deviations from factory specifications were identified in power output, fuel efficiency, and exhaust gas temperature (EGT). Following the installation of Speed of Air pistons, notable improvements were observed in torque, horsepower, thermal efficiency, and fuel economy, highlighting the benefits of this modification for diesel applications.

1. Introduction

This study focuses on evaluating the performance changes in a 2015 VW Golf TDI after installing Speed of Air pistons. The Volkswagen Golf TDI, equipped with a 2.0-liter EA288 CRUA turbocharged diesel engine has a bore of 81 mm, a stroke of 95.5 mm, and a compression ratio of 16.2:1. It is factory-rated to deliver 150 hp and 236 ft-lbs of torque, with fuel economy estimates of 31 mpg in city driving and 45 mpg on the highway.

Due to its accessible design and ease of piston replacement without removing the engine block, the Golf TDI was chosen as an ideal candidate for this performance study.

The car used in this testing was equipped with a 6 Speed manual transmission, CR190 turbocharger, performance exhaust into a factory muffler and Stevenson Stage 2 tune.

2. Methodology

2.1 Baseline Testing with Stock Pistons

Baseline testing was conducted at Bob Cessna Motorsports in Cherry Tree, PA, using a Superflo dynamometer using STP correction values. Key parameters recorded included:

- **Horsepower and Torque:** Measurements were taken across the engine’s entire rpm range to capture peak and average values.

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- **Exhaust Gas Temperature (EGT):** Peak EGT was recorded to evaluate thermal load and combustion efficiency.

Real-world fuel economy tests were conducted by recording fuel consumption on the owners daily commute.

2.2 Installation of Speed of Air Pistons

Following baseline testing, the stock pistons were replaced with Speed of Air pistons. Installation involved new total seal rings and OEM gaskets, with no additional modifications made to the engine. A 2,000-mile break-in period was observed to ensure optimal performance before conducting post-installation testing at the same facility.

2.3 Data Collection and Analysis

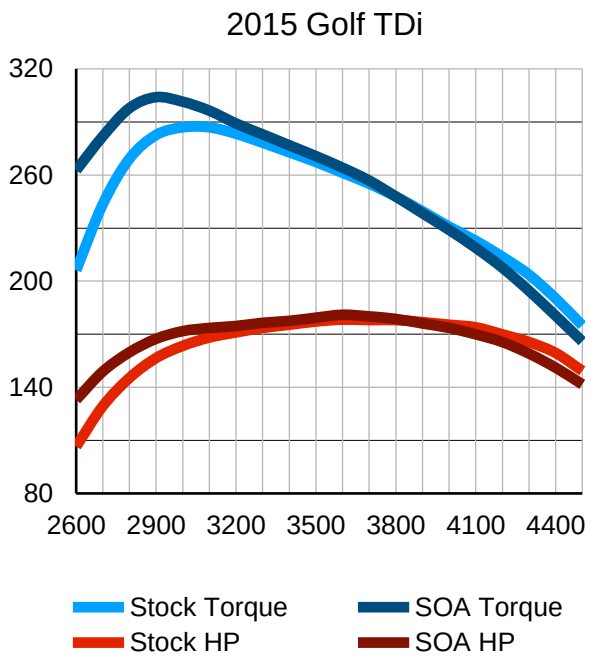
Post-installation data on horsepower, torque, fuel economy, and EGT were collected and compared against baseline values to determine the effects of Speed of Air pistons on the engine's performance characteristics.

3. Results

3.1 Baseline Performance with Stock Pistons

Testing of the 2015 VW Golf TDI with stock pistons showed:

- **Horsepower:** Peak output of 178 hp at 3200 rpms, with an average of 164 hp across test conditions.
- **Torque:** Peak torque reached 287 ft-lbs at 3000 rpms, with an average of 246 ft-lbs.
- **Exhaust Gas Temperature (EGT):** Peak EGT recorded at 838°C.
- **Fuel Economy:** averaged at 46 mpg.



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3.2 Performance with Speed of Air Pistons

After installing Speed of Air pistons, the 2015 VW Golf TDI showed the following changes:

- **Horsepower:** Peak horsepower increased to 181 hp at 3600 rpms, with an average of 167 hp (an improvement of 1.7%).
- **Torque:** Peak torque rose to 304 ft-lbs at 2900 rpms, with an average of 253 ft-lbs (an increase of 5.9%).
    - At 2,600 rpm, a substantial gain of 26 hp (24.8%) and 57 ft-lbs of torque (27.4%) was recorded.
    - Average torque gain bellow 3000 rpms was 13.3%.
    - Average horsepower gain bellow 3000 rpms was 12.4%
- **Exhaust Gas Temperature (EGT):** Decreased to 553°C, indicating improved combustion efficiency and better thermal management.
- **Fuel Economy:**

2015 Golf TDi

RPM	Stock Torque	SOA Torque	Stock HP	SOA HP	Torque Differnce	HP Differnce
2600	206	263	107	133	57	26
2700	243	282	129	149	38	20
2800	269	298	145	160	29	14
2900	283	304	157	167	21	11
3000	287	301	163	172	14	8
3100	287	296	168	174	9	5
3200	283	289	171	175	6	4
3300	278	283	174	176	5	3
3400	273	277	175	178	4	2
3500	267	271	177	179	3	2
3600	261	264	178	181	3	3
3700	255	257	178	180	2	2
3800	248	248	178	179	0	1
3900	239	238	177	176	-1	-1
4000	231	229	175	174	-2	-2
4100	223	219	174	170	-4	-4
4200	214	208	170	166	-6	-4
4300	204	195	166	159	-9	-7

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- Average fuel economy increased to 53 mpg (15%)

- **Power Loss:**
  - With SOA pistons there was a power loss above 3800 rpms continuing through to redline. Horsepower decrease by 8 (5.1%) at redline and torque decreased by 9 (5.2%) for an overall loss of horsepower by 2.9% and torque by 3%.

4. Discussion

4.1 Low-End Power and Torque Gains

The installation of Speed of Air pistons in the 2015 VW Golf TDI resulted in substantial low-end performance gains. The most notable gains were observed below 3,000 rpm, with a torque increase of 13.3% and horsepower increase of 12.4% where the engine's power delivery is critical for daily driving and acceleration.

4.2 High-RPM Power Loss

Despite the improvements at lower and mid-range rpm, a decline in performance was observed above 3,800 rpm, with a 2.9% reduction in horsepower and a 3% decrease in torque at redline. This decrease could be attributed to the design focus of the Speed of Air pistons, which appear optimized for enhancing low to mid-range efficiency rather than peak power at high rpm. The reduced performance at higher rpm could also be a result of altered air dynamics due to the piston modifications and made up for in tuning specific to Speed of Air pistons. Given that most daily driving occurs within the low to mid-range rpm, this trade-off may be acceptable for drivers seeking better real-world performance and efficiency rather than maximum output at high engine speeds.

4.3 Thermal Management Improvements

The reduction in peak exhaust gas temperature (EGT) from 838°C to 553°C (a 34% decrease) indicates a substantial enhancement in thermal efficiency. Lower EGTs are beneficial as they reduce the thermal stress on the engine's components and potentially extend their lifespan. The improved combustion efficiency, suggested by the lower EGTs, points to a more complete burn of the air-fuel mixture, resulting in less unburned fuel exiting the exhaust. This reduction in thermal load may also contribute to lower NOx

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emissions, a common concern for diesel engines, as it reduces the likelihood of nitrogen oxides forming at high combustion temperatures.

4.4 Fuel Economy Gains

The study revealed a significant increase in fuel economy, with average mpg improving by 15% from 46 mpg to 53 mpg. This improvement can be attributed to the enhanced combustion efficiency facilitated by the Speed of Air pistons. The increased average torque across the low to mid-range rpm band likely allows the engine to maintain speed with less throttle input, thereby reducing fuel consumption. These gains are especially beneficial for highway driving, where steady-state cruising efficiency is paramount. The ability to achieve higher fuel efficiency without sacrificing torque makes the Speed of Air pistons a compelling upgrade for drivers who prioritize both performance and economy.

5. Conclusion

The installation of Speed of Air pistons in the 2015 VW Golf TDI led to measurable improvements in performance, thermal management, and fuel efficiency, with the most significant benefits observed in the mid-range rpm range. The key findings of the study are:

- **Performance Enhancements**: Notable gains in low-end torque and horsepower improved the vehicle's acceleration and responsiveness during daily driving scenarios. The increases in power delivery at typical driving speeds are likely to enhance the overall driving experience without the need for aggressive downshifting.

- **Thermal Efficiency**: A substantial reduction in EGTs indicates improved combustion efficiency, which may contribute to longer engine and turbocharger lifespans by reducing thermal stress. Lower EGTs also suggest a more complete burn of the air-fuel mixture, potentially reducing harmful emissions.

- **Fuel Economy**: The 15% increase in average fuel economy underscores the potential of Speed of Air pistons to enhance efficiency in real-world driving conditions. This improvement is particularly valuable for long-distance travelers and commuters looking to reduce fuel costs and emissions.

Overall, the Speed of Air pistons offer a compelling upgrade for the VW Golf TDI by enhancing mid-range power and fuel efficiency without significant sacrifices in peak

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performance. While there is a slight decrease in high-rpm output, the benefits in everyday driving scenarios make this modification advantageous for those prioritizing practical performance gains and improved fuel economy.

These findings support the use of Speed of Air pistons as a viable aftermarket upgrade for drivers seeking to optimize their diesel engine's performance and efficiency. Further research, including long-term durability testing and emissions analysis, would provide additional insights into the overall impact of this modification on the vehicle's longevity and environmental footprint.

Note: Fisher Motor Works conducted this test independently without solicitation or compensation from Speed of Air.