THESIS

INVESTIGATION OF SUPERTURBOCHARGER PERFORMANCE IMPROVEMENTS THROUGH STEADY STATE ENGINE SIMULATION

Submitted by

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ABSTRACT

INVESTIGATION OF SUPERTURBOCHARGER PERFORMANCE IMPROVEMENTS THROUGH STEADY STATE ENGINE SIMULATION

An integrated supercharger/turbocharger (SuperTurbo) is a device that combines the advantages of a supercharging, turbocharging and turbocompounding while eliminating some of their individual disadvantages. High boost, turbocompounding, and advanced controls are important strategies in meeting impending fuel economy requirements. High boost increases engine power output while many losses remain constant, producing an overall efficiency gain. Turbocompounding increases engine efficiency by capturing excess exhaust turbine power at high speed and torque. Supercharging increases low speed high torque operating performance.

Steady state performance gains of a Superturbocharger equipped engine are investigated using engine simulation software. The engine simulation software uses a 1-D wave flow assumption to model the engine's unsteady flow behavior through one dimensional pipes. With these pipes connected to other engine components the overall performance of the engine can be modeled. GT-Power was chosen to run the simulations due to an already correlated engine model being available. This software is used to 'tune' an existing stock engine model to approximate stock engine data over the full speed and

torque range. The SuperTurbo is added to the model and simulations are performed over the full engine speed and torque range for direct comparison with the stock engine.

The model results show turbocompounding to be most effective at high speeds and torques in the area above 10 bar BMEP in the 3000 – 4000 RPM range and above 5 bar BMEP in the 500 – 6000 RPM range. In addition to turbocompounding there are fuel savings due to the reduced use of the compressor when it is not needed. With the stock configuration there is boost pressure created by compressor power that is then restricted by the throttle in the 2500 RPM range in the 8-12 bar BMEP range on up to 6000 RPM in the 2-10 bar BMEP range. The control of compressor speed to produce no boost at these locations improves efficiency by not wasting energy creating boost that is not needed.

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CHAPTER 1: INTRODUCTION

1.1 Scope and Focus of Thesis

In this work, an already calibrated engine model is modified by adding a model of a device called a superturbocharger (SuperTurbo). This device incorporates a transmission between the turbocharger shaft and the engine's crankshaft. The transmission consists of a high speed traction drive section and a continuously variable section that will allow control of turbocharger speed, independent of crankshaft speed. This allows for more options for load control as the load can now be adjusted with both the SuperTurbo gear ratio and the throttle valve.

Chapter one discusses work leading up to this investigation as well as the current status of the SuperTurbo development. Chapter two describes the modeling software and the available calibrated stock engine model, as well as the SuperTurbo addition. Chapter three describes the simulations of the two independent load control mechanisms consisting of the throttle and the SuperTurbo. Chapter four summarizes the results, presents a conclusion and possibilities for future work.

1.2 Literature Review

There are several aspects of engines that relate to current efforts to make them more fuel efficient, while keeping emissions low and maintaining drivability. Both steady state and transient modes are considered. Forced induction as a means of downsizing the engine is investigated. Waste heat recovery methods can be used to increase fuel efficiency. Control efforts are also an important consideration.

1.2.1 Transient and Steady State Performance

It has become increasingly common for smaller, better performing engines to replace larger engines in automobiles. In the past, engine manufacturers were able to accommodate increased performance requirements with increased displacement. However, since the advent of political uncertainty surrounding emissions and fuel prices, it has become necessary for engine and automobile manufacturers to continually improve fuel economy and lower emissions without sacrificing drivability. A common goal has been to produce equivalent power, through means such as boosting, from a smaller engine leading to potential fuel and emissions savings [(1), (2), (3), (4)]. This technique has often been referred to as engine downsizing [(1), (5), (6)]. Through the study of previous and current efforts along with modern engine modeling software, further engine downsizing can be realized.

Engine performance relating to fuel economy, emissions, and power can be divided into two operating modes: transient and steady state. Steady state behavior has usually been characterized by low load constant speed driving, such as on the highway. In stationary applications where engines run at near constant speed and load, the engines can be designed around a single operating point, making them among the most efficient of all reciprocating engines available. The problem arises with trying to obtain improved fuel economy while at the same time having satisfactory transient performance.

A vehicle can experience several different types of transients. One type of transient response is when the speed remains relatively constant while the load is changed, which occurs as the clutch is being let out on an automobile with a manual transmission. Another type of transient situation is where the load is kept relatively constant while the speed undergoes transient behavior. In urban settings automobiles most often undergo a combination of the two where load and speed are both experiencing transient behavior [7], [8]. This is where drivability of the downsized engine comes into play. The automobile will intermittently need extra power for the quick accelerations necessary in daily driving. If the downsized engine is not able to adequately accept its given load at a given speed, the engine speed will drop and in the extreme case, eventually stall if corrective measures such as downshifting are not implemented [8].

When a torque (or horsepower) curve vs. engine speed is given for a specific engine, it indicates the steady state torque at a given engine speed. Loading (increased torque) the engine above this line results in a decrease in engine speed. Steady state loads are associated with friction in the system as well as air drag forces. The transient situation must also take into account the energy used to accelerate the inertial loads [8], [9], [10]. As a car is accelerating through its gear range, it is continually going through the speed range of the engine. This requires the engine to overcome inertia from the engine, the drive train, and from the automobile itself, in addition to the friction and air resistance that is also experienced at steady state operation. This plays an important role in the drivability of an automobile.

Another disadvantage during transient performance is the rapidly changing intake air. In contrast with steady state operation, where there is ample time for the ECU to optimize the air fuel ratio accurately, transient response is susceptible to transient response characteristics in all control systems, such as overshoot and settling time, resulting in poorer fuel and emissions ratings [7]. When an automobile engine operates at steady state mode, it has the advantage of being able to accurately keep the air to fuel (A/F) ratio at the desired level with an O_2 sensor due to the near constant rate of air being delivered. Along with the use of a 3-way catalyst, satisfactory power, fuel consumption, and emissions can be realized.

Automobile engines require a large range of operating conditions that need to be considered for overall performance. Engines must have satisfactory steady state fuel and emissions performance and maintain this performance during transient operation, which require dramatic increases in load. These considerations must also take into account the overall economic value with respect to the additional complexity. Boosted engines are becoming increasingly more complex, but the cost benefit ratio of such systems has been realized through their ever-increasing use.

1.2.2 Forced Induction

As the saying goes, "There is no replacement for displacement." A forced induction engine is simply not capable of meeting the transient performance of a naturally aspirated engine of the same power output [(3), (4), (8), (9)]. This has been the main challenge confronting the use of forced induction engines with regards to both superchargers and turbochargers.

Forced induction refers to the concept of forcing more air into the intake manifold stream than a naturally aspirated engine is capable of. This compressed air is referred to as boost. The two most common types of forced induction are supercharging and turbocharging. While turbocharging is sometimes referred to as a type of supercharging [(1)], they will be referred to as two separate concepts herein. Supercharging uses energy from the crankshaft to drive a compressor; turbochargers use exhaust gas energy to drive a compressor. Another type of forced induction is the Comprex pressure wave charger [(9), (10), (11)]. This system uses the exhaust gas pulses as a means for compressing the intake air. There are also studies on injecting a stored source of compressed air into the intake stream [(8)].

Supercharging is historically associated with high performance and racing applications without regard for fuel economy. Compared to other pressure charging methods, supercharging is not very desirable for steady state performance as it requires crankshaft power. Additionally, at steady state operation this extra power is not needed. Through the technique of downsizing, a supercharged engine can replace a larger naturally aspirated engine for transient needs while still having adequate low load capability for steady state operation. A supercharger needs to be selected that can quickly develop boost with minimal losses at low loads when not in use.

In one study, a positive displacement backflow vane type supercharger was selected for its capability of developing the necessary boost at speeds close to engine speed due to its closely matched volumetric efficiency [1]. This eliminated the complexity of high speed operation. It was also chosen since it was compact and lightweight compared to compressors with similar outputs. With the proper selection of a supercharger, the engine acts as a smaller naturally aspirated engine at steady state speeds while still being able to develop the torque needed at higher loads with the assistance of the supercharger. While good results were obtained, this design was not widely implemented. Figure 1.1 shows fuel economy and 0-60 mph time

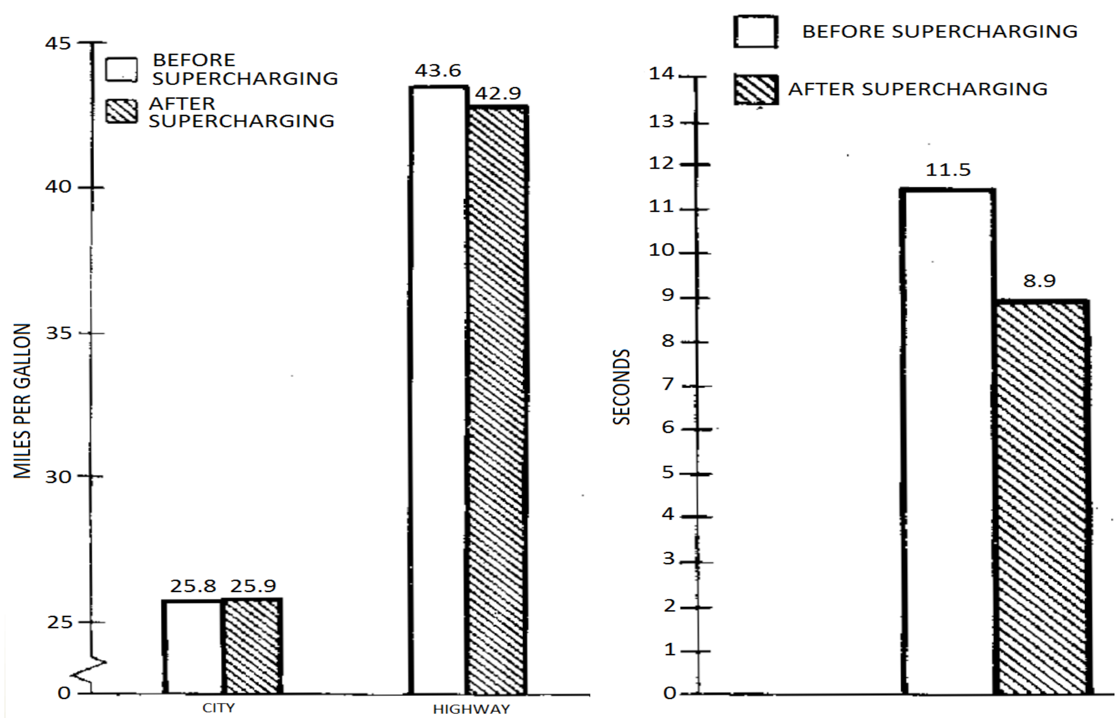

Figure 1.1: 1980 Scirocco fuel economy and 0-60 mph times [1]

comparisons for a 1980 Volkswagen Scirocco with a 1.6 liter inline 4 cylinder engine with a 5 speed manual transmission. The axle ratio was kept constant at 3.89:1 and the continuous fuel injection system left unchanged. The graph shows almost identical city fuel economy with slightly worse highway fuel economy, but a 0-60 mph time decrease from 11.5 to 8.9 seconds (23% decrease). Figure 1.2 shows the same comparison for a 1979 Dodge Omni with a 1.7 liter

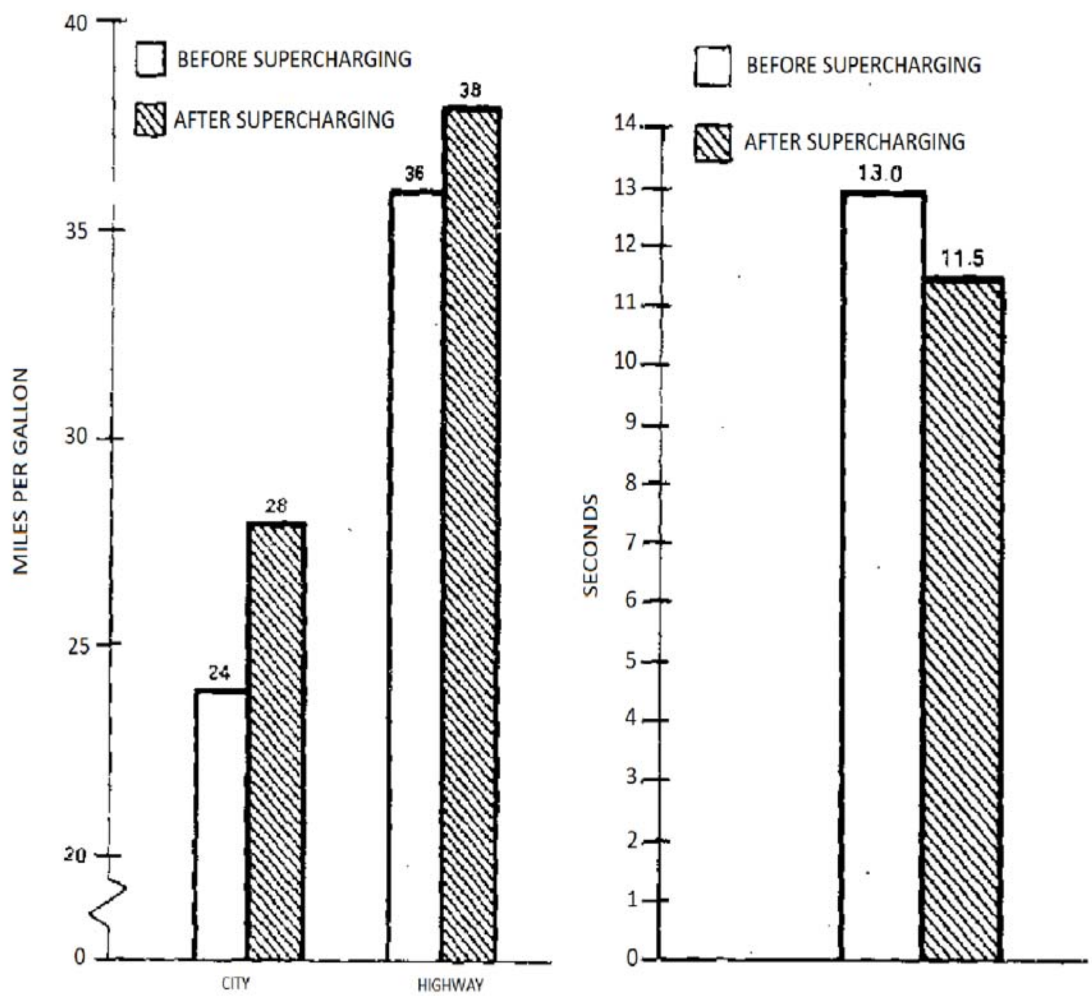

Figure 1.2: 1979 Omni fuel economy and 0-60 mph times [(1)]

inline 4 cylinder engine with a 4 speed manual transmission. The axel ratio was 3.47:1 as received and reduced to 3.08:1 for the supercharged testing. The fuel system was switched from a Holley 2v to a Pierburg 1v most likely in order to be able to operate under boost pressure. The results show improved fuel economy for both city and highway (about 17% and 9% respectively), as well as improved 0-60 mph time response (13% faster).

Turbochargers are becoming increasingly used for improved efficiency. Unlike the supercharger, a turbine in the exhaust system powers the compressor instead of the crankshaft. The losses due to the increased back pressure in the exhaust are overcome, by the advantages of the forced induction. This makes it ideal for improved load acceptance during steady state applications where the engine performance can be designed around a smaller range of operating points. However, turbochargers have inherent disadvantages with transient performance.

In a turbocharger, the compressor and turbine must be matched for a required pressure ratio and mass flow. Perfect matching can only be accomplished for one particular operating point [(12)]. Due to this, compromises in efficiency are often made in order to enable operation over a wider range of conditions.

When a turbocharged engine increases its speed, the excess turbine power needed to accelerate the turbo machinery inertia can result in what is known as turbo lag, a temporary mismatch of the turbocharger-engine system. This causes reduced fuel efficiency and higher emissions during this period. A turbocharger that is optimized for steady state performance will have a considerable amount of turbo lag. To address this issue it is common practice to sacrifice efficiency even further in order to reduce the inertia and thus the turbo lag [(12)].

Boosted engines also have the disadvantage of an increased likelihood of self ignition, commonly known as knock. This is often dealt with by a retarded spark advance. Turbocharged engines have yet another disadvantage involving exhaust gas temperatures. The maximum turbine inlet temperature can easily be exceeded during full load operation, requiring the engine to run rich in order to reduce turbine inlet temperature to an acceptable level, as well to decrease the tendency for knock by reducing in-cylinder temperature. Periods of transient response, where the engine is required to run rich, leads to higher fuel consumption and emissions [5].

Testing was done to compare the differences between a turbocharger and a supercharger on a 2.3 liter spark ignition engine [4]. The first objective was to optimize the turbocharger operation in two areas. First, tests were conducted to evaluate the effect of turbine inlet temperature on turbocharger performance. The stock manifold used was excessively long resulting in a temperature loss of about 56 C compared to the rerouted crossover pipe, which was 60% shorter. The shortened pipe had a significant impact in turbocharger speed change with an improvement of about 31%, while steady state tests showed only a slight improvement. Next, the effect of intake volume between the compressor discharge and the ends of the intake manifold were investigated. Through calculations it was predicted that a 25-fold increase in volume (from 40 to 1000 cu. In.) would affect the response time by 0.1 seconds. These surprising results were then verified experimentally where an increase from 50.6 cu. in. to 1174 cu. in. resulted in a delay in the range of 0.1 to 0.125 seconds. Following the turbocharger optimization tests were a series of tests to compare the supercharger setup with the turbocharger setup. The supercharger used was the Bendix clutched, positive displacement type referenced earlier. The transient tests conducted consist of transient load only, from an idle condition at a set speed to wide-open throttle at that same speed. The results are shown in Figure 1.3. The supercharger shows a quick response in the

time it takes to develop boost, where the turbocharger comes up to ambient pressure quickly as the throttle is opened, but then develops boost at a much slower rate taking up to a second longer at 3000 RPM and never reaching full boost at the 2000 RPM condition. The slow turbocharger boost rise in the 2000 RPM condition triggered the ignition timing switch, which

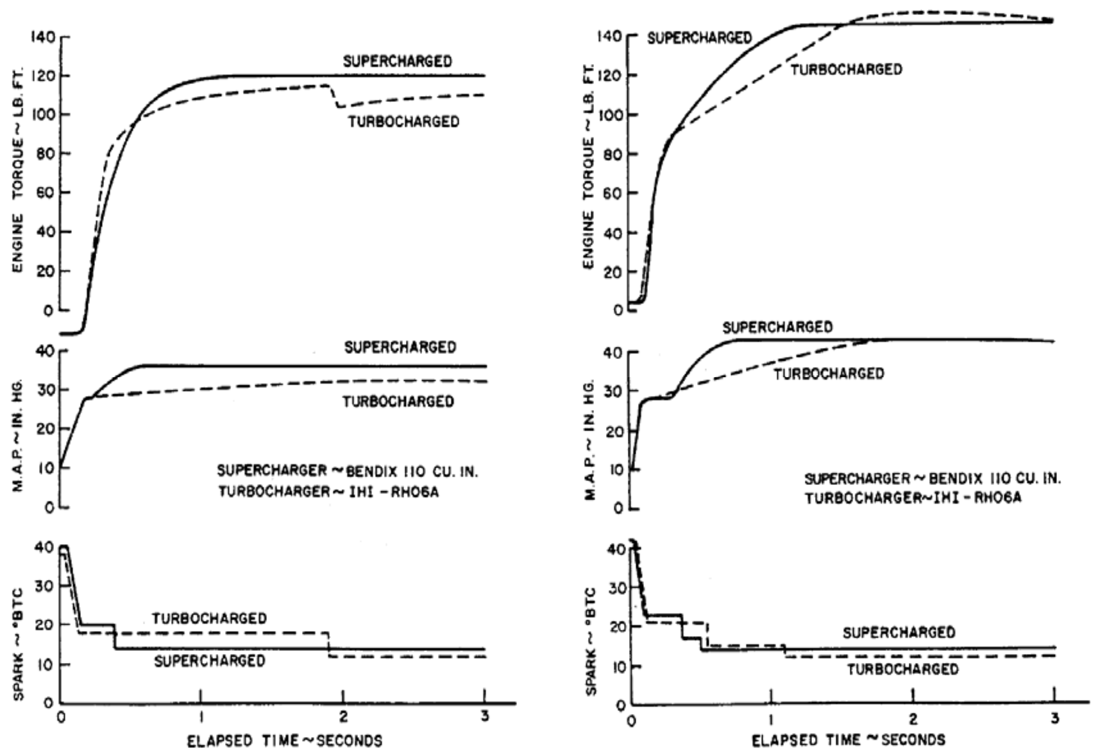

Figure 1.3: Comparison of turbocharged/supercharged 2.3l EFI spark-ignited engine performance of WOT transient at 2000 rpm (left) and 3000 rpm (right) [(4)]

resulted in 6 degrees of spark retard and added to the torque difference as shown. The steady state performance tests are shown in Figure 1.4.

The major differences between supercharging and turbocharging appear to be the higher temperature difference across the supercharger compressor indicating more parasitic losses, whereas the turbine in the turbocharger has a much higher level of backpressure in the exhaust, which also leads to pumping inefficiencies. Another tradeoff between these two setups was that the supercharger was capable of accepting load more quickly while the turbocharger was able to accept more load overall.

1.2.3 Waste Heat Recovery

For reciprocating engines there is a rule of thirds which approximately states that only one third of the combustion energy is used as mechanical energy with another third of the

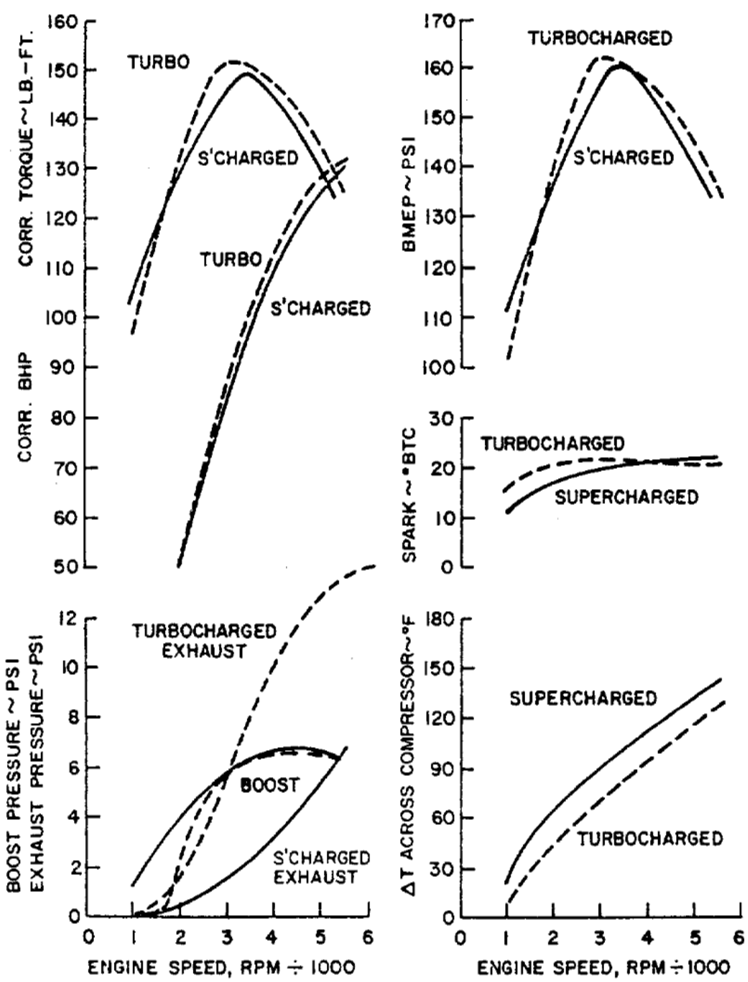

Figure 1.4: Steady state WOT performance tests [4]

energy transferred to the cooling system and the final third wasted in exhaust heat. While modern engines are more efficient thermal energy in the exhaust still accounts for a significant amount of the total thermal energy released during combustion. A turbocharger is capable of converting some of this energy into compressed air, but there is considerably more energy available to a turbine than a compressor is capable of using at steady state. This leads to the method of turbocompounding where extra energy available in the exhaust that is not used for turbocharging is converted to mechanical energy with a power turbine and then transferred to the crankshaft of the reciprocating engine.

Mechanical turbocompounding has an extensive history dating back to WWII with a wide range in application and arrangement [13], [14]. While turbocompounding might commonly be thought of as a solution to improved steady state operation, it has been shown that if the turbines are placed in series, the compressor turbine is able to maintain higher speeds during transient load tests, which in turn improves the transient response of the system [15] as shown in

Figure 1.5. This figure shows the turbocompounded engine reaching 85% of maximum load from one half to over a second faster across the engine speed range shown.

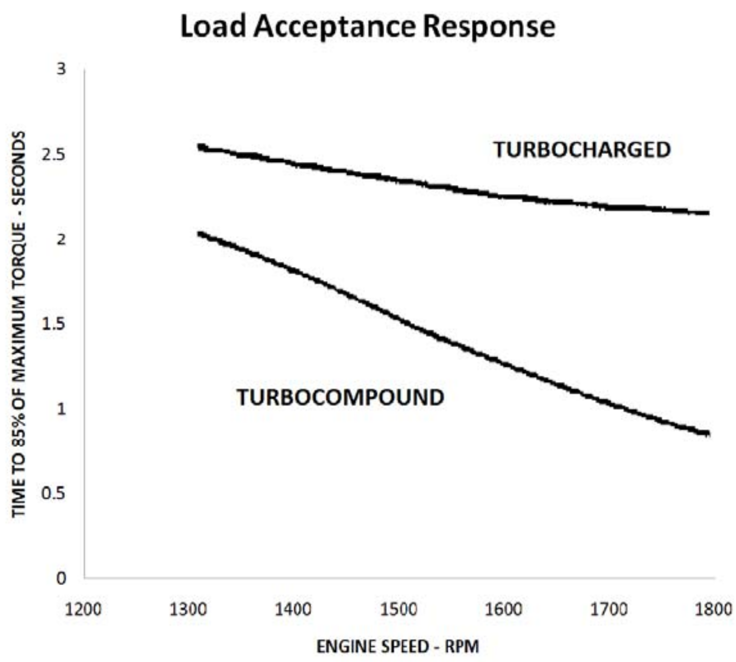

Figure 1.5: Comparison of load acceptance response between [15]

Both electrical and mechanical turbocompounding have been studied [12], [16]. Mechanical turbocompounding seems to be the preferred method due to the electrical system's increased inertia and its sensitivity to the high temperatures inherent in the turbocharger system [17].

Other methods studied for recovering waste heat energy include Rankine bottoming cycles [16] and charge air cooling [18]. Rankine bottoming cycles use exhaust heat to create a steam cycle that goes through a power turbine. Charge air cooling uses exhaust gas energy in combination with heat exchangers, suction compressors, and expanders to cool the intake air.

1.2.4 Control Strategies

With the increased complexity of modern engines due to downsizing techniques, it is becoming necessary for controls to play a larger role in engine performance. Modern fuel systems are able to deliver fuel at a very controllable rate. The more difficult part of air fuel ratio control deals with precise control of the intake air.

Although there has been much research going on in the area of transient engine system control, it helps to first have an accurate and quantified analysis and evaluation of the transient behavior. This has led to the development of transient response specifications as well as the classification and evaluation of different acceleration types as shown in Figure 1.6. These correspond to throttle changes from 10-17% assuming 0% is fully closed and 100% is fully open. The speeds were changed at a constant load setting. It was shown that the driving behavior of an individual can also have an effect on performance.

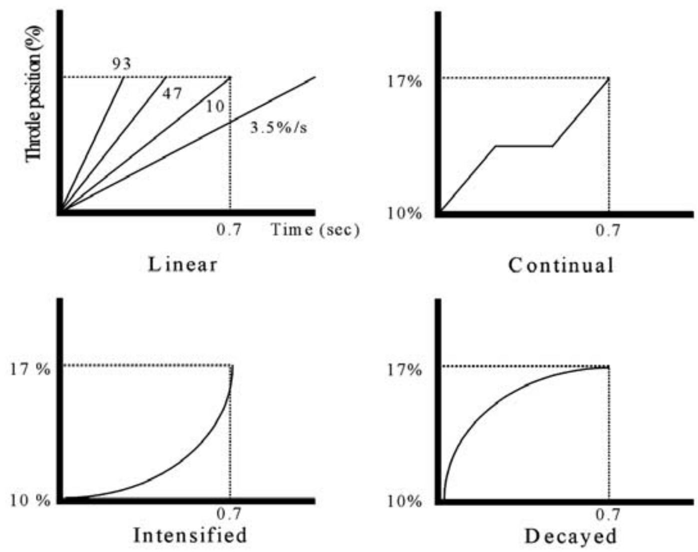

Figure 1.7: Acceleration speeds and types [7]

Figure 1.7 shows the

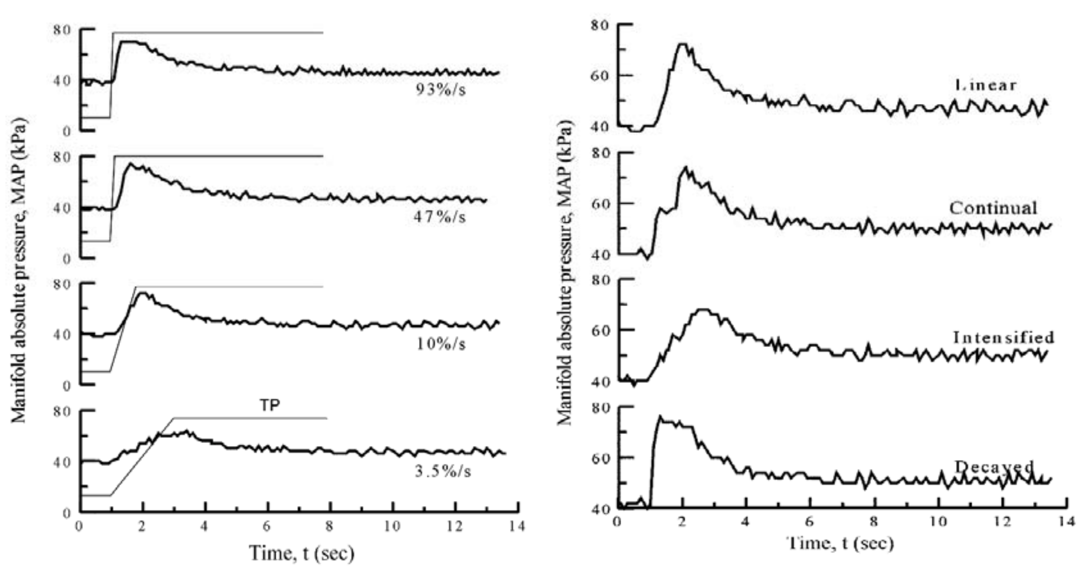

Figure 1.6: MAP responses according to the throttle valve opening speed (left) and acceleration type (right) [7]

difference in manifold absolute pressure (MAP) vs. time for the different acceleration types. The air excess ratio of an automobile [7] was also affected as shown in Figure 1.8, which in turn leads

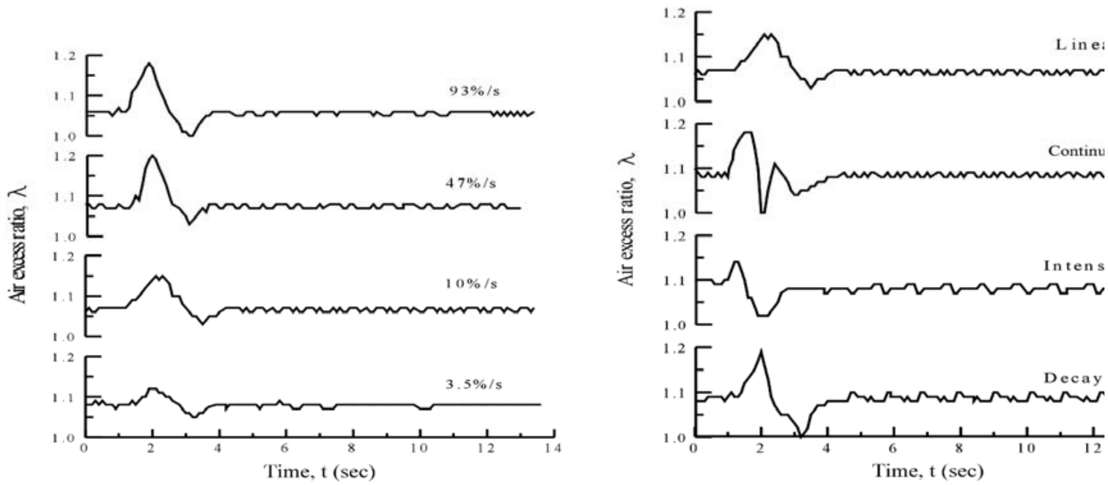

Figure 1.8: Air excess ratio responses according to the valve opening speed and acceleration type [7]

to poorer emissions. The engine speed response for all acceleration types except for the two slowest linear types were shown to be fairly similar indicating that there is a limit to acceleration performance as shown in Figure 1.9, and anything beyond that limit only leads to poorer fuel economy and emissions. This lead to the idea that control of throttle position, independent from pedal position, could be a desired control strategy for improved fuel and emissions performance.

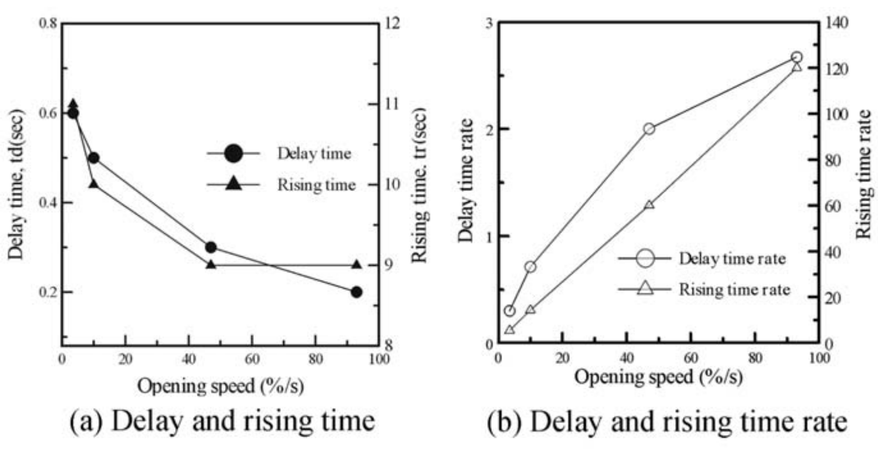

Figure 1.9: Transient response specifications of RPM [7]

Integration of throttle and wastegate control for turbocharged engines has been studied [3]. Due to the increased need for accurate throttle control with turbine engines, control strategies have been developed for electronically actuated intake throttles for improved response. The airflow can then be controlled independently of the foot pedal position. With this setup, the driver still requests a speed or load increase, but the control of the intake throttle valve are performed by the computer controlling the overall system.

Decoupling the throttle response from the foot pedal has led the way to additional improvements in air flow control. Modeling performed on an engine using GT-Power engine simulation software shows the effect of different throttle arrangements for a supercharger and compares them to the effects of different fueling and wastegate management for a turbocharger [5]. The engine simulations were first calibrated according to experiments involving spark advance, combustion, max combustion pressure, full-load curves, etc. Once the engine model was validated, changes to the model involving the location of the throttle were implemented. Intake air can be controlled by many different throttle arrangements for a supercharged engine. The throttle can be placed either before or after the compressor. There was also the option of having a bypass/recirculating valve for the compressor on both of the previous conditions for a total of 4 different arrangements. Modeling on 3 of the 4 configurations, leaving out throttle after the compressor with bypass, showed that throttle before the compressor, with bypass, has the best low load fuel consumption with the same version without the bypass slightly higher as shown in Figure 1.10. The condition with the throttle after the compressor with no bypass was shown to be much less efficient at these operating points, largely due to the operating points being at high compression ratios lying outside the original compressor map which only went up to a pressure ratio of 3. The effect of having a bypass with the throttle after the compressor was not shown. The use of bypass in this

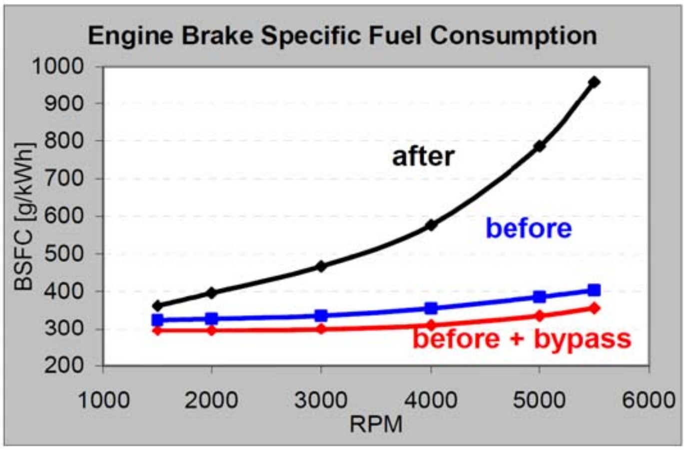

Figure 1.10: Comparison of fuel consumptions for three types of supercharger regulation [5]

situation could have resulted in lower pressure ratios that are inside the compressor map. This engine was compared to a turbocharged version with different variations in fuel control and wastegate control. The turbocharged version was shown to produce more power at reduced fuel consumption over the full load range at maximum turbo speed. The first condition was the maximum allowable torque and power with the disadvantage of poorest fuel economy. The second condition was modified by reducing fuel use at lower engine speeds, only so that the high speed power and fuel consumption is the same. The third version was the economic version where the wastegate diameter was enlarged causing both power and fuel consumption to drop. The first situation had the wastegate open during low engine speeds on the full load curve. A more optimum situation would be that the wastegate is closed at lower engine speeds and then opened at the higher engine speeds. These results lead to the idea that a larger turbocharger could reduce fuel consumption and increase efficiency [5].

Another valve control approach consists of a valve system that closes off the intake to the compressor and bypasses it at low loads for a turbocharged engine, labeled as the fast response turbocharging method. This testing was done empirically due to unavailability of turbine maps and zero flow compressor maps. Figure 1.11 shows that by having zero flow through the compressor, the speed of the compressor was substantially higher at a lower load than the WOT compressor speed. This implied the possibility of improved transient response [2].

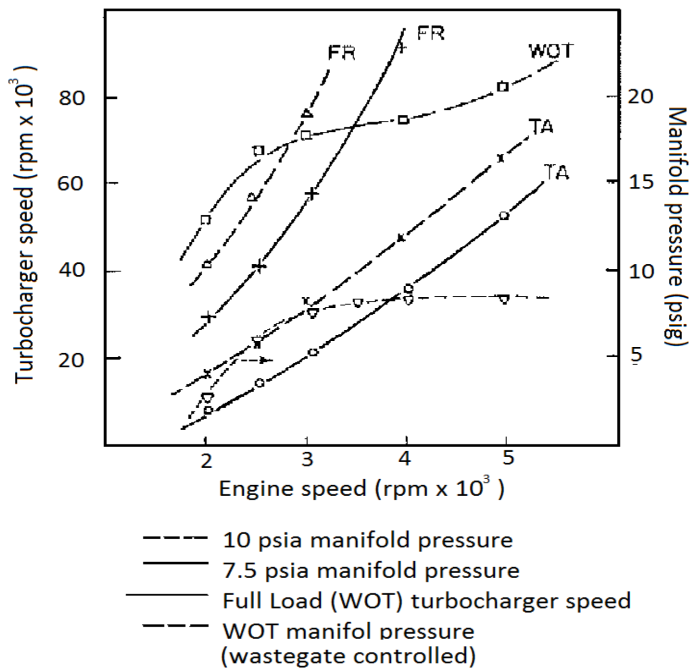

Figure 1.12: Turbocharger speed for conventional system (TA) and for zero airflow (FR) for two sub-ambient pressures [(2)]

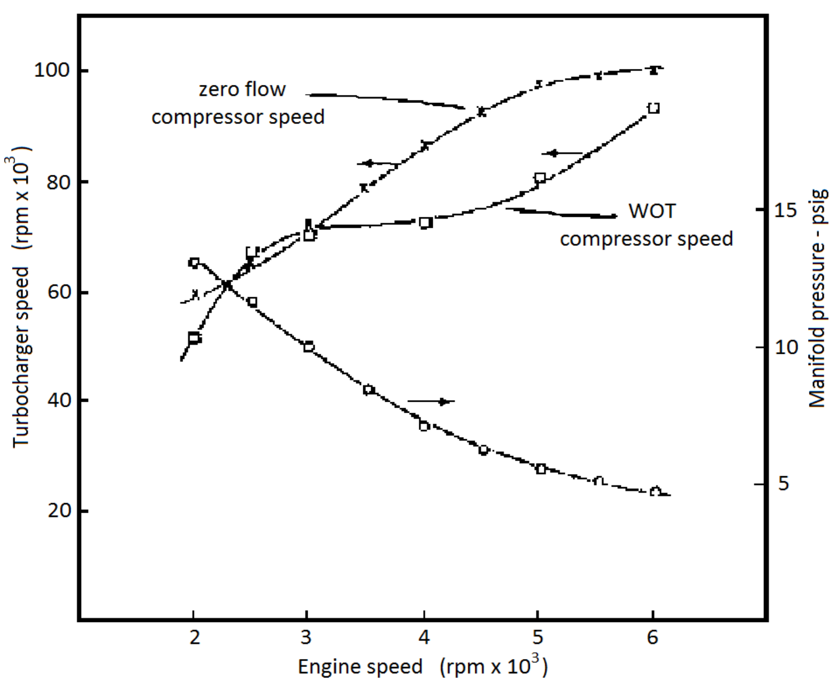

Figure 1.11: Control of zero flow compressor speed for fast response system [(2)]

After this finding, the turbo shaft speed was limited by the use of a throttle that choked the bypassing airflow through the engine to a level low enough that the turbine had only enough power to keep the compressor speed at an acceptable level, as shown in Figure 1.12. It was also determined that bearing losses in the compressor dominated at low speeds while turbulent losses dominated at higher speeds, which helps to keep the compressor from spinning too fast. Other methods such as use of a wastegate control to maintain shaft speed were also found to be effective, but not essential.

After the effective valve areas were chosen in a manner to ensure smooth airflow transfer, transient tests were implemented. Tests were carried out where the engine speed was held constant at a low load and then the throttle was opened suddenly as shown in Figure 1.13.

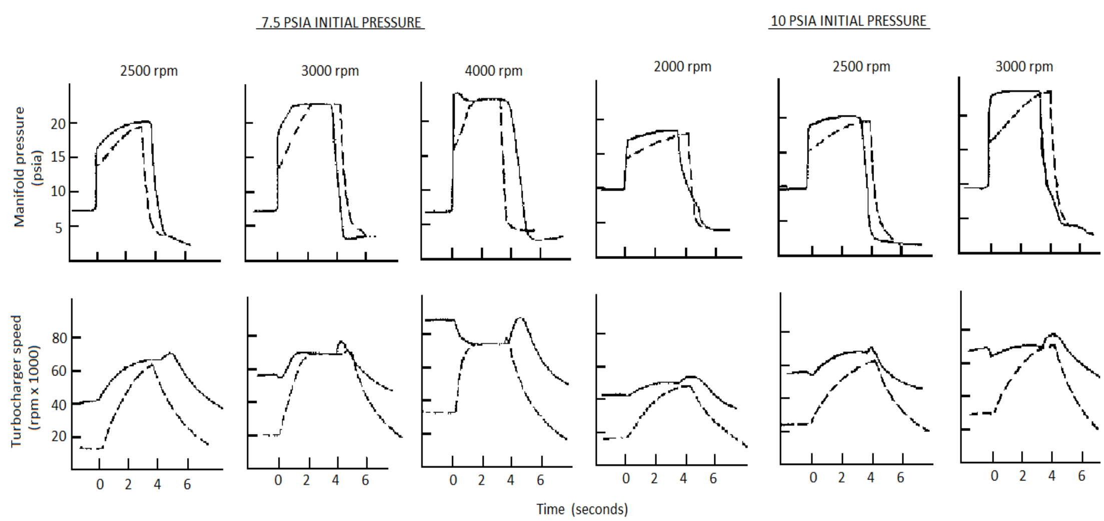

Figure 1.13: Transient response of conventional (- -) and fast response (-) system [(2)]

It was found that when initial low load turbo speed was below steady state full load speed, manifold pressure immediately following fast throttle opening was above ambient pressure but less than full load. If the initial low load turbo speed was above steady state full load speed, the manifold pressure would temporarily exceed steady state full load pressure while the turbo speed decelerated. When installed in the same automobile, the fast response system showed significant improvement over the traditional system as shown in Table 1.1. The fast response system also allowed the turbine shaft to maintain its speed during gear changes. Some drawbacks to this system were the complexity of the mechanical valve linkages and the possibility of surge instability, although in the experiments carried out, no evidence of surge was found. There were additional measures suggested that could help suppress surge oscillations if

Table 1.1: Level road acceleration tests [2]

	1	2	3	4
GEAR	3	4	4	3
ENGINE SPEED (RPM)	3000	2500	2800	3600
INITIAL ROAD SPEED (MPH)	45	53	60	55
FINAL ROAD SPEED (MPH)	70	70	80	70
INITIAL MANIFOLD PRESSURE (psia)	10	10	7.5	7.5
ΔT (sec) CONVENTIONAL	5.6	6.1	7.1	3.3
ΔT (sec) FAST RESPONSE	5.1	5.1	6.3	2.8

present. Overall, the fast response system was shown to improve performance over a conventional turbocharging system [2].

Air cycle calculations were carried out to investigate several load control strategies as alternatives to throttling for an Otto cycle engine [19]. This study was motivated by the fact that Otto cycle engines are not capable of the part load efficiencies of a diesel engine due primarily to throttling losses. After presenting the base case of a throttled engine (strategy I), several alternatives were presented consisting of variable fueling, variable compression ratio, and early intake valve closing. After studying the tradeoffs between these strategies, the final two strategies for comparison consisted of versions of variable valve timing with boost. The first strategy met load demand first with boost, and if no boost was available, would utilize delayed intake valve closing (strategy V-I). The second concept delayed valve timing first, then used turbocharger boost to meet the high load demands (strategy V-II). The results indicated that the first method had increased thermal efficiency and reduced peak pressure over the second method as shown in Figure 1.14. Then when compared to the naturally aspirated throttled engine, it was shown that there are efficiency gains over the full range of loads, as well as peak pressure reductions over much of the range as shown in Figure 1.15.

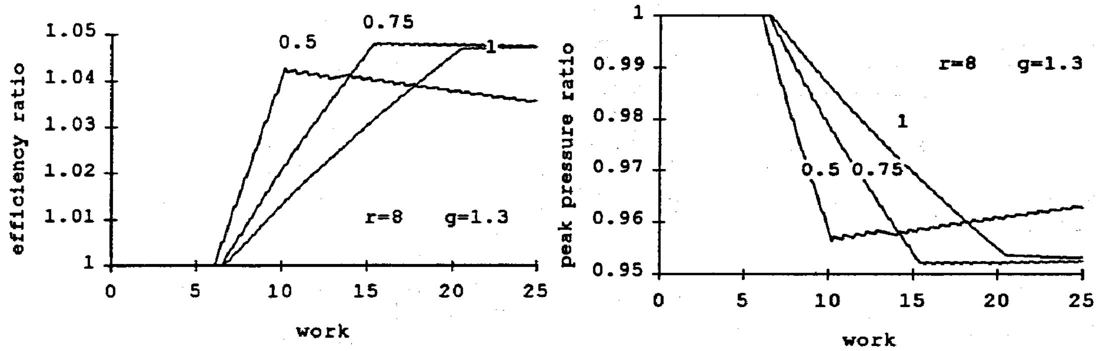

Figure 1.14: Ratio of efficiency of strategy V-I to strategy V-II for different values of F (left) and ratio of peak pressure of strategy V-I to strategy V-II for different values of F (right) [19]

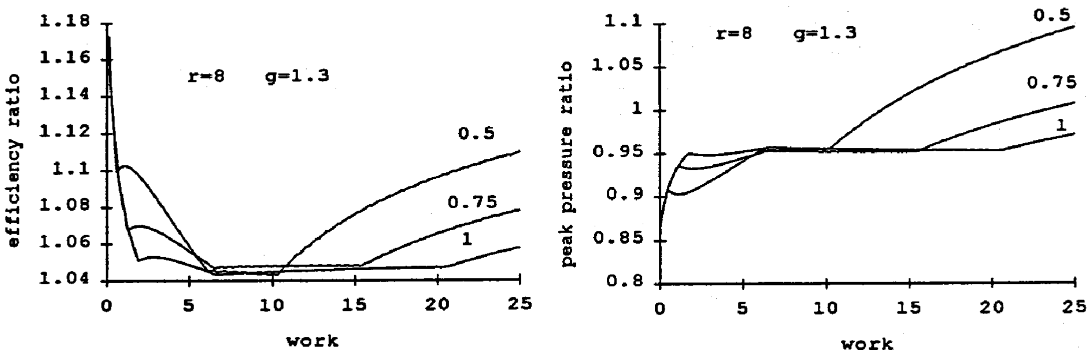

Figure 1.15: Ratio of efficiency of strategy V-I to strategy I for different values of F (left) and ratio of peak pressure of strategy V-I to strategy I for different values of F (right) [19]

1.3 SuperTurbo

The SuperTurbocharger is a concept currently being developed by VanDyne SuperTurbo. As shown in Figure 1.16, it allows power to flow from the crankshaft to the turbine shaft to supplement turbine power when substantial boost is needed and it also allows turbocompounding where excess turbine power flows back to the crankshaft. As Figure 1.17 illustrates it combines the advantages of a

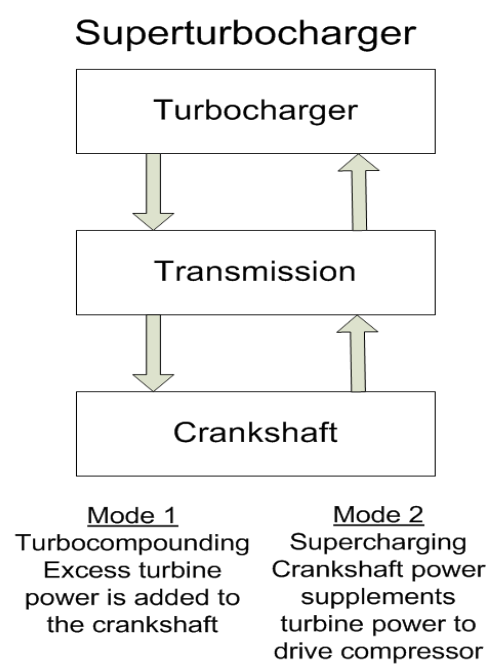

Figure 1.16: SuperTurbo power flow diagram

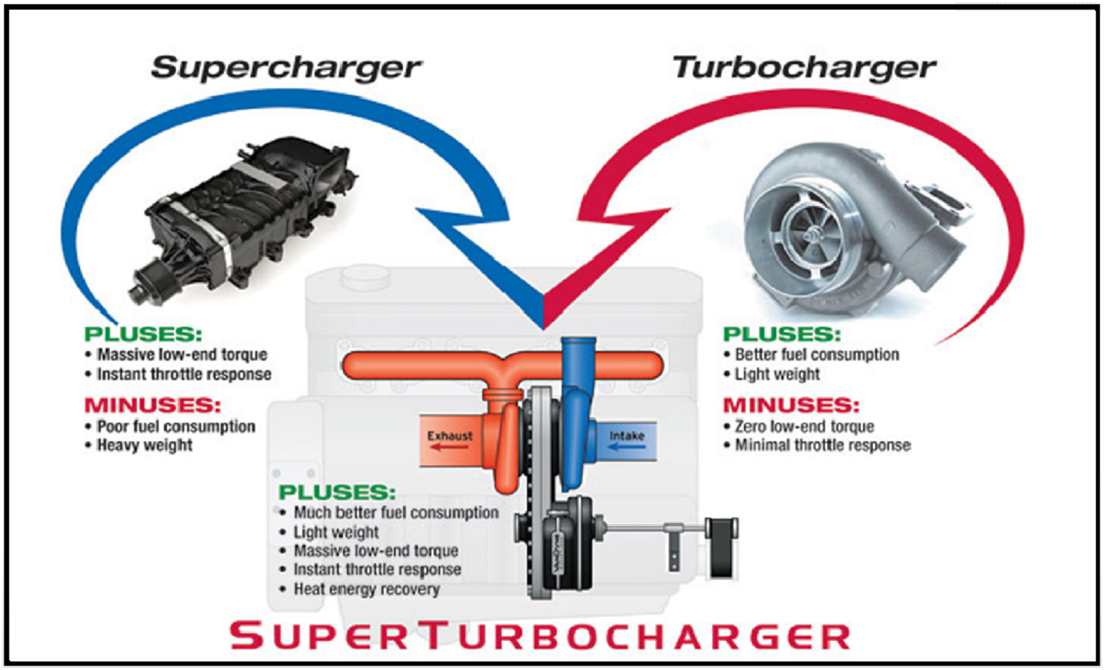

Figure 1.17: The SuperTurbocharger combines the advantages of a supercharger and a turbocharger as well as eliminating some of their individual disadvantages

supercharger and a turbocharger while eliminating some of their individual disadvantages.

The rationale for design consisted of a comparison of double stage turbocompound, single stage turbocompounding, and electrical turbocompounding to the already established single stage conventional turbocharger setup. It was decided that the thermal sensitivity and added inertia of the electrical system were larger drawbacks than the mechanical and packaging constraints inherent with the single stage mechanical SuperTurbocharger concept.

Initial modeling work was done with GT-Power on an 11 liter Hyundai natural gas engine [17]. The modeling showed an improvement in brake specific fuel consumption (BSFC) of as much as 10% for high speed and load as shown in Figure 1.18. This was due in part to the extra 22kW of power available from the turbine shaft, which was estimated to make up approximately 6% of the total power output.

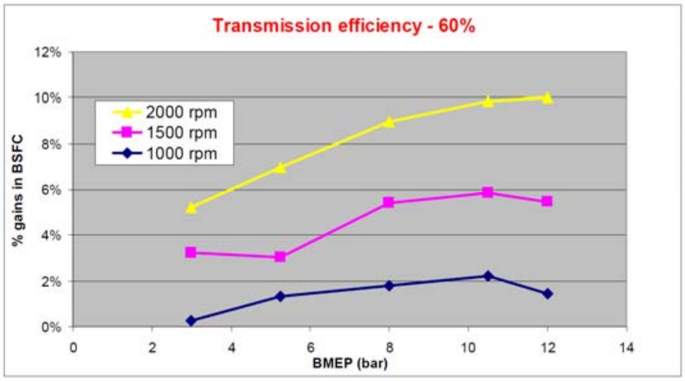

Figure 1.19: Simulated improvement in BSFC of Hyundai natural gas engine with mechanical/hydraulic transmission to transfer power between crankshaft and turbine shaft [17]

The Hyundai engine was not available for testing, so a Mack E7G engine with similar geometry and performance was selected. The turbocharger selected was not ideal for this engine, but was considered over others due to the variable nozzle turbine feature that increased the controllable parameters. The turbocharger was left unmodified except for the turbo shaft, which was modified for a planetary gear arrangement. Once the speed was reduced significantly from the planetary gear arrangement, it was connected to the crankshaft through a continuously variable hydraulic transmission.

Testing showed an almost 6% gain in BSFC at high engine speed and load as shown in Figure 1.19, while also showing reduced efficiency at other operating points. These results were consistent with the belief that the current turbocompounding setup was not as optimized as it would need to be to fully realize these benefits due to turbocharger miss-match and the use of off the shelf

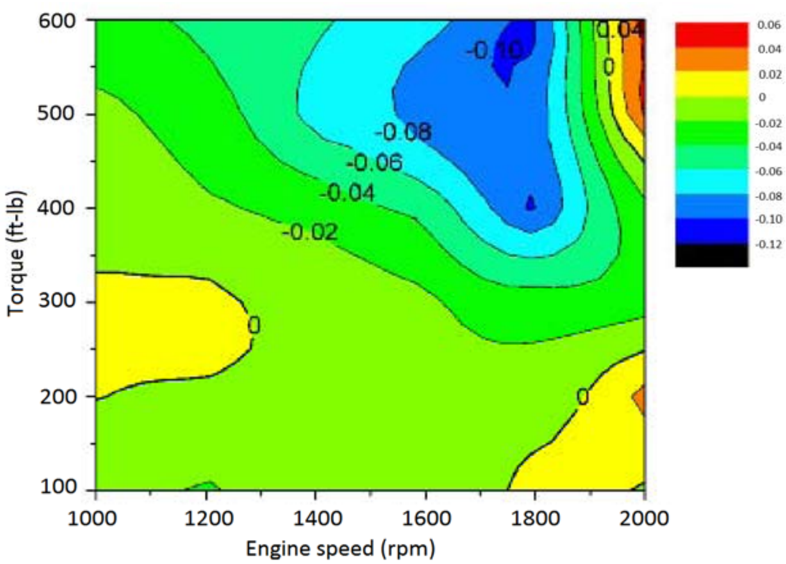

Figure 1.18: Improvement in BSFC for Mack E7G engine with SuperTurbocharger compared to stock turbocharger [17]

hydraulic transmission components. Wide open throttle (WOT) results shown in Figure 1.20

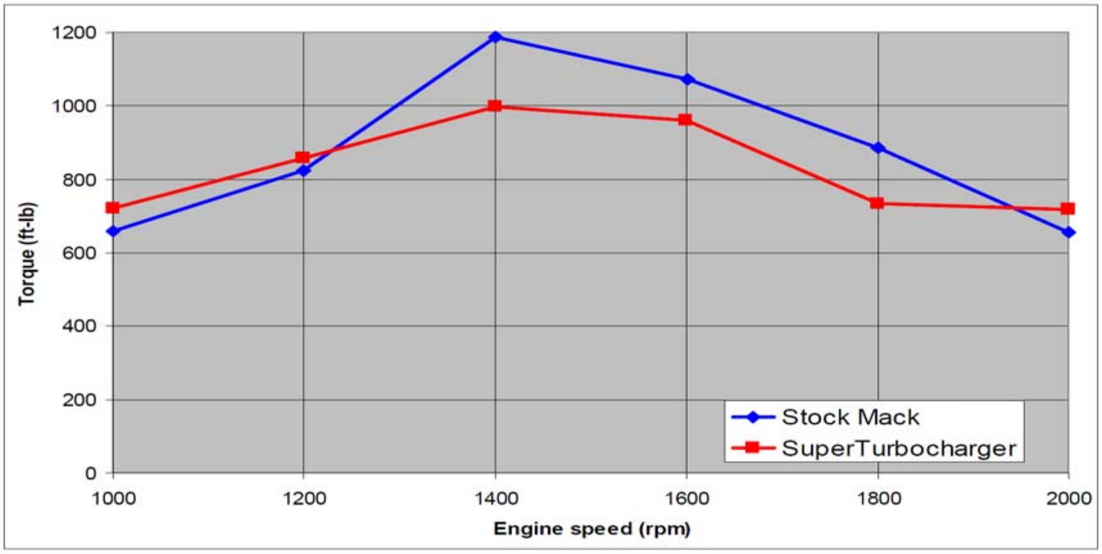

Figure 1.20: WOT curve for MACK E7G with SuperTurbocharger and stock turbocharger [17]

indicate a slight improvement in torque at lower speeds. These results were thought to be less than optimal due to the pressure limits on the hydraulic system as well as the overall limits of the speed ratio between the turbine and crank shaft. During a load acceptance test from 50 ft-lb to 400 ft-lb at 1600 RPM, the two methods were almost identical in load acceptance up to 300 ft-lb. The major difference was once boosting was required to get from 300 to 400 ft-lb, the SuperTurbo application was able to accept the load in less than 1.5 seconds due to the supercharging effect of using crankshaft power to supplement turbine power, while the regular turbocharger application took almost 13 seconds to reach full load as shown in Figure 1.21.

Some challenges realized were the turbocharger mismatch due to unavailability of turbo maps from the manufacturer, as well as the inefficiencies of the hydraulic transmission chosen for this application due to non-optimized operating points [17]. Since its first prototype demonstration, VanDyne SuperTurbo has spun out of its parent company Woodward Governor to focus more on automobile applications.

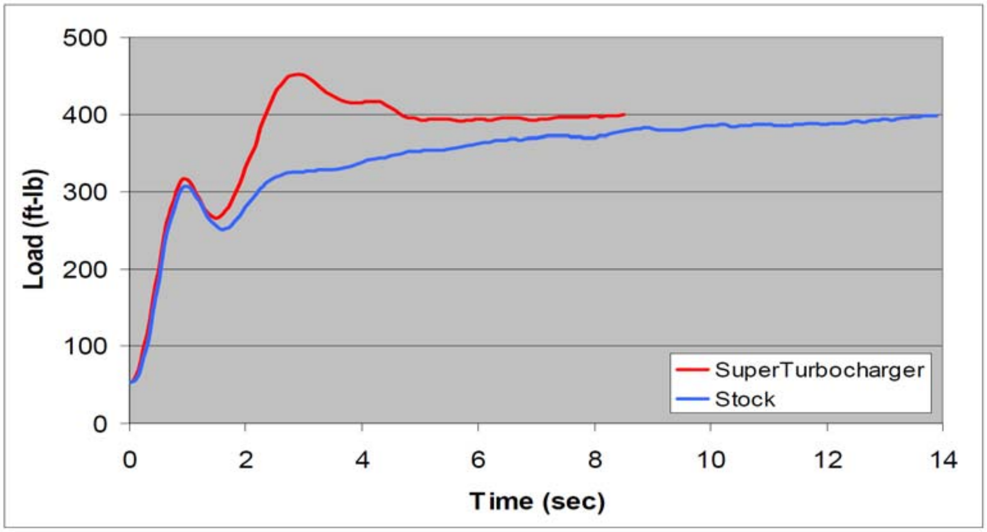

Figure 1.21: Step change response of a SuperTurbocharger compared to stock turbo [17]

Current work has focused on development of a SuperTurbo application for a 2L Volkswagen inline 4 cylinder engine as a downsized candidate for replacing a larger 3.2L V6 engine. Using engine data to compare the SuperTurbo L4 with a naturally aspirated 3.2L V6, it was estimated that the EPA city fuel efficiency would increase by as much as 17% [6]. Transient load simulation tests showed a time of 0.3 seconds to reach production Brake Mean Effective Pressure (BMEP) limit and 0.36 seconds to reach 90% of the peak BMEP for this configuration as shown in Figure 1.22. As shown in Figure 1.23, the WOT torque curve of the SuperTurbo L4 engine exceeds the naturally aspirated V6 except for the 1000 RPM operating point which is likely not to be experienced by the engine due to the stall speed limit on the torque converter and the fact that the vehicle's acceleration will be accompanied by an increase in engine speed. At wide open throttle the BSFC was higher on the SuperTurbo version as expected due to the need for retarded timing to prevent knock, which led to higher temperatures than the turbine could stand, which in turn led to fuel enrichment and higher BSFC numbers as shown in Figure 1.24. Although the BSFC numbers were higher than the naturally aspirated configuration, they

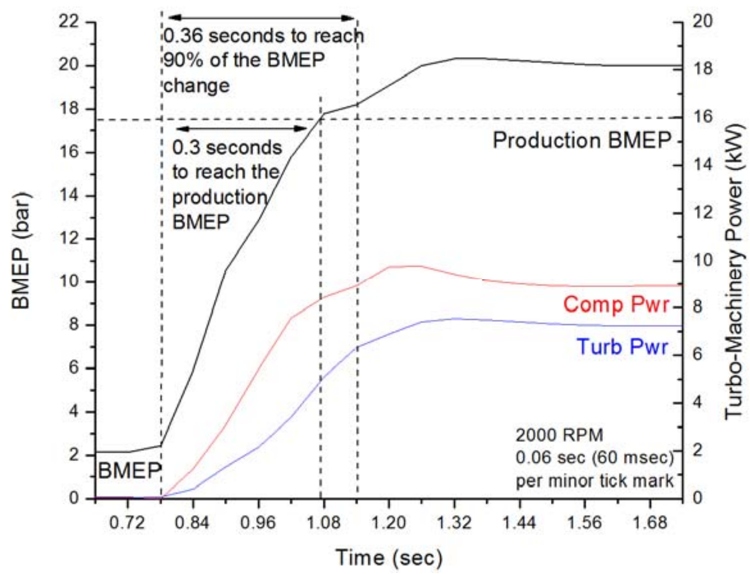

Figure 1.23: SuperTurbo transient response for a pedal snap from 2-bar BMEP to WOT at 2000 RPM. The engine reaches 90% of the peak in 0.36 seconds [17]

were still lower than expected stock engine values due to the added advantage of turbocompounding.

The current development of the SuperTurbo consists of a new design for the high-speed section of the transmission as well as new concepts for the continuously variable transmission (CVT) part of the SuperTurbo. The high speed section of the transmission makes use of traction fluid instead of gears for the planetary set-up which is supposed to be more efficient at the high rotational speeds associated with a turbocharger.

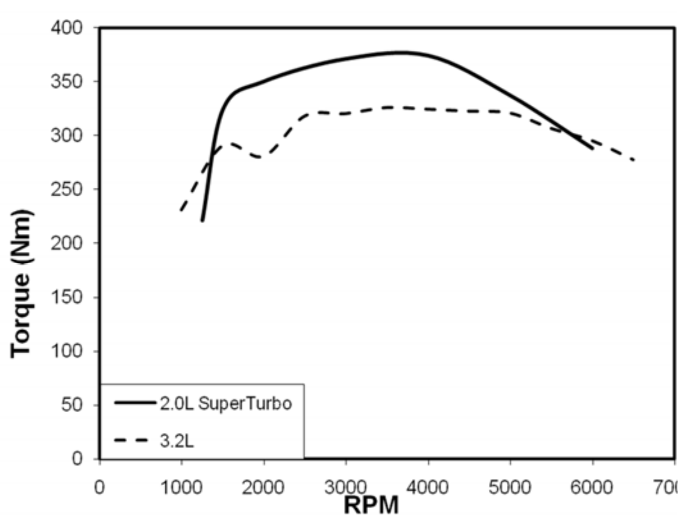

Figure 1.22: Torque curve of the SuperTurbocharged 2.0 Liter versus a N/A 3.2 Liter V6 [17]

The focus of this

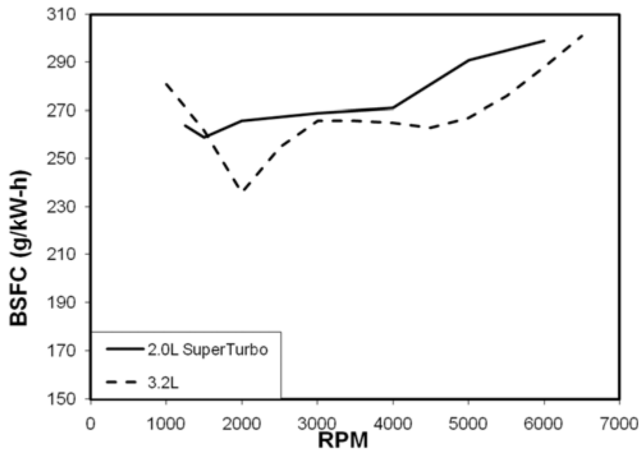

Figure 1.24: Full load efficiency curve of the SuperTurbocharged 2.0 Liter versus a N/A 3.2 Liter V6 [17]

project will be the calibration and use of an already developed engine model with a SuperTurbo model added in to see what efficiency gains are possible with this technology.

CHAPTER 2: ENGINE MODEL

2.1 GT-Power

Engine simulation software is becoming increasingly common as evidenced by its use in the above examples. Its iterative use during the phases of engine concept, design, and development for a turbocharged engine has been thoroughly investigated [20]. Most engine simulation software makes use of 1D flow simulation to approximate the flow behavior due to the highly reduced computational demand. With simulation software, the performance of new concepts can be investigated during the design process. These models are often based on previously developed models from existing engines. Although this is an approximation, it can still provide valuable insight into concept performance at a low cost. The major computations involve the gas conditions in the pipes. This leads to a calculation of the trapped air mass used in the combustion calculation to determine the indicated mean effective pressure (IMEP). Friction and pumping losses (FMEP and PMEP) are subtracted from IMEP to give predicted performance. This dependency makes the later calculations involving performance less accurate than the initial calculations about gas conditions.

A fully developed model relies on test data, which is typically not available during the initial concept stage of the engine. This requires assumptions to be made or data to be taken from elsewhere. The combustion model requires in-cylinder pressure data that must be estimated from similar engine data in the absence of test data. Until data is available for correlation, the accuracy will be affected according to how close the assumed data matches test data. Application to the design process includes optimization of the intake and exhaust manifold, variable valve timing if available and turbocharger match. While going through the iterative process of choosing a proper turbocharger, it is important to work closely with the design engineers to realize all of the constraints in the design.

GT-Power can be a valuable tool for selecting a particular turbocharger based on the tradeoffs between minimizing the turbo lag for low speed torque and higher power output. The modeling of the compressor and turbocharger is accomplished with the use of compressor and turbine maps, which relate pressure ratios to mass flow for constant speed lines and efficiency contours. The simulation software assumes quasi-steady flow, meaning that it assumes steady flow relationships at instantaneous conditions. However, the unsteady flow that a turbine experiences is most likely outside the turbine map provided by the manufacturer. An extrapolation method is suggested by the software manufacture to account for this. When modeling the effect of a turbocharger, it is suggested that the inlet conditions be set to the compressor outlet conditions and a nozzle added to the exhaust to simulate the backpressure from a turbine. This gives a good estimate, but does not take into account the link between intake and exhaust.

Once a prototype engine is available, it is likely that test data is available to validate and update the current model to provide greater accuracy. For turbocharged engines correlation data is very important because the model is especially dependent on turbocharger performance, particularly at low speeds where the wastegate is shut [20]. As shown in Figures 2.1-2.5, a close match to test data can be modeled to within about 5% accuracy for most of the speed range of this WOT test.

Discrepancies in volumetric efficiency are attributed to the combustion model as shown in Figure 2.1. The difference between compressor pressure outputs in Figure 2.4 is due to the difference in tested and manufacturer supplied compressor efficiency. The heat transfer model used for the exhaust is cited as the cause for turbine inlet temperature discrepancies in Figure 2.5. These discrepancies are thought to cause the air flow and torque discrepancies of Figure 2.2 and Figure 2.3. With the proper correlation data, an engine's performance can be modeled with validated accuracy. With the proper test data to validate a model, it is still possible to investigate different design strategies that deviate from the original model, but at a reduced level of accuracy.

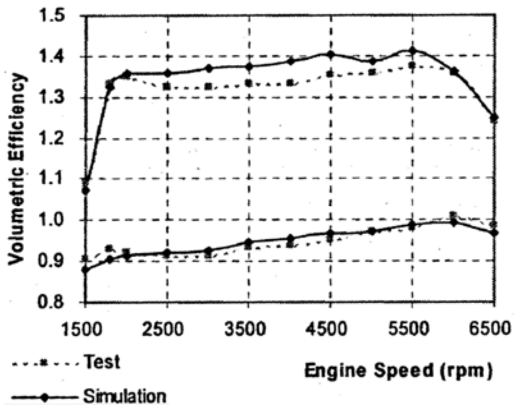

Figure 29: Volumetric efficiency correlation [20]

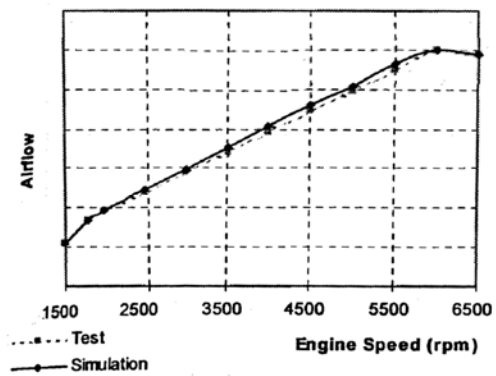

Figure 28: Airflow correlation [20]

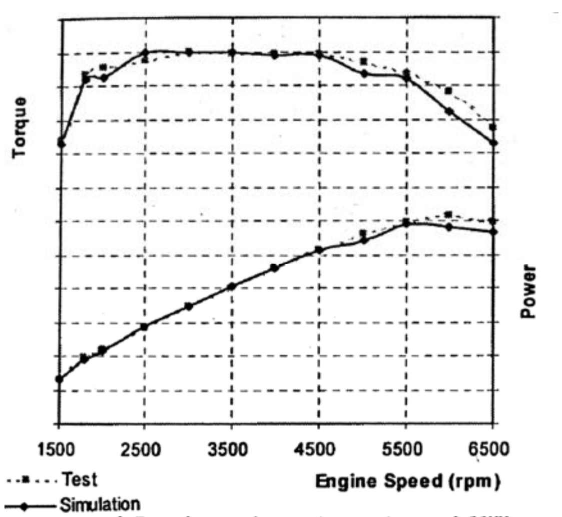

Figure 27: Performance Correlation [20]

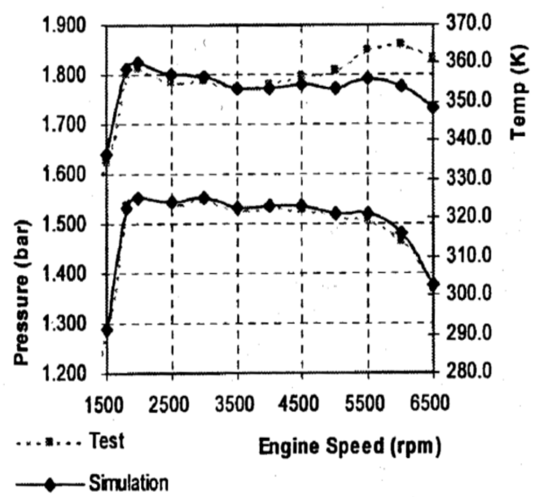

Figure 26: Compressor Outlet Conditions [20]

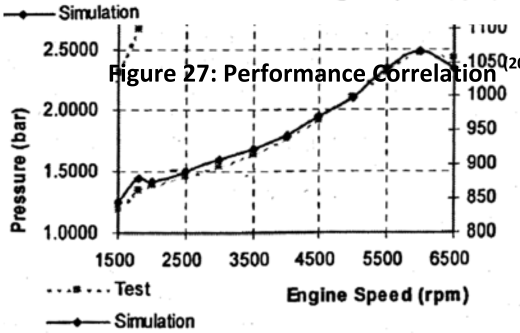

Figure 25: Turbine Inlet Conditions [20]

2.2 Stock model from Volkswagen

GT-Power is chosen as the modeling software due to the availability of a previously developed stock engine model from Volkswagen. The original model Southwest Research Institute (SwRI) received of a 2.0L L4 turbocharged GDI engine is validated against test data [6]. Although it is cited as being validated, it is unknown to what extent the original model is validated. Additional validation is carried out for this project using a more extensive data set provided by Volkswagen that covers the entire speed and load range. The original model did not have a throttle so it is likely only validated against WOT data with the timing parameters set for WOT operation only. The data provided by Volkswagen is contained in Appendix A. A map view of the simulation layout along with a map view of the controls layout is shown in Figures 2.6 and

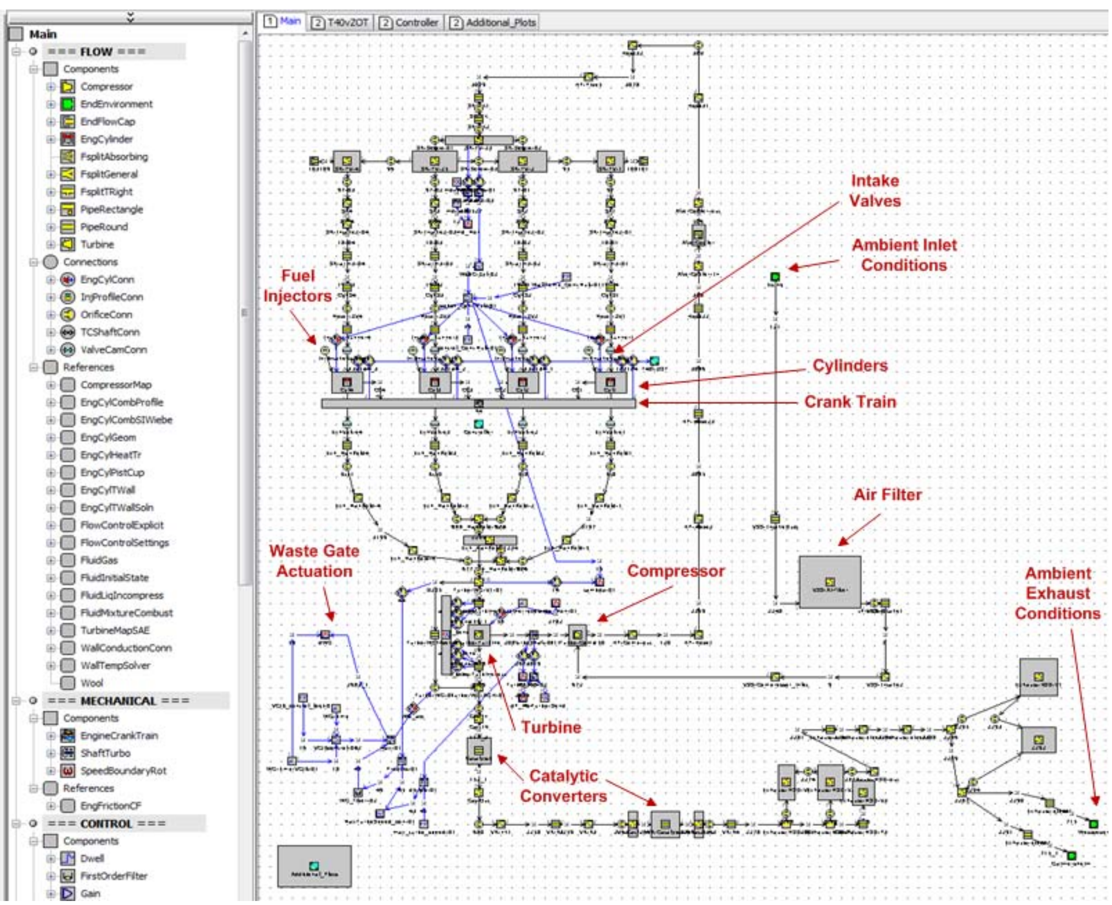

Figure 30: Main View of GT-Power Model in original form from Volkswagen

2.7, respectively. The map view of the engine model has several of the major components labeled. On the left side of the map view, the tree view shows all of the parts currently set up to use in the model. The majority of the components used are pipe objects as they represent the flow boundaries throughout the system.

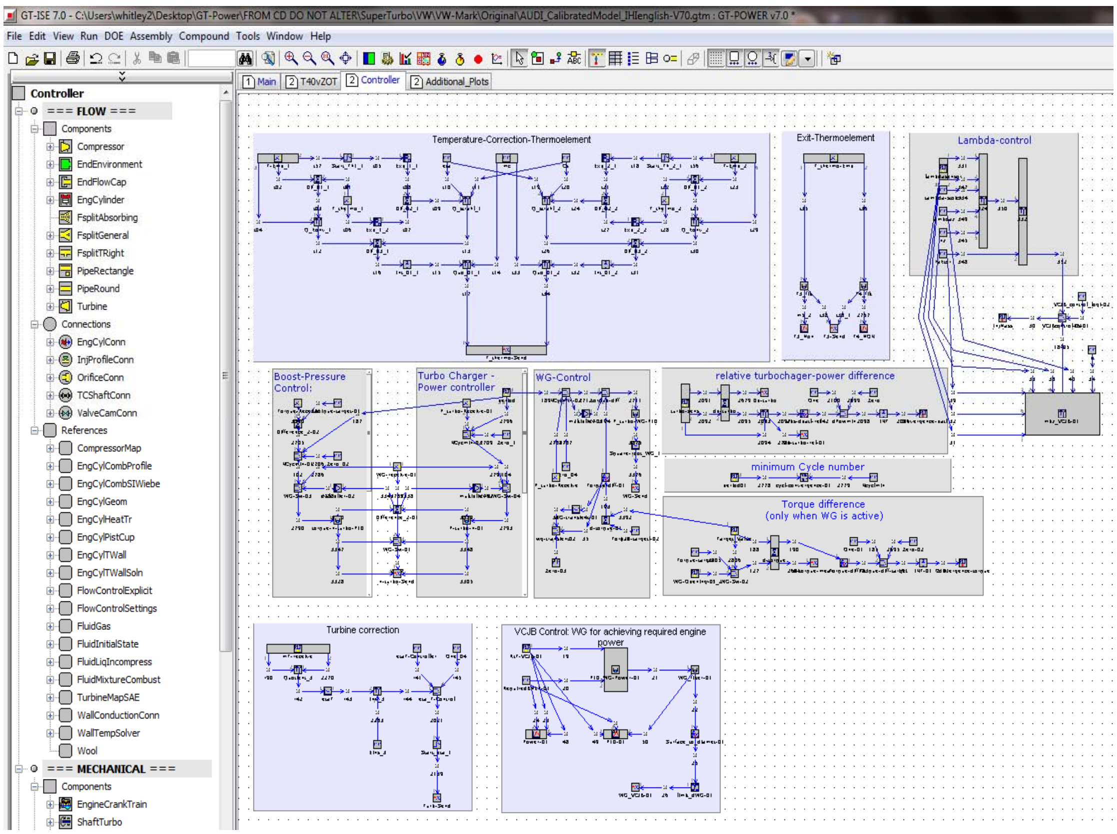

Figure 31: View of the controls page dealing with temperature corrections, wastegate control, and lambda control.

For this original model the wastegate is set up to control desired engine brake mean effective pressure (BMEP) since there is no throttle. For this project a throttle is added and the wastegate is used to control boost pressure rather than BMEP so that the throttle is able to independently control BMEP. The original model contains two sets of maps for both the turbine and compressor.

The GT-Power model is set up to run until it converges based on several requirements specified in the Run Setup menu. There are a maximum number of periods or engine cycles the user must specify that the simulation will not go over, but it will not necessarily converge by this point. The output file provides information on the number of cycles run for each case and convergence. There are also a minimum number of cycles the user can set that the simulation must run before being allowed to stop even if all the convergence parameters are met. In the flow convergence tab a mass flow steady state auto shut off limit is set. There is another tab that lets the user select which result (RLT) variable should converge before the simulation ends. RLT variables are the single valued results such as averages, maximums, and minimums during a cycle as opposed to instantaneous values which are usually plotted versus crank angle or time. The RLT variables that are listed to define convergence are the turbine shaft speed, the shaft torque imbalance between the compressor and the turbine, BMEP, and the orifice diameter of the wastegate. With the exception of the shaft torque imbalance being set to target zero, the parameters are set to converge on a cycle-to-cycle basis all within a certain user defined tolerance.

2.3 SuperTurbo added by SwRI

The main addition to the model by SwRI is the transmission between the turbocharger and the engine crankshaft. In some of SwRI models the wastegate is removed while it remains in other versions of the model from SwRI. The most used version has a gear ratio controller that would adjust the gear ratio according to a desired air mass flow rate through the compressor. The addition of the CVT to the SuperTurbo transmission presents challenges with torque oscillations due to the cyclic behavior of the engine and the pressure pulses on the turbine. It is assumed during the initial modeling done by SwRI that the final version of the transmission will have some way of dampening these oscillations [(6)]. This method is not yet finalized so the SwRI model without the gear ratio control and with wastegate control is used for this project. To deal with the torque oscillations the SwRI model senses a torque value from the SuperTurbo shaft. These sensed instantaneous torque value are then averaged over two cycles at an interval of twelve times per cycle.   This averaged value is multiplied by the efficiency if it is positive and divided by the efficiency if it is negative. This final value is imposed on the shaft labeled ST_TQeff_shaft_01 with a torque object which is in turn connected to the CVT transmission as shown in Figure 2.8. In addition to the assumption that the final version of the CVT will include damping, it is also assumed that the mechanical efficiency will be 80%. GT-Power defines the efficiency based on torque so that torque out will be 80% of the torque in value. This efficiency is an estimation and will need to be modified once data is available on efficiency versus speed, load, gear ratio and parasitic losses.

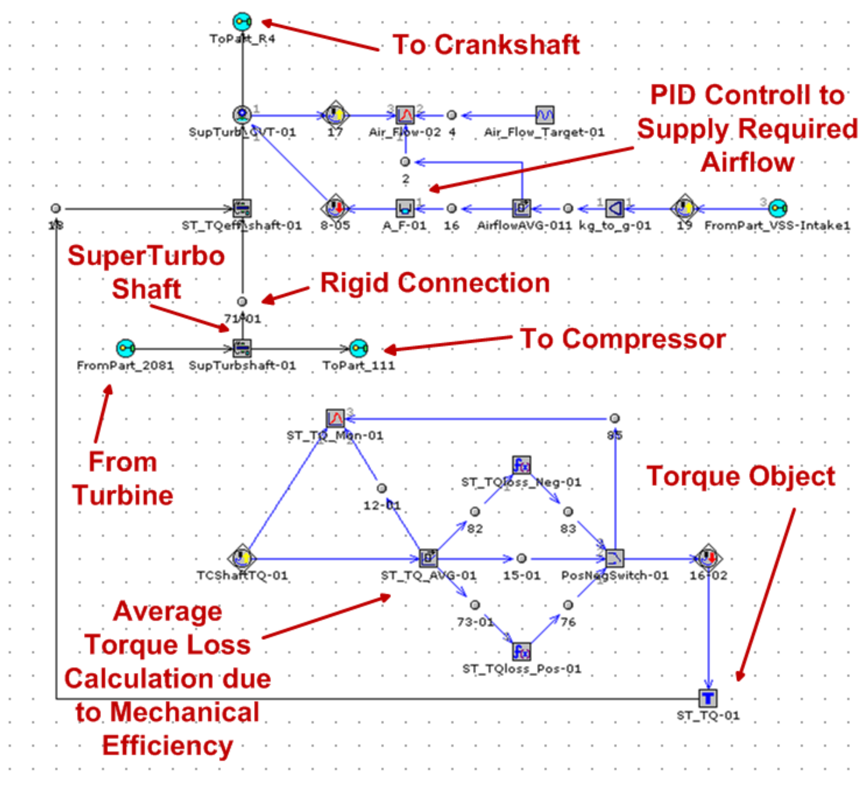

Figure 32: SuperTurbo Model added by SwRI

2.4 Stock Engine Model Tuning

In addition to the modification to the SuperTurbo model, there are several changes that need to be made in order to compare the stock simulation against the stock test data. The original model is set to operate at wide open throttle, so it has no information or controls to allow operation at part load or throttled operation. In addition, the engine has several parameters that change depending on both load and engine speed such as ignition timing, camshaft timing, and injection timing. An example of these timing events relative to crank angle and piston location is shown in Figure 2.9. This extended validation concentrates on getting a

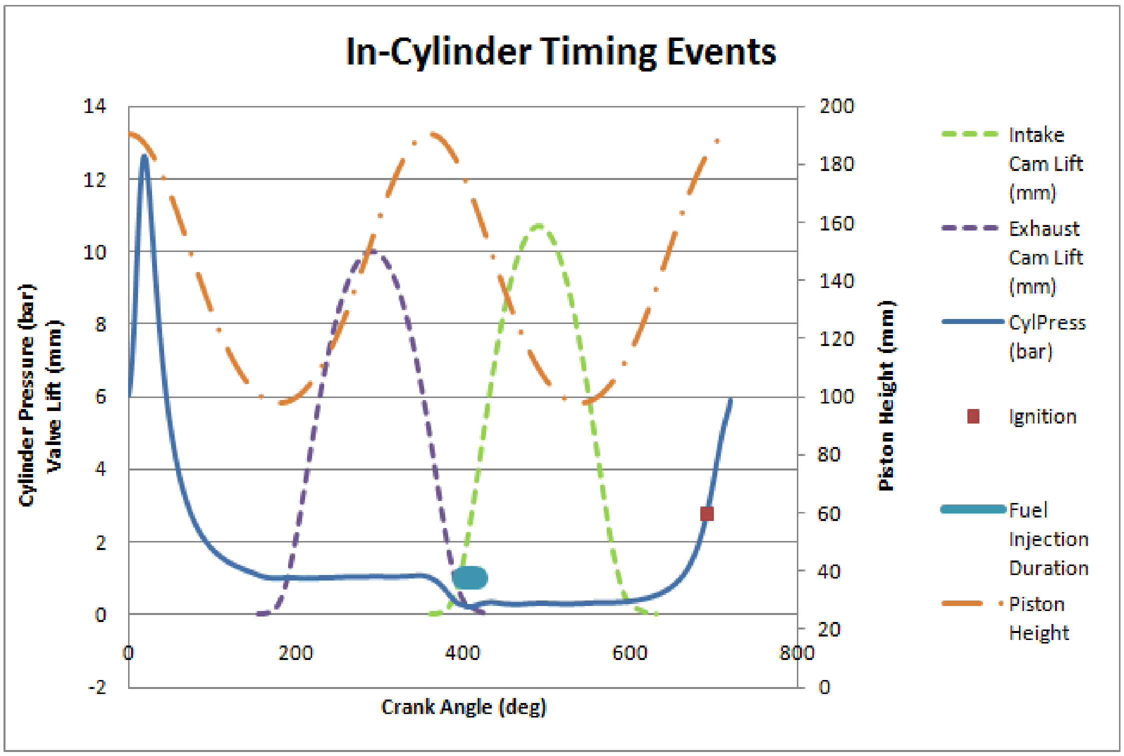

Figure 33: In-Cylinder Timing Events

close match for BMEP and BSFC while also checking that other parameters do not have excessive discrepancies.

In order to isolate different tuning effects the original model is stripped down to start at the intake manifold and end at the exhaust manifold. This version of the model is labeled m1.

Intake and exhaust manifold pressures and temperatures are available from test data to set as ambient intake and exhaust conditions for this configuration. This configuration allows for isolated tuning of parameters within this flow path of the engine.

Another advantage model m1 has over the full engine model is the elimination of the turbocharger and associated wastegate control. The wastegate control and turbo lag associated with the turbocharger's large inertia take a considerable amount of computational time to converge to steady state values. The elimination of this part of the model allows for much faster tuning of the parameters that are independent of the turbocharger operation except for minor pressure pulse effects.

To get the most accurate comparison several parameters from the test data are specified for the engine in the design of experiment (DOE) setup folder. The parameters imposed on the model from test data include compressor outlet temperature, compressor outlet pressure, turbine inlet temperature, turbine inlet pressure, ignition timing, fuel injection timing, fuel injection duration, lambda, camshaft timing, and engine speed. Since the original model is set up for WOT operation only, it has no information or controls for these parameters during part load operation.

The lambda values available from test data are imposed on the model as targets. In the controls page of the model there is a group of objects used to control the amount of fuel injected based on the desired lambda value and the air flow through the engine. For turbocharged engines this is an especially important aspect since fuel is often used to cool down the turbine at high engine speeds and loads. If the temperature limit is exceeded the turbine can expand and cause catastrophic failure. Extra fueling is also sometimes used to prevent pre-detonation. The injected fuel mass is an important parameter for characterizing the improvements in BSFC.

The first parameter to tune in model version m1 is the camshaft timing data. While all of the other timing parameters are referenced relative to the crank shaft top dead center (TDC) position the crankshaft timing data is not referenced to anything. The timing has to be referenced to before or after TDC and can be referenced to the crankshaft angle or the camshaft angle. All of these possibilities are run and the case with the closest BMEP match to the test data is chosen.

While this initial tuning is able to show an overall BMEP trend match to test data for the camshaft timing reference chosen, the model is not able to reach as high of values for BMEP as the test engine is able to at lower loads as depicted in Figure 2.10. The error is larger as the reference BMEP is reduced. Analysis of IMEP, trapped air mass and other parameters indicate that the FMEP model is inaccurate. At higher loads this difference is not as significant since FMEP is a smaller fraction of IMEP. GT-Power uses the Chen-Flynn engine friction model to calculate FMEP values as shown below

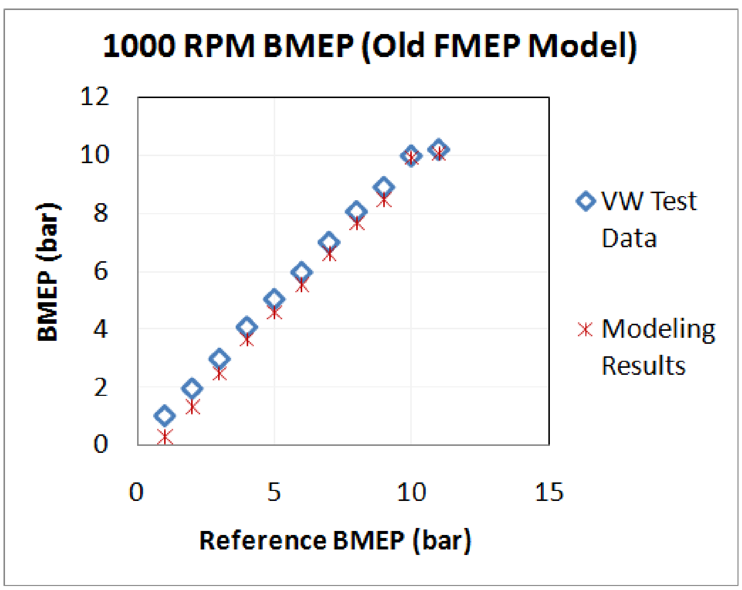

Figure 34: Error in BMEP values for modeling data compared to test data

$$FMEP\ (bar) = C + PCPF + MPSF + MPSSF$$

where,

C = Constant Term

PCPF = Peak Cylinder Pressure Factor

MPSF = Mean Piston Speed Factor

MPSSF = Mean Piston Speed Squared Factor

The C value for the original model is set at 0.8443 bar when the recommended value for this is suggested by the GT-Power Help Navigator to be between 0.3 and 0.5 bar. Several different versions of FMEP were modeled by varying the different coefficients to be mostly within the range suggested by GT-Power in an effort to lower the error in the low BMEP range of the map. The old and new output of the FMEP model is shown in Figure 2.11. Ideally there would be test data for FMEP values so that the FMEP model could be evaluated directly, but unfortunately this data is not available. After this change the BMEP error comes down to more acceptable levels as shown in Figure 2.12.

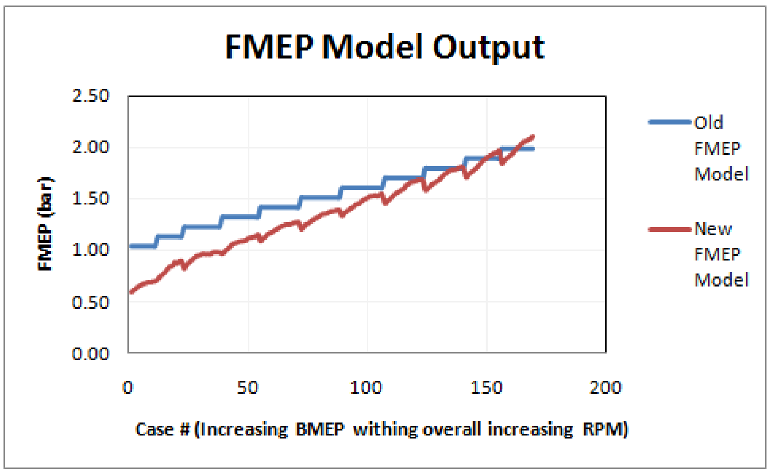

Figure 35: FMEP Model Output from GT-Power

The next step in tuning the stock model consists of adding a throttle component to the model and extending the inlet conditions back to the outlet of the compressor. The addition of the throttle makes this model m2. The new inlet conditions are then set to the outlet conditions of the compressor based on the available test data. The flow through the throttle is based on an array of discharge coefficients versus throttle angles. The discharge coefficients are defined by the ratio of effective flow area to the reference flow area which originates from the isentropic velocity equation for flow through orifices. The flow coefficients were determined as follows: First, an initial guess is used and a simulation ran over the BMEP range for an engine speed of

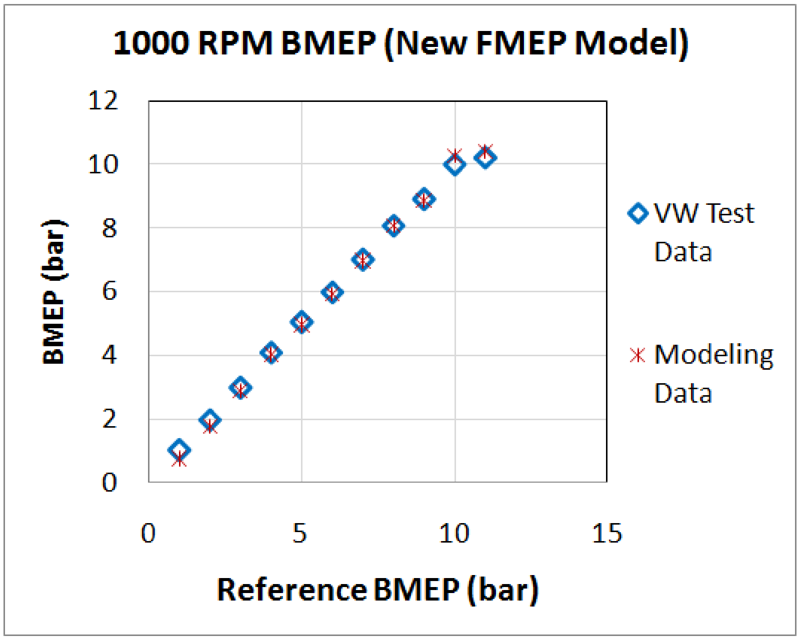

Figure 36: Error in BMEP values for modeling data compared to test data

1000 RPM at the throttle angles listed in the test data. The model predicted pressure drop values were compared with test data and then the flow coefficients were adjusted iteratively until a close match is achieved. This is done for 1500 RPM as well and then the results were applied to the whole speed range to verify that they are a good match for the entire speed range. GT-Power has an Excel spreadsheet that calculates coefficients automatically if the specified test data is available.

The final step of validating the model against test data requires the addition of the turbocharger into the model (model m3 and m4). As previously mentioned the wastegate in the original model is used to control BMEP instead of the more typical configuration of controlling boost pressure. Since the throttle is controlling BMEP, the wastegate controller is altered to control the desired boost pressure sensed after the intercooler. The reference boost pressure is based on post intercooler pressure measurements from the test data.

The final comparison will consist of two configurations. In the first round of this final comparison the throttle angle will continue to be specified based on the test data (model m3) while the second round will use a throttle controller object that will adjust to give the desired BMEP (model m4). This will allow for the comparison of matching parameters based on the exact throttle angle, and a slightly different version where the throttle angle can vary to give the referenced BMEP values.

The test data imposed on this simulation configuration include ignition timing, injection timing, injection duration, camshaft timing, lambda values, and engine speed as well as the throttle angle added for the previous configuration. In addition to these, reference boost pressure sensed after the intercooler is added as a target for the wastegate controller. Depending on the simulation type mentioned above, reference BMEP will also be used in place of the imposed throttle angles and the throttle will be controlled to try to match this reference BMEP value.

The results from these simulations show a close overall match to the test data for both configuration setups. While the first version has larger BMEP difference, the second one has throttle angle differences as expected. The for the configuration where throttle angle was adjusted to match BMEP values the average BSFC error is about 3.2% with a standard deviation of 4.3%.

Even though most of the parameters of importance match well with test data, the exhaust temperatures are much higher than those reported in the test data. This would have been apparent with the earlier models, except this parameter is not directly compared upstream of the boundary conditions that are specified to match the test data in model m1. It appears that there are heat transfer discrepancies between the model and the test data that have not been accounted for since the individual exhaust runners were all indicating higher exhaust temperature directly out of the cylinder model. This difference is likely due to several issues unrelated to the heat transfer model of the cylinder. The precise location of the measurement is unknown. The measurements themselves are difficult to interpret due to radiation and conduction losses that need to be accounted for. Additionally, the temperature at this location is undergoing rapid oscillations. The errors in the GT-Power model as they correlate to the given test data are also dependant on the inherent error in the actual measuring of the test data. GT-Power's manual indicates that this is to be expected and correlations are given to how much these exhaust temperatures are likely to be off depending on different wall and ambient air temperatures.

Another noticeable difference is the modeling output of the turbine pressure and temperature drops across the turbine. More research into the details of the GT-Power turbine model reveals some possible reasons for these differences. The turbine map data entered into GT-Power goes through pre-processing which extrapolates the data over a wider range and fits it to a curve for use in the actual simulation. In post-processing there are plots which indicate how well the turbine data is suited for this processing. Analysis of the plots reveals that both sets of turbine data provided in the original model are for a very narrow range compared to the range that the turbine data will be extrapolated out to as shown in Figure 2.13. Data for the first turbine map does not fit the normalized curve as well as the second turbine map and the pressure ratio curve for the second turbine map also gives a better fit as shown in Figure 2.14. The efficiency curve of the second map is less smooth and shows two local maximums when it is desirable to have only one maximum.

This leads to an experiment comparing two simulation runs with the two different turbine maps. The results from the second turbine map are very similar to the results of the first map with a few exceptions. The second turbine map is unable to produce results for a few of the low load, low speed cases. This is presumably due to the fact that the data seems to be slightly more towards the higher end of the blade speed ratio (BSR) line causing the low speed, low load operating points to use data extrapolated out to a distance that is unreliable. The second map does not match the temperature

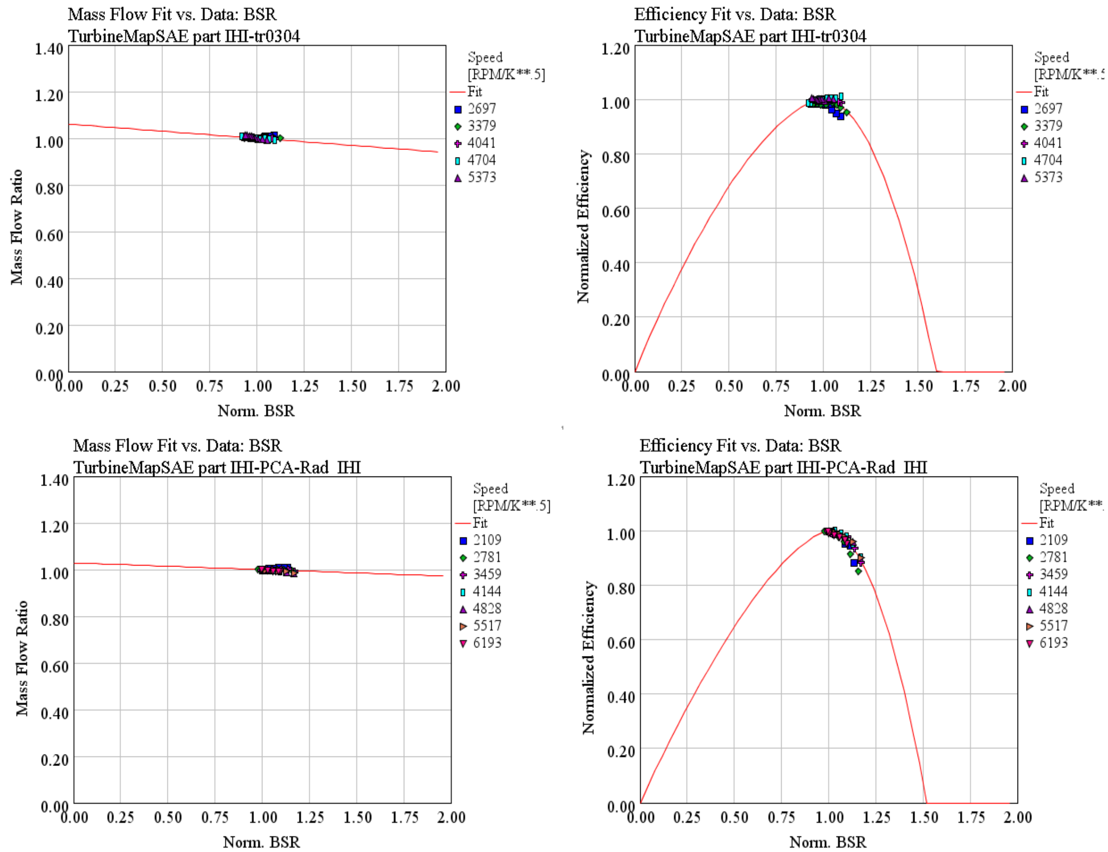

Figure 37: Turbine Map Data Analysis Plots for Turbine Map 1 (above) and Turbine Map 2 (below)

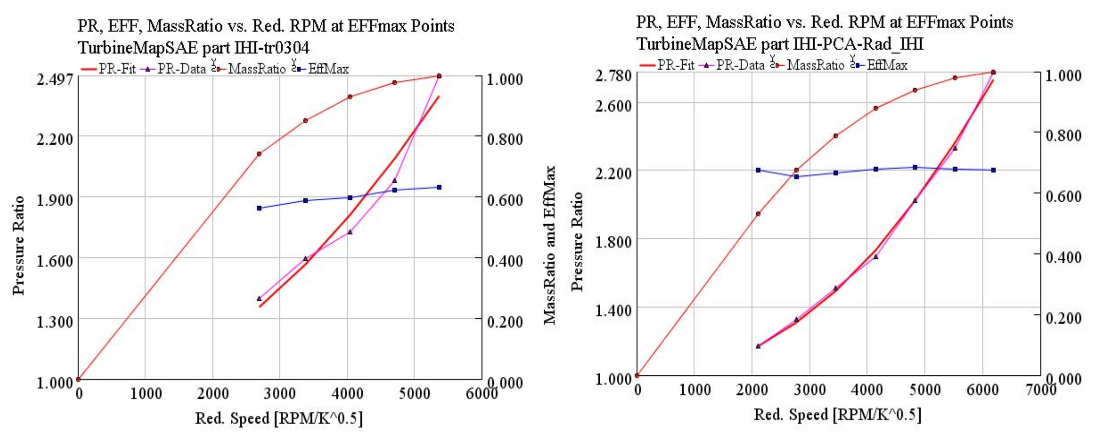

Figure 38: Turbine Map Data Analysis Plots for Turbine Map 1 (left) and Turbine Map 2 (right); the Blade Speed Ratio (BSR) is used for normalization and extrapolation calculations in GT-Power

and pressure drops across the turbine as well as the first turbine map, although the difference between the two are much smaller than the overall difference from the test data. Since the second map does not match as well the best option is to continue using the first map. Despite these obvious faults of the model, they will still serve as a useful tool for evaluating a comparison between the original stock engine model and a SuperTurbo version of the model.

While it is preferable to have a more extensive set of data that will allow for more precise correlation, as well as more information about the iterative build-up of the model, the current model will still be adequate in serving its purpose of showing improvements to the SuperTurbo model over the stock engine model.

CHAPTER 3: ENGINE SIMULATIONS

With a stock simulation model ready for use simulations are run to see where efficiency improvements can be made and then the SuperTurbo version is ran for comparison. The stock model is modified to be able to run at engine speed and load points not listed in the test data. Stock model runs at these new data points are analyzed to see what areas of the BSFC map may offer the most improvement. The SuperTurbo is added to the model to evaluate the improvements.

3.1 Simulation of Stock Engine Configuration

For the remaining simulations the engine model is modified to be able to run at operating points other than those listed in the test data. This allows operation between test data points where the exact load and speed dependant parameters are not provided. The new data points are at BMEP intervals of one bar and engine speed intervals of 500 RPM. The results from this simulation are analyzed to see areas of potential BSFC improvements.

Modifying the model to be able to run at points other than those listed in the test data is accomplished through the use of the neural network tool in GT-Power. Neural networks consist of interconnected processing elements called neurons which work together in parallel to compute an output based off one or more inputs. Neural networks are trained to interpolate the nonlinear behavior of important engine parameters that vary based on engine load and speed. The neural network tool consists of a training tool and a neural network control component for use in the simulation model. The neural network training tool teaches a neural network the desired output based on a given set of inputs. The use of neural networks instead of a simple look-up table has several advantages such as being able to determine the output in a shorter amount of time, being able to handle data where linear interpolation is insufficient, and being able to handle more inputs.

The different training methods are briefly explained in the Train Neural Network document provided with the software [(21)]. Once the neural network is trained, a file is created that can be accessed by the neural network control component for use in any model. To train the neural network, the user specifies input data such as BMEP and engine speed values. The desired output values are entered, such as camshaft timing, ignition timing, etc. The user selects one of the various training methods or lets the software automatically choose one. If automatic is chosen the software runs several training methods and output the results of the method that provided the lowest root mean square (RMS) training and testing error. As a built in default, the training methods set aside 10% of the data to validate the training once the training is complete. Parameter modeling using this method consists of ignition timing, injection timing, injection duration, camshaft timing, lambda values, reference boost pressure, and reference BMEP.

With a more general model capable of running at any point within the range of engine speeds and BMEPs, the model is run for comparison against a SuperTurbo configuration. Since wastegate data is not included in the test data, the modeling is split into two sections with overlap in the transition area. One section contains data points where the wastegate is closed. The second set uses the wastegate to control desired boost.

Based on results from the stock engine modeling there are several areas of possible BSFC improvement. The first case occurs when the wastegate is open. With typical turbocharger configurations the wastegate is open when the exhaust gas supplies the turbine with more energy than the compressor is able to effectively use. This area of the map covers the higher

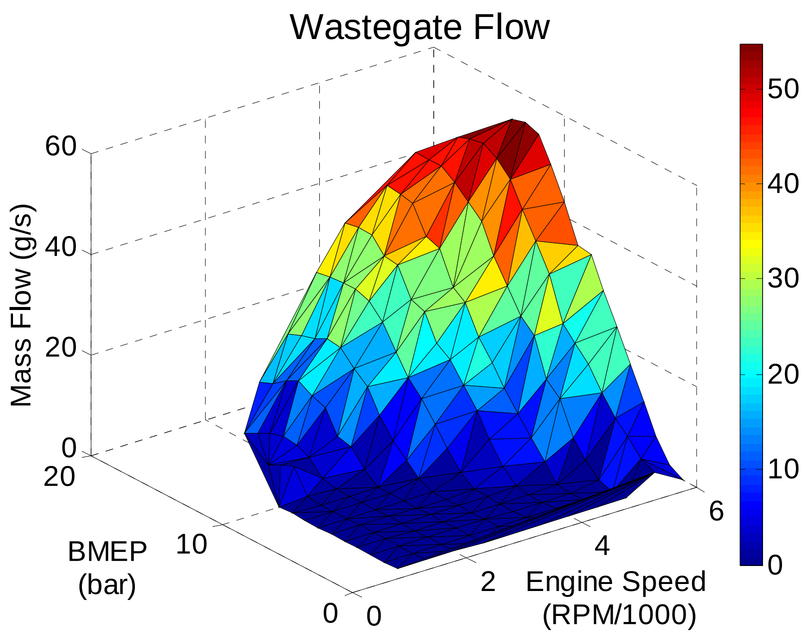

Figure 39: Wastegate flow versus engine speed (RPM/1000) and load (bar)

engine speed and load regions of the engines operating range as shown in Figure 3.1. The wasted exhaust gas flow corresponds to the additional energy available that can be used for turbocompounding with the red highest flow area able to show the most improvement. The wastegate diameter is evaluated using the model by controlling the diameter based on desired boost pressure input from the test data available. With the SuperTurbo configuration the wastegate is closed and the gear ratio is controlled to act as a brake on the turbine so that it does not over-speed. This braking energy is fed back to the crankshaft through the transmission.

The second case occurs when the compressor is creating boost pressure that is not needed. The compressor uses energy from the turbine to create boost and the throttle is actuated to control engine load so that much of the energy spent on creating boost is lost through the pressure drop across the throttle. This is done with the stock configuration to keep turbine speeds high. Even though boost is not needed the stock configuration creates the boost in anticipation that boost will be needed soon. The turbo speed is kept high and a recirculation valve is used when the boost is not needed. Once boost is needed the turbo is already at or near a speed where it is able to adequately provide boost so that turbo lag is less of an issue. The area of the map with boost pressure higher than atmospheric pressure and manifold pressure less than atmospheric pressure covers a large area of the map except for high load cases where the throttle is at or near wide open position and low load and speed cases where the boost pressure is already near atmospheric as shown in Figure 3.2. The wasted boost pressure is calculated by subtracting manifold pressure from boost pressure if manifold pressure is greater

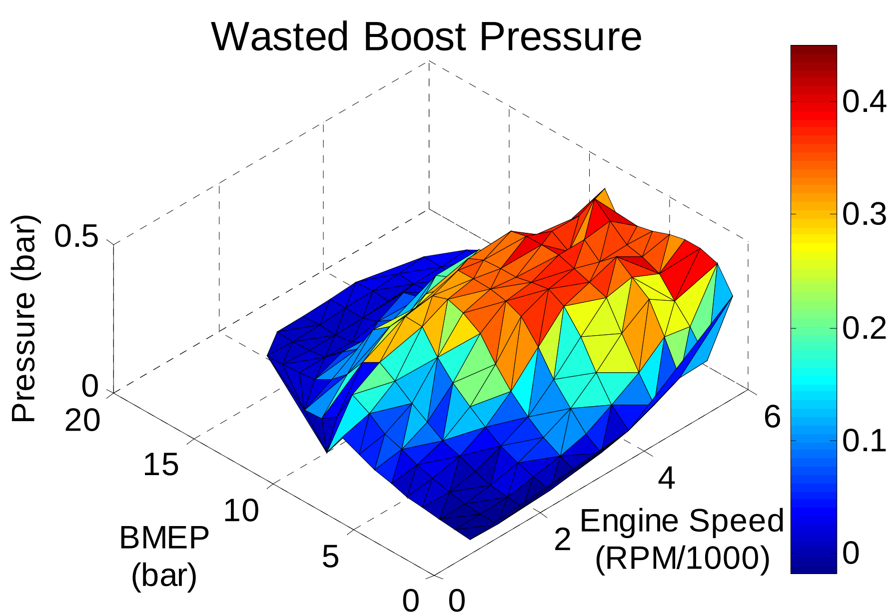

Figure 40: Boost pressure created by the compressor that is unneeded

than atmospheric pressure and by subtracting atmospheric pressure from boost pressure when manifold pressure is lower than atmospheric pressure. The compressor is wasting the most power in the red higher pressure difference area so it should show the most improvement.

When boost pressure is not needed the compressor can be controlled to provide almost no boost with the braking energy going to the crankshaft instead of being wasted. Reduced low load compressor use also has the advantage of supplying the cylinder with cooler air. Since the air is not being compressed as much before passing through the throttle restriction the intake air temperature is denser due to its lower temperature.

Another source of improvement is the substitution of the stock turbine design for a new turbine design that is optimized for this type of application. Turbochargers have a tradeoff between turbine efficiency and turbo lag. The turbine must be larger in order to be more efficient causing the turbo lag to increase. With the SuperTurbo design the turbine inertia is less of an issue since engine power is available to accelerate the turbine so the size can be increased to make it more efficient.

3.2 Comparison of SuperTurbo Model to SuperTurbo Test Data

While development of the SuperTurbo is in the early stages some test data is available which demonstrates turbocompounding ability. The configuration consists of the high speed section of the SuperTurbo and a fixed gear ratio pulley between the high-speed section and the crankshaft. In addition it utilizes the lower efficiency stock turbine. The test data currently available uses a pulley from a 4000 RPM max load test at 2707 RPM part load conditions. Unfortunately, the engine speed and load tested do not deviate much in ratio from the 4000 RPM full load condition so the improvement is not as much as it could be for this operating point. While there is some turbocompounding benefit due to the wastegate being closed the gear ratio is not optimal for this condition since the boost pressure is higher than the required manifold pressure and the throttle is not wide open. The more optimal comparison for this operating point would be at a condition where the throttle is wide open or a gear ratio where wasted boost is not created.

The model is run with the parameters available from test data imposed into the model. These include lambda, ignition timing, gear ratio, and atmospheric conditions. While not all of the results match the test data parameters that are available they are close enough of a match to provide validation in terms of turbocompounding ability. While the ignition timing is imposed on the model from the test data, there seems to be some discrepancy with regards to the combustion model with the 50% burned crank angle location being a couple of degrees off. The BMEP and IMEP(360) data points show less than one percent difference and the IMEP(720) data shows about two and a half percent difference. However, the FMEP data show a difference of sixty percent. This is due to the way it is calculated. The BMEP value is calculated based on the brake torque measured. This gives an unrealistic number for the actual in-cylinder BMEP value since it now incorporates turbocompounding power. Since the BMEP now incorporates turbocompounding power, the calculation of FMEP based on BMEP, IMEP(360) and PMEP is off.

The modeling data is available for comparison in Appendix D. The BSFC values are between one and two percent off but it is still possible to determine the benefits of the turbocompounding by comparing the SuperTurbo model to the stock model at these same conditions. The BSFC improvement of the SuperTurbo model over stock model is about 1.2%. The amount of torque added to the crankshaft in the test data is 4.31 Newton meters (N-m) which is close to the modeling prediction of 4.51 N-m. This close match of transferred torque provides validation that the model is capable of predicting the improvements due to turbocompounding.

3.3 Simulation of SuperTurbo Engine Configuration

The SuperTurbo configuration incorporates a new turbine wheel in production form so a different model is used for the SuperTurbo turbine. Since the design is not fully developed and tested a simplified version of a turbine is modeled. GT-Power has a simplified turbine model that predicts output power, mass flow rate and outlet temperature using an orifice flow model and imposed efficiency. The new turbine design is capable of much higher efficiencies than a normal turbocharger turbine since there is no longer a tradeoff between turbine inertia and turbo lag.

The differences in the two designs are illustrated in Figure 3.3. The figure shows that the new turbine design has noticeably longer blades and a larger inlet area. The orifice diameter in the model is determined based on matching the pre-turbine pressure of the stock configuration at 5000 RPM full load with the SuperTurbo version at the same load, but with the wastegate closed.

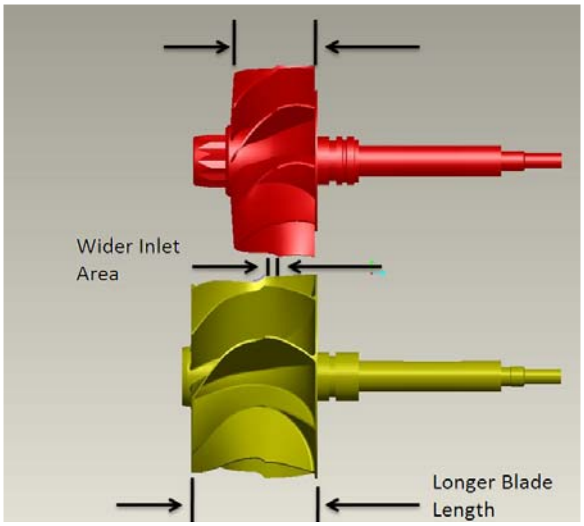

Figure 41: The new turbine design has a wider inlet area to allow less back pressure as well as longer blades to improve efficiency

The final configuration is split into a high load section where boost is needed, and a low load section where boost is not needed. The high load cases will have a wide open throttle and will use the SuperTurbo gear ratio to control engine load. The limit on how low of a load can be achieved with this method is dependent on the compressor pressure ratio. Modeling of pressure ratios below one without test data is not recommended by GT-Power due to the need to extrapolate the available data out to these points. The second section uses the throttle to control load while the SuperTurbo gear ratio is used to control the speed of the compressor such that its pressure ratio remains slightly above one.

Initial modeling with the simple turbine reveals that flow convergence parameters are not converging for some cases. The flow convergence is specified in terms of change in mass and pressure flow from one period to the next at any flow path location. The location of the changing flow is further down the exhaust stream in the muffler section of the model. The source of this is thought to be due to the simple turbine having less of a pressure drop across the turbine part of the system. While the pressure drop across the turbine is the same, the stock model's wastegate is open allowing for more of an overall pressure drop which dampens the pressure oscillations coming from the engine. Due to this the flow convergence parameters were slightly relaxed from a fractional value of .002 to .02.

3.4 Results

The primary parameter of interest for this modeling is brake specific fuel consumption (BSFC). The results show improvement in BSFC over the entire range of the map as shown in Figure 3.4. The improvements correspond to the predicted areas of improvement in the range of

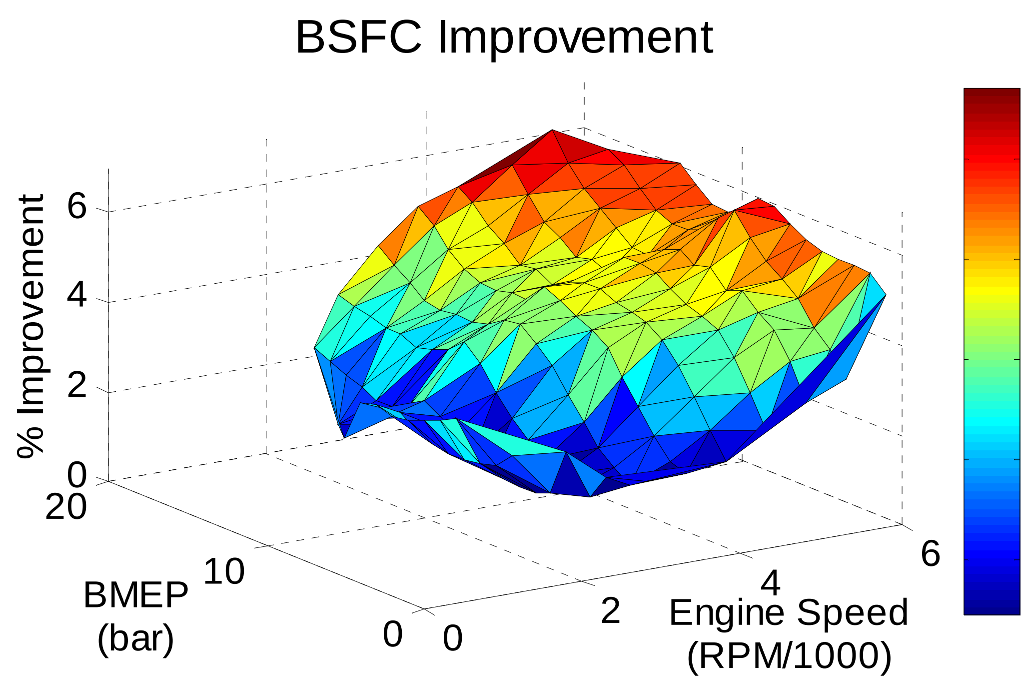

Figure 42: Brake specific fuel consumption improvement over stock engine

2 – 6 % over stock conditions. The high load and speed areas are affected more by turbocompounding from the wastegate being closed as shown in Figure 3.5. The middle to lower region is affected most by the reduced losses associated with using energy to compress air that is later restricted by the throttle as Figure 3.6 illustrates.

The power transfer from the turbine to the crankshaft is higher with increasing speed and load as shown in Figure 3.7 maxing out at 6000 RPM 14 bar BMEP. This correlates well with

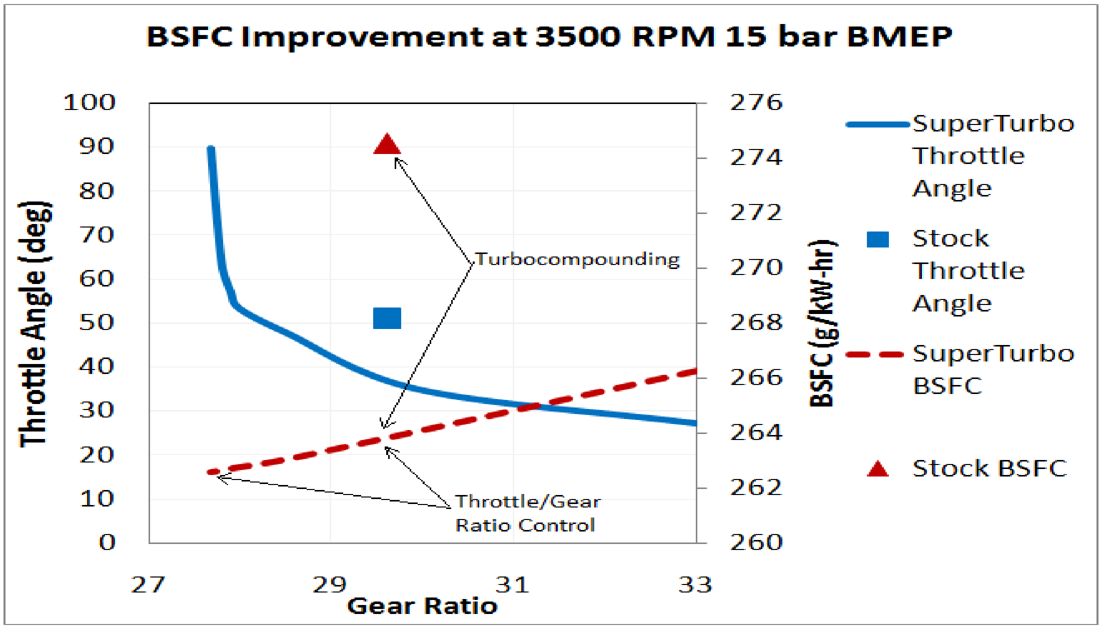

Figure 44: At this higher load point the contribution from turbocompounding dominates the

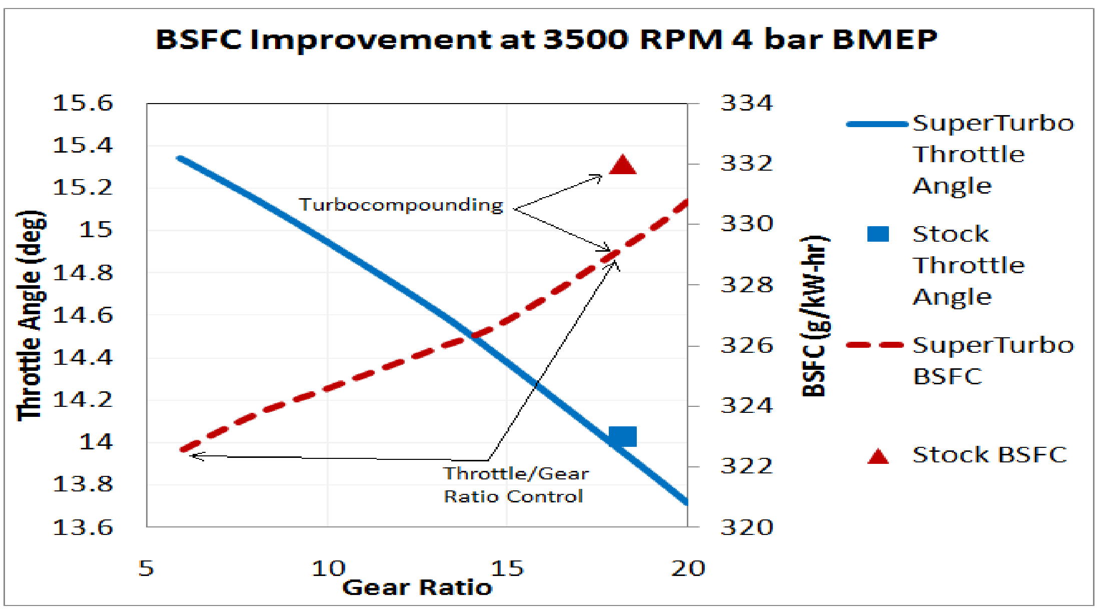

Figure 43: Brake specific fuel consumption improvement over stock engine as low load case where

BMEP contribution from the turbocompounding as shown in Figure 3.8. This contribution means the in-cylinder power requirement is reduced resulting in overall fuel savings. BMEP contribution is obtained by calculating in-cylinder BMEP values as listed below and subtracting that number from the overall BMEP for the entire engine system reported by GT-Power.

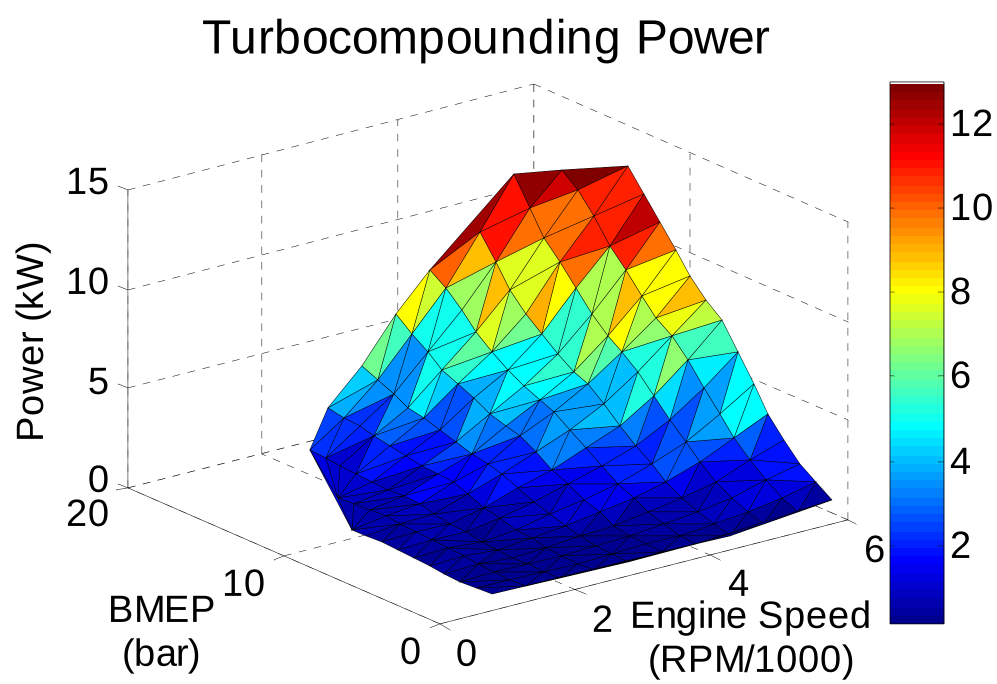

Figure 46: Power transferred from SuperTurbo to Crankshaft

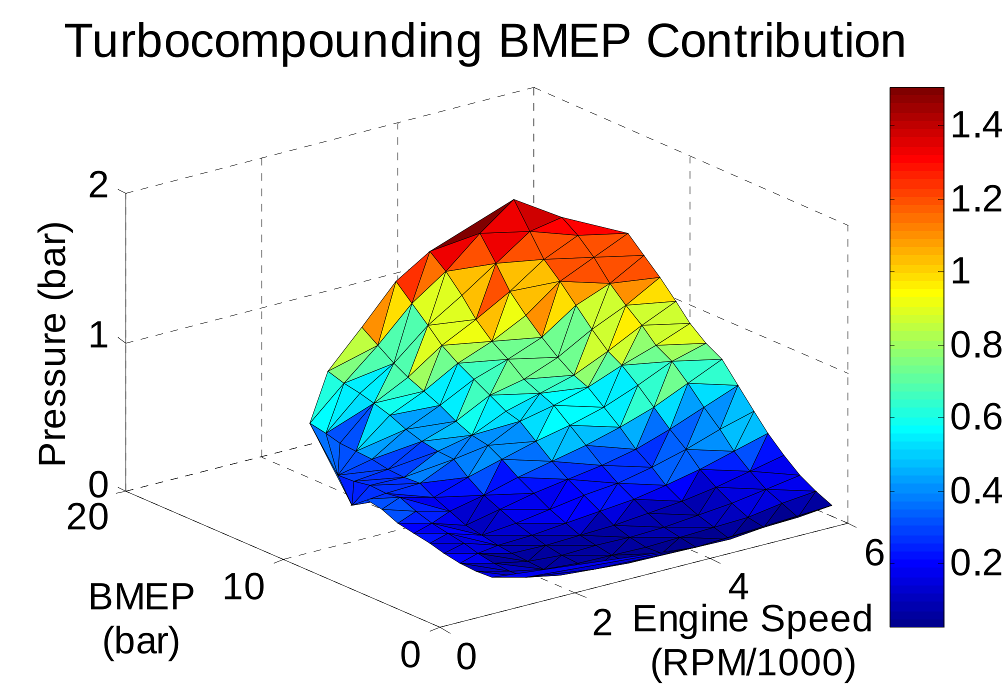

Figure 45: BMEP contribution from Turbocompounding

BMEP = IMEP(360) + PMEP – FMEP

where,

BMEP = Brake Mean Effective Pressure

IMEP(360) = Indicated Mean Effective Pressure (during compression/combustion stroke)

PMEP = Pumping Mean Effective Pressure

FMEP = Friction Mean Effective Pressure

The mid to lower load region of the map is improved by the reduced use of the compressor when it is not needed as illustrated in Figure 3.9. The mid region of the map saves

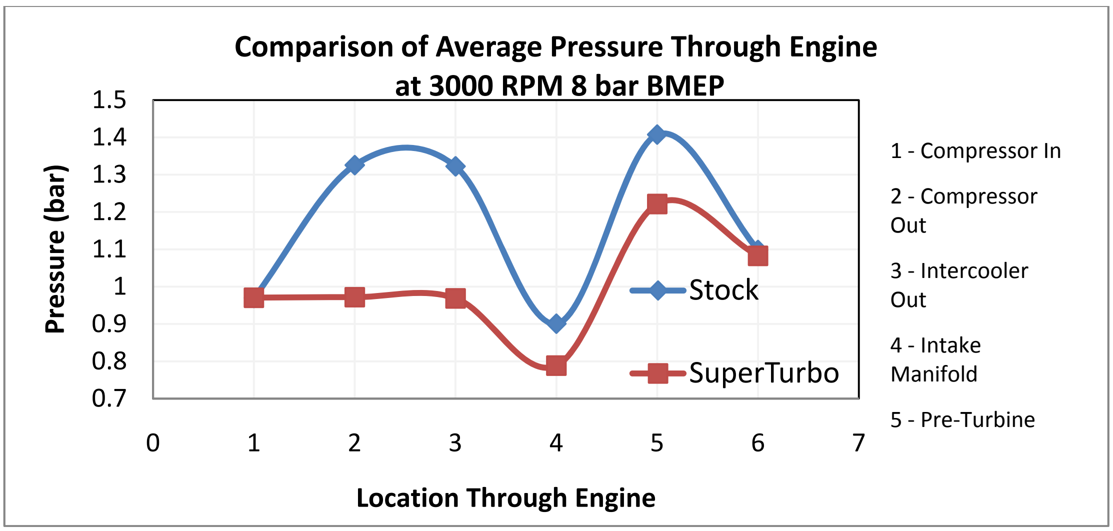

Figure 47: Pressure at different locations through the engine for 3000 RPM 8 bar BMEP

up to three or four kilowatts that are typically wasted by the compressor due to the SuperTurbo control of the gear ratio as illustrated in Figure 3.10. The difference is due to the ability of the superturbo to control the pressure ratio of the compressor. At low loads where the intake manifold pressure is below atmospheric the pressure ratio is controlled to be just above one where at higher loads the throttle is wide open and the gear ratio is controlled to give the required manifold pressure. This power difference correlates well with Figure 3.2 above showing areas where boost pressure is not needed. This reduction in power also corresponds to a reduction in in-cylinder power requirement for the same brake power.

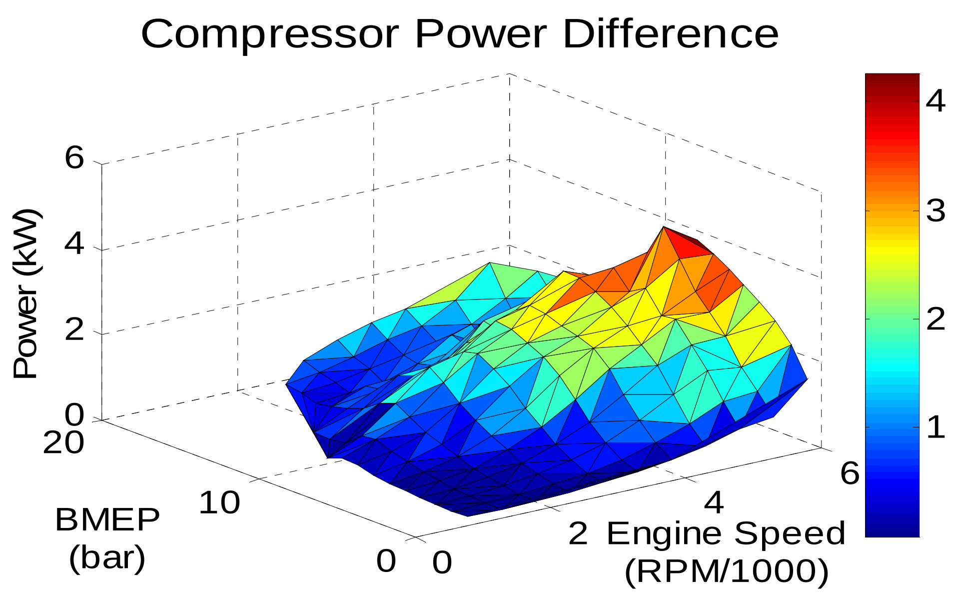

Figure 48: Power transferred from SuperTurbo to Crankshaft

While the wasted compressor boost pressure and power goes down with lower gear ratio as shown in Figure 3.11, the PMEP rises slightly with decreasing gear ratio even though pressure drop across the throttle is decreasing as shown in Figure 3.12. From the stock configuration to the superturbo configuration there is a reduction in pumping losses, but as the gear ratio is reduced the pumping losses gradually creep higher. The reduction in pumping losses at this location comes from the reduced backpressure of the improved turbine design as illustrated in Figure 3.13. With the stock gear ratio imposed there are additional pumping losses on the intake side due to the slightly lower manifold pressure. These losses are made up for by the higher reduction in pumping losses on the exhaust side. As the gear ratio is reduced the exhaust pressure drops, but not as much as the intake pressure drops which causes a very slight increase in pumping losses. These pumping losses are insignificant compared to the reduced compressor power losses shown above leading to overall BSFC improvement.

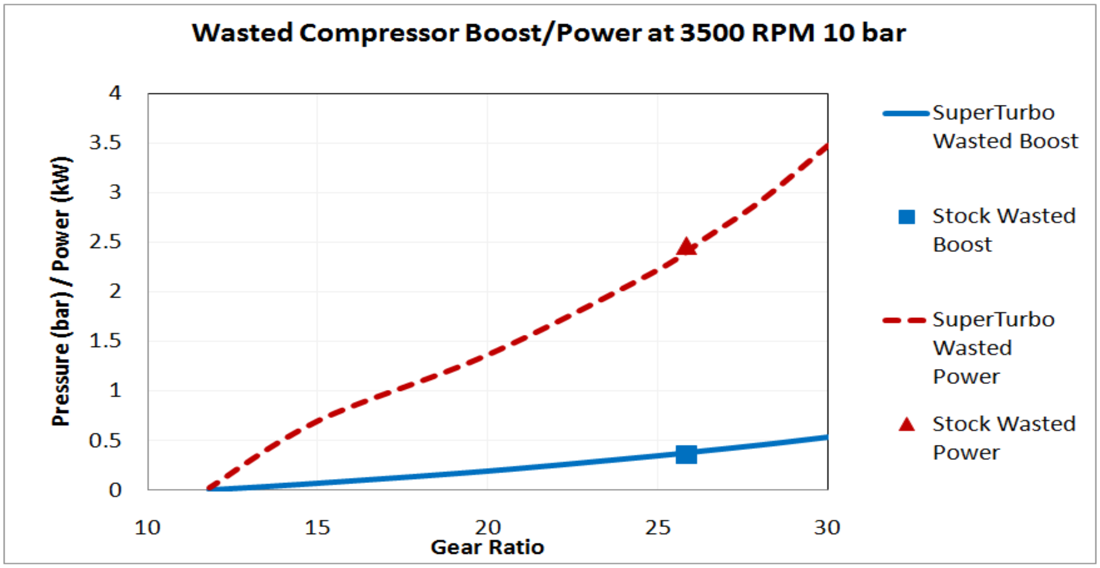

Figure 50: Wasted boost pressure and compressor power as a function of SuperTurbo gear ratio

A comparison of the log pressure vs. volume (P-V) plots shows the difference in intake and exhaust pressures in Figure 3.14. For the 3500 RPM 4 bar BMEP case the savings from lower exhaust back pressure clearly makes up for the lower intake manifold pressure. For the higher load case of 15 bar BMEP the pumping losses are higher than stock as illustrated in Figure 3.15. For this case the backpressure is close to stock, but the intake pressure is reduced enough to

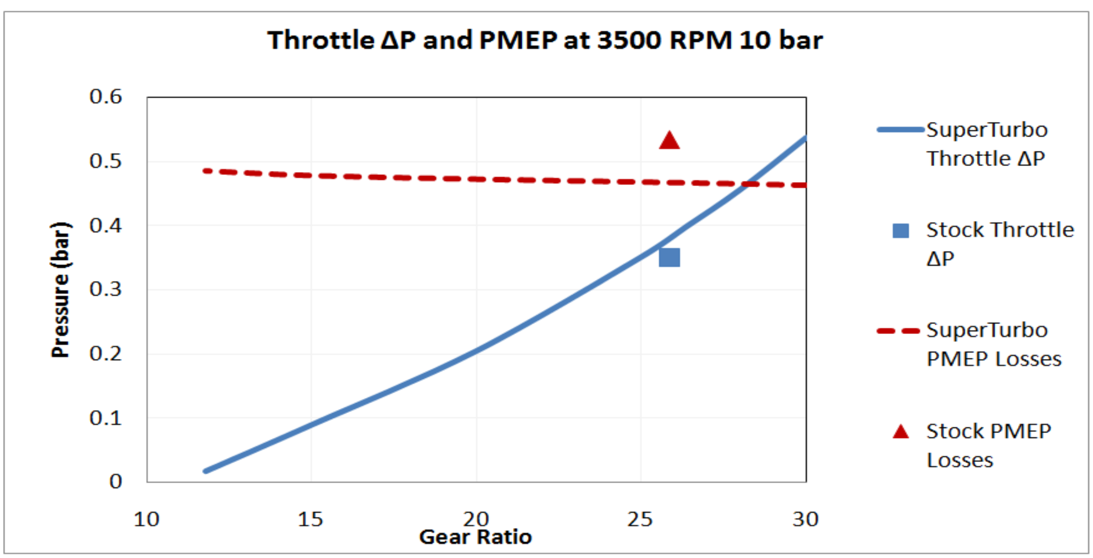

Figure 49: While the pressure drop across the throttle reduces with gear ratio, the pumping losses increase slightly

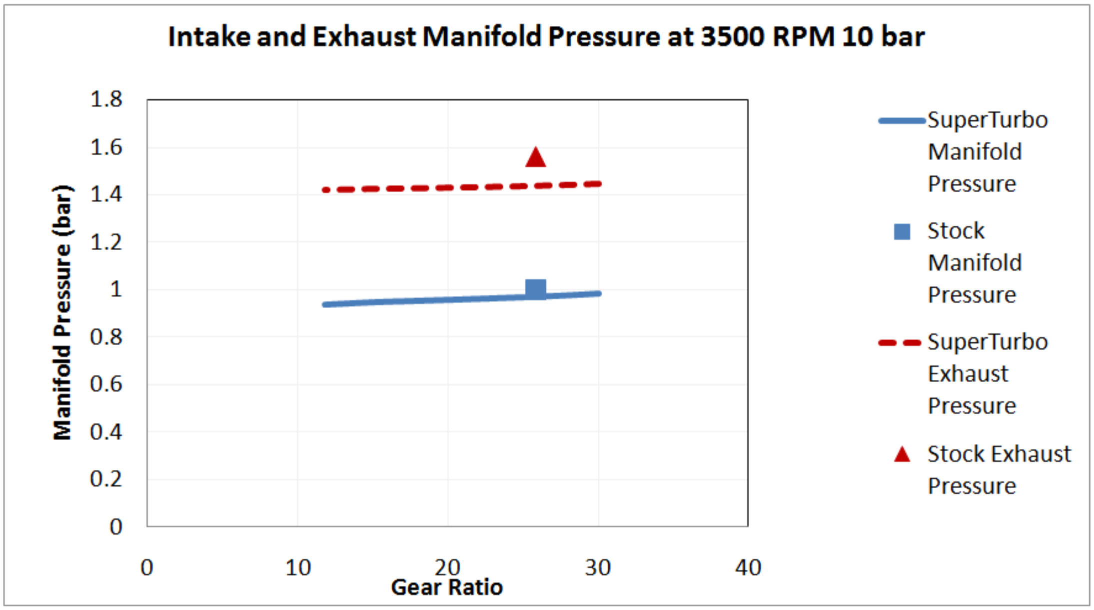

Figure 51: The reduced backpressure more than compensates for the increased pumping losses from the reduced intake manifold pressure

cause an overall increase in pumping losses. Although the pumping losses are higher compared to stock, they are insignificant compared to the turbocompounding benefit.

The intake manifold pressure is lower for the SuperTurbo configuration over the entire operating range as shown in Figure 3.16. The entire area has a reduction in pressure of about 2-7%. This is to be expected since the cylinder does not need as much air to create the same overall power in the system. While the new turbine design allows reduced backpressure for much of the operating range as shown in Figure 3.17 the higher speed

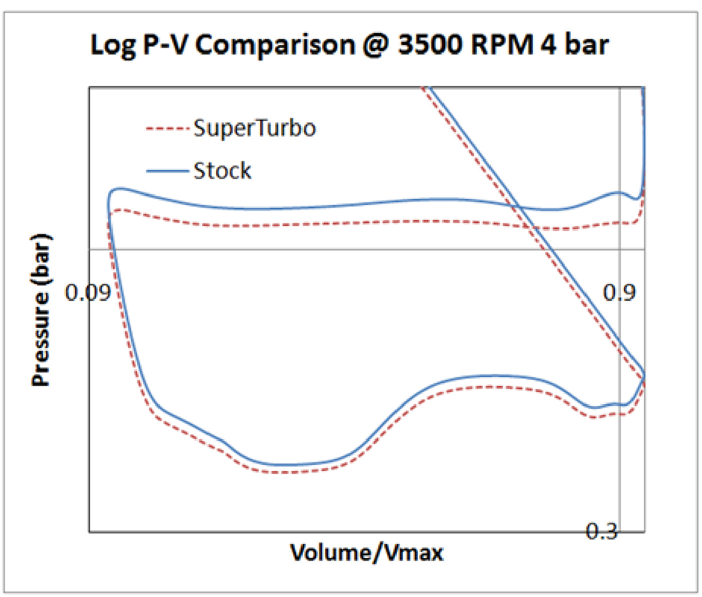

Figure 52: Log P-V plot comparing pumping losses at 3500 RPM 4

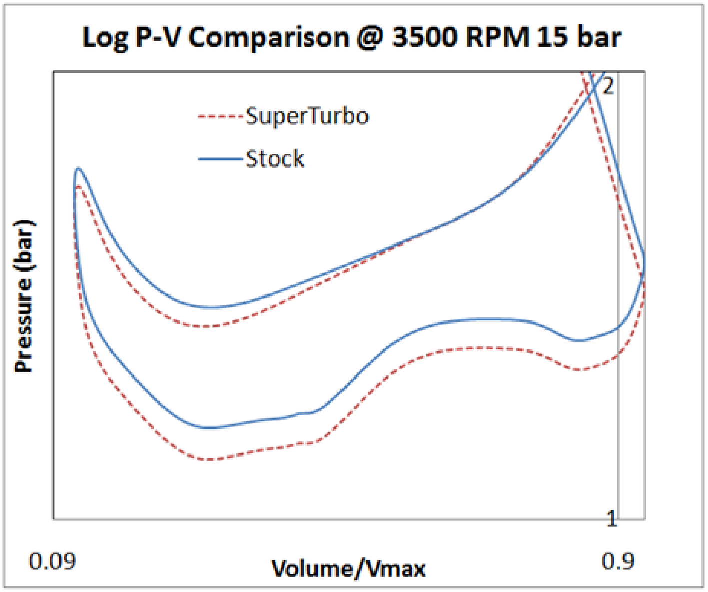

Figure 53: Log P-V plot comparing pumping losses at 3500 RPM 15

and load area has higher backpressure due to the wastegate being closed for turbocompounding. These pressure differences correlate to lower pumping losses in the mid range of the engine while the high load and high engine speed area of the engine experiences higher pumping losses compared to stock as illustrated in Figure 3.18. The low load and speed area shows almost no difference. The overall gear ratio used stays under 30 for most of the map except for the low speed high load region as Figure 3.19 shows.

Another source of improvement not realized with the modeling relates to the intake air

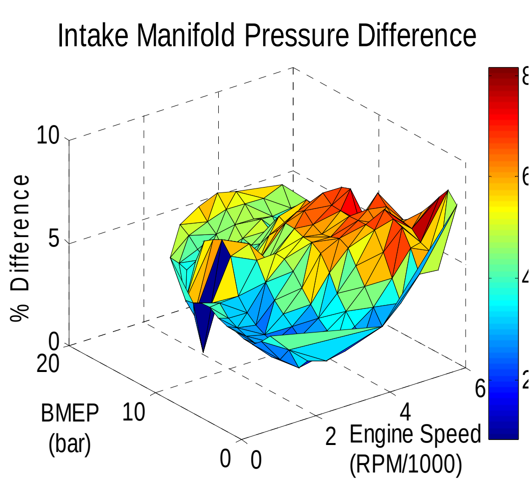

Figure 54: Difference in intake manifold pressure calculated as stock pressure minus SuperTurbo pressure so (+) indicates stock pressure is greater

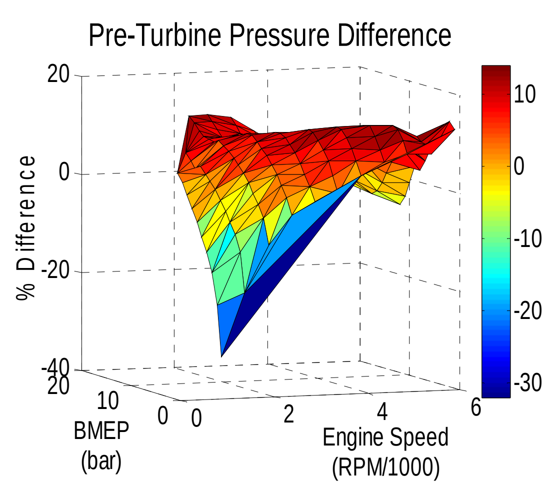

Figure 55: Difference in pre-turbine pressure calculated as stock pressure minus SuperTurbo pressure so (+) indicates stock pressure is greater

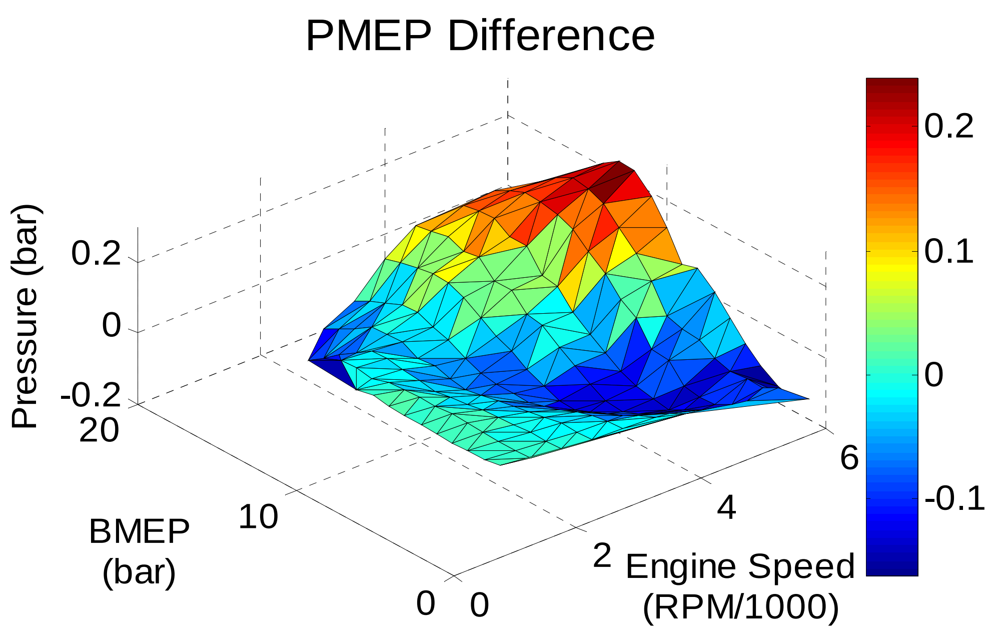

Figure 57: Stock PMEP minus SuperTurbo PMEP

temperature. The model does a poor job of estimating the temperature rise across the compressor, but the differences can be estimated with the use of test data. The lower load region of the map where the compressor is controlled to produce no boost should have almost

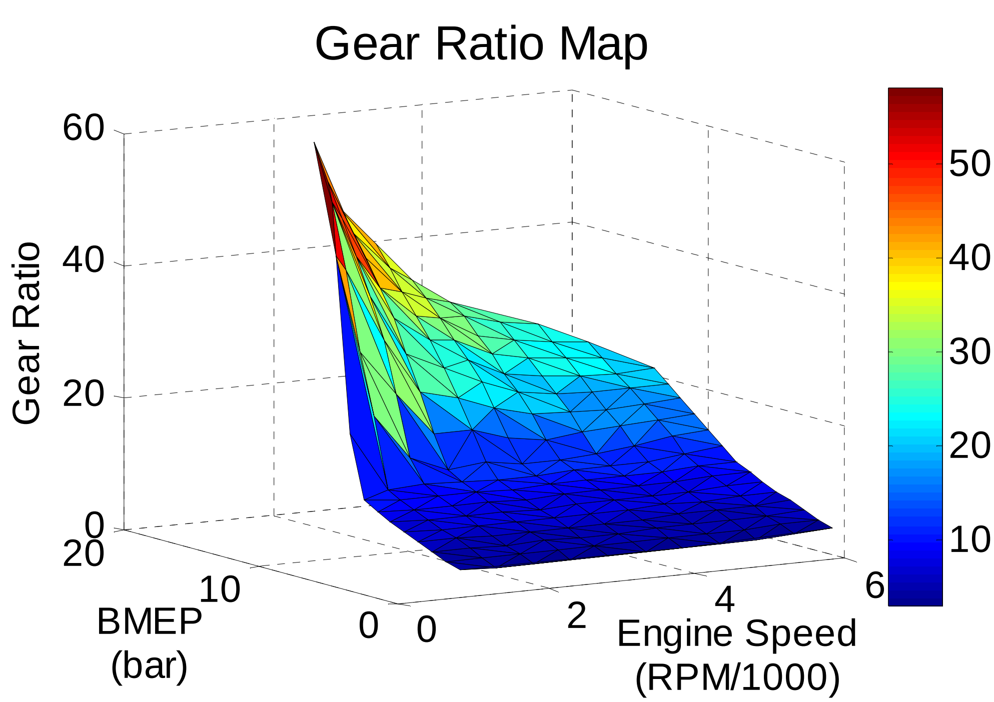

Figure 56: Overall gear ratio from turbine shaft to crankshaft

no temperature rise compared to the stock configuration. This results in lower intake manifold temperatures which provide denser in-cylinder air meaning less pressure is required.

The model results help solidify the understanding of how the SuperTurbo is able to benefit a reciprocating engine over the entire steady state operating range. The turbocompounding advantage goes up with higher load and engine speed since that is the area where most of the additional exhaust energy is passed through the wastegate. The mid to lower load range of the engine is able to realize more benefit due to the control of the compressor speed. Instead of creating boost that is not needed to prevent turbo lag boost is able to be created on demand at any given operating point with the use of the SuperTurbo. The mid range also benefits from reduced pumping losses. Even though the higher load and speed range has higher pumping losses compared to stock, the benefits from turbocompounding more than make up for the pumping losses and is able to supplement some of the in-cylinder BMEP requirement.

CHAPTER 4: SUMMARY AND CONCLUSION

4.1 Summary

A modeling project was carried out on a Volkswagen engine model using GT-Power. The addition of a SuperTurbo to the model was used to predict potential BSFC improvements. The SuperTurbo acts as a supercharger for the engine giving the intake manifold boost when it is needed and provides turbocompounding when excess boost is available. The stock engine model was used that Volkswagen had already correlated with test data for a wide open throttle configuration. Additional test data was used to correlate the data over the entire range of operating points. The SuperTurbo model developed by SwRI was added to the model and the original turbine model was replaced by a simplified version of a turbine model to represent characteristics of a new turbine design for use in the superturbo configuration.

It was predicted that the improvements would come from two sources. One source of improvement is where the turbine wastegate is open. This wasted energy was available to offset in-cylinder power with the use of turbocompounding. The second source of improvement comes from the reduced use of the compressor at low loads where boost is not needed. The modeling results confirmed the areas of improvement. The actual magnitude of improvements will depend on transmission efficiencies yet to be determined.

4.2 Conclusion and Future Work

- The original model required modification for accurate part load simulations.
- The improved model is able to match stock data with acceptable accuracy due to imposing engine timing parameters from the test data as well as modifying the FMEP model and throttle model.
- The SuperTurbo simulations resulted in significant BSFC benefits.
- The area of operation where the stock engine wastegate is normally open shows improvement due to utilization of excess exhaust energy through turbocompounding with a maximum of 6.7% improvement at 5000 RPM; 17 bar BMEP although the maximum amount of turbocompounding is 12.95 kW at 6000 RPM; 14 bar BMEP.
- The area of operation where boost pressure is limited when it is not needed also shows improvement due to the minimization of wasted compressor power with the largest power savings being 4.3 kW at 5500 RPM; 8 bar BMEP which coincides with the highest point for wasted boost pressure.
- The simulations showed approximate magnitudes of possible improvements with an assumed transmission mechanical efficiency of 80%.
- The actual magnitudes of improvements will depend heavily on the final efficiency of the turbocompounding action of the transmission between the turbine shaft and the crankshaft.

Possibilities of future work consist of further improvements to the current configuration by optimizing the timing parameters. This will require knowledge about the limitations affecting the current timing parameters. Once more information is known about the parasitic losses and mechanical efficiency of the final transmission it can be included into the model to show more realistic improvements.

Now that steady state results have been modeled these can be incorporated into transient models that are able to benefit more from the supercharging function of the SuperTurbo. The combination of transient and steady state modeling can then be used to determine fuel saving benefits over prescribed drive cycles. With a working model capable of both transient and steady state operation, control strategies can be developed and tested before being implemented on hardware.

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Appendix A: Volkswagen Test Data

	DREH			PME	ED	EE	EB	EK	NW_E	VPBS	BE98	ZZP
Index	engine speed [1/min]	Torque [Nm]	Power [kW]	bmep [bar]	injection time [ms]	injektion end [°KWvOT]	injection start [°KWvOT]	injection duration [°KW]	intake cam shaft position [°KW]	fuel consumption [l/h]	spec. fuel consumption [g/kWh]	ignition timing [°KWvOT]
1	1010	16.2	1.72	1.02	0.95	304	310	6	-1	1.25	552.8	20
2	1009	31.2	3.30	1.96	1.31	304	312	8	-4	1.71	394.1	20
3	1006	47.4	5.00	2.98	1.64	307	317	10	-9	2.22	337.3	19
4	1006	64.9	6.84	4.08	1.88	305	316	11	-10	2.71	301.2	17
5	1009	80.2	8.48	5.04	2.11	299	312	13	-10	3.18	285	15
6	1006	95.0	10.01	5.97	2.28	295	309	14	-10	3.59	272.6	14
7	1004	111.4	11.71	7	2.43	294	309	15	-9	4.11	266.7	11
8	1018	128.3	13.68	8.06	2.69	292	308	16	-10	4.69	260.6	8
9	1011	141.6	15.00	8.9	2.93	288	306	18	-9	5.14	260.5	5
10	1010	158.8	16.80	9.98	3.17	281	300	19	-7	5.83	263.5	3
11	1011	162.3	17.19	10.2	3.29	278	298	20	-6	6.12	270.5	2
12	1500	15.4	2.43	0.97	0.94	309	317	8	0	1.93	601.9	23
13	1500	31.7	4.98	1.99	1.29	307	319	12	-16	2.67	404.4	22
14	1500	47.3	7.43	2.97	1.52	304	318	14	-28	3.26	331.1	22
15	1499	62.5	9.82	3.93	1.77	302	318	16	-35	3.91	300	21
16	1501	78.5	12.33	4.93	1.97	300	318	18	-35	4.55	278.4	20
17	1501	95.8	15.06	6.02	2.16	298	317	19	-36	5.3	265.4	19
18	1499	112.0	17.59	7.04	2.43	297	319	22	-31	6.05	259.8	15
19	1500	125.5	19.71	7.89							258.2	
20	1500	128.4	20.18	8.07	2.67	297	321	24	-26	6.89	257.9	16
21	1500	143.9	22.60	9.04	2.76	291	316	25	-15	7.78	259.7	11
22	1499	176.0	27.63	11.06	3.26	277	306	29	-9	9.36	255.8	7
23	1498	213.3	33.46	13.4	4.09	269	306	37	-5	11.95	269.5	0
24	2000	17.0	3.57	1.07	0.86	309	319	10	-34	2.71	579.8	17
25	2000	32.0	6.70	2.01	1.28	304	319	15	-36	3.53	400.1	29
26	2000	47.0	9.83	2.95	1.23	304	319	15	-38	4.32	333.2	28
27	2000	63.5	13.30	3.99	1.46	301	319	18	-39	5.3	302.9	26
28	2000	80.4	16.83	5.05	1.66	299	319	20	-38	6.25	282.2	24
29	2000	95.8	20.07	6.02	1.86	296	318	22	-38	7.13	269.8	23
30	2000	111.6	23.37	7.01	2.18	290	316	26	-37	8.05	261.8	21
31	2000	127.5	26.70	8.01	2.3	284	312	28	-34	9.04	257.3	20
32	2000	145.3	30.43	9.13	2.53	278	308	30	-30	10.2	254.5	18
33	2000	161.7	33.87	10.16	2.83	274	308	34	-23	11.24	252.1	14
34	2000	177.1	37.10	11.13	3.03	272	308	36	-18	12.18	249.5	12
35	2000	190.7	39.93	11.98	3.2	274	312	38	-14	12.98	246.8	9
36	2000	207.2	43.40	13.02	3.48	274	316	42	-10	14.11	246.9	9
37	2000	243.5	51.00	15.3	4.03	273	321	48	-9	17.09	254.5	4
38	2000	254.8	53.37	16.01	4.48	261	315	54	-6	18.09	257.3	2
39	2000	280.1	58.67	17.6	5.31	243	307	64	-3	21.28	275.6	-3
40	2500	16.7	4.38	1.05	0.82	311	323	12	-35	3.52	613.6	31
41	2500	32.6	8.54	2.05	1.03	308	323	15	-36	4.61	408.8	30
42	2500	47.9	12.54	3.01	1.24	305	324	19	-38	5.67	343.4	29
43	2500	63.8	16.71	4.01	1.47	300	322	22	-39	6.8	309.2	27
44	2500	80.9	21.17	5.08	1.77	293	320	27	-39	8.01	287.3	25
45	2500	96.6	25.29	6.07	1.89	290	318	28	-38	9.14	274.3	23
46	2500	111.4	29.17	7	2.11	284	316	32	-37	10.17	265	22
47	2500	129.1	33.79	8.11	2.38	277	313	36	-34	11.44	257.3	19
48	2500	143.6	37.58	9.02	2.63	273	312	39	-31	12.58	254.2	16
49	2500	160.0	41.88	10.05	2.77	271	313	42	-23	13.96	253.2	13
50	2500	173.8	45.50	10.92	2.96	268	312	44	-18	14.91	248.9	12
51	2500	189.6	49.63	11.91	3.18	267	315	48	-15	16.04	245.3	13
52	2500	206.7	54.13	12.99	3.41	266	317	51	-10	17.44	244.6	10
53	2500	224.9	58.88	14.13	3.73	264	320	56	-9	18.95	244.4	8
54	2500	239.5	62.71	15.05	3.99	262	322	60	-9	20.45	247.8	5
55	2500	271.4	71.04	17.05	4.81	240	312	72	-1	24.31	259.9	2
56	3002	16.6	5.20	1.04	0.86	312	327	15	-35	4.44	646.4	32
57	3000	35.0	11.00	2.2	1.07	309	328	19	-36	6.23	429.3	31
58	3002	47.6	14.96	2.99	1.31	304	328	24	-38	7.03	357.2	29
59	3002	63.7	20.01	4	1.47	299	325	26	-39	8.36	317	28
60	3002	81.5	25.62	5.12	1.78	288	320	32	-38	9.85	291.9	25
61	3002	97.1	30.52	6.1	1.94	284	319	35	-38	11.23	279.4	23
62	3002	111.1	34.92	6.98	2.13	279	317	38	-37	12.48	271.4	22
63	3002	127.3	40.03	8	2.31	277	319	42	-34	13.88	263.5	20
64	3002	144.8	45.53	9.1	2.63	272	319	47	-29	15.43	257.4	20
65	3002	159.8	50.23	10.04	2.73	268	317	49	-24	16.77	253.4	19
66	3000	179.5	56.40	11.28	3	263	317	54	-17	18.38	247.5	17
67	3000	193.9	60.90	12.18	3.24	259	317	58	-5	19.75	246.4	15
68	3000	209.3	65.75	13.15	3.52	255	318	63	-4	21.2	244.8	12
69	3000	222.5	69.90	13.98	3.82	249	318	69	-4	22.7	246.6	11
70	3000	239.5	75.25	15.05	4.17	243	318	75	-4	24.86	250.8	9
71	3000	253.9	79.75	15.95	4.43	238	318	80	-3	27.12	258.3	7
72	3000	269.3	84.60	16.92	4.96	229	318	89	-3	29.87	268.2	5
73	3500	15.4	5.66	0.97	0.9	318	337	19	-6	5.24	702.6	30
74	3500	32.0	11.73	2.01	1.02	315	336	21	-6	6.91	446.6	28
75	3500	47.7	17.50	3	1.29	310	337	27	-6	8.44	366.7	28
76	3500	63.7	23.33	4	1.49	302	333	31	-6	10.1	328.8	26
77	3500	81.3	29.81	5.11	1.79	291	329	38	-5	11.9	303	25
78	3500	96.9	35.53	6.09	1.95	285	326	41	-5	13.6	291	23
79	3500	111.7	40.95	7.02	2.18	276	322	46	-5	15.02	278.6	22
80	3500	127.3	46.67	8	2.44	267	318	51	-5	16.58	270	20
81	3500	143.1	52.44	8.99	2.57	264	318	54	-5	18.11	262.3	20
82	3500	161.4	59.15	10.14	2.81	260	319	59	-5	19.99	256.6	19
83	3500	175.2	64.23	11.01	3.03	255	319	64	-4	21.49	254.1	17
84	3500	192.7	70.64	12.11	3.29	249	318	69	-4	23.34	251.1	15
85	3500	209.3	76.71	13.15	3.57	244	319	75	-4	25.39	251.4	14
86	3500	221.5	81.20	13.92	3.78	239	318	79	-4	26.98	252.4	13
87	3500	241.6	88.55	15.18	4.2	230	318	88	-1	29.85	256	10
88	3500	256.4	93.98	16.11	4.71	219	318	99	-1	32.76	264.9	9
89	3499	276.1	101.18	17.35	5.06	212	318	106	-1	36.83	276.4	6

	DREH			PME	ED	EE	EB	EK	NW_E	VPBS	BE98	ZZP
Index	engine speed [1/min]	Torque [Nm]	Power [kW]	bmep [bar]	injection time [ms]	injektion end [°KWvOT]	injection start [°KWvOT]	injection duration [°KW]	intake cam shaft position [°KW]	fuel consumption [l/h]	spec. fuel consumption [g/kWh]	ignition timing [°KWvOT]
90	4000	16.9	7.07	1.06	0.89	317	338	21	-5	6.51	697.5	30
91	4000	31.8	13.33	2	1.09	312	338	26	-5	8.25	469.7	29
92	4000	48.7	20.40	3.06	1.34	306	338	32	-5	10.32	384.6	28
93	4000	64.3	26.93	4.04	1.55	301	338	37	-4	12.08	341.1	26
94	4000	80.2	33.60	5.04	1.73	297	339	42	-5	13.93	314.8	25
95	4000	94.4	39.53	5.93	1.93	290	336	46	-5	15.44	296.6	23
96	4000	111.2	46.60	6.99	2.15	286	338	52	-5	17.54	285.7	23
97	4000	126.4	52.93	7.94	2.4	281	339	58	-4	19.17	274.9	20
98	4000	143.1	59.93	8.99	2.63	271	334	63	-4	21.05	266.9	20
99	4000	161.1	67.47	10.12	2.94	257	328	71	-4	23.14	260.5	19
100	4000	174.1	72.93	10.94	3.11	250	325	75	-4	24.91	259.4	18
101	4000	193.4	81.00	12.15	3.4	238	320	82	-4	27.55	258.3	16
102	4000	210.7	88.27	13.24	3.61	232	319	87	-4	29.99	258.1	15
103	4000	221.5	92.80	13.92	3.87	225	318	93	-4	32.01	262	13
104	4000	241.9	101.33	15.2	4.54	209	318	109	-4	35.71	267.7	11
105	4000	253.9	106.33	15.95	4.81	202	317	115	-3	39.12	279.4	8
106	4000	272.0	113.93	17.09	5.67	181	317	136	-1	45.04	300.1	7
107	4000	284.7	119.27	17.89	6.02	179	323	144	0	48.86	311.2	6
108	4500	15.8	7.43	0.99	0.91	313	338	25	-5	7.61	775.5	28
109	4500	32.6	15.38	2.05	1.19	306	338	32	-5	9.76	481.6	26
110	4500	48.5	22.88	3.05	1.35	301	337	36	-5	11.94	396	25
111	4500	64.6	30.45	4.06	1.56	296	338	42	-5	14.05	350.1	24
112	4500	79.6	37.50	5	1.73	291	338	47	-5	16.02	324.4	24
113	4500	98.0	46.20	6.16	2.1	282	339	57	-4	18.4	302.7	22
114	4500	112.4	52.95	7.06	2.25	277	338	61	-5	20.27	290.7	21
115	4500	128.0	60.30	8.04	2.5	269	336	67	-5	22.57	284.2	20
116	4500	139.9	65.93	8.79	2.67	262	334	72	-5	24.26	279.4	19
117	4500	162.3	76.50	10.2	3.02	245	327	82	-5	27.44	272.3	19
118	4500	177.5	83.63	11.15	3.31	238	327	89	-4	29.66	269.3	18
119	4500	191.9	90.45	12.06	3.43	234	327	93	-5	31.98	268.5	17
120	4500	209.4	98.70	13.16	3.82	223	326	103	-4	35.25	271.2	14
121	4500	223.9	105.53	14.07	4.19	208	321	113	-3	38.8	279.3	12
122	4500	237.9	112.13	14.95	4.59	194	318	124	-3	42	284.5	10
123	4500	253.9	119.63	15.95	5.13	195	333	138	-1	46.61	296	7
124	4501	270.6	127.53	17	5.92	191	351	160	0	55.21	328.9	4
125	5000	16.2	8.50	1.02	0.96	309	338	29	-5	9.09	815.8	27
126	5000	30.1	15.75	1.89	1.19	302	338	36	-5	11.13	535.9	26
127	5000	50.1	26.25	3.15	1.49	296	341	45	-5	14.09	408	24
128	5000	66.4	34.75	4.17	1.7	287	338	51	-5	16.5	360.5	24
129	5000	79.6	41.67	5	1.85	282	338	56	-4	18.31	333.7	23
130	5000	94.4	49.42	5.93	2.05	276	338	62	-5	20.72	318.6	22
131	5000	114.3	59.83	7.18	2.42	266	339	73	-4	24.21	307.4	20
132	5000	128.8	67.42	8.09	2.68	258	338	80	-5	27.07	305.1	21
133	5000	145.0	75.92	9.11	2.93	250	338	88	-4	29.88	298.8	21
134	5000	160.4	84.00	10.08	3.22	243	340	97	-4	32.41	293.1	19
135	5000	177.8	93.08	11.17	3.44	242	345	103	-4	35.46	289.4	19
136	5000	195.8	102.50	12.3	3.97	238	357	119	-4	38.72	287.1	16
137	5000	208.8	109.33	13.12	4.11	231	354	123	-4	41.79	290.3	14
138	5000	221.9	116.17	13.94	4.4	224	356	132	-4	45.48	297.3	12
139	5000	237.1	124.17	14.9	4.83	212	357	145	-3	49.33	301.8	11
140	5000	255.8	133.92	16.07	5.41	195	357	162	-1	55.98	317.4	9
141	5000	265.2	138.83	16.66	6.14	173	357	184	-1	61.06	334	6
142	5500	16.1	9.26	1.01	0.99	313	346	33	-4	10.48	861	28
143	5500	34.9	20.08	2.19	1.23	305	346	41	-5	13.52	511	25
144	5500	50.0	28.78	3.14	1.47	299	348	49	-4	15.98	421.4	24
145	5500	61.1	35.20	3.84	1.67	296	351	55	-4	17.83	384.3	23
146	5500	78.0	44.92	4.9	1.99	292	358	66	-4	20.87	352.8	22
147	5500	95.8	55.18	6.02	2.19	283	355	72	-4	24.33	334.7	22
148	5500	114.1	65.73	7.17	2.52	272	355	83	-3	28.01	323.8	21
149	5500	129.2	74.43	8.12	2.76	267	358	91	-3	30.95	315.7	21
150	5500	143.9	82.87	9.04	3.07	261	362	101	-3	34.1	312.5	20
151	5500	161.1	92.77	10.12	3.33	256	366	110	-3	37.73	309	19
152	5500	176.8	101.84	11.11	3.66	245	366	121	-3	41.15	306.7	17
153	5500	190.7	109.82	11.98	3.91	237	366	129	-3	44.78	309.8	16
154	5500	207.4	119.44	13.03	4.25	226	366	140	-3	49.42	314.3	15
155	5500	217.4	125.22	13.66	4.54	216	366	150	-3	53.34	323.5	13
156	5500	243.3	140.16	15.29	5.54	180	363	183	-1	66.26	359	10
157	6000	15.6	9.80	0.98	1.11	308	348	40	-1	12.61	974.2	28
158	6001	32.8	20.60	2.06	1.34	299	347	48	0	15.85	585.3	25
159	6000	49.3	31.00	3.1	1.58	298	355	57	0	19.26	472.1	23
160	6000	63.2	39.70	3.97	1.83	297	363	66	0	21.98	420.6	23
161	6000	80.7	50.70	5.07	2.15	291	368	77	-1	25.46	381.3	22
162	6000	95.7	60.10	6.01	2.39	287	373	86	-1	28.56	360.6	21
163	6000	113.3	71.20	7.12	2.7	277	374	97	-2	32.29	344.6	21
164	6000	127.8	80.30	8.03	2.95	269	375	106	-2	35.96	339.9	20
165	6000	142.8	89.70	8.97	3.26	259	376	117	-2	39.6	335.2	19
166	6000	158.8	99.80	9.98	3.53	250	377	127	-2	43.73	332.9	19
167	6000	180.0	113.10	11.31	4.07	231	378	147	-2	49.33	331.2	16
168	6000	188.9	118.70	11.87	4.25	223	376	153	-2	52.23	334.2	15
169	6000	206.4	129.70	12.97	4.93	199	376	177	-2	59.8	350	13
170	6001	224.4	141.02	14.1	5.56	175	375	200	-1	70.94	382.1	12

Index	TLVV before compressor T [°C]	TLNV after compressor T [°C]	TLNK after intercooler T [°C]	TSAU manifold temperature [°C]	TAK1 exhaust manifold T1 [°C]	TAK2 exhaust manifold T2 [°C]	TAK3 exhaust manifold T3 [°C]	TAK4 exhaust manifold T4 [°C]	TAVT before turbine T [°C]	TANT after turbine T [°C]	TAVK before catalyst T [°C]	TANK after catalyst T [°C]
1	22	30	10	26	410	404	382	391	378	287	290	320
2	21	28	17	25	449	436	423	424	383	308	308	359
3	22	30	17	26	459	458	453	448	412	334	336	383
4	22	30	21	26	457	469	466	458	446	374	378	410
5	22	31	23	27	460	479	477	460	474	397	400	439
6	23	32	24	28	462	490	489	465	497	419	421	468
7	23	34	26	30	469	506	499	476	525	450	450	498
8	24	36	26	30	480	521	526	492	556	480	480	527
9	24	38	26	30	491	534	540	500	578	501	503	541
10	24	40	26	28	500	547	552	514	601	521	523	563
11	25	41	28	29	501	549	552	511	602	522	522	533
12	22	29	16	25	505	480	474	490	458	367	366	398
13	23	30	18	25	516	508	518	502	477	393	393	423
14	24	31	18	26	507	516	525	502	504	431	433	437
15	24	33	16	27	504	518	518	494	541	461	461	469
16	24	35	21	27	515	532	528	508	567	489	488	502
17	24	37	22	28	521	544	538	517	587	505	506	529
18	25	41	24	28	538	569	563	543	619	535	535	560
19												
20	25	45	28	30	550	595	588	561	645	561	562	601
21	25	48	27	30	579	613	621	590	680	590	592	631
22	25	52	30	31	581	643	651	600	726	651	651	683
23	27	72	33	32	616	692	695	642	790	655	655	667
24	21	30	8	26	546	530	519	525	481	387	387	431
25	22	31	14	25	586	578	565	568	528	460	475	494
26	23	33	17	26	588	588	571	573	572	504	504	533
27	24	37	21	27	592	595	580	577	607	526	526	564
28	23	39	23	27	598	606	590	585	634	548	549	590
29	23	42	25	28	603	619	604	598	655	570	572	610
30	24	47	25	29	612	631	624	611	677	588	586	638
31	24	51	26	29	622	641	644	628	701	609	609	654
32	25	56	27	29	634	652	665	642	727	639	639	682
33	24	59	29	30	641	666	679	647	746	659	660	700
34	25	62	30	30	642	672	685	650	758	671	672	716
35	25	62	30	31	649	685	696	657	778	691	689	732
36	25	64	30	31	654	698	713	666	799	710	715	749
37	25	82	32	32	690	753	760	705	862	751	748	763
38	25	88	33	32	695	758	761	713	866	749	750	754
39	25	109	33	33	719	783	779	737	891	752	752	743
40	22	32	8	24	602	588	580	582	544	452	449	510
41	22	33	16	25	635	639	626	618	599	530	531	562
42	22	37	19	26	633	643	635	620	634	562	564	592
43	23	42	19	26	642	649	648	623	665	582	583	623
44	24	47	22	27	648	658	656	628	687	599	600	651
45	24	52	26	27	656	673	669	642	711	620	620	674
46	24	55	26	28	658	681	676	651	724	636	638	689
47	25	60	26	29	670	694	689	667	746	658	659	708
48	25	63	28	30	679	705	700	678	763	674	676	724
49	25	64	30	31	696	721	721	694	791	704	702	752
50	25	64	30	31	696	727	723	695	797	712	715	763
51	25	64	32	33	702	738	734	707	816	729	732	779
52	26	65	32	33	715	749	747	717	838	748	751	796
53	26	70	34	34	732	769	765	730	864	767	769	810
54	26	74	34	34	737	784	779	741	880	778	783	807
55	25	96	36	36	757	808	796	763	904	783	788	786
56	24	36	12	25	687	683	679	665	650	557	557	587
57	24	39	13	24	690	695	684	675	667	586	582	618
58	24	43	20	27	692	699	689	682	693	614	614	651
59	25	49	23	28	699	706	697	687	719	631	630	672
60	25	55	25	29	706	715	704	692	742	656	657	703
61	26	60	26	30	716	728	714	700	763	679	678	723
62	26	64	26	29	721	736	724	708	777	690	691	741
63	27	67	28	31	730	749	740	718	797	708	708	759
64	27	68	29	32	738	756	747	728	813	726	725	778
65	26	63	33	33	738	761	755	734	827	742	741	796
66	26	63	33	34	742	768	761	742	842	761	760	809
67	26	63	34	34	739	767	765	744	849	774	774	829
68	26	63	35	35	745	776	769	750	860	787	789	828
69	26	69	35	36	751	787	779	761	873	791	793	822
70	26	75	37	37	759	795	791	768	886	795	795	815
71	26	84	39	38	764	804	796	773	893	790	791	804
72	26	94	40	40	774	814	805	782	905	791	790	797
73	24	36	18	25	714	701	698	682	691	610	616	644
74	24	39	22	26	722	733	725	702	709	643	646	675
75	25	45	24	27	734	742	736	723	738	666	666	710
76	25	51	25	28	739	755	746	734	766	686	688	733
77	25	58	26	29	742	761	753	738	787	705	707	761
78	26	63	28	30	745	765	758	745	803	719	720	780
79	26	67	29	31	751	769	764	749	814	728	731	787
80	26	66	30	32	756	776	771	755	829	743	746	798
81	26	66	32	33	761	783	777	762	842	756	757	812
82	26	67	33	34	765	786	783	767	854	770	771	827
83	25	67	35	35	770	793	790	773	865	785	784	832
84	25	66	36	36	774	798	796	780	877	799	801	835
85	25	67	37	37	778	809	803	788	889	811	812	839
86	25	68	38	38	776	814	809	790	894	816	817	836
87	25	74	39	39	783	820	810	801	904	819	819	830
88	25	82	40	40	785	825	818	803	908	816	816	823
89	25	93	41	41	796	835	823	813	919	814	815	819

	TLVV	TLNV	TLNK	TSAU	TAK1	TAK2	TAK3	TAK4	TAVT	TANT	TAVK	TANK
Index	before compressor T [°C]	after compressor T [°C]	after intercooler T [°C]	manifold temperature [°C]	exhaust manifold T1 [°C]	exhaust manifold T2 [°C]	exhaust manifold T3 [°C]	exhaust manifold T4 [°C]	before turbine T [°C]	after turbine T [°C]	before catalyst T [°C]	after catalyst T [°C]
90	24	41	22	25	732	726	723	706	729	611	614	675
91	25	50	20	26	751	768	758	733	747	655	655	705
92	26	58	24	27	765	776	770	753	770	687	690	737
93	26	63	26	29	773	787	780	765	799	712	713	762
94	25	67	31	31	775	794	787	772	820	733	733	789
95	25	63	32	31	775	792	788	773	836	750	750	804
96	25	68	30	32	783	801	795	782	852	763	763	818
97	25	67	31	33	787	806	799	787	866	777	777	832
98	25	67	33	35	788	808	804	791	875	790	791	842
99	25	67	33	36	790	810	809	795	884	801	803	845
100	25	66	37	37	794	813	813	800	892	812	815	848
101	25	68	38	38	796	821	819	804	901	821	820	847
102	25	68	40	39	793	823	824	809	907	827	827	844
103	25	72	41	40	800	833	829	818	917	832	831	846
104	25	77	42	42	803	843	837	822	925	836	837	846
105	25	83	44	43	807	842	834	827	927	832	833	839
106	25	95	44	44	801	839	829	819	918	815	816	817
107	25	101	45	45	797	835	820	809	910	801	792	802
108	24	41	19	25	763	763	755	738	767	676	677	718
109	25	49	22	27	784	796	786	768	782	712	714	748
110	25	58	24	28	797	804	797	783	807	731	733	777
111	25	65	27	29	801	814	807	795	832	749	750	796
112	25	69	30	32	803	815	808	797	847	758	759	810
113	25	68	31	33	805	818	810	803	866	776	777	830
114	25	67	33	34	806	822	812	808	878	790	791	843
115	25	68	35	36	808	825	817	810	886	800	801	837
116	25	66	36	37	807	824	817	811	891	809	808	840
117	25	66	39	38	807	825	820	819	900	820	820	843
118	25	67	40	40	807	825	823	819	904	823	824	841
119	25	67	42	41	807	832	828	822	911	830	832	845
120	25	72	43	42	812	837	834	827	919	835	838	846
121	25	75	48	45	812	840	835	831	927	836	839	843
122	25	82	47	46	821	852	845	839	933	840	839	848
123	25	92	48	47	826	857	852	841	937	835	836	838
124	25	106	48	48	821	843	843	827	922	813	815	811
125	25	47	18	25	800	799	789	776	812	720	721	754
126	25	54	23	27	811	819	809	793	819	743	742	780
127	25	64	25	28	829	831	822	812	845	763	764	805
128	25	70	27	30	833	839	827	824	866	776	777	825
129	25	67	30	32	831	841	828	824	880	791	792	840
130	25	68	32	33	829	839	826	822	888	801	801	841
131	25	68	33	34	822	830	817	813	887	801	803	825
132	25	65	35	36	812	822	812	810	885	803	803	819
133	25	68	37	37	813	821	815	817	891	808	809	823
134	25	69	39	39	819	825	818	824	900	817	817	828
135	25	70	39	39	819	830	823	827	908	825	826	834
136	25	69	43	42	820	834	831	831	915	835	837	840
137	25	73	43	43	824	836	836	834	919	835	835	838
138	25	80	46	45	826	848	840	837	924	835	834	836
139	25	86	48	47	829	847	840	843	926	831	831	832
140	25	99	48	48	836	855	844	852	931	826	828	826
141	25	107	50	50	832	848	829	839	918	809	810	808
142	24	42	18	26	817	827	815	795	838	746	744	792
143	25	51	22	27	831	842	832	813	856	775	775	820
144	25	58	24	28	841	851	840	828	879	794	795	838
145	25	62	27	30	848	860	848	837	894	809	809	848
146	25	65	29	31	849	862	847	841	906	820	821	850
147	25	67	31	33	843	857	840	835	906	822	821	842
148	25	68	33	35	834	848	835	829	904	820	821	836
149	25	68	34	36	832	844	835	831	906	824	824	837
150	25	70	37	37	829	842	834	831	907	826	827	835
151	25	71	38	38	832	847	843	836	916	835	836	841
152	25	72	40	40	829	844	836	834	915	836	837	838
153	25	69	43	43	826	844	842	834	918	842	843	842
154	25	78	44	46	825	851	846	841	921	838	839	836
155	25	82	49	48	823	849	841	847	919	834	837	830
156	24	100	51	51	815	843	835	842	908	808	813	805
157	25	64	19	25	862	853	843	843	891	780	781	789
158	25	69	23	27	871	873	865	859	899	810	811	830
159	25	68	26	29	869	868	858	859	905	815	815	833
160	25	68	29	31	864	862	849	857	907	819	820	833
161	25	66	32	34	857	856	844	851	912	828	828	839
162	25	65	34	35	855	855	844	851	917	835	835	845
163	25	67	36	37	852	857	844	852	921	841	840	848
164	25	67	40	40	845	847	839	846	916	839	841	842
165	25	68	42	42	841	844	837	845	915	839	838	839
166	25	70	43	43	839	848	838	851	920	844	843	842
167	25	71	46	45	840	848	842	848	921	845	845	841
168	25	77	49	48	841	851	841	849	921	842	843	836
169	25	85	51	51	835	844	833	846	911	827	826	820
170	25	100	52	52	822	836	818	837	894	799	799	794

	TOEL	TKWE	TKWA	PLVV	PLNV	PLNK	PSAU	O2VK	NATL	PAVT	PANT	PANK
Index	oel temperature [°C]	cooling water inlet T [°C]	cooling water outlet T [°C]	before compressor p [mbar]	after compressor p [mbar]	after intercooler p [mbar]	manifold pressure [mbar]	O_2 before catalyst [%]	TC speed [1/min]	before turbine p [mbar]	after turbine p [mbar]	after catalyst p [mbar]
1	83	56	85	991	992	991	286	0.94	12777	1012	992	987
2	85	57	87	991	994	993	365	0.89	13342	1017	992	989
3	86	58	89	990	998	996	452	0.85	18187	1027	994	990
4	88	59	90	989	1005	1004	545	0.84	22371	1037	996	990
5	89	58	90	990	1016	1015	623	0.81	27935	1048	998	992
6	90	58	91	990	1026	1024	701	0.78	28738	1060	1002	994
7	91	60	91	991	1041	1038	793	0.74	33529	1073	1000	989
8	92	58	92	991	1060	1057	891	0.79	38897	1096	1006	996
9	92	58	92	991	1075	1072	966	0.74	43855	1109	1007	992
10	93	59	93	990	1095	1089	1077	0.71	48091	1132	1011	995
11	94	59	93	990	1099	1092	1091	0.36	48168	1134	1013	994
12	86	58	86	994	997	996	282	0.79	10234	1032	1003	999
13	89	58	88	991	999	998	360	0.73	15083	1043	1006	999
14	89	58	89	991	1009	1007	468	0.63	20452	1056	1007	1000
15	90	59	89	991	1023	1021	592	0.6	27350	1071	1009	999
16	91	59	90	991	1041	1038	672	0.59	33429	1092	1012	1000
17	92	59	91	990	1064	1061	756	0.6	40061	1118	1015	1000
18	93	59	91	990	1094	1091	822	0.58	47392	1149	1021	1001
19												
20	94	59	92	990	1130	1125	886	0.64	54536	1186	1025	1002
21	94	60	92	989	1168	1163	951	0.66	61073	1229	1029	1003
22	95	60	93	990	1203	1197	1128	0.61	67010	1272	1038	1006
23	98	61	94	989	1390	1375	1381	0.24	89284	1456	1048	1010
24	89	59	87	990	1005	1004	332	0.73	19704	1041	998	991
25	90	59	88	990	1016	1014	413	0.7	25483	1058	1001	991
26	92	59	89	989	1032	1030	497	0.68	31278	1080	1004	992
27	93	59	89	989	1059	1056	588	0.62	38956	1112	1008	992
28	94	60	90	989	1094	1090	674	0.61	47442	1150	1012	993
29	94	60	90	988	1130	1126	752	0.57	54544	1189	1017	994
30	96	60	91	988	1167	1162	816	0.58	61077	1228	1023	996
31	96	61	91	988	1206	1201	884	0.56	67497	1270	1028	997
32	97	61	92	987	1246	1240	952	0.58	73216	1317	1036	999
33	98	61	92	986	1281	1274	1016	0.59	78014	1353	1042	1001
34	98	61	92	986	1310	1301	1092	0.6	81022	1385	1048	1002
35	99	62	92	986	1320	1311	1172	0.59	82863	1404	1054	1004
36	99	62	93	984	1346	1335	1268	0.57	85615	1436	1062	1006
37	101	62	94	983	1519	1504	1500	0.3	102840	1625	1079	1012
38	101	62	94	981	1583	1568	1574	0.22	108339	1691	1082	1012
39	103	63	94	980	1800	1784	1791	0.11	124112	1904	1096	1017
40	92	59	88	991	1021	1019	333	0.72	26804	1075	1010	1001
41	93	59	88	991	1040	1037	410	0.66	33645	1103	1014	1001
42	94	60	89	991	1069	1066	494	0.66	41682	1139	1019	1001
43	96	60	90	990	1111	1107	579	0.63	51237	1185	1024	1002
44	97	61	91	989	1162	1157	664	0.66	60346	1237	1030	1004
45	97	61	91	989	1206	1200	739	0.62	67256	1281	1037	1005
46	98	61	91	989	1245	1239	801	0.65	72836	1320	1044	1006
47	99	62	91	988	1289	1281	875	0.63	78548	1368	1052	1008
48	99	62	91	987	1322	1314	930	0.61	82759	1405	1059	1011
49	100	62	92	986	1333	1322	994	0.62	83987	1432	1070	1014
50	101	62	92	985	1340	1327	1054	0.65	85240	1452	1078	1016
51	101	62	92	984	1345	1331	1138	0.62	86380	1464	1088	1019
52	102	63	92	983	1355	1340	1239	0.58	88308	1491	1099	1023
53	102	63	93	981	1417	1399	1352	0.54	95113	1564	1112	1026
54	103	63	93	980	1462	1442	1442	0.38	99711	1620	1121	1030
55	104	63	94	977	1710	1687	1695	0.2	119222	1872	1139	1036
56	94	61	88	991	1043	1040	338	0.64	33995	1102	1014	1000
57	95	60	89	990	1081	1078	435	0.64	44537	1151	1020	1001
58	97	61	89	990	1122	1117	510	0.65	53212	1198	1025	1001
59	98	61	90	989	1174	1169	592	0.56	62557	1252	1032	1003
60	99	62	90	989	1228	1222	680	0.6	70617	1309	1041	1004
61	100	62	90	988	1272	1264	753	0.58	76655	1358	1049	1006
62	100	62	91	987	1314	1305	815	0.61	82154	1408	1057	1008
63	101	63	91	986	1348	1338	886	0.6	86328	1452	1067	1010
64	102	63	91	984	1361	1349	949	0.62	88282	1481	1079	1013
65	103	63	91	984	1330	1315	1004	0.59	85825	1467	1089	1017
66	103	63	91	982	1339	1321	1093	0.54	87446	1487	1102	1021
67	104	63	92	980	1340	1320	1202	0.62	87627	1505	1115	1025
68	104	63	92	979	1340	1317	1269	0.49	88602	1523	1125	1028
69	105	63	92	978	1407	1383	1341	0.39	95560	1597	1133	1031
70	106	64	93	975	1478	1447	1448	0.29	101756	1682	1145	1036
71	106	64	93	974	1574	1542	1543	0.21	110637	1790	1155	1040
72	107	64	93	971	1688	1655	1656	0.14	119415	1918	1170	1045
73	96	61	88	991	1046	1043	310	0.67	36309	1110	1018	1000
74	98	61	89	990	1086	1082	395	0.68	46320	1161	1026	1002
75	99	62	89	989	1138	1132	475	0.69	56873	1221	1035	1003
76	100	62	90	988	1197	1190	556	0.62	66208	1285	1044	1005
77	101	62	90	988	1264	1256	649	0.65	75982	1363	1056	1007
78	103	62	91	986	1318	1308	732	0.68	82970	1426	1067	1009
79	103	63	90	985	1362	1350	808	0.66	87980	1485	1077	1012
80	104	63	91	984	1359	1345	877	0.61	88245	1495	1088	1015
81	105	63	91	983	1375	1359	950	0.58	90495	1530	1100	1018
82	106	64	91	981	1381	1361	1038	0.58	92267	1570	1114	1023
83	106	64	92	979	1388	1366	1103	0.5	92894	1593	1125	1026
84	107	64	92	977	1382	1356	1187	0.43	92944	1614	1139	1031
85	107	64	92	975	1394	1365	1266	0.36	95384	1654	1153	1036
86	108	64	92	973	1402	1370	1325	0.3	97130	1681	1163	1040
87	108	64	91	970	1475	1436	1433	0.21	104878	1788	1181	1046
88	108	65	92	968	1567	1525	1522	0.16	112481	1906	1196	1052
89	109	65	92	964	1705	1660	1656	0.13	122525	2077	1221	1061

	TOEL	TKWE	TKWA	PLVV	PLNV	PLNK	PSAU	O2VK	NATL	PAVT	PANT	PANK
Index	oel temperature [°C]	cooling water inlet T [°C]	cooling water outlet T [°C]	before compressor p [mbar]	after compressor p [mbar]	after intercooler p [mbar]	manifold pressure [mbar]	O_2 before catalyst [%]	TC speed [1/min]	before turbine p [mbar]	after turbine p [mbar]	after catalyst p [mbar]
90	99	61	88	991	1106	1102	341	0.74	50252	1180	1027	1004
91	101	62	89	989	1176	1171	419	0.62	62812	1260	1036	1005
92	102	62	90	988	1257	1250	509	0.64	74568	1350	1048	1008
93	103	63	90	987	1304	1296	584	0.56	80935	1410	1060	1010
94	104	63	90	986	1362	1351	668	0.6	87677	1480	1073	1013
95	105	63	90	985	1331	1318	730	0.58	84706	1468	1084	1016
96	106	64	90	983	1394	1379	811	0.57	91748	1548	1099	1020
97	106	64	91	982	1390	1373	878	0.53	92478	1563	1112	1024
98	107	64	91	979	1397	1376	956	0.51	93877	1597	1128	1028
99	108	64	91	976	1391	1365	1037	0.43	94447	1637	1144	1034
100	109	65	91	975	1384	1356	1100	0.38	94686	1652	1156	1038
101	109	65	92	972	1398	1366	1191	0.3	97293	1705	1174	1045
102	110	65	92	970	1393	1355	1269	0.25	99037	1736	1191	1051
103	110	65	92	967	1449	1409	1333	0.2	103904	1822	1205	1056
104	110	65	92	963	1496	1447	1432	0.17	110171	1928	1231	1066
105	111	65	92	960	1564	1510	1507	0.14	115580	2035	1249	1073
106	112	65	92	955	1710	1653	1649	0.11	126513	2240	1276	1085
107	112	66	93	951	1796	1736	1732	0.09	132086	2363	1292	1092
108	102	62	88	990	1106	1102	350	0.69	50427	1187	1034	1005
109	104	63	89	989	1183	1177	438	0.63	64340	1280	1047	1007
110	105	63	89	988	1265	1257	519	0.61	76124	1378	1060	1010
111	106	63	90	986	1340	1329	599	0.55	85218	1464	1075	1013
112	107	64	90	984	1395	1381	676	0.56	91083	1534	1089	1017
113	108	64	90	982	1404	1388	761	0.54	93176	1569	1107	1022
114	109	64	90	980	1395	1375	823	0.51	93253	1584	1123	1026
115	109	65	91	978	1400	1377	893	0.37	94613	1615	1136	1031
116	110	65	91	977	1380	1355	946	0.33	93063	1619	1148	1035
117	111	65	91	973	1373	1340	1053	0.28	95459	1667	1171	1043
118	112	65	91	970	1385	1348	1128	0.24	98162	1712	1188	1049
119	112	65	92	967	1381	1339	1201	0.21	99827	1751	1205	1056
120	113	66	92	963	1426	1378	1296	0.18	104940	1846	1228	1065
121	113	66	92	960	1462	1408	1376	0.16	110514	1911	1258	1076
122	113	66	92	955	1539	1480	1480	0.14	116786	2074	1276	1084
123	114	66	92	949	1674	1611	1611	0.1	125677	2269	1305	1096
124	114	66	93	940	1838	1769	1769	0.07	137213	2524	1347	1115
125	106	63	88	989	1157	1151	359	0.6	59995	1250	1043	1006
126	107	63	89	988	1228	1221	431	0.63	71112	1336	1055	1009
127	108	64	90	986	1343	1332	530	0.53	85341	1470	1075	1013
128	109	64	90	984	1405	1392	605	0.51	92332	1550	1093	1017
129	110	64	90	982	1392	1376	665	0.49	91918	1558	1108	1021
130	111	65	90	980	1395	1375	727	0.38	93496	1588	1124	1026
131	111	65	91	977	1408	1383	812	0.25	95848	1642	1142	1033
132	112	65	91	974	1378	1349	877	0.19	94778	1649	1158	1038
133	113	65	91	971	1403	1370	960	0.17	98539	1710	1178	1046
134	114	66	91	967	1399	1358	1040	0.16	100861	1766	1198	1053
135	115	66	91	963	1397	1350	1123	0.15	102780	1818	1221	1062
136	115	66	91	959	1364	1308	1212	0.14	104281	1852	1247	1073
137	116	66	92	954	1408	1347	1285	0.12	109180	1950	1269	1082
138	116	67	92	950	1483	1417	1375	0.1	116563	2087	1295	1093
139	117	67	92	944	1541	1468	1467	0.09	121792	2216	1321	1105
140	117	67	92	935	1703	1624	1623	0.07	133517	2491	1367	1124
141	118	67	92	928	1800	1717	1716	0.06	139720	2664	1395	1138
142	110	64	89	989	1127	1120	367	0.63	55466	1233	1053	1008
143	111	64	89	987	1212	1201	454	0.57	69464	1339	1073	1012
144	112	64	90	984	1288	1274	525	0.49	80044	1437	1092	1016
145	112	65	90	983	1335	1319	579	0.42	86043	1498	1106	1020
146	113	65	90	980	1363	1343	652	0.34	89162	1563	1126	1026
147	114	65	91	977	1387	1362	730	0.25	93889	1631	1147	1033
148	114	66	91	973	1403	1373	814	0.2	97098	1697	1169	1042
149	116	66	91	969	1402	1366	888	0.17	99342	1743	1190	1050
150	116	67	91	965	1408	1366	966	0.15	102093	1802	1210	1058
151	117	67	91	961	1398	1347	1050	0.14	105105	1866	1237	1068
152	118	67	91	956	1387	1328	1126	0.12	106665	1918	1261	1079
153	119	67	92	952	1322	1253	1187	0.1	102805	1933	1286	1090
154	119	67	92	945	1419	1342	1288	0.09	116108	2116	1319	1104
155	120	67	92	940	1449	1365	1359	0.08	119241	2215	1342	1115
156	120	68	92	923	1670	1574	1571	0.06	136843	2649	1415	1150
157	113	64	89	987	1317	1308	397	0.35	82263	1419	1062	1008
158	114	65	90	984	1391	1379	485	0.4	90860	1524	1086	1013
159	115	65	90	982	1391	1375	552	0.29	91755	1557	1106	1019
160	116	66	90	979	1399	1380	614	0.23	93980	1602	1125	1024
161	117	66	90	976	1376	1350	686	0.21	93445	1637	1150	1033
162	117	66	90	972	1371	1340	755	0.19	95204	1679	1171	1041
163	119	67	91	968	1375	1336	840	0.16	98091	1747	1199	1051
164	119	67	91	964	1364	1318	915	0.15	100280	1795	1220	1060
165	120	67	91	959	1352	1296	989	0.13	103602	1866	1245	1070
166	121	67	91	954	1342	1277	1063	0.12	106447	1933	1275	1083
167	122	68	92	945	1312	1232	1165	0.1	109925	2035	1318	1102
168	122	68	92	941	1368	1282	1226	0.09	116227	2152	1339	1112
169	123	68	92	931	1430	1330	1320	0.08	123084	2359	1381	1133
170	123	68	92	917	1584	1475	1463	0.09	137980	2698	1436	1161

	PAVE	LAMS	PMAX	DPMX	APMX	BLBY	PRAIL	ESM	DRKW	WPED
Index	before exhaust pipe p [mbar]	lambda [-]	combustion maximum p [bar]	max. p rise dp/dt [bar/°KW]	max. p crank angle position [°KWnOTh]	blowby [l/min]	injection pressure [bar]	injection mass [mg]	throttle opening [%]	pedal position [%]
1	988	0.999	12.6	0.57	15.2	4.9	43	7.6	1.9	7
2	988	0.999	19.2	1.03	11.6	6.7	43	10.4	3.2	13
3	988	0.997	25.9	1.5	10.2	8.2	50	13.5	4.4	17
4	989	0.999	32.2	1.97	10	9.7	58	16.6	5.6	20
5	989	0.999	36.4	2.36	11.1	10.7	58	19.3	6.6	22
6	989	0.998	40.8	2.7	12.1	12	66	21.9	7.7	25
7	987	0.998	44.4	2.9	14.5	13.4	73	25.2	9.3	27
8	987	1.002	45	2.8	18	14.7	76	28.3	12	31
9	986	0.998	46.9	2.89	20.1	16.3	78	31.3	15.1	34
10	986	0.997	50.7	3.13	21.6	19.3	82	35.4	32.8	45
11	986	0.957	51.8	3.33	21.5	19.3	83	37.2	55.2	100
12	999	1.001	12.7	0.51	14.9	5.1	53	7.9	3.4	15
13	999	0.999	19.1	0.96	12.3	6.2	53	10.9	5.1	19
14	999	0.999	23.8	1.13	12.8	6.7	55	13.3	6.2	22
15	998	0.999	27	1.12	14.7	9.1	58	16	7.4	25
16	998	1	32.9	1.52	13.6	10.3	58	18.6	8.7	27
17	998	1	39.1	1.9	13.7	11.4	66	21.6	10.4	30
18	999	0.999	42.4	2.13	15.4	12.9	75	24.8	11.9	33
19										
20	999	0.999	45.3	2.32	16.6	14.4	79	28.2	13.5	35
21	999	0.999	46.2	2.39	19	16.3	85	31.8	15.1	38
22	999	0.998	51.2	2.61	22.7	19.1	93	38.3	24	44
23	999	0.958	53.2	2.55	29.5	22.8	93	48.9	84.5	98
24	990	1	14.7	0.66	15.7	5.7	65	8.3	5.4	17
25	990	1	18.9	0.78	13	6.9	72	10.9	7.1	21
26	990	1	24	1.07	12.3	7.9	85	13.3	8.4	24
27	991	0.999	29.9	1.43	11.6	9.5	93	16.3	10	26
28	991	0.999	35.5	1.77	11.4	11.2	93	19.2	11.5	29
29	991	0.999	40.4	2.08	11.8	12.5	93	21.9	12.9	31
30	991	0.999	44	2.31	12.7	13.3	95	24.7	14.2	33
31	991	0.999	46.2	2.39	14.6	14.7	97	27.8	15.5	36
32	992	0.998	50.6	2.71	15.7	15.9	100	31.3	17	40
33	992	0.998	54.3	2.96	16.8	17.7	103	34.5	18.9	42
34	992	0.998	59.3	3.45	16.8	19.3	103	37.4	20.5	44
35	992	0.998	60.5	3.41	18.6	20	103	39.9	23.6	46
36	992	0.998	61.3	3.19	20.7	22	103	43.3	29.3	48
37	993	0.976	62.8	2.88	26	24.7	103	52.5	51.2	52
38	993	0.96	65.2	3.09	27	25.8	103	55.5	71.1	56
39	994	0.921	65.6	2.96	30.6	28.6	103	65.4	99.8	100
40	1000	1.001	15.1	0.7	15.8	6.9	76	8.7	6.8	20
41	1000	1.001	20.2	0.91	12.9	8.5	84	11.3	8.6	24
42	1000	0.999	26.2	1.3	11.5	9.7	91	13.9	10.1	26
43	1000	1	31.9	1.68	11	10.8	93	16.7	11.5	29
44	1000	1	38	2.09	10.8	12.1	93	19.7	13	32
45	1000	1	42.8	2.41	11.2	13.2	94	22.5	14.2	35
46	1000	1	48.2	2.82	11	14.4	96	25	15.3	37
47	1000	1.001	53	3.23	11.6	16	98	28.1	16.6	39
48	1000	1	56	3.38	12.8	17.3	100	30.9	17.7	41
49	1000	1	57.3	3.3	15.8	18.7	103	34.3	19.7	44
50	1001	1	63.3	3.85	14.5	19.9	103	36.6	21.4	46
51	1001	1	65.2	3.82	16.1	20.9	103	39.4	24.2	48
52	1001	1	66.7	3.8	17.6	22.4	103	42.8	29.4	51
53	1001	1	66.8	3.54	20.6	23.6	103	46.6	36.5	54
54	1002	0.983	67.9	3.46	22.4	24.5	103	50.3	63.2	55
55	1002	0.941	70.7	3.42	25.9	28.7	104	59.7	99.8	100
56	999	1.002	13.5	0.45	16.8	7.3	93	9.1	8.3	21
57	999	1.001	21.5	0.91	13.9	8.1	93	12.8	10.3	25
58	999	1.001	24.6	1.06	14.1	9.2	93	14.4	11.6	28
59	999	1	30.3	1.42	13.4	10.3	93	17.1	13	31
60	999	1	36.3	1.82	12.9	12.3	93	20.2	14.5	34
61	1000	1	41.7	2.19	12.5	14.3	94	23	15.7	36
62	1000	1	47	2.57	12.1	14.8	97	25.5	16.8	39
63	1000	1	52	2.91	12.6	15.3	99	28.4	18.1	41
64	1000	1	56.5	3.26	12.8	16.3	102	31.6	19.6	43
65	1001	1	60.6	3.66	12.8	16.5	103	34.3	22.6	45
66	1001	0.999	64.7	3.85	13.9	18.4	104	37.6	25.2	48
67	1002	1	68.1	3.92	14.7	19.8	104	40.4	30.6	50
68	1002	0.989	72.2	4.18	14.9	23.1	104	43.4	39.9	53
69	1002	0.976	73.7	4.21	16.6	24.1	104	46.5	41.9	59
70	1003	0.955	76.2	4.41	18.2	25.5	104	50.9	97.6	62
71	1003	0.932	76.9	4.26	20.3	26.4	104	55.5	97.5	67
72	1004	0.905	76.7	3.95	22.7	26.7	104	61.2	97.7	100
73	999	1	16.1	0.77	13.3	4.2	97	9.2	9.6	22
74	999	1	21.9	1.13	12.4	5.2	103	12.1	11.7	26
75	1000	1	27	1.41	12.3	6.8	103	14.8	13.3	29
76	1000	1	31.5	1.62	12.9	10.1	103	17.7	14.7	32
77	1000	1	37.4	2	12.6	12	103	20.9	16.2	35
78	1000	1	43.4	2.42	11.7	13.8	103	23.9	17.4	38
79	1000	1	49.5	2.91	10.9	15.3	103	26.4	18.5	41
80	1001	1	54	3.18	11.4	15.8	103	29.1	20.2	42
81	1001	1	58.7	3.45	11.8	16.2	103	31.8	21.7	44
82	1002	1	64.5	3.87	11.8	16.8	104	35.1	24.4	47
83	1002	0.993	67.4	4.01	12.7	17.4	104	37.7	26.3	49
84	1003	0.985	71.2	4.19	13.7	18.9	104	41	30.4	52
85	1003	0.976	74.6	4.34	14.6	19.8	104	44.6	36.1	54
86	1004	0.963	77.2	4.56	15.5	21.1	104	47.4	45.3	57
87	1004	0.936	77.4	4.36	18.4	22.3	104	52.4	99.8	63
88	1005	0.912	80.6	4.45	19.5	22.9	104	57.5	99.8	68
89	1006	0.883	82.8	4.37	21.5	27	105	64.6	99.8	100

	PAVE	LAMS	PMAX	DPMX	APMX	BLBY	PRAIL	ESM	DRKW	WPED
Index	before exhaust pipe p [mbar]	lambda [-]	combustion maximum p [bar]	max. p rise dp/dt [bar/°KW]	max. p crank angle position [°KWnOTh]	blowby [l/min]	injection pressure [bar]	injection mass [mg]	throttle opening [%]	pedal position [%]
90	1002	1	18.8	0.97	11.2	8.6	100	10	11.1	24
91	1002	0.999	24.5	1.34	10.5	9.8	103	12.7	12.7	27
92	1003	0.999	30.1	1.67	10.9	11.3	103	15.8	14.3	31
93	1003	0.999	35	1.95	11.1	12.8	103	18.6	15.8	33
94	1003	0.999	40.3	2.28	11.1	14	103	21.4	17.1	36
95	1004	0.999	44.4	2.57	11.3	15.5	103	23.7	18.9	38
96	1004	0.999	50.6	3.01	11	16.1	103	26.9	20.1	40
97	1004	0.999	54.6	3.26	11.5	16.6	104	29.4	21.6	42
98	1005	0.999	60.5	3.65	11.3	17.7	104	32.3	23.4	45
99	1006	0.991	66.4	4.08	11.3	18.7	104	35.5	26.4	47
100	1006	0.985	69.1	4.17	12.4	18.7	104	38.2	28.7	49
101	1007	0.969	74.8	4.59	12.8	19.4	104	42.3	32.8	52
102	1008	0.954	80	4.88	13.1	19.8	104	46.1	40.9	54
103	1008	0.937	77.9	4.48	16	20.1	104	49.2	43	57
104	1009	0.919	80.4	4.49	17.9	22.8	105	54.8	63.7	59
105	1010	0.887	81.8	4.49	19.3	24.3	105	60.1	99.8	64
106	1012	0.835	84.2	4.47	21.2	26.7	105	69.2	99.8	72
107	1013	0.808	88	4.65	21.3	27.8	105	75	99.9	100
108	1002	1.001	18.6	0.9	12.6	15.8	101	10.4	12.4	24
109	1003	1	24.6	1.29	12	15.6	103	13.3	14.3	28
110	1003	1	29.9	1.61	12.2	12.6	103	16.3	15.8	31
111	1003	0.999	35.4	1.94	12	13.7	103	19.2	17.2	34
112	1004	0.999	41.5	2.37	11	14.7	103	21.9	18.5	37
113	1004	1	47.4	2.74	11.1	15.7	103	25.1	20.4	40
114	1005	0.995	52.1	3.11	11.2	16.8	104	27.7	22	41
115	1005	0.98	57.1	3.49	11.3	17.8	104	30.8	23.6	43
116	1006	0.974	61.7	3.85	11	18.6	104	33.1	25.3	44
117	1007	0.963	69.1	4.35	11.4	19.4	104	37.5	29.4	48
118	1008	0.951	74	4.67	11.7	20.5	104	40.5	32.2	50
119	1008	0.943	76.7	4.74	12.9	21.1	104	43.6	37.4	52
120	1009	0.928	81.8	5.16	13.6	21.4	105	48.1	44.1	56
121	1011	0.902	82.5	4.97	15.6	22.9	105	53	54.9	58
122	1011	0.886	81.3	4.54	18.3	24.1	105	57.3	89.2	62
123	1013	0.861	81.7	4.28	20.5	26.4	105	63.6	99.9	69
124	1015	0.792	79.4	3.81	23.8	28.2	106	75.4	99.9	100
125	1002	1.001	20.2	0.98	12.7	20.8	103	11.2	13.7	25
126	1002	1	25.6	1.33	11.7	22	103	13.7	15.3	28
127	1003	0.999	32.7	1.8	11.4	23.1	103	17.3	17.1	32
128	1003	0.999	38	2.12	11.4	16.6	103	20.3	18.6	36
129	1004	0.999	42.4	2.41	11.4	15.4	103	22.5	20.2	38
130	1004	0.983	47.7	2.79	11.3	16.1	104	25.5	21.7	39
131	1005	0.949	55.6	3.45	10.6	16.8	104	29.7	23.7	42
132	1006	0.928	61	3.88	10.6	17.3	104	33.3	25.8	44
133	1007	0.919	67.8	4.39	10.2	18	104	36.7	27.6	46
134	1007	0.914	72.6	4.65	10.7	18.1	104	39.8	30.7	49
135	1009	0.91	78.5	5.09	10.8	19.2	105	43.6	34.3	52
136	1010	0.899	79.6	4.98	13.3	19.6	105	47.6	45.1	54
137	1011	0.885	84.3	5.23	13.6	21.7	105	51.3	50.1	56
138	1012	0.863	84.2	4.94	15.9	22.8	105	55.9	55.2	58
139	1014	0.846	89.3	5.22	16.1	24.3	105	60.6	99.8	63
140	1016	0.818	90.7	4.97	18.2	26	106	68.8	99.9	70
141	1018	0.785	89.2	4.58	20.3	28.2	106	75	99.9	100
142	1002	1.001	21	1.02	13.1	27.7	103	11.7	15.5	27
143	1003	1.001	27.8	1.46	12.2	27.1	103	15.1	17.7	31
144	1003	0.999	32.7	1.72	12.1	26.9	103	17.9	19.1	35
145	1004	0.994	36.3	1.95	12.3	26.2	103	19.9	20.1	37
146	1004	0.979	42.3	2.35	12.1	19.8	103	23.3	21.8	39
147	1005	0.953	50.1	2.96	11.3	18	103	27.2	23.5	42
148	1006	0.929	57.9	3.6	10.6	17.6	104	31.3	25.5	44
149	1007	0.917	63.7	4.02	10.5	18.6	104	34.6	27.5	46
150	1008	0.905	70	4.48	10.2	18.9	104	38.1	29.6	49
151	1009	0.896	74.1	4.63	11.3	19.6	104	42.1	33.3	52
152	1011	0.879	81	5.23	10.9	21.3	105	46	37.9	55
153	1012	0.865	80.8	4.91	13.6	21.7	105	50	51.8	56
154	1014	0.848	85.6	5.11	14.2	22.6	105	55.2	55	60
155	1015	0.823	86.8	5.07	15.4	23.9	106	59.6	76.9	62
156	1020	0.762	90.3	4.82	18	25.3	106	74	99.9	100
157	1000	0.98	23.6	1.19	12.2	35.7	103	12.9	15.7	29
158	1001	0.984	29.3	1.5	12.4	33.7	103	16.2	17.9	34
159	1002	0.964	35	1.87	12.2	34.1	103	19.7	20	37
160	1002	0.942	39.7	2.17	12.1	33.6	103	22.5	21.6	40
161	1003	0.927	46.2	2.61	11.6	33.3	104	26.1	23.9	42
162	1004	0.919	51.8	3.04	11.4	26.3	104	29.2	25.8	44
163	1005	0.904	57.4	3.4	12	22.9	104	33.1	28.1	47
164	1007	0.888	65	4.02	10.8	21	104	36.8	30.6	49
165	1008	0.872	71.4	4.54	10.6	20.7	105	40.5	34.3	52
166	1009	0.859	75.6	4.7	11.6	21.3	105	44.8	38.9	55
167	1011	0.839	79.7	4.72	13.6	21.6	105	50.5	54.1	59
168	1013	0.823	82.4	4.85	13.9	22.5	106	53.5	56.8	61
169	1015	0.789	89.8	5.27	14	24.5	106	61.2	99.9	68
170	1019	0.738	90.4	4.83	16.7	26.6	107	72.6	99.9	100

Appendix B: Volkswagen Stock Modeling Data

	Engine Speed (cycle average); Part R4	Brake Torque; Part R4	Brake Power (kW); Part R4	BMEP - Brake Mean Effective Pressure; Part R4	Angle at End of Injection; Part in-1	Angle at Start of Injection; Part in-1	Valve-Open Timing Angle; Part IntakeValve1	Fuel Flow; Part R4	BSFC - Brake Specific Fuel Consumption; Part R4	Combustion Start; Part Cyl1	Average Inlet Temperature; Part Turbo-Comp
Index	RPM	N-m	kW	bar	deg	deg	nk Angle (4-stro	kg/hr	g/kW-h	deg	K
1	1000	15.7906	1.65358	1	470.797	409.687	361.2	1.07282	648.787	-20.0087	295.473
2	1000	31.5808	3.30713	1.99999	464.377	403.249	365.63	1.439	435.119	-19.8457	295.579
3	1000	47.3722	4.9608	3.00004	463.555	402.377	368.927	1.795	361.837	-18.8728	295.663
4	1000	63.1618	6.61429	3.99999	464.585	403.438	369.677	2.14718	324.628	-17.0804	295.731
5	1000	78.9537	8.26801	5.00008	468.443	407.291	369.465	2.50346	302.789	-15.2464	295.79
6	1000	94.7489	9.92208	6.00037	472.084	410.929	369.85	2.86677	288.928	-13.5444	295.841
7	1000	110.551	11.5768	7.00108	472.107	410.951	368.96	3.24791	280.553	-11.1889	295.887
8	1000	126.323	13.2285	7.99996	473.731	412.55	369.693	3.66958	277.399	-7.94047	295.931
9	1000	142.105	14.8812	8.99943	476.087	414.998	368.698	4.12589	277.254	-4.76196	295.968
10	1000	158.266	16.5736	10.0229	482.143	420.989	366.525	4.58532	276.664	-2.43348	295.834
11	1000	158.508	16.5989	10.0382	482.142	421.135	366.474	4.59208	276.649	-2.40612	295.839
12	1500	15.7903	2.48033	0.999986	463.96	402.848	360.577	1.69305	682.591	-23.003	295.328
13	1500	31.5807	4.96068	1.99998	462.116	401.086	375.973	2.22218	447.959	-21.9791	295.379
14	1500	47.3715	7.4411	3	462.954	401.937	388.583	2.73139	367.068	-21.9133	295.416
15	1500	63.1614	9.92137	3.99996	463.27	402.003	394.969	3.23045	325.605	-21.3006	295.444
16	1500	78.9519	12.4017	4.99996	463.264	401.998	395.284	3.71362	299.443	-19.8665	295.465
17	1500	94.7438	14.8823	6.00005	464.36	403.112	395.834	4.19078	281.595	-18.2339	295.481
18	1500	110.533	17.3625	6.99997	462.351	401.077	391.344	4.67113	269.036	-16.5707	295.489
19	1500	126.333	19.8444	8.0006	460.06	398.963	386.595	5.15626	259.834	-14.4812	295.494
20	1500	142.128	22.3255	9.00088	464.73	403.678	375.384	5.66337	253.673	-12.0063	295.496
21	1500	157.915	24.8052	10.0006	471.269	410.073	371.32	6.17985	249.135	-9.57078	295.495
22	1500	173.688	27.2828	10.9995	474.983	413.855	369.234	6.72017	246.315	-7.02616	295.478
23	1500	189.487	29.7645	12.0001	476.167	414.972	366.238	7.30375	245.384	-4.05381	295.404
24	1500	205.269	32.2436	12.9995	475.422	414.388	364.758	7.94906	246.532	-1.09494	295.375
25	2000	15.7901	3.30707	0.999974	474.374	401.147	393.78	2.19198	662.816	-16.0573	294.469
26	2000	31.5813	6.61437	2.00002	473.911	400.841	396.008	2.86699	433.448	-28.6367	294.382
27	2000	47.372	9.92156	3.00003	474.285	401.188	398.285	3.53508	356.302	-28.2418	294.309
28	2000	63.1631	13.2288	4.00007	473.864	400.863	399.071	4.17815	315.836	-25.5407	294.245
29	2000	78.9538	16.5361	5.00008	474.496	401.139	397.768	4.83646	292.48	-24.1432	294.189
30	2000	94.7447	19.8433	6.0001	475.103	401.822	398.223	5.50208	277.277	-22.7955	294.134
31	2000	110.534	23.1502	7.00005	477.117	404.032	397.013	6.17607	266.782	-21.4149	294.08
32	2000	126.324	26.4572	8	481.954	408.641	394.713	6.86215	259.367	-19.9652	294.026
33	2000	142.119	29.7653	9.00027	484.937	411.61	391.024	7.57916	254.631	-17.9681	293.969
34	2000	157.916	33.0738	10.0007	485.752	412.59	383.664	8.37826	253.32	-15.0333	293.903
35	2000	173.685	36.3764	10.9993	484.771	411.533	378.934	9.24907	254.26	-11.7716	293.829
36	2000	189.502	39.6892	12.001	481.455	408.328	373.71	10.0956	254.368	-9.61673	293.751
37	2000	205.282	42.9942	13.0004	477.177	404.117	370.139	10.8921	253.338	-8.59647	293.666
38	2000	221.076	46.3021	14.0006	473.583	400.462	369.556	11.7815	254.448	-7.27913	293.514
39	2000	236.868	49.6096	15.0007	471.678	398.466	369.622	12.9255	260.544	-4.97951	293.315
40	2000	252.653	52.9156	16.0003	477.934	404.877	366.144	14.4497	273.07	-2.00817	293.098
41	2000	268.433	56.2204	16.9996	487.164	414.1	363.262	16.2866	289.692	1.1599	292.766
42	2500	15.7901	4.13383	0.999973	475.081	397.073	395.136	2.88585	698.105	-30.837	294.59
43	2500	31.5814	8.268	2.00003	474.872	396.742	396.015	3.72985	451.119	-30.1814	294.525
44	2500	47.3728	12.4022	3.00008	474.527	396.501	397.642	4.55052	366.914	-29.0529	294.469
45	2500	63.1633	16.5361	4.00008	475.495	397.475	399.253	5.34206	323.054	-27.0631	294.418
46	2500	78.9547	20.6703	5.00014	478.121	400.078	399.101	6.13471	296.789	-25.0294	294.367
47	2500	94.7471	24.8047	6.00026	480.222	401.817	398.089	6.94299	279.906	-23.4307	294.314
48	2500	110.535	28.9379	7.00007	482.276	403.971	396.984	7.76106	268.197	-21.8193	294.258
49	2500	126.323	33.0714	7.99995	485.13	406.916	394.493	8.59624	259.93	-19.3517	294.199
50	2500	142.119	37.2068	9.00031	486.101	407.776	390.945	9.49351	255.156	-15.9149	294.132
51	2500	157.972	41.3571	10.0043	485.363	407.263	383.622	10.4293	252.176	-13.289	294.059
52	2500	173.703	45.4753	11.0005	484.423	406.076	376.765	11.2754	247.946	-12.9806	293.987
53	2500	189.493	49.6093	12.0005	483.047	404.679	374.71	12.1376	244.665	-12.6736	293.91
54	2500	205.279	53.742	13.0002	481.15	403.115	369.993	13.1538	244.758	-10.5353	293.818
55	2500	221.055	57.8722	13.9993	478.391	400.367	368.844	14.4555	249.783	-7.72934	293.707
56	2500	236.857	62.009	15	476.138	398.014	369.161	15.9905	257.874	-5.38869	293.574
57	2500	252.648	66.143	16	482.332	403.987	364.204	17.6579	266.966	-3.58982	293.433
58	2500	268.437	70.2766	16.9999	485.947	407.928	361.057	19.3608	275.494	-2.04677	293.28
59	2500	284.228	74.4108	18	485.758	407.439	362.414	21.0931	283.468	-0.554534	293.108
60	3000	15.79	4.96059	0.999971	486.931	392.902	394.855	3.53571	712.76	-32.2332	294.539
61	3000	31.5813	9.92156	2.00002	486.788	392.444	396.013	4.5301	456.591	-30.9697	294.47
62	3000	47.3727	14.8826	3.00008	486.028	391.831	397.871	5.51845	370.799	-29.5789	294.407
63	3000	63.1642	19.8436	4.00014	489.342	395.229	398.919	6.48865	326.989	-27.5665	294.344
64	3000	78.9553	24.8045	5.00018	493.518	399.513	398.636	7.45621	300.599	-25.1988	294.279
65	3000	94.7487	29.7662	6.00036	494.91	400.882	397.93	8.44673	283.769	-23.2709	294.209
66	3000	110.52	34.721	6.99916	497.285	402.973	396.892	9.45385	272.281	-21.7012	294.134
67	3000	126.334	39.6889	8.00061	494.993	400.982	394.204	10.4625	263.613	-20.3854	294.054
68	3000	142.122	44.6491	9.00051	495.359	401.084	389.518	11.4631	256.737	-19.556	293.97
69	3000	157.918	49.6113	10.0008	496.815	402.73	384.283	12.4594	251.141	-19.2037	293.88
70	3000	173.695	54.5678	10.9999	497.694	403.348	374.896	13.519	247.747	-17.7841	293.782
71	3000	189.479	59.5265	11.9995	497.456	403.084	365.626	14.7534	247.845	-15.1465	293.668
72	3000	205.265	64.486	12.9993	496.757	402.468	364.05	16.2363	251.78	-12.6938	293.536
73	3000	221.077	69.4532	14.0006	496.146	401.915	364.132	17.9023	257.76	-10.8103	293.387
74	3000	236.864	74.413	15.0004	495.956	401.767	364.009	19.7102	264.876	-9.04531	293.213
75	3000	252.653	79.3734	16.0003	496.136	402.1	363.038	21.6748	273.074	-6.93526	293.009
76	3000	268.455	84.3375	17.001	496.766	402.328	364.574	23.8471	282.758	-4.40047	292.751
77	3000	284.19	89.281	17.9975	494.884	400.633	367.819	26.2099	293.566	-1.80091	292.451
78	3500	15.7898	5.78727	0.999957	494.317	383.199	365.981	4.18053	722.366	-29.7883	294.492
79	3500	31.5818	11.5753	2.00005	495.619	384.064	365.876	5.33747	461.107	-28.2944	294.418
80	3500	47.3731	17.3631	3.0001	494.218	382.962	366.345	6.5106	374.967	-27.4246	294.342
81	3500	63.1569	23.1482	3.99968	498.011	386.999	365.796	7.68542	332.009	-26.3348	294.264
82	3500	78.9624	28.9412	5.00063	508.799	397.384	365.128	8.86277	306.233	-24.8466	294.18
83	3500	94.7248	34.7184	5.99885	506.222	394.714	364.968	10.046	289.357	-23.3221	294.087
84	3500	110.549	40.5185	7.00101	508.951	397.722	365.128	11.2219	276.957	-21.9596	293.987
85	3500	126.339	46.3058	8.00097	514.695	403.498	365.131	12.393	267.634	-20.9009	293.884
86	3500	142.1	52.0824	8.99909	513.378	402.057	365.044	13.5747	260.639	-20.2673	293.77
87	3500	157.888	57.8688	9.9989	512.656	401.071	364.94	14.8303	256.274	-19.0549	293.647
88	3500	173.69	63.6609	10.9997	512.454	401.04	364.238	16.2751	255.654	-17.091	293.492
89	3500	189.481	69.4482	11.9997	512.377	401.372	363.844	18.001	259.2	-15.2972	293.345
90	3500	205.288	75.2421	13.0007	512.963	401.668	364.09	19.8436	263.73	-14.0542	293.168
91	3500	221.079	81.0296	14.0007	512.872	401.823	363.895	21.7667	268.627	-12.985	292.962
92	3500	236.858	86.8128	15	513.196	401.858	362.27	23.8335	274.539	-11.4257	292.713
93	3500	252.648	92.6003	16	513.328	401.835	361.087	26.1862	282.788	-9.13727	292.404
94	3500	268.439	98.388	17	513.204	401.932	360.999	28.7836	292.552	-6.77114	292.036
95	3500	284.229	104.175	18	513.873	402.514	360.497	31.3462	300.899	-5.22553	291.658

	Engine Speed (cycle average); Part R4	Brake Torque; Part R4	Brake Power (kW); Part R4	BMEP - Brake Mean Effective Pressure; Part R4	Angle at End of Injection; Part in-1	Angle at Start of Injection; Part in-1	Valve-Open Timing Angle; Part IntakeValve1	Fuel Flow; Part R4	BSFC - Brake Specific Fuel Consumption; Part R4	Combustion Start; Part Cyl1	Average Inlet Temperature; Part Turbo-Comp
Index	RPM	N-m	kW	bar	deg	deg	nk Angle (4-str	kg/hr	g/kW-h	deg	K
96	4000	15.7898	6.61401	0.999955	508.476	381.237	363.359	5.03884	761.844	-31.066	294.439
97	4000	31.582	13.229	2.00006	509.575	382.086	365.064	6.34943	479.962	-29.2112	294.353
98	4000	47.3701	19.8424	2.99991	509.32	381.918	364.735	7.67652	386.875	-27.7746	294.263
99	4000	63.1657	26.4588	4.00024	509.526	382.054	364.48	9.01267	340.63	-26.2761	294.167
100	4000	78.9404	33.0665	4.99923	508.19	380.956	364.823	10.35	313.006	-24.768	294.063
101	4000	94.7482	39.6881	6.00033	511.518	384.231	365.122	11.6725	294.107	-23.4163	293.951
102	4000	110.538	46.3022	7.00031	509.372	381.953	364.799	12.9708	280.132	-22.0759	293.829
103	4000	126.323	52.9142	7.99996	508.529	381.172	364.223	14.2889	270.039	-20.5326	293.695
104	4000	142.125	59.5332	9.00067	513.721	386.079	363.933	15.6688	263.195	-19.5339	293.551
105	4000	157.908	66.1443	10.0002	518.411	390.807	363.898	17.1727	259.625	-19.2781	293.399
106	4000	173.696	72.7578	11.0001	522.561	395.263	363.91	18.9732	260.772	-18.1028	293.221
107	4000	189.472	79.3658	11.9991	526.828	399.446	364.079	20.961	264.106	-16.3707	293.022
108	4000	205.275	85.9856	12.9999	528.854	401.28	364.226	23.1248	268.938	-14.8522	292.786
109	4000	221.044	92.5908	13.9986	529.177	401.661	363.867	25.3342	273.614	-13.2055	292.518
110	4000	236.857	99.2143	15	529.558	402.001	364.107	27.8848	281.056	-11.0126	292.187
111	4000	252.648	105.829	16	530.193	403.025	362.916	30.7129	290.213	-8.58235	291.766
112	4000	268.435	112.442	16.9998	530.779	403.249	361.125	33.7078	299.78	-6.73941	291.315
113	4000	284.226	119.056	17.9998	522.535	395.456	359.819	36.5242	306.781	-6.03479	290.867
114	4500	15.7917	7.44167	1.00008	537.221	381.951	365.088	5.94333	798.656	-27.9447	294.388
115	4500	31.5828	14.883	2.00011	537.042	382.009	365.008	7.39787	497.068	-26.0387	294.287
116	4500	47.3866	22.3304	3.00096	538.656	382.969	364.992	8.89991	398.556	-25.2181	294.176
117	4500	63.1715	29.7689	4.0006	537.702	382.081	364.998	10.4239	350.16	-24.7181	294.054
118	4500	78.9621	37.21	5.00061	537.08	381.926	364.747	11.9163	320.246	-23.8616	293.926
119	4500	94.7572	44.6533	6.0009	536.961	381.27	364.574	13.3977	300.038	-22.4486	293.788
120	4500	110.544	52.0928	7.00069	536.776	381.724	364.736	14.8999	286.025	-21.0061	293.634
121	4500	126.332	59.5327	8.00053	539.365	384.001	365.002	16.4374	276.107	-20.2683	293.466
122	4500	142.123	66.9739	9.00054	543.712	388.137	365.088	18.0636	269.712	-19.7685	293.284
123	4500	157.892	74.4049	9.99918	547.39	392.019	364.948	19.8757	267.129	-19.1821	293.083
124	4500	173.696	81.8521	11	549.122	393.667	364.704	21.8724	267.219	-18.4035	292.861
125	4500	189.476	89.2887	11.9994	547.81	392.763	364.468	24.1548	270.524	-16.6162	292.597
126	4500	205.291	96.7411	13.0009	548.605	393.227	364.148	26.5942	274.901	-14.5445	292.299
127	4500	221.066	104.175	13.9999	554.346	398.958	363.161	29.4114	282.327	-12.3164	291.932
128	4500	236.857	111.616	15	548.062	392.642	361.696	32.6053	292.119	-9.73043	291.449
129	4500	252.638	119.053	15.9993	541.939	386.525	361.114	36.3709	305.503	-6.81164	290.876
130	4500	268.429	126.494	16.9994	524.088	369.012	360.004	40.5396	320.486	-4.03664	290.168
131	5000	15.8049	8.27541	1.00091	565.307	382.012	364.903	6.93203	837.666	-27.0838	294.337
132	5000	31.593	16.542	2.00076	565.022	381.75	365.174	8.50381	514.072	-25.6545	294.22
133	5000	47.3822	24.8093	3.00068	562.547	379.284	365.113	10.0905	406.723	-24.5271	294.09
134	5000	63.1764	33.0791	4.00091	564.296	381.036	364.96	11.7233	354.403	-23.6549	293.946
135	5000	78.9523	41.3393	4.99999	568.862	385.613	364.873	13.4085	324.353	-22.8719	293.787
136	5000	94.733	49.6021	5.99937	564.839	381.602	364.787	15.0776	303.97	-21.7405	293.622
137	5000	110.555	57.8867	7.00139	563.859	380.683	364.629	16.9143	292.197	-20.5786	293.428
138	5000	126.309	66.1353	7.99905	565.01	381.913	364.408	18.7265	283.155	-20.6092	293.224
139	5000	142.113	74.4103	8.99991	564.947	381.891	364.177	20.6928	278.091	-20.8174	292.985
140	5000	157.912	82.6827	10.0005	568.578	385.544	364.005	22.7236	274.829	-20.058	292.725
141	5000	173.688	90.9429	10.9995	562.396	378.743	363.961	24.9657	274.521	-19.0917	292.435
142	5000	189.489	99.2165	12.0002	547.023	363.423	364.064	27.5664	277.841	-17.1842	292.096
143	5000	205.275	107.482	12.9999	548.502	364.937	364.202	30.8069	286.625	-13.9369	291.655
144	5000	221.069	115.752	14.0001	548.173	364.629	364.018	34.4376	297.513	-12.2726	291.146
145	5000	236.858	124.019	15.0001	546.494	362.962	362.613	38.5022	310.455	-10.9519	290.544
146	5000	252.662	132.294	16.0009	546.047	362.514	361.132	43.2926	327.246	-8.54358	289.766
147	5000	268.439	140.554	17	547.383	363.848	360.593	48.8748	347.729	-5.1955	288.678
148	5500	15.7879	9.09319	0.999837	559.307	373.907	364.167	8.36201	919.591	-27.9659	294.256
149	5500	31.583	18.1905	2.00012	559.645	374.264	364.427	10.007	550.126	-25.5778	294.122
150	5500	47.3722	27.2844	3.00004	557.764	372.433	364.473	11.6774	427.988	-23.9241	293.972
151	5500	63.1599	36.3775	3.99987	553.309	368.004	364.273	13.4894	370.816	-22.9849	293.796
152	5500	78.9665	45.4814	5.00089	546.846	361.531	363.935	15.4033	338.673	-22.4108	293.6
153	5500	94.7281	54.5595	5.99905	550.011	364.82	363.587	17.4142	319.179	-21.5992	293.387
154	5500	110.519	63.6544	6.99908	551.023	365.906	363.307	19.6206	308.237	-20.9824	293.141
155	5500	126.312	72.7504	7.99923	546.996	361.936	363.115	21.9735	302.04	-20.9982	292.855
156	5500	142.104	81.8458	8.99931	546.298	360.471	363.001	24.2004	295.683	-20.4747	292.565
157	5500	157.906	90.9471	10	545.77	360	362.955	26.5052	291.436	-19.0128	292.236
158	5500	173.684	100.035	10.9993	545.672	360	362.973	29.0314	290.213	-17.3258	291.865
159	5500	189.469	109.126	11.9989	545.986	360.389	363.036	32.0568	293.76	-16.3343	291.427
160	5500	205.276	118.231	13	545.693	360.116	363.056	35.8063	302.851	-14.9729	290.895
161	5500	221.056	127.319	13.9993	545.564	360	362.792	40.4845	317.977	-11.9963	290.208
162	5500	236.845	136.413	14.9992	545.596	360	361.761	45.8765	336.306	-10.0992	289.375
163	5500	252.636	145.508	15.9993	546.082	360.423	358.977	51.3238	352.721	-9.85915	288.465
164	6000	15.7928	9.92291	1.00015	568.782	372.198	361.039	9.8677	994.435	-27.8503	294.164
165	6000	31.581	19.8429	2	569.438	372.909	360.055	11.7096	590.117	-25.191	294.007
166	6000	47.3692	29.763	2.99986	562.608	366.183	359.839	13.5841	456.41	-23.4387	293.829
167	6000	63.1569	39.6827	3.99968	556.496	360	360.253	15.5952	392.998	-22.5212	293.622
168	6000	78.9454	49.6028	4.99955	556.63	360.17	360.838	17.7704	358.253	-22.0226	293.385
169	6000	94.7387	59.5261	5.99973	556.098	360	361.324	20.1136	337.896	-21.4269	293.118
170	6000	110.529	69.4475	6.99973	556.73	360	361.673	22.6514	326.165	-20.7262	292.816
171	6000	126.315	79.3662	7.99945	556.636	360.161	361.919	25.393	319.948	-19.9848	292.474
172	6000	142.122	89.298	9.00049	556.415	360	362.087	28.4766	318.893	-19.3658	292.057
173	6000	157.915	99.2212	10.0007	556.359	360.211	362.185	31.4696	317.166	-18.5413	291.624
174	6000	173.703	109.141	11.0004	556.898	360.125	362.202	34.6222	317.226	-16.8702	291.14
175	6000	189.475	119.051	11.9993	556.621	360	362.102	38.3265	321.935	-14.6371	290.557
176	6000	205.265	128.972	12.9993	556.849	360.183	361.784	43.0485	333.781	-12.9635	289.811
177	6000	221.056	138.893	13.9993	557.757	360.931	361.024	48.7881	351.263	-11.935	288.88

	Average Outlet Temperature; Part Turbo-Comp	Mass Averaged Temperature (Outlet); Part AfterCooler	Mass Averaged Temperature; Part SR-TV-23	Mass Averaged Temperature (Outlet); Part Exh_Manifold-1	Mass Averaged Temperature (Outlet); Part Exh_Manifold-2	Mass Averaged Temperature (Outlet); Part Exh_Manifold-3	Mass Averaged Temperature (Outlet); Part Exh_Manifold-4	Average Inlet Temperature; Part Turbo-Turbine	Average Outlet Temperature; Part Turbo-Turbine	Mass Averaged Temperature; Part Cat-IN	Mass Averaged Temperature; Part Cat-Out
Index	K	K	K	K	K	K	K	K	K	K	K
1	296.575	294.856	298.559	812.852	843.036	832.274	813.12	763.132	748.529	724.925	721.46
2	297.463	294.874	297.759	867.703	894.691	883.536	868.345	809.307	795.42	772.953	770.124
3	298.779	294.915	297.391	906.53	935.538	924.966	905.457	850.942	836.956	815.101	812.31
4	300.577	294.998	297.176	934.462	963.291	953.951	933.803	887.572	872.478	851.413	848.745
5	302.614	295.142	297.056	962.04	991.367	982.787	960.24	919.975	903.876	883.314	880.592
6	305.04	295.374	297.04	987.348	1016.9	1008.48	984.803	948.666	931.678	911.401	908.603
7	308.239	295.749	297.165	1016.32	1047.44	1039.19	1014.2	979.663	961.361	941.13	938.212
8	312.432	296.296	297.41	1052.87	1085.76	1077.61	1050.78	1017.57	997.256	976.851	973.791
9	317.68	296.66	297.576	1087.64	1121.95	1113.99	1085.15	1053.61	1030.61	1010.17	1007.12
10	323.136	296.412	297.226	1113.63	1148.56	1140.55	1110.22	1080.09	1054.07	1033.88	1031.15
11	323.221	296.42	297.224	1113.91	1148.75	1140.79	1110.41	1080.31	1054.25	1034.06	1031.34
12	297.154	298.046	299.552	887.509	908.902	901.297	889.927	830.167	816.578	796.05	793.579
13	298.292	298.065	298.998	925.645	950.768	941.036	925.603	870.597	857.408	837.746	835.506
14	300.029	298.147	298.884	942.72	967.093	958.064	941.509	893.94	880.896	861.876	859.777
15	302.231	298.331	298.93	954.423	979.266	971.006	953.549	913.639	899.773	881.801	879.692
16	304.729	298.624	299.077	968.869	993.375	985.448	968.306	933.074	917.946	901.002	898.846
17	307.611	298.824	299.179	983.532	1008.07	1000.57	982.93	951.376	934.768	918.629	916.453
18	311.123	299.043	299.311	999.291	1024.09	1017.09	998.572	970.048	951.579	936.009	933.837
19	315.118	299.268	299.451	1017.06	1041.97	1035.47	1016.13	989.854	969.213	954.015	951.869
20	319.873	299.509	299.639	1037.79	1062.58	1057.04	1036.54	1011.82	988.432	973.493	971.388
21	324.546	299.708	299.815	1057.8	1084.22	1078.48	1055.7	1033.89	1007.55	992.607	990.556
22	318.913	299.284	299.45	1079.33	1106.83	1101.45	1077.51	1061.23	1035.09	1021.95	1019.9
23	327.752	299.806	299.991	1102.86	1133.07	1128.23	1101.15	1085.17	1053.89	1040.63	1038.77
24	338.142	300.521	300.537	1130.06	1162.22	1157.26	1127.96	1110.51	1073.73	1060.51	1058.81
25	297.472	299.992	300.211	1035.85	1061.25	1049.48	1037.92	965.239	949.041	925.13	922.734
26	298.623	299.985	300.169	1000.05	1024.74	1013.93	1000.55	942.32	928.563	908.115	905.894
27	300.865	300.115	300.249	1014.6	1040.23	1030.24	1013.62	965.69	951.551	931.874	929.583
28	303.798	300.352	300.418	1035.33	1061.04	1052.15	1034.33	994.276	978.379	959.593	957.206
29	307.181	300.579	300.585	1051.04	1076.84	1068.71	1050.47	1015.46	997.667	980.001	977.607
30	310.97	300.797	300.758	1065.44	1091.13	1083.74	1064.79	1033.35	1013.58	996.81	994.497
31	315.03	300.993	300.915	1079.87	1105.85	1099.32	1079.19	1050.61	1028.8	1012.68	1010.49
32	319.335	301.166	301.052	1095.26	1121.5	1115.74	1094.27	1068.02	1043.99	1028.38	1026.34
33	324.189	301.392	301.224	1114.64	1142.12	1137.2	1111.88	1088.81	1062.16	1046.9	1045.01
34	329.967	301.789	301.541	1136.45	1166.72	1162.39	1132.77	1112.27	1082.37	1067.51	1065.75
35	334.867	302.197	301.896	1164.78	1195.09	1191.43	1160.71	1140.99	1107.56	1093.23	1091.6
36	335.26	302.348	302.059	1188.83	1216.78	1213.63	1184.87	1164.95	1129.49	1116.59	1115.1
37	338.966	302.747	302.427	1204.82	1230.63	1228.13	1200.79	1179.58	1141.35	1129.53	1128.16
38	343.961	303.313	302.88	1221.56	1250.94	1249.09	1216.85	1197.11	1155.39	1144.61	1143.31
39	353.109	304.157	303.487	1239.98	1276.33	1276.13	1234.63	1216.69	1169.54	1159.68	1158.42
40	365.119	305.265	304.526	1257.22	1291.79	1292.78	1251.71	1229.76	1175.94	1167.35	1166.11
41	378.262	306.489	305.686	1273.83	1306.11	1308.21	1268.26	1242.05	1180.48	1173.34	1172.07
42	299.547	300.217	300.353	1019.42	1042.59	1033.38	1022.21	958.694	943.879	922.736	920.442
43	301.928	300.391	300.437	1031.7	1056.89	1048.21	1031.68	980.163	965.396	945.718	943.397
44	305.449	300.649	300.611	1044.42	1068.28	1059.81	1043.25	1000.78	984.637	966.088	963.73
45	309.696	300.909	300.831	1057.87	1080.12	1072.04	1056.43	1020.23	1001.86	984.457	982.115
46	314.329	301.141	301.032	1071.49	1092.54	1085.2	1069.89	1038.01	1017.18	1000.82	998.538
47	319.227	301.338	301.199	1083.77	1104.94	1098.21	1082.16	1053.89	1030.46	1015	1012.81
48	324.309	301.598	301.416	1096.04	1118.29	1112.27	1094.32	1069.3	1043.13	1028.43	1026.33
49	329.736	301.994	301.734	1112.43	1136.74	1131.3	1110.6	1088.33	1059.11	1045	1042.98
50	335.859	302.478	302.14	1136.48	1162.92	1158.34	1134.32	1114.22	1081.34	1067.75	1065.77
51	337.735	302.732	302.399	1160.04	1187.27	1183.69	1158	1140.25	1104.87	1092.29	1090.34
52	336.538	302.776	302.457	1167.04	1194.35	1191.61	1165.7	1150.1	1113.88	1103.08	1101.21
53	339.944	303.132	302.779	1173.62	1201.58	1199.59	1172.29	1158.07	1119.43	1109.85	1108.02
54	337.11	303.068	302.757	1191.12	1217.44	1216.84	1187.81	1176.71	1137.65	1130.31	1128.53
55	342.098	303.612	303.254	1204.85	1232.32	1232.73	1201.16	1191.07	1148.41	1142.45	1140.68
56	345.709	304.116	303.717	1211.42	1239.19	1240.29	1207.57	1198.52	1152.76	1148.62	1146.87
57	355.602	305.118	304.619	1215.2	1243.14	1245.08	1211.34	1200.82	1149.34	1146.4	1144.65
58	366.573	306.244	305.647	1219.98	1248.36	1251	1216.09	1204.05	1146.2	1144.32	1142.56
59	376.815	307.36	306.661	1228.19	1255.65	1258.77	1224.16	1210.28	1146.12	1145.39	1143.61
60	301.941	300.014	300.362	1078.11	1094.44	1086.82	1078.2	1024.99	1011.07	992.348	989.854
61	305.512	300.288	300.479	1088.51	1104.5	1097.13	1087.98	1042.51	1027.39	1009.78	1007.27
62	310.7	300.593	300.675	1097.45	1113.04	1105.89	1097.06	1059.26	1041.48	1025.01	1022.53
63	316.521	300.862	300.867	1107.02	1122.73	1116.06	1106.71	1075.15	1054.03	1038.81	1036.4
64	322.583	301.089	301.04	1118.78	1135.84	1129.72	1118.7	1091.83	1067.18	1053.04	1050.69
65	328.805	301.546	301.415	1130.84	1149.51	1144.32	1130.83	1107.65	1079.33	1066.17	1063.9
66	335.001	302.048	301.837	1142.45	1162.61	1158.26	1142.59	1122.13	1090.18	1078.06	1075.85
67	338.072	302.388	302.15	1153.54	1174.88	1171.27	1153.71	1136.52	1101.82	1090.65	1088.49
68	339.413	302.623	302.371	1162.98	1185.15	1182.3	1163.07	1148.39	1111.65	1102.24	1100.13
69	339.31	302.758	302.501	1170.25	1192.64	1190.53	1170.16	1157.91	1119.75	1112.43	1110.37
70	337.959	302.799	302.561	1178.48	1204.57	1202.99	1176.89	1169.94	1130.75	1125.82	1123.79
71	336.383	302.82	302.611	1186.65	1219.42	1219.51	1184.99	1184.09	1143.89	1141.35	1139.36
72	338.953	303.173	302.934	1193.58	1225.4	1226.49	1191.57	1191.94	1149.08	1148.36	1146.41
73	339.931	303.436	303.179	1194.83	1225.19	1227.29	1192.66	1194.57	1149.84	1151.17	1149.28
74	346.152	304.176	303.846	1199.11	1227.48	1230.42	1196.69	1197.75	1148.59	1151.48	1149.65
75	356.402	305.3	304.859	1209.36	1237.29	1240.86	1206.65	1206.04	1150.35	1154.5	1152.69
76	367.594	306.57	306.016	1223.85	1251.95	1255.89	1220.96	1218.8	1155.55	1161.22	1159.43
77	380.011	308.044	307.369	1239.58	1266.75	1271.04	1235.95	1231.89	1160.44	1167.53	1165.77
78	304.519	299.222	300.474	1122.51	1134.73	1129.2	1124.68	1082.21	1069.14	1053.09	1050.4
79	310.076	299.545	300.312	1131.91	1145.12	1139.47	1133.16	1098.04	1082.17	1067.04	1064.36
80	317.044	299.858	300.325	1139.65	1152.21	1146.37	1141.05	1112.42	1092.52	1078.57	1075.98
81	324.44	300.175	300.467	1147.99	1159.84	1154.36	1149.76	1125.62	1101.23	1088.61	1086.1
82	331.631	300.733	300.857	1158.76	1170.91	1166.19	1160.38	1139.69	1110.81	1099.46	1097.02
83	338.31	301.316	301.307	1169.34	1183.87	1179.86	1170.85	1153.82	1120.52	1109.98	1107.61
84	340.086	301.62	301.569	1178.48	1197.08	1193.81	1179.66	1167.18	1130.97	1122.35	1120.06
85	340.145	301.796	301.682	1186.35	1207.49	1205.16	1187.41	1178.53	1140.77	1134.64	1132.4
86	339.879	301.942	301.808	1193.51	1214.77	1213.23	1194.42	1187.71	1148.43	1144.75	1142.58
87	338.792	302.017	301.88	1206.54	1221.22	1220.57	1207.4	1199.28	1158.84	1157.53	1155.43
88	337.084	302.055	302.068	1218.39	1228.48	1228.58	1216.7	1209.61	1167.06	1167.75	1165.74
89	339.734	302.412	302.247	1215.18	1226.59	1227.93	1213.5	1209.69	1165.76	1168.74	1166.82
90	338.043	302.419	302.267	1209.32	1222.01	1224.47	1208.01	1207.57	1163.21	1168.39	1166.58
91	340.084	302.76	302.592	1206.22	1219.95	1223.33	1205.01	1206.47	1159.71	1166.64	1164.92
92	345.565	303.453	303.222	1209.85	1224.41	1228.55	1208.67	1210.42	1159.38	1167.95	1166.32
93	354.266	304.524	304.193	1221.04	1236.16	1240.89	1219.86	1220.6	1163.2	1173.46	1171.9
94	364.754	305.836	305.395	1234.15	1249.51	1254.82	1232.85	1232.29	1167.21	1179.35	1177.84
95	374.926	307.161	306.615	1241.49	1256.79	1262.56	1240.09	1238.4	1166.1	1179.89	1178.43

Index	Average Outlet Temperature; Part Turbo-Comp	Mass Averaged Temperature (Outlet); Part AfterCooler	Mass Averaged Temperature; Part SR-TV-23	Mass Averaged Temperature (Outlet); Part Exh_Manifold-1	Mass Averaged Temperature (Outlet); Part Exh_Manifold-2	Mass Averaged Temperature (Outlet); Part Exh_Manifold-3	Mass Averaged Temperature (Outlet); Part Exh_Manifold-4	Average Inlet Temperature; Part Turbo-Turbine	Average Outlet Temperature; Part Turbo-Turbine	Mass Averaged Temperature; Part Cat-IN	Mass Averaged Temperature; Part Cat-Out
	K	K	K	K	K	K	K	K	K	K	K
96	308.448	298.814	300.961	1144.55	1164.5	1159.79	1145.83	1118.92	1104.9	1090.82	1087.99
97	316.08	299.166	300.169	1157.54	1171.92	1166.84	1157.33	1133.43	1115.18	1102.08	1099.38
98	324.63	299.527	300.08	1166.65	1178.78	1173.53	1166.31	1146.56	1123.1	1111.26	1108.67
99	332.866	300.174	300.416	1175	1187.36	1182.32	1175.02	1158.94	1130.29	1119.84	1117.32
100	339.748	300.801	300.841	1184.01	1197.08	1192.5	1183.88	1171.39	1138	1128.56	1126.11
101	341.858	301.153	301.106	1192.11	1204.57	1200.76	1192.07	1181.78	1145.37	1138.34	1135.95
102	339.941	301.219	301.144	1200.27	1210.91	1207.97	1200.79	1191.59	1153.94	1149.99	1147.68
103	337.833	301.244	301.166	1207.58	1218.83	1216.66	1208.36	1201.51	1162.94	1161.94	1159.7
104	337.49	301.384	301.3	1213.39	1228.66	1227.63	1213.78	1211.21	1171.15	1172.43	1170.29
105	336.601	301.463	301.379	1207.19	1225.07	1226.72	1207.61	1209.32	1168.46	1171.93	1169.92
106	340.222	301.937	301.808	1201.67	1219.19	1221.39	1202.2	1205.07	1161.09	1166.31	1164.43
107	338.211	301.923	301.799	1196.46	1213.35	1216.39	1197.2	1202.29	1158.13	1165.53	1163.77
108	343.757	302.614	302.423	1194.89	1211.59	1215.19	1195.55	1201.06	1152.62	1161.67	1160.02
109	341.554	302.586	302.414	1193.86	1210.08	1214.6	1194.58	1202.05	1153.4	1164.36	1162.83
110	349.64	303.601	303.338	1200.09	1216.63	1221.58	1200.64	1207.7	1152.94	1165.68	1164.22
111	354.05	304.314	303.998	1207.72	1224.03	1229.39	1207.9	1215.23	1156.1	1170.88	1169.51
112	363.942	305.633	305.214	1212.75	1229.31	1234.99	1212.49	1219.35	1152.73	1169.55	1168.25
113	372.921	306.872	306.363	1210.32	1226.83	1233.12	1209.85	1216.49	1143.33	1161.79	1160.55
114	313.261	299.897	301.176	1151.51	1192.33	1188.58	1152.78	1138.15	1121.16	1107.3	1104.45
115	322.56	300.252	300.875	1168.21	1193.55	1189.54	1169	1151.23	1129	1116.4	1113.82
116	332.27	300.963	301.17	1181.69	1195.36	1191.19	1182.46	1163.5	1135.26	1124.28	1121.73
117	340.556	301.707	301.666	1191.16	1199.62	1195.56	1192.18	1174.59	1140.79	1131.15	1128.68
118	342.01	302.039	301.906	1197.21	1205.57	1202	1198.44	1184.36	1147.58	1140.84	1138.44
119	342.14	302.267	302.093	1203.2	1213.87	1210.97	1204.35	1194.34	1155.29	1151.58	1149.26
120	343.1	302.55	302.34	1209.66	1223.46	1221.1	1210.84	1204.5	1162.99	1161.97	1159.74
121	343.181	302.757	302.535	1213.18	1232.73	1231.08	1214.28	1212.94	1169.55	1171.14	1169.02
122	342.718	302.908	302.683	1212.09	1233.99	1234.9	1213.18	1215.68	1170.94	1175.01	1173.01
123	342.767	303.095	302.861	1206.82	1226.26	1228.03	1207.71	1211.41	1165.31	1171.67	1169.79
124	339.733	302.992	302.791	1198.38	1215.59	1218.32	1199.27	1204.78	1159.04	1167.75	1166.01
125	344.64	303.642	303.389	1194.78	1211.26	1214.52	1195.58	1201.7	1152.01	1162.48	1160.83
126	341.249	303.497	303.288	1190.89	1205.63	1209.95	1191.62	1199.59	1150.42	1162.96	1161.43
127	348.076	304.398	304.123	1190.95	1205.25	1209.98	1191.46	1199.5	1144.89	1159.34	1157.88
128	348.904	304.724	304.454	1192.67	1205.57	1210.99	1192.36	1201.66	1144.81	1161.37	1160
129	359.681	306.193	305.816	1198.04	1211.73	1217.49	1197.68	1206.79	1141.39	1160.45	1159.14
130	371.487	307.873	307.375	1204.58	1219.02	1225.09	1204.2	1212.99	1138.37	1159.91	1158.65
131	318.765	300.981	301.996	1171.24	1184.26	1181.69	1172.47	1145.29	1125.23	1112.31	1109.57
132	329.395	301.559	302.053	1191.87	1205.17	1202.34	1191.66	1168.85	1142.38	1130.47	1127.87
133	337.921	302.31	302.469	1208.94	1222.76	1219.82	1208.56	1190.67	1158.15	1147.64	1145.1
134	341.759	302.821	302.79	1218.03	1231	1226.8	1218.89	1203.77	1166.98	1159.43	1156.96
135	344.495	303.27	303.114	1221.81	1235.32	1231.88	1223.17	1211.77	1171.37	1166.91	1164.53
136	338.504	303.031	302.877	1224.4	1237.89	1236.56	1224.72	1218.49	1178.63	1178.65	1176.36
137	342.194	303.539	303.32	1224.8	1238.15	1237.68	1225.11	1221.33	1177.81	1180.21	1178.04
138	335.649	303.167	302.981	1218.3	1231.18	1231.38	1218.72	1218.62	1176.93	1182.82	1180.77
139	339.316	303.677	303.436	1214.81	1227.5	1228.34	1215.1	1216.94	1171.87	1179.77	1177.82
140	338.89	303.818	303.568	1211.4	1223.14	1224.83	1211.53	1215.48	1169.26	1179.34	1177.48
141	338.529	303.96	303.708	1205.55	1217.38	1219.91	1205.72	1212.1	1164.83	1176.91	1175.13
142	337.773	304.066	303.816	1201.02	1210.57	1213.85	1201.08	1208.77	1160.6	1174.62	1172.91
143	343.186	304.842	304.555	1200.95	1210.23	1213.95	1200.88	1209.26	1156.28	1172.45	1170.81
144	348.567	305.649	305.335	1192.7	1201.26	1205.44	1192.4	1201.64	1143.81	1162.21	1160.64
145	355.57	306.678	306.317	1181.89	1189.46	1193.96	1181.22	1191	1127.17	1147.99	1146.48
146	367.938	308.425	307.947	1178.57	1186.07	1190.7	1177.82	1187.23	1113.84	1137.29	1135.83
147	383.023	310.647	310.028	1184.97	1192.71	1197.44	1184.14	1192.96	1107.95	1134.17	1132.75
148	318.545	300.619	301.844	1186.78	1182.52	1180.27	1188.61	1155.65	1134.17	1123.72	1121.1
149	326.192	301.249	301.698	1206.68	1202.99	1200.3	1207.85	1179.07	1151.89	1143.47	1140.93
150	330.308	301.724	301.767	1223.01	1219.19	1216.29	1224.01	1199.61	1167.98	1162.59	1160.1
151	335.982	302.356	302.176	1233.32	1230.38	1228.14	1234.33	1214.32	1177.66	1174.99	1172.58
152	338.225	302.758	302.478	1235.94	1233.88	1232.06	1236.88	1221.16	1181.21	1181.82	1179.51
153	338.768	303.021	302.726	1231.73	1231.26	1230.08	1232.71	1221.38	1179.23	1183.09	1180.89
154	342.954	303.606	303.265	1226.32	1226.86	1226.4	1227.42	1219.21	1173.18	1179.57	1177.47
155	347.093	304.222	303.86	1220.31	1222.11	1222.05	1221.47	1216	1165.87	1174.67	1172.68
156	339.893	303.747	303.48	1211.45	1214.55	1215.26	1212.69	1211.73	1164.03	1175.92	1173.99
157	339.531	303.904	303.661	1207.77	1211.42	1212.71	1209.12	1210.66	1161.73	1175.73	1173.87
158	339.485	304.094	303.884	1203.11	1207.28	1209.06	1204.51	1208.36	1158.05	1174.02	1172.21
159	340.482	304.4	304.23	1192.67	1196.88	1199.07	1193.85	1199.86	1147.61	1165.55	1163.81
160	345.207	305.128	304.963	1178.64	1182.73	1185.05	1179.48	1186.93	1130.29	1150.42	1148.75
161	353.588	306.324	306.122	1167.11	1170.73	1173.04	1167.59	1175.62	1111.91	1134.64	1133.04
162	365.681	308.048	307.745	1152.26	1155.21	1157.57	1152.55	1160.33	1087.41	1112.68	1111.15
163	378.061	309.856	309.468	1131.85	1134.06	1136.26	1132.05	1139.42	1057.52	1084.79	1083.35
164	335.286	301.724	303.213	1201.12	1196.24	1191.34	1200.75	1169.17	1139.26	1128.49	1125.99
165	342.871	302.505	303.167	1217.64	1211.23	1206.26	1216.8	1188.42	1152.65	1144.1	1141.68
166	343.534	302.858	302.964	1228.36	1221.61	1216.75	1227.59	1203.74	1164.63	1159.9	1157.54
167	342.07	303.034	302.863	1232.98	1226.58	1221.8	1232.71	1213.35	1172.09	1171.86	1169.56
168	340.076	303.131	302.883	1231.61	1226.1	1221.98	1231.62	1216.9	1174.2	1178.16	1175.95
169	338.364	303.217	302.954	1225.55	1221.22	1218.03	1226.09	1215.62	1171.77	1179.33	1177.2
170	337.065	303.315	303.082	1216.83	1213.05	1210.7	1217.56	1210.89	1165.98	1176.63	1174.6
171	336.433	303.463	303.264	1206.32	1203.53	1202.03	1207.53	1204.25	1158.1	1171.42	1169.47
172	345.852	304.64	304.345	1200.35	1197.72	1196.55	1201.46	1199.16	1145.74	1161.29	1159.42
173	342.72	304.548	304.337	1189.47	1187.1	1186.74	1190.84	1191.51	1138.39	1156.31	1154.51
174	341.505	304.641	304.521	1180.21	1178.11	1178.37	1181.89	1184.85	1130.95	1150.92	1149.17
175	343.8	305.129	305.096	1170.77	1168.31	1169.17	1172.33	1176.85	1119.88	1141.95	1140.26
176	352.813	306.436	306.376	1157.16	1154.15	1155.16	1158.45	1163.27	1098.84	1123.45	1121.84
177	365.357	308.244	308.094	1137.95	1134.33	1135.14	1139.11	1143.51	1069.65	1096.67	1095.16

	Average Inlet Pressure; Part Turbo-Comp	Average Outlet Pressure; Part Turbo-Comp	Average Pressure (Outlet); Part AfterCooler	Average Pressure; Part SR-TV-23	Average Speed; Part Turbo-Turbine	Average Inlet Pressure; Part Turbo-Turbine	Average Outlet Pressure; Part Turbo-Turbine	Average Pressure; Part Cat-Out	Air-Fuel Ratio (Inducted Air/Total Fuel); Part R4	Pressure; Maximum; Part Cyl1	Maximum Rate of Pressure Rise; Part Cyl1
Index	bar	bar	bar	bar	RPM	bar	bar	bar	No Unit	bar	bar/deg
1	0.982904	0.985978	0.985881	0.318741	7960.37	1.00355	0.992424	0.984846	14.2336	16.2049	0.842642
2	0.98283	0.988475	0.988335	0.392553	10814	1.01448	0.995172	0.985928	14.239	20.8915	1.12366
3	0.982738	0.992734	0.992548	0.469025	14291.2	1.03395	1.00006	0.987249	14.2429	24.9943	1.35847
4	0.982628	0.999252	0.999015	0.549094	18370.1	1.0584	1.0059	0.988811	14.2454	28.323	1.52412
5	0.982498	1.00743	1.00714	0.631337	22456.6	1.08405	1.01212	0.990612	14.2465	31.3095	1.66482
6	0.982346	1.01814	1.01779	0.714514	26873	1.11127	1.01887	0.992671	14.2468	34.0667	1.79695
7	0.982163	1.03372	1.03331	0.802997	32154	1.14284	1.02712	0.995138	14.2486	36.0068	1.87079
8	0.981932	1.05646	1.05597	0.897966	38541.1	1.1816	1.03778	0.998305	14.2458	36.8108	1.89101
9	0.981614	1.08821	1.08765	1.00141	46044.5	1.22711	1.05018	1.00207	14.2447	37.5857	1.92073
10	0.979736	1.12491	1.12571	1.12358	54311.3	1.27421	1.06255	1.006	14.2437	38.9368	1.99305
11	0.979747	1.12555	1.12635	1.12506	54446	1.2749	1.06272	1.00605	14.2438	38.9582	1.99422
12	0.977766	0.983284	0.983109	0.322537	10886.5	1.02	1.00302	0.982454	14.2197	21.0018	1.14123
13	0.977602	0.987092	0.98684	0.383937	14241.6	1.02991	1.00231	0.984117	14.2292	26.1743	1.45251
14	0.977404	0.993734	0.993401	0.481245	18600.7	1.05343	1.00822	0.986214	14.2364	31.858	1.78624
15	0.977173	1.00325	1.00283	0.580743	23364.7	1.08252	1.01598	0.988576	14.2407	37.2849	2.09586
16	0.976913	1.01523	1.01472	0.662493	28233.6	1.11262	1.02392	0.99113	14.2423	41.8178	2.3417
17	0.976623	1.0305	1.02985	0.743976	33385.1	1.1437	1.03184	0.993867	14.2411	45.768	2.54343
18	0.976297	1.05096	1.05016	0.80515	39171	1.17675	1.03997	0.996833	14.2373	49.294	2.70743
19	0.975934	1.07665	1.07569	0.865304	45375.8	1.21243	1.04842	1.00005	14.2317	51.9733	2.79977
20	0.975517	1.11057	1.10944	0.916097	52406	1.25327	1.05763	1.00367	14.226	54.0347	2.82055
21	0.975048	1.14839	1.14707	0.993501	59261.5	1.2953	1.06749	1.00761	14.2237	55.4179	2.8124
22	0.97413	1.11012	1.10934	1.07146	53529	1.31972	1.09037	1.01294	14.2275	56.1268	2.77687
23	0.971745	1.18866	1.19209	1.18542	67875.5	1.37815	1.09895	1.01782	14.2414	56.1406	2.69399
24	0.97066	1.29428	1.29841	1.29477	81930	1.44739	1.10803	1.0235	14.2587	56.0348	2.62522
25	0.978616	0.988453	0.988206	0.31391	14413.2	1.02093	0.997729	0.985377	14.2062	13.241	0.581893
26	0.978351	0.993328	0.992971	0.401909	17904.7	1.03741	1.00364	0.987894	14.2167	23.4595	1.22833
27	0.978021	1.00351	1.00304	0.491005	23252.9	1.06588	1.01296	0.99131	14.2277	28.6421	1.50197
28	0.977641	1.01856	1.01792	0.57497	29297	1.09879	1.02348	0.995233	14.2363	31.9714	1.63819
29	0.97719	1.03823	1.03737	0.65459	35636.6	1.13396	1.03454	0.999579	14.2405	35.8088	1.81306
30	0.97667	1.06287	1.06176	0.740202	42214.8	1.17147	1.04619	1.00431	14.239	39.4263	1.9672
31	0.976079	1.09266	1.09128	0.819049	48999.2	1.21177	1.05846	1.00943	14.232	42.7024	2.0987
32	0.975412	1.12814	1.12646	0.892511	55965.8	1.25546	1.07119	1.01494	14.2214	45.6053	2.20426
33	0.974642	1.17291	1.17093	0.962845	63647	1.30528	1.08514	1.02114	14.2115	47.5811	2.24132
34	0.973693	1.23322	1.23093	1.03023	72682.3	1.36522	1.10115	1.02852	14.2093	48.2077	2.18918
35	0.972532	1.29189	1.28926	1.11707	80462.6	1.4313	1.12145	1.03746	14.2224	48.2641	2.11562
36	0.971225	1.30402	1.30103	1.19936	82282.3	1.48461	1.14587	1.0471	14.2512	49.47	2.12808
37	0.969686	1.33996	1.33705	1.28121	86319.9	1.54282	1.16347	1.05564	14.2731	51.9021	2.21003
38	0.966603	1.38488	1.38438	1.36115	91727	1.61087	1.18172	1.06509	14.2287	53.9009	2.27816
39	0.962649	1.47045	1.47246	1.45819	100894	1.70289	1.19936	1.07604	14.0431	54.7065	2.30349
40	0.958349	1.58418	1.58759	1.57457	110468	1.81841	1.21701	1.08893	13.7109	55.0227	2.32054
41	0.951638	1.71862	1.72428	1.71285	121336	1.95278	1.23816	1.10438	13.3345	55.2822	2.36033
42	0.979344	0.997275	0.996916	0.330417	19450.2	1.04122	1.00367	0.988889	14.205	20.765	1.04855
43	0.978916	1.00856	1.00804	0.416421	25028.8	1.066	1.01136	0.992849	14.2057	26.4704	1.34301
44	0.978399	1.02755	1.02679	0.503064	32086.1	1.10122	1.02025	0.997254	14.2139	31.7052	1.61176
45	0.977805	1.05387	1.05282	0.58875	39729.9	1.14022	1.02957	1.00202	14.2252	36.0199	1.8234
46	0.977117	1.08675	1.08539	0.668245	47567.8	1.1817	1.03949	1.00723	14.2341	39.8428	1.99586
47	0.976321	1.12679	1.12506	0.744624	55615.3	1.22594	1.04997	1.0129	14.2366	43.6509	2.16384
48	0.975422	1.1743	1.17221	0.820145	63829.6	1.27318	1.06099	1.01901	14.231	47.0998	2.30363
49	0.97441	1.23193	1.22952	0.889025	72515.2	1.32513	1.07319	1.02583	14.2196	49.23	2.34752
50	0.973208	1.30158	1.29882	0.959074	81515	1.3859	1.08786	1.03402	14.2098	49.7947	2.27437
51	0.971825	1.32472	1.32151	1.01934	84217.6	1.43613	1.10644	1.04354	14.2076	50.9894	2.24564
52	0.970422	1.32224	1.31854	1.07916	84514.6	1.46973	1.12341	1.05206	14.2258	54.818	2.4002
53	0.968892	1.35713	1.353	1.15364	88335.7	1.52076	1.13777	1.06048	14.2318	58.5385	2.55148
54	0.967009	1.33778	1.33307	1.22631	87211.2	1.55706	1.16216	1.07212	14.1659	59.3806	2.51952
55	0.964693	1.38896	1.38374	1.31836	92790.3	1.63087	1.18354	1.08468	13.9601	59.3589	2.44792
56	0.961878	1.42959	1.42398	1.40978	97493.3	1.70347	1.20636	1.09819	13.6341	60.0293	2.44083
57	0.958899	1.53091	1.52488	1.51729	106170	1.80493	1.22288	1.11113	13.2949	61.498	2.47667
58	0.955708	1.64617	1.63952	1.63139	115594	1.91546	1.23941	1.12475	13.0141	63.1034	2.52637
59	0.952084	1.76034	1.75318	1.74447	123770	2.03012	1.25861	1.13992	12.7949	64.6675	2.58188
60	0.977019	1.00637	1.0059	0.339743	24830.8	1.06247	1.01074	0.990763	14.2276	21.5803	1.11643
61	0.976411	1.02577	1.02501	0.423371	32171.3	1.09423	1.02026	0.996041	14.2118	27.0052	1.40201
62	0.975663	1.05844	1.05733	0.50762	41456.4	1.13851	1.0315	1.00193	14.2049	32.1218	1.66908
63	0.974787	1.10165	1.10014	0.589418	51148.7	1.18719	1.04337	1.00832	14.2082	36.4812	1.88542
64	0.973772	1.15496	1.153	0.668193	60966.9	1.23937	1.05589	1.0153	14.218	40.0603	2.04026
65	0.972588	1.21921	1.21686	0.748115	71018.6	1.29608	1.06906	1.02295	14.2279	43.5639	2.1858
66	0.971239	1.29139	1.28864	0.827733	80661.2	1.35614	1.08276	1.0312	14.2329	47.0357	2.3244
67	0.969736	1.32543	1.32219	0.90058	84543.2	1.40736	1.09809	1.04009	14.2322	50.3594	2.45523
68	0.968099	1.34515	1.34139	0.965471	86989.9	1.45363	1.11431	1.0494	14.2296	53.9247	2.60704
69	0.966324	1.3515	1.34716	1.02838	88229.8	1.49494	1.13134	1.0591	14.2227	57.9546	2.79539
70	0.964321	1.34547	1.34045	1.08717	88380.5	1.53407	1.15113	1.07007	14.1852	60.3214	2.85809
71	0.961951	1.33466	1.32885	1.15632	88145.2	1.57686	1.17437	1.08292	14.0618	60.7796	2.78198
72	0.95917	1.36329	1.35672	1.24018	91688.3	1.64009	1.19602	1.0965	13.8135	61.5185	2.74025
73	0.955933	1.3763	1.36888	1.32544	93920.6	1.69847	1.2191	1.11091	13.4931	62.9227	2.76316
74	0.952179	1.44407	1.436	1.4229	101023	1.78655	1.24005	1.12628	13.1969	64.5061	2.79362
75	0.947942	1.55336	1.5446	1.53415	109860	1.90546	1.26235	1.14416	12.9551	65.4538	2.79082
76	0.942524	1.68083	1.67141	1.66012	120149	2.04239	1.28963	1.1657	12.7512	65.6489	2.75983
77	0.936359	1.82673	1.8165	1.80435	129419	2.19931	1.31932	1.19003	12.57	65.7349	2.74312
78	0.976637	1.01995	1.01931	0.330802	30110.2	1.08539	1.02087	0.995258	14.2359	20.9431	1.08262
79	0.975802	1.05399	1.05295	0.407201	40293.1	1.12784	1.0328	1.00216	14.2318	25.83	1.33202
80	0.974762	1.10554	1.10401	0.483283	51899.5	1.18251	1.0471	1.00995	14.217	30.7887	1.58772
81	0.97352	1.17228	1.17024	0.558409	63795.4	1.24238	1.06219	1.01843	14.2053	35.4034	1.81947
82	0.97207	1.25126	1.24876	0.63388	75497	1.30697	1.07795	1.0277	14.2053	39.4379	2.00574
83	0.970384	1.32331	1.3203	0.710158	84098.9	1.37378	1.09447	1.03775	14.2211	43.1464	2.16078
84	0.968463	1.34884	1.34521	0.78455	87201.1	1.42779	1.11323	1.04872	14.2485	46.5897	2.30364
85	0.9664	1.35868	1.35439	0.857049	88868.6	1.47256	1.13369	1.06042	14.2623	50.0341	2.44711
86	0.964104	1.36369	1.35867	0.928478	90153.6	1.51849	1.15436	1.07257	14.2561	53.815	2.61536
87	0.961579	1.35859	1.35276	0.999307	90475.1	1.56353	1.17712	1.08586	14.184	56.6645	2.71953
88	0.958422	1.34619	1.33938	1.07522	90342.1	1.6204	1.20068	1.10045	14.0301	58.3869	2.73795
89	0.955324	1.37609	1.36848	1.15173	94055.8	1.67471	1.22504	1.1159	13.7125	60.3472	2.78501
90	0.951607	1.36031	1.35171	1.22628	94034.7	1.72152	1.25107	1.13219	13.3889	62.8547	2.88167
91	0.947254	1.38296	1.37362	1.30723	97592	1.78957	1.2755	1.14927	13.1093	65.541	2.98748
92	0.941968	1.44126	1.43139	1.40048	103659	1.88376	1.3014	1.16888	12.8787	67.3715	3.03307
93	0.935544	1.53713	1.52655	1.51192	111882	2.01123	1.33162	1.19288	12.6709	67.9758	3.00745
94	0.928006	1.66174	1.65022	1.63442	121464	2.15962	1.36522	1.22026	12.4697	68.4049	2.98764
95	0.920411	1.78348	1.77091	1.75401	129463	2.30642	1.39591	1.24654	12.279	69.9526	3.03796

Index	Average Inlet Pressure; Part Turbo-Comp	Average Outlet Pressure; Part Turbo-Comp	Average Pressure (Outlet); Part AfterCooler	Average Pressure; Part SR-TV-23	Average Speed; Part Turbo-Turbine	Average Inlet Pressure; Part Turbo-Turbine	Average Outlet Pressure; Part Turbo-Turbine	Average Pressure; Part Cat-Out	Air-Fuel Ratio (Inducted Air/Total Fuel); Part R4	Pressure; Maximum; Part Cyl1	Maximum Rate of Pressure Rise; Part Cyl1
	bar	bar	bar	bar	RPM	bar	bar	bar	No Unit	bar	bar/deg
96	0.976063	1.04329	1.04237	0.345858	37382.3	1.11386	1.03221	1.00104	14.1363	23.079	1.20643
97	0.974921	1.09769	1.09624	0.420055	50291.3	1.17013	1.04707	1.00974	14.2089	28.2659	1.49185
98	0.973513	1.17392	1.17188	0.495407	64039.8	1.2361	1.06397	1.01945	14.2346	33.3637	1.76688
99	0.971849	1.26579	1.26323	0.570081	77420.4	1.30689	1.08179	1.03005	14.2312	38.1168	2.02902
100	0.969928	1.33754	1.3344	0.643235	85598.5	1.37641	1.10047	1.04148	14.2223	42.4891	2.24641
101	0.967747	1.36735	1.36352	0.714551	89180	1.43237	1.12114	1.05384	14.23	46.5616	2.45543
102	0.965314	1.36068	1.35603	0.78384	89411.2	1.47449	1.14426	1.06723	14.258	50.2728	2.63079
103	0.962586	1.34776	1.34219	0.853117	89112.1	1.51636	1.16897	1.08171	14.2736	53.4591	2.76581
104	0.959621	1.34891	1.3424	0.922503	90171.8	1.56521	1.19362	1.09676	14.2149	57.0163	2.92642
105	0.956485	1.34309	1.33559	0.989535	90720.5	1.60844	1.21624	1.11115	14.031	61.4671	3.16345
106	0.952791	1.38364	1.3752	1.06406	95538	1.67705	1.23778	1.12667	13.7374	64.9189	3.31756
107	0.948645	1.36328	1.35357	1.13582	95403.6	1.72275	1.26552	1.14466	13.4078	67.2192	3.39053
108	0.943767	1.42472	1.41398	1.2194	101919	1.81274	1.29025	1.16375	13.1089	69.8353	3.47847
109	0.938235	1.39512	1.38308	1.29453	101804	1.86592	1.32273	1.18553	12.8471	71.6984	3.5167
110	0.931465	1.48376	1.47065	1.39326	109728	1.98975	1.35355	1.21049	12.5993	72.7238	3.4902
111	0.922942	1.52656	1.51276	1.4933	115265	2.10458	1.39208	1.23991	12.3501	73.0687	3.43097
112	0.913953	1.64326	1.62822	1.60732	124090	2.25493	1.42653	1.26948	12.105	74.2925	3.43595
113	0.905149	1.74896	1.73277	1.71057	131383	2.39419	1.45498	1.29542	11.8822	77.2847	3.55494
114	0.974416	1.07469	1.07347	0.36649	45511.1	1.1458	1.04055	1.00567	13.8759	23.5696	1.31821
115	0.972911	1.15244	1.15055	0.444126	60666.5	1.21405	1.05876	1.01627	14.0832	28.7853	1.64397
116	0.971011	1.25688	1.25436	0.523206	76388.2	1.29322	1.07885	1.02832	14.2099	34.3609	1.98615
117	0.968758	1.34376	1.34057	0.60094	86370.8	1.37258	1.09995	1.04145	14.2632	39.9859	2.31445
118	0.966257	1.3698	1.36581	0.672413	89707.3	1.42954	1.12295	1.05538	14.2652	45.0317	2.63663
119	0.963481	1.38188	1.37701	0.741067	91795.7	1.48202	1.14719	1.07021	14.2456	49.3204	2.94913
120	0.960354	1.39939	1.39357	0.810332	94471	1.53914	1.17243	1.08612	14.2207	53.2965	3.13587
121	0.956891	1.40653	1.39967	0.879206	96167.3	1.59336	1.19867	1.10292	14.1697	57.783	3.47039
122	0.953122	1.40736	1.39937	0.947266	97322.3	1.64454	1.22458	1.11999	14.0467	62.4668	3.73141
123	0.948947	1.41189	1.40271	1.01639	99001.9	1.69845	1.24956	1.13731	13.8292	67.1251	3.98358
124	0.944359	1.37914	1.36848	1.08211	98114.8	1.73748	1.27684	1.15581	13.5419	71.4874	4.25026
125	0.938918	1.43173	1.41985	1.16029	103736	1.82599	1.30315	1.17621	13.2281	74.4179	4.41402
126	0.932806	1.3846	1.37084	1.2294	102706	1.87201	1.33699	1.19967	12.9104	76.2408	4.51928
127	0.925362	1.45708	1.44197	1.32196	109967	1.98988	1.36876	1.22551	12.5871	77.7223	4.54007
128	0.91577	1.44442	1.42812	1.40418	112781	2.08335	1.41033	1.25692	12.254	78.2058	4.48155
129	0.904488	1.56743	1.54924	1.52393	123114	2.2585	1.45324	1.29339	11.9219	77.8677	4.37864
130	0.890844	1.70077	1.68032	1.65304	133058	2.45995	1.50104	1.33503	11.6151	77.6487	4.24647
131	0.974676	1.11854	1.11699	0.381909	54312.3	1.18445	1.05014	1.01219	13.5321	24.3221	1.31807
132	0.972782	1.22261	1.22034	0.46093	71361.1	1.26478	1.07208	1.02506	13.8747	29.5672	1.62858
133	0.970434	1.31996	1.31696	0.539685	83752.5	1.34776	1.09603	1.03962	14.1179	34.7211	1.91449
134	0.967643	1.36704	1.36317	0.616753	89182.2	1.41871	1.1215	1.05542	14.242	39.8577	2.21846
135	0.964463	1.40563	1.4008	0.692253	93857.9	1.48771	1.14736	1.07204	14.2514	44.871	2.49768
136	0.961086	1.35673	1.35069	0.756076	90394.8	1.51848	1.17582	1.0895	14.1736	49.0675	2.73582
137	0.957083	1.39936	1.39222	0.829957	95562	1.59354	1.20236	1.10784	14.0485	53.4256	3.00169
138	0.952855	1.33498	1.32627	0.892795	91352.2	1.61696	1.23157	1.12674	13.9085	58.6421	3.28837
139	0.947887	1.3756	1.3656	0.968169	96717.5	1.69429	1.25865	1.14664	13.7639	64.5604	3.63006
140	0.942517	1.36961	1.35801	1.03848	98306.8	1.75173	1.28808	1.16774	13.589	69.1106	3.89186
141	0.936539	1.35745	1.34404	1.10681	99703.7	1.81094	1.31847	1.19007	13.3484	73.3012	4.13309
142	0.929629	1.33449	1.31888	1.17035	100871	1.87382	1.35214	1.21514	13.0291	76.0104	4.25899
143	0.920742	1.38217	1.36459	1.25934	107336	1.99261	1.3905	1.24576	12.6416	76.1957	4.16317
144	0.910649	1.42936	1.40975	1.34903	114022	2.11679	1.42751	1.27676	12.2079	78.7543	4.26976
145	0.898941	1.49604	1.47441	1.44558	121777	2.25896	1.46471	1.30944	11.7607	81.7147	4.38428
146	0.884127	1.62952	1.60557	1.57457	132250	2.46626	1.50966	1.35033	11.3405	82.4431	4.32971
147	0.864024	1.79183	1.76495	1.73132	144913	2.73375	1.56868	1.40393	10.9836	81.265	4.14376
148	0.973393	1.12513	1.12297	0.397311	56330.3	1.21551	1.06658	1.02142	13.2438	28.4891	1.69569
149	0.971036	1.20704	1.20407	0.471891	70199.6	1.29216	1.09176	1.03638	13.6492	33.8062	2.05883
150	0.968153	1.26563	1.26173	0.545582	79190.2	1.36331	1.11943	1.05324	13.9383	39.0247	2.40331
151	0.964636	1.32674	1.32178	0.622454	86463.4	1.44667	1.14842	1.07201	14.0746	44.6582	2.7615
152	0.960638	1.35479	1.3486	0.696113	90347.3	1.51796	1.17792	1.09157	14.0588	50.4141	3.13216
153	0.956224	1.36562	1.35809	0.767922	92757.4	1.58166	1.20731	1.11165	13.9262	55.8338	3.48619
154	0.95112	1.41436	1.4055	0.84412	98699.7	1.6658	1.23642	1.13287	13.7282	61.6463	3.85113
155	0.945199	1.46116	1.45083	0.92222	103830	1.75747	1.2668	1.15573	13.52	68.2378	4.2806
156	0.939208	1.37817	1.36563	0.984932	100311	1.78111	1.30004	1.17899	13.3337	73.5672	4.64398
157	0.932478	1.36341	1.34882	1.05416	101595	1.84455	1.33263	1.20345	13.1627	77.7332	4.90464
158	0.924944	1.3442	1.32723	1.12482	103372	1.91295	1.36635	1.22938	12.9435	81.2792	5.20759
159	0.916184	1.3336	1.31399	1.20098	106297	1.99334	1.40048	1.2569	12.6104	85.9447	5.32716
160	0.905705	1.3679	1.3458	1.28763	112415	2.11022	1.43536	1.28691	12.1526	90.0398	5.59399
161	0.892463	1.44798	1.42339	1.39026	121608	2.27224	1.47612	1.32309	11.6206	90.7265	5.49682
162	0.876786	1.57201	1.54493	1.5095	132143	2.47769	1.51682	1.36185	11.0891	93.1909	5.53974
163	0.860147	1.70447	1.67506	1.63712	142808	2.68709	1.55085	1.39689	10.6227	98.9021	5.91064
164	0.970803	1.28744	1.28489	0.423194	80104.4	1.30817	1.08125	1.03069	13.0412	31.4368	1.79492
165	0.967852	1.36837	1.3649	0.499684	89011.3	1.39396	1.10873	1.04787	13.3859	36.9281	2.17205
166	0.964317	1.39207	1.38749	0.571305	92446.7	1.4609	1.13916	1.06696	13.609	42.333	2.519
167	0.960101	1.3899	1.38397	0.641804	93655.6	1.52245	1.1717	1.08801	13.6928	48.0589	2.8768
168	0.955205	1.37756	1.37007	0.712373	93970	1.58182	1.20521	1.11052	13.6466	54.1099	3.24844
169	0.949664	1.36307	1.35383	0.78283	94712.2	1.6415	1.23892	1.13407	13.4942	60.1005	3.63154
170	0.943424	1.34807	1.33687	0.853978	95864.8	1.7029	1.27292	1.15871	13.2642	66.0306	4.01002
171	0.936383	1.33138	1.31795	0.92666	97377.6	1.76883	1.30751	1.18465	12.991	71.8879	4.37166
172	0.927873	1.43389	1.41886	1.01449	107646	1.90685	1.34185	1.21303	12.709	78.4639	4.79496
173	0.919171	1.3729	1.35485	1.08652	107101	1.96236	1.37858	1.24154	12.4417	83.8553	5.11979
174	0.909551	1.32973	1.30838	1.1607	108445	2.03186	1.41577	1.2713	12.1698	87.7355	5.34489
175	0.898189	1.32714	1.30239	1.24511	112793	2.13551	1.4547	1.30398	11.8286	90.3894	5.43559
176	0.883985	1.4109	1.38346	1.34846	122462	2.30462	1.49471	1.34046	11.3761	94.1094	5.54174
177	0.86674	1.53461	1.50468	1.46685	133642	2.52049	1.53472	1.37966	10.8516	99.0674	5.77368

Index	Crank Angle at Maximum Pressure; Part Cyl1	Fuel Mass Trapped at Cyl. Cycle-Start; Part Cyl1	Throttle Angle; Part Throttle-1	Average Map Pressure Ratio; Part Turbo-Turbine	Average Map Pressure Ratio; Part Turbo-Comp	Average Mass Flow Rate (Outlet); Part Turbo-WG-Pipe-01	Average Pressure Drop Across Boundary; Part Throttle-1	IMEP720 - Net Indicated Mean Effective Pressure; Part R4	IMEP360 - Gross Indicated Mean Effective Pressure; Part	FMEP - Friction Mean Effective Pressure; Part R4	PMEP - Pumping Mean Effective Pressure; Part R4
Index	deg	mg	deg	No Unit	No Unit	g/s	bar	bar	bar	bar	bar
1	14.5475	8.94742	2.24273	1.0125	1.00313	0	0.667077	2.03432	2.7095	1.03432	-0.675188
2	14.8726	12.0011	3.25466	1.02173	1.00574	0	0.59569	3.03436	3.64443	1.03438	-0.610078
3	15.8252	14.9715	4.15949	1.03835	1.01017	0	0.523404	4.03446	4.57388	1.03443	-0.539421
4	17.5386	17.9076	5.09851	1.05944	1.01691	0	0.449774	5.03445	5.49929	1.03447	-0.464841
5	19.2809	20.8755	5.9861	1.08128	1.02537	0	0.375612	6.03458	6.42326	1.03451	-0.388687
6	20.7713	23.906	7.03382	1.10396	1.03642	0	0.303042	7.03491	7.34686	1.03455	-0.311954
7	23.1161	27.0826	8.48047	1.12947	1.05246	0	0.230019	8.03564	8.26651	1.03457	-0.230872
8	26.3047	30.599	10.6567	1.15961	1.07584	0	0.15765	9.03453	9.1792	1.03459	-0.144673
9	29.5426	34.4016	14.3056	1.19414	1.10848	0	0.0857974	10.034	10.0864	1.0346	-0.0524206
10	31.9918	38.2263	57.2222	1.22942	1.14796	0	0.0013377	11.0575	10.9985	1.03461	0.0589571
11	32.0199	38.2822	90	1.22994	1.1486	0	0.000484042	11.0728	11.012	1.03461	0.0607965
12	6.04505	9.40891	3.93128	1.01887	1.00564	0	0.660423	2.12926	2.82491	1.12929	-0.695641
13	6.74999	12.3481	5.36667	1.03113	1.0097	0	0.602696	3.12931	3.76293	1.12935	-0.633617
14	6.81462	15.1832	6.52751	1.05101	1.0167	0	0.511907	4.12941	4.66621	1.12942	-0.536804
15	7.45302	17.9661	7.57728	1.07478	1.02667	0	0.421779	5.12944	5.5813	1.12949	-0.451861
16	8.34291	20.6498	8.70758	1.09921	1.03919	0	0.351842	6.1295	6.5125	1.12955	-0.383002
17	9.82778	23.2984	10.0704	1.12442	1.05511	0	0.285405	7.12963	7.44613	1.1296	-0.316496
18	11.0706	25.9661	11.4248	1.1512	1.07637	0	0.244444	8.12961	8.38761	1.12965	-0.258003
19	12.7987	28.6574	12.8515	1.17999	1.10302	0	0.209721	9.13027	9.33436	1.12968	-0.204098
20	14.8687	31.472	13.9188	1.21277	1.13815	0	0.192565	10.1306	10.2937	1.12971	-0.163176
21	16.9858	34.3372	15.3	1.24537	1.17732	0.200148	0.152682	11.1303	11.2302	1.12973	-0.0998322
22	19.4259	37.339	27.0148	1.24226	1.13913	4.93037	0.0367001	12.1292	12.1492	1.12974	-0.0199828
23	22.1667	40.5821	51.7242	1.29206	1.22194	3.88729	0.00483341	13.1298	13.0604	1.12974	0.0693408
24	25.0292	44.1677	79.1284	1.35139	1.33113	2.45703	0.00153528	14.1292	13.9793	1.12973	0.149923
25	19.8545	9.13775	5.28892	1.02621	1.01005	0	0.674056	2.22405	2.91732	1.2241	-0.693268
26	9.20735	11.9511	6.84138	1.03818	1.0153	0	0.590744	3.22422	3.84695	1.22422	-0.622732
27	9.77739	14.7353	8.26137	1.05949	1.02605	0	0.51164	4.22429	4.77818	1.22429	-0.553887
28	11.7168	17.4154	9.47735	1.08398	1.04181	0	0.442463	5.22437	5.71579	1.22433	-0.491424
29	12.7708	20.1583	10.7579	1.10987	1.06238	0	0.382164	6.22443	6.65515	1.22438	-0.430716
30	14.1549	22.9324	12.1903	1.13714	1.08808	0	0.32079	7.2245	7.59616	1.22443	-0.371659
31	15.3114	25.7405	13.7351	1.16611	1.11914	0	0.271309	8.22447	8.53941	1.22447	-0.314935
32	16.5521	28.5979	14.8445	1.19736	1.15608	0	0.232857	9.22447	9.48483	1.2245	-0.260361
33	18.0859	31.583	15.9504	1.23271	1.20263	0	0.206811	10.2248	10.4334	1.22453	-0.208622
34	20.8301	34.9089	16.8247	1.27498	1.26525	0	0.199245	11.2252	11.3887	1.22453	-0.163492
35	23.879	38.5372	18.4146	1.31671	1.32641	0.883654	0.170505	12.2238	12.3298	1.22453	-0.10605
36	26.0086	42.0655	23.2535	1.339	1.34016	3.65769	0.0996551	13.2255	13.2651	1.22455	-0.0395941
37	27.1975	45.3845	30.7411	1.37386	1.37854	4.4998	0.0534415	14.2249	14.2148	1.22458	0.0100864
38	28.5167	49.09	46.1429	1.41624	1.42778	4.98367	0.0198061	15.2251	15.1795	1.2246	0.0456379
39	30.7305	53.857	55.6444	1.48049	1.5196	4.25058	0.00987272	16.2252	16.145	1.22461	0.080212
40	33.9789	60.2084	63.6951	1.56406	1.6408	2.77807	0.00781607	17.2249	17.1111	1.22462	0.113783
41	37.3063	67.8674	90	1.65677	1.78613	1.56724	0.00519485	18.2242	18.0687	1.22462	0.155468
42	5.54406	9.61837	6.85474	1.04243	1.0183	0	0.666114	2.31905	3.03153	1.31911	-0.712474
43	5.97485	12.4323	8.62524	1.06143	1.03026	0	0.591119	3.31916	3.9669	1.31917	-0.647732
44	6.86471	15.1684	10.1588	1.09052	1.05017	0	0.523106	4.31928	4.90839	1.31924	-0.589111
45	8.1222	17.8075	11.4449	1.12287	1.07765	0	0.463333	5.31934	5.85753	1.3193	-0.53819
46	9.34526	20.4498	12.621	1.15675	1.11192	0	0.416216	6.31944	6.81235	1.31935	-0.492912
47	10.4472	23.1439	13.7555	1.19218	1.15362	0	0.379315	7.3196	7.77068	1.31939	-0.451074
48	11.5144	25.8708	14.5498	1.22924	1.20304	0	0.35074	8.31945	8.73151	1.31943	-0.412058
49	13.4916	28.655	15.2235	1.26896	1.26293	0	0.338967	9.31934	9.69524	1.31946	-0.375901
50	16.335	31.6464	15.8024	1.31373	1.33529	0.0303856	0.338004	10.3197	10.6615	1.31946	-0.341761
51	18.7376	34.7699	17.0484	1.34133	1.36036	2.20172	0.300126	11.3237	11.6217	1.31947	-0.298061
52	19.0073	37.5878	19.0424	1.35324	1.35928	5.24455	0.236986	12.3199	12.5695	1.31951	-0.249572
53	19.2297	40.4611	20.8989	1.38565	1.39652	5.995	0.196671	13.3199	13.5318	1.31955	-0.211892
54	21.2543	43.8468	27.479	1.38947	1.37871	10.4165	0.103567	14.3196	14.4676	1.31956	-0.148005
55	24.0162	48.1859	33.1088	1.43286	1.43346	11.2867	0.0617526	15.3187	15.4266	1.31956	-0.107918
56	26.2067	53.3023	52.9796	1.4713	1.47799	12.9234	0.00995072	16.3194	16.3861	1.31957	-0.0666926
57	28.0053	58.8603	88.7174	1.54307	1.58489	11.4061	0.00295381	17.3194	17.3631	1.31958	-0.0436527
58	29.8323	64.5361	89.5297	1.6208	1.70642	9.63962	0.00317358	18.3194	18.3446	1.3196	-0.0252226
59	31.1626	70.3108	90	1.696	1.82751	8.47526	0.00341884	19.3195	19.3306	1.31962	-0.0110947
60	5.21124	9.84309	8.23933	1.05812	1.03002	0	0.665593	2.41397	3.14805	1.41404	-0.734079
61	5.91291	12.6028	10.1271	1.08252	1.05049	0	0.600916	3.41405	4.0926	1.41408	-0.678544
62	7.21607	15.3437	11.7112	1.11835	1.08467	0	0.548822	4.41417	5.04897	1.41415	-0.634796
63	8.33948	18.0361	13.012	1.15762	1.12978	0	0.509674	5.41428	6.01399	1.4142	-0.599707
64	10.0327	20.7225	13.9165	1.19899	1.18536	0	0.48355	6.41436	6.98382	1.41425	-0.56946
65	11.5667	23.4732	14.5343	1.24312	1.25231	0	0.467247	7.41457	7.95804	1.41428	-0.543468
66	12.6366	26.2698	15.1003	1.28897	1.32756	9.51274E-11	0.459159	8.4134	8.93335	1.41432	-0.519954
67	13.5928	29.0699	16.0385	1.32245	1.36396	1.40126	0.41956	9.41487	9.89978	1.41436	-0.484903
68	14.2282	31.8479	17.2173	1.34873	1.38586	3.47604	0.373519	10.4148	10.8583	1.4144	-0.443479
69	14.4974	34.6161	18.7969	1.36812	1.39421	6.17485	0.315978	11.4151	11.8148	1.41444	-0.399656
70	15.9428	37.5573	21.1067	1.38114	1.39011	9.78798	0.249991	12.4143	12.7681	1.41447	-0.353839
71	18.2072	40.9816	25.2756	1.39272	1.3815	13.9844	0.168655	13.4139	13.7174	1.41447	-0.303576
72	20.4072	45.1011	30.2871	1.42515	1.41374	16.1643	0.112107	14.4136	14.6828	1.41447	-0.269165
73	22.013	49.7299	42.6438	1.44988	1.43051	19.25	0.0382713	15.4149	15.6429	1.41448	-0.227986
74	23.7319	54.7509	64.265	1.50333	1.50401	19.6244	0.00727777	16.4147	16.6262	1.4145	-0.211452
75	26.0327	60.2079	87.75	1.58058	1.62074	18.3146	0.00415911	17.4147	17.6296	1.41451	-0.214899
76	28.5246	66.2449	87.93	1.66357	1.7577	17.4709	0.00451839	18.4153	18.6357	1.41451	-0.220337
77	31.2222	72.8143	90	1.75633	1.91475	16.3029	0.00487333	19.4119	19.642	1.41451	-0.230155
78	7.60453	9.9724	9.46538	1.07185	1.04431	0	0.687679	2.50885	3.30343	1.50894	-0.794581
79	9.00414	12.7265	11.4277	1.10474	1.07998	0	0.644669	3.50896	4.26138	1.50898	-0.752421
80	9.63765	15.5192	13.005	1.14749	1.13378	0	0.619408	4.50906	5.23034	1.50904	-0.721275
81	10.0912	18.3132	14.0254	1.19387	1.20334	0	0.61027	5.50868	6.20738	1.50909	-0.698694
82	11.1995	21.1114	14.6683	1.24299	1.28564	1.13623E-10	0.613088	6.50967	7.19215	1.50914	-0.682479
83	12.5258	23.927	15.3005	1.29196	1.36112	0.226083	0.608114	7.50791	8.17667	1.50917	-0.668751
84	13.7328	26.7227	16.209	1.32348	1.38925	2.30226	0.558306	8.51009	9.15099	1.5092	-0.640895
85	14.3568	29.5123	17.282	1.34231	1.40148	5.64809	0.494553	9.51008	10.1136	1.50923	-0.603552
86	14.8378	32.3253	18.6635	1.36135	1.40899	8.83471	0.426916	10.5082	11.0781	1.50927	-0.569832
87	16.0295	35.3135	20.6076	1.37613	1.40638	12.5557	0.349623	11.508	12.0416	1.5093	-0.533571
88	17.8548	38.7325	23.7191	1.40063	1.39694	15.4579	0.259612	12.5088	13.0154	1.50931	-0.506547
89	19.3535	42.8613	26.4624	1.42021	1.43079	19.217	0.211621	13.5088	13.9858	1.50932	-0.476978
90	20.3233	47.2489	32.6769	1.43022	1.41844	23.8903	0.119393	14.5099	14.9508	1.50935	-0.440881
91	21.6965	51.8266	41.3451	1.46069	1.4462	26.4993	0.0594541	15.5099	15.9373	1.50938	-0.427354
92	22.9242	56.7475	50.951	1.51088	1.5116	27.5723	0.0230647	16.5092	16.9407	1.5094	-0.43152
93	25.1194	62.3491	89.6374	1.58157	1.61693	27.6125	0.00591245	17.5091	17.9624	1.5094	-0.453221
94	27.5059	68.5334	90	1.66159	1.75326	27.4353	0.00641428	18.5092	18.9948	1.50941	-0.485685
95	28.9855	74.6358	90	1.74004	1.88705	26.9652	0.00689388	19.5091	20.0306	1.50943	-0.521435

Index	Crank Angle at Maximum Pressure; Part Cyl1	Fuel Mass Trapped at Cyl. Cycle-Start; Part Cyl1	Throttle Angle; Part Throttle-1	Average Map Pressure Ratio; Part Turbo-Turbine	Average Map Pressure Ratio; Part Turbo-Comp	Average Mass Flow Rate (Outlet); Part Turbo-WG-Pipe-01	Average Pressure Drop Across Boundary; Part Throttle-1	IMEP720 - Net Indicated Mean Effective Pressure; Part R4	IMEP360 - Gross Indicated Mean Effective Pressure; Part R4	FMEP - Friction Mean Effective Pressure; Part R4	PMEP - Pumping Mean Effective Pressure; Part R4
Index	deg	mg	deg	No Unit	No Unit	g/s	bar	bar	bar	bar	bar
96	5.47358	10.5045	10.9067	1.08989	1.06877	0	0.695336	2.60378	3.43013	1.60389	-0.826349
97	6.27152	13.2337	12.7862	1.13378	1.12559	0	0.6747	3.6039	4.40917	1.60392	-0.805275
98	7.0531	15.9979	14.0134	1.18455	1.20502	0	0.67467	4.60379	5.39773	1.60398	-0.793944
99	8.29188	18.781	14.7219	1.23782	1.30073	0.000574072	0.691048	5.60416	6.3945	1.60403	-0.790339
100	9.2412	21.5671	15.4739	1.28685	1.37616	0.559176	0.688767	6.60319	7.39121	1.60407	-0.788026
101	10.1307	24.3214	16.4545	1.31774	1.40896	2.91784	0.646279	7.60431	8.37697	1.60411	-0.772662
102	11.5271	27.0254	17.6887	1.33049	1.40465	7.01965	0.569133	8.60432	9.3457	1.60414	-0.741383
103	12.2822	29.7711	19.111	1.34048	1.39424	11.4183	0.485421	9.60396	10.3137	1.60416	-0.709761
104	13.223	32.6449	20.7624	1.35679	1.39848	15.0854	0.41562	10.6047	11.2931	1.60419	-0.688386
105	13.362	35.7777	22.9748	1.36952	1.39574	18.8175	0.341073	11.6042	12.2704	1.60423	-0.666187
106	14.6054	39.5278	24.6998	1.40635	1.44112	20.4924	0.30553	12.6041	13.2738	1.60426	-0.669686
107	15.8992	43.6695	29.4557	1.41343	1.42449	25.5144	0.211154	13.6032	14.2472	1.60428	-0.644078
108	17.2962	48.1774	31.0832	1.46286	1.49255	26.5681	0.18727	14.604	15.2683	1.60431	-0.66433
109	18.7281	52.7803	41.0697	1.46911	1.46786	32.0707	0.0797866	15.6026	16.2474	1.60432	-0.644754
110	20.5847	58.0942	44.5235	1.5361	1.56593	32.3921	0.0677651	16.604	17.2923	1.60433	-0.688329
111	22.6817	63.9862	89.8621	1.58289	1.61884	35.294	0.00796712	17.604	18.321	1.60433	-0.717016
112	24.7639	70.2256	89.8774	1.65991	1.74851	35.3391	0.00859995	18.6038	19.3767	1.60435	-0.772882
113	25.1591	76.0938	90	1.73204	1.86702	35.0503	0.00916848	19.6038	20.4331	1.6044	-0.829264
114	5.1879	11.0058	12.0621	1.11495	1.10269	0	0.705487	2.69881	3.5644	1.69881	-0.865592
115	5.97979	13.7006	13.7943	1.167	1.18385	0	0.704519	3.69884	4.56078	1.69884	-0.861932
116	6.67966	16.4826	14.672	1.22679	1.29277	0.00227087	0.728861	4.69974	5.56944	1.69891	-0.869704
117	6.84604	19.3048	15.5375	1.28354	1.38413	0.424891	0.736944	5.69942	6.57969	1.69896	-0.880272
118	7.39304	22.0685	16.6948	1.31254	1.41343	3.4214	0.690347	6.69946	7.57117	1.699	-0.871711
119	8.50556	24.8117	17.9008	1.33423	1.42869	6.96146	0.632529	7.69976	8.56099	1.69904	-0.861232
120	9.2704	27.5933	19.0472	1.35831	1.44991	10.2424	0.579377	8.69959	9.55635	1.69908	-0.856758
121	10.0541	30.4405	20.3501	1.3773	1.46082	13.9285	0.515956	9.69945	10.5503	1.69911	-0.850843
122	10.3489	33.4519	22.0282	1.39297	1.46557	17.8141	0.44685	10.6995	11.5439	1.69915	-0.844419
123	10.9394	36.8074	24.1324	1.41148	1.47453	21.4618	0.380235	11.6981	12.5404	1.69919	-0.842217
124	11.2319	40.505	28.0581	1.41298	1.4456	26.8793	0.279185	12.699	13.5246	1.69922	-0.825579
125	12.6856	44.7316	29.9731	1.45886	1.50525	28.4502	0.251544	13.6984	14.555	1.69926	-0.85659
126	14.3804	49.2491	36.8751	1.45732	1.46306	34.8541	0.131782	14.6999	15.545	1.69926	-0.845152
127	16.5862	54.4661	40.0985	1.51774	1.54528	35.983	0.10932	15.6989	16.5947	1.69928	-0.895771
128	18.6663	60.3807	81.8292	1.54377	1.54221	41.0556	0.0102365	16.6989	17.6298	1.69927	-0.930867
129	21.3027	67.3548	89.8334	1.62977	1.68067	41.6053	0.0105684	17.6983	18.7153	1.69927	-1.01702
130	23.9749	75.0756	89.8613	1.72407	1.83279	42.0644	0.0114497	18.6983	19.8135	1.69927	-1.11521
131	6.01211	11.5428	13.0426	1.14542	1.14717	0.000446281	0.73327	2.79453	3.71821	1.79373	-0.923677
132	7.11159	14.1646	14.3291	1.20486	1.25559	0.00174381	0.757113	3.79439	4.73188	1.79377	-0.937485
133	7.98182	16.8111	15.3138	1.26256	1.35764	0.852268	0.774504	4.79431	5.74833	1.7938	-0.954021
134	8.33311	19.5341	16.5392	1.30344	1.40875	3.46321	0.74317	5.79458	6.7555	1.79385	-0.960924
135	8.97486	22.344	17.7349	1.33981	1.45158	6.39558	0.704858	6.79368	7.76379	1.7939	-0.970106
136	9.28258	25.127	19.587	1.33387	1.40498	12.995	0.590455	7.79305	8.73655	1.79391	-0.943497
137	10.1043	28.1886	20.6736	1.37275	1.45281	15.4477	0.557514	8.7951	9.7594	1.79395	-0.964297
138	10.3542	31.2104	23.3289	1.35847	1.39114	22.7927	0.427651	9.79277	10.7284	1.79398	-0.935629
139	10.3109	34.488	25.0085	1.39641	1.4379	25.2407	0.390751	10.7937	11.7554	1.79403	-0.961754
140	10.4782	37.8729	28.2519	1.41209	1.43725	29.8277	0.311705	11.7942	12.7642	1.79407	-0.970011
141	11.4217	41.6103	31.8742	1.42736	1.43089	34.5855	0.228031	12.7933	13.7749	1.79411	-0.981578
142	12.9886	45.945	37.9675	1.44107	1.41441	39.9241	0.137603	13.7941	14.7941	1.79413	-1.00004
143	15.5349	51.3456	44.4118	1.49435	1.47248	42.3954	0.0927242	14.7937	15.8591	1.79412	-1.06543
144	17.2515	57.3967	50.8137	1.55003	1.53133	44.9674	0.0462321	15.7939	16.9313	1.79415	-1.13737
145	18.5948	64.171	89.473	1.61606	1.61202	46.9151	0.0120503	16.7938	18.0162	1.79418	-1.2224
146	20.731	72.155	89.9157	1.71758	1.7651	46.8509	0.0129985	17.7947	19.1405	1.79419	-1.34589
147	23.7345	81.4589	89.9361	1.83807	1.9543	46.7762	0.0141662	18.7937	20.3034	1.7942	-1.50964
148	2.69699	12.6719	14.4817	1.1588	1.15524	3.29903	0.723088	2.88842	3.86478	1.88871	-0.976364
149	4.55871	15.1646	15.7465	1.20926	1.24146	4.70511	0.729035	3.88866	4.88422	1.88871	-0.99556
150	5.68428	17.6954	17.0766	1.24897	1.30438	7.68629	0.712425	4.8886	5.8976	1.88877	-1.009
151	5.86014	20.4408	18.3352	1.29738	1.37059	10.0125	0.695035	5.88844	6.92516	1.88881	-1.03672
152	6.44121	23.3407	19.7884	1.33072	1.40344	13.7664	0.647681	6.88949	7.94516	1.88884	-1.05567
153	6.62399	26.3875	21.3331	1.35521	1.4191	18.1144	0.584757	7.88763	8.95894	1.88887	-1.07131
154	7.09084	29.7302	22.4897	1.39771	1.47434	20.8774	0.555241	8.88765	9.99772	1.88891	-1.11007
155	7.14804	33.2937	23.7525	1.44336	1.5285	23.469	0.521615	9.88787	11.0445	1.88898	-1.15659
156	7.23056	36.6683	27.8486	1.42339	1.44942	31.9313	0.372148	10.888	12.0259	1.88901	-1.13796
157	8.34088	40.1603	31.1668	1.43935	1.44116	36.9381	0.284625	11.8887	13.0507	1.88904	-1.16197
158	9.36569	43.9875	35.7636	1.45723	1.42917	41.9301	0.1906	12.8879	14.0808	1.88906	-1.1929
159	10.2649	48.5717	45.2329	1.48328	1.42727	46.507	0.0990327	13.8876	15.1237	1.8891	-1.23616
160	11.6436	54.2523	54.0064	1.53558	1.47323	49.249	0.0418451	14.8887	16.201	1.88917	-1.3123
161	13.7628	61.3403	83.1242	1.61248	1.56912	50.8633	0.0142762	15.888	17.3125	1.88917	-1.42452
162	15.5343	69.5104	89.8295	1.71683	1.71311	50.5178	0.0150422	16.8879	18.4588	1.88922	-1.5709
163	15.5537	77.7643	89.9327	1.82595	1.86742	49.383	0.0161769	17.888	19.5985	1.88931	-1.71042
164	2.74248	13.7091	14.6247	1.23903	1.32429	1.52778E-05	0.858352	2.98365	4.0874	1.98366	-1.10375
165	3.68286	16.2663	15.8834	1.29399	1.41029	1.64563	0.86123	3.98346	5.1242	1.98368	-1.14074
166	4.54751	18.8688	17.456	1.32323	1.43828	6.07884	0.811572	4.98332	6.1421	1.98371	-1.15878
167	5.58559	21.6615	19.2578	1.34277	1.44043	11.6134	0.736982	5.98316	7.15642	1.98376	-1.17326
168	5.5075	24.6826	21.204	1.35783	1.43283	17.6056	0.651903	6.98303	8.17232	1.9838	-1.18929
169	5.82036	27.9364	23.2251	1.372	1.42365	23.6407	0.564509	7.98315	9.19269	1.98381	-1.20955
170	6.32458	31.4605	25.4716	1.38652	1.41465	29.6488	0.475251	8.98314	10.218	1.98384	-1.23482
171	7.00638	35.2682	28.7046	1.40348	1.40473	35.4696	0.3821	9.98283	11.25	1.98386	-1.26721
172	6.81376	39.5505	29.4745	1.4808	1.51882	35.9233	0.39418	10.9839	12.3574	1.98394	-1.37345
173	7.5504	43.7071	33.9478	1.48323	1.46502	43.0318	0.255886	11.9841	13.3823	1.98398	-1.39815
174	8.61489	48.0851	42.6308	1.49607	1.43052	49.2217	0.132602	12.9839	14.422	1.98401	-1.43804
175	10.284	53.229	56.533	1.53256	1.43949	53.6867	0.0391924	13.9828	15.4913	1.98403	-1.50855
176	11.745	59.7874	89.5057	1.61485	1.54007	54.7393	0.0147166	14.9829	16.6217	1.98409	-1.63886
177	12.6326	67.7607	89.1515	1.72616	1.68528	53.9317	0.0159953	15.9829	17.7933	1.98416	-1.81046

	Average Mass Flow Rate; Part Turbo-Comp	Average Efficiency; Part Turbo-Comp	Average Power; Part Turbo-Comp	Average Mass Flow Rate; Part Turbo-Turbine	Average Efficiency; Part Turbo-Turbine	Average Power; Part Turbo-Turbine	Average Pressure (Outlet); Part SR-DK1	Average Pressure (Inlet); Part SR-DK2	Average Mass Flow Rate; Part Throttle-01	Orifice Diameter (End of Cycle); Part Turbo-WG-01
Index	kg/s	%	kW	kg/s	%	kW	bar	bar	No Unit	mm
1	0.0042417	24.3033	0.00463392	0.00453998	38.3279	0.00462615	0.985828	0.318742	4.2417	7.97885E-07
2	0.00569166	25.8118	0.0107462	0.00609138	39.6723	0.0107566	0.988244	0.392548	5.69166	7.97885E-07
3	0.00710169	27.4791	0.0222741	0.00759937	39.373	0.0222967	0.992412	0.469011	7.10169	7.97885E-07
4	0.00849648	29.2762	0.0415083	0.00909266	38.2927	0.0414859	0.998828	0.54907	8.49648	7.97885E-07
5	0.00990687	31.0663	0.0682166	0.0106022	35.7464	0.0682683	1.00689	0.631305	9.90687	7.97885E-07
6	0.0113444	32.954	0.105354	0.0121422	32.7834	0.105362	1.01748	0.714474	11.3444	7.97885E-07
7	0.0128555	35.1457	0.160371	0.0137576	32.6534	0.160339	1.03292	0.802948	12.8555	7.97885E-07
8	0.0145206	37.7198	0.242094	0.0155412	32.129	0.24204	1.05549	0.897906	14.5206	7.97885E-07
9	0.0163253	40.5539	0.358293	0.0174718	33.2622	0.357982	1.08705	1.00134	16.3253	7.97885E-07
10	0.0181419	43.4658	0.500979	0.0194161	34.3692	0.500852	1.12461	1.12344	18.142	7.97885E-07
11	0.0181691	43.5203	0.503201	0.0194446	34.3877	0.503151	1.12524	1.12493	18.1691	7.97885E-07
12	0.00668739	26.1244	0.0122458	0.00715761	40.0552	0.012218	0.982985	0.322539	6.68738	7.97885E-07
13	0.00878332	28.0181	0.0257618	0.00940056	40.342	0.0258044	0.986637	0.383926	8.78332	7.97885E-07
14	0.0108015	30.3265	0.0502511	0.0115603	41.4948	0.0503054	0.993104	0.481209	10.8015	7.97885E-07
15	0.0127788	32.7807	0.087531	0.0136762	39.5882	0.0874446	1.00243	0.580686	12.7788	7.97885E-07
16	0.0146917	35.1277	0.13743	0.0157233	36.7054	0.137306	1.0142	0.662421	14.6917	7.97885E-07
17	0.0165783	37.5071	0.203125	0.0177422	35.0687	0.203232	1.02921	0.743888	16.5783	7.97885E-07
18	0.0184736	40.031	0.2918	0.019771	35.3346	0.291846	1.04939	0.805045	18.4736	7.97885E-07
19	0.0203836	42.6359	0.404238	0.0218163	35.5485	0.403883	1.07478	0.865182	20.3836	7.97885E-07
20	0.0223796	45.4933	0.551467	0.023953	36.4814	0.551343	1.10837	0.915957	22.3796	7.97885E-07
21	0.0244176	48.383	0.717239	0.025933	37.3499	0.717613	1.14585	0.993342	24.4176	2.22852
22	0.0265579	47.7781	0.62921	0.0234952	36.9854	0.628692	1.1077	1.07125	26.5579	11.6497
23	0.028894	54.1999	0.945741	0.0270347	38.4506	0.945935	1.18946	1.18506	28.894	9.77037
24	0.0314846	59.2627	1.36284	0.0312352	38.9629	1.36271	1.2954	1.29436	31.4846	7.3253
25	0.00864991	28.0727	0.0261363	0.00925872	40.1799	0.0260972	0.988007	0.31391	8.64991	7.97885E-07
26	0.011322	30.1467	0.0484041	0.0121183	41.6275	0.0484484	0.992645	0.401884	11.322	7.97885E-07
27	0.0139713	33.0287	0.0924385	0.0149531	42.6165	0.0925211	1.00256	0.490944	13.9713	7.97885E-07
28	0.0165228	36.1636	0.159373	0.0176833	43.8615	0.159513	1.01727	0.574872	16.5228	7.97885E-07
29	0.0191318	39.3746	0.251041	0.020475	44.2405	0.25125	1.03653	0.654465	19.1318	7.97885E-07
30	0.0217627	42.5205	0.370142	0.0232906	44.723	0.370451	1.0607	0.74005	21.7627	7.97885E-07
31	0.0244164	45.7369	0.516825	0.0261317	44.2363	0.516925	1.09	0.818868	24.4164	7.97885E-07
32	0.0271082	48.9992	0.693308	0.0290144	43.1502	0.693143	1.12494	0.892298	27.1082	7.97885E-07
33	0.0299189	52.4948	0.913779	0.0320251	41.6433	0.91305	1.16915	0.962599	29.9189	7.97885E-07
34	0.0330682	56.4965	1.20533	0.0353965	39.819	1.20439	1.22889	1.02995	33.0682	7.97885E-07
35	0.0365401	60.024	1.51547	0.0382257	38.5575	1.51508	1.28689	1.11674	36.5401	4
36	0.0399659	61.6365	1.67603	0.0391122	38.4021	1.67599	1.29819	1.19898	39.9659	8.06262
37	0.0431851	62.2356	1.97639	0.0417099	38.9227	1.97628	1.33363	1.28074	43.1851	8.70736
38	0.046565	62.5821	2.37389	0.0448543	39.3307	2.37298	1.37936	1.36043	46.565	8.9
39	0.0504201	62.8585	3.04757	0.0497602	39.8754	3.0465	1.46576	1.45717	50.4201	7.9
40	0.0550321	62.6157	4.00763	0.0562686	40.4565	4.00613	1.57948	1.57328	55.0321	6.1
41	0.0603263	62.8641	5.21466	0.0632826	41.2131	5.21335	1.71422	1.71117	60.3263	4.392
42	0.011387	30.8247	0.056925	0.0121885	42.0395	0.0567994	0.996588	0.330413	11.387	7.97885E-07
43	0.0147182	33.9473	0.109981	0.0157541	43.2498	0.110079	1.00752	0.416379	14.7182	7.97885E-07
44	0.0179671	37.666	0.19924	0.0192309	45.0642	0.199422	1.02603	0.502966	17.9671	7.97885E-07
45	0.0211092	41.4893	0.325803	0.0225927	46.3435	0.326084	1.05182	0.588594	21.1092	7.97885E-07
46	0.0242569	45.2409	0.489266	0.0259603	46.2957	0.489691	1.08411	0.66805	24.2569	7.97885E-07
47	0.0274578	49.0787	0.691273	0.0293855	45.3818	0.691858	1.1235	0.744388	27.4578	7.97885E-07
48	0.0306802	52.9441	0.931781	0.0328357	43.9615	0.931882	1.17036	0.819867	30.6802	7.97885E-07
49	0.0339539	56.9342	1.21945	0.036342	42.232	1.21906	1.22737	0.888703	33.9539	7.97885E-07
50	0.0374754	60.547	1.58035	0.0400788	40.8716	1.58181	1.29636	0.958706	37.4754	0.713195
51	0.0411598	61.7504	1.81634	0.0418614	40.7682	1.82014	1.31861	1.01891	41.1598	6.08294
52	0.0445571	63.2477	1.91457	0.0424434	40.6368	1.91498	1.31515	1.07868	44.5571	9.30001
53	0.0479844	63.8767	2.23017	0.0453602	40.9882	2.23028	1.34917	1.1531	47.9844	9.67204
54	0.0517595	65.2509	2.26047	0.0449973	40.8628	2.2598	1.32853	1.22569	51.7595	12.632
55	0.056054	65.8544	2.73555	0.0487844	41.3332	2.73403	1.37858	1.31766	56.054	12.7125
56	0.0605601	66.67	3.18241	0.0520784	41.6309	3.18155	1.41801	1.40901	60.5601	13.1864
57	0.065211	66.5929	4.08631	0.0587099	42.2419	4.08523	1.51838	1.51646	65.211	11.8901
58	0.0699926	66.2622	5.17142	0.0657268	42.8473	5.16979	1.63255	1.6305	69.992	10.5034
59	0.0749678	66.1333	6.32614	0.0723515	43.5388	6.32445	1.74571	1.74351	74.9681	9.50177
60	0.0139733	33.6936	0.104397	0.0149557	42.285	0.104211	1.00542	0.339741	13.9733	7.97885E-07
61	0.0178836	37.6897	0.199421	0.0191419	45.4848	0.199462	1.02427	0.423315	17.8836	7.97885E-07
62	0.0217752	42.3231	0.358419	0.0233076	48.3062	0.358742	1.05627	0.507489	21.7752	7.97885E-07
63	0.0256096	46.9419	0.573887	0.0274113	49.3189	0.574401	1.09874	0.589203	25.6096	7.97885E-07
64	0.029449	51.6	0.84238	0.031519	48.8168	0.843097	1.15126	0.667912	29.449	7.97885E-07
65	0.0333848	56.299	1.16726	0.0357296	47.4754	1.16824	1.21476	0.747779	33.3848	7.97885E-07
66	0.0373753	60.5313	1.54357	0.0400027	45.7941	1.54236	1.28617	0.827339	37.3753	0.0000383
67	0.0413634	61.8193	1.83959	0.0428671	45.2317	1.84	1.31927	0.900119	41.3634	4.78941
68	0.04531	63.126	2.07951	0.0450177	44.4996	2.07917	1.33796	0.964939	45.31	7.4
69	0.0492242	64.4043	2.25714	0.0465101	43.8259	2.25673	1.34316	1.02778	49.2242	9.7
70	0.053269	65.6688	2.37344	0.0472373	43.2233	2.37259	1.33576	1.08649	53.269	12.0277
71	0.0576277	66.6403	2.48047	0.0477409	42.8401	2.47993	1.32333	1.15555	57.6277	14.1
72	0.0623002	67.4313	2.84914	0.0506458	43.0477	2.84836	1.35038	1.2393	62.3002	14.7
73	0.0670933	68.2325	3.14144	0.0528232	43.1404	3.13802	1.36154	1.32445	67.0933	15.5856
74	0.0722528	68.9551	3.84482	0.0581043	43.5918	3.84329	1.42781	1.42183	72.2528	15.1922
75	0.0780012	68.9173	4.96837	0.0657053	44.3199	4.9677	1.53574	1.53299	78.0012	14.12
76	0.0844686	69.0583	6.34855	0.0736188	45.1292	6.34779	1.66183	1.65886	84.4686	13.2624
77	0.0915163	68.8952	8.04321	0.0824936	46.0648	8.04081	1.80618	1.80298	91.5163	12.3134
78	0.0165312	36.5056	0.167375	0.0176929	45.0693	0.16708	1.01866	0.330835	16.5312	7.97885E-07
79	0.0211008	41.666	0.333767	0.0225831	48.888	0.334079	1.05195	0.407178	21.1008	7.97885E-07
80	0.0257121	47.2064	0.58985	0.0275199	51.0566	0.590391	1.10262	0.483183	25.7122	7.97885E-07
81	0.0303259	52.7973	0.924855	0.0324601	51.5694	0.923932	1.16843	0.558221	30.3259	7.97885E-07
82	0.0349733	58.2985	1.3237	0.0374342	50.7204	1.32493	1.24654	0.633597	34.9733	4.21734E-05
83	0.0396988	61.0877	1.77416	0.0422457	50.1825	1.78155	1.31762	0.709764	39.6988	1.91153
84	0.0444764	62.7048	2.07108	0.0452178	49.8802	2.10509	1.34193	0.784028	44.4761	6.01265
85	0.0490982	64.2791	2.29276	0.0468939	48.9198	2.29357	1.35045	0.856422	49.0982	9.24511
86	0.053753	65.6184	2.49993	0.0486921	48.2188	2.49735	1.35399	0.92774	53.753	11.3111
87	0.0584297	66.7074	2.65812	0.0499955	47.414	2.65651	1.34724	0.998452	58.4297	13.1913
88	0.0637377	67.7328	2.79683	0.0524213	47.7325	2.95906	1.3328	1.07423	63.7345	14.2343
89	0.0685659	68.5244	3.19846	0.0543491	46.7004	3.19736	1.36103	1.15061	68.5659	15.405
90	0.0737884	69.142	3.32511	0.0554261	46.1741	3.31701	1.34296	1.22502	73.7886	16.6993
91	0.0792658	69.7995	3.74557	0.0588097	46.2328	3.7457	1.36362	1.30583	79.2659	17.0449
92	0.0852623	70.2571	4.51252	0.0643104	46.6291	4.51099	1.42016	1.39894	85.2623	16.8128
93	0.0921675	70.6272	5.70127	0.071829	47.2388	5.69949	1.51416	1.51026	92.1675	16.2235
94	0.0997008	71.1848	7.23828	0.0802611	48.161	7.23615	1.63684	1.63262	99.7008	15.589
95	0.106917	71.1841	8.87705	0.0886589	49.0514	8.8745	1.75661	1.75207	106.917	14.9525

	Average Mass Flow Rate; Part Turbo-Comp	Average Efficiency; Part Turbo-Comp	Average Power; Part Turbo-Comp	Average Mass Flow Rate; Part Turbo-Turbine	Average Efficiency; Part Turbo-Turbine	Average Power; Part Turbo-Turbine	Average Pressure (Outlet); Part SR-DK1	Average Pressure (Inlet); Part SR-DK2	Average Mass Flow Rate; Part Throttle-01	Orifice Diameter (End of Cycle); Part Turbo-WG-01
Index	kg/s	%	kW	kg/s	%	kW	bar	bar	No Unit	mm
96	0.0197859	40.2	0.279982	0.0211859	49.019	0.279719	1.04148	0.345932	19.7859	7.97885E-07
97	0.0250615	46.4326	0.550199	0.0268245	51.4603	0.550713	1.09491	0.420051	25.0615	7.97885E-07
98	0.0303548	52.8717	0.931593	0.0324855	52.9044	0.93243	1.17007	0.495317	30.3548	7.97885E-07
99	0.0356301	59.1393	1.3935	0.0381312	52.7242	1.39479	1.26096	0.569897	35.6302	0.1
100	0.0408866	61.3405	1.88759	0.0432049	52.6108	1.88603	1.33159	0.642927	40.8866	3
101	0.046142	63.0591	2.23267	0.0464637	52.4727	2.23445	1.36005	0.714063	46.142	6.69
102	0.0513737	64.9662	2.39036	0.0479547	52.0647	2.39119	1.35174	0.783143	51.3737	10.18
103	0.0566537	66.3911	2.52047	0.049205	51.5914	2.52027	1.33697	0.852267	56.6537	12.69
104	0.0618701	67.4062	2.73732	0.0511369	51.2345	2.73689	1.33621	0.921504	61.8701	14.1834
105	0.0669305	68.2203	2.90824	0.0528831	50.9247	2.9075	1.32834	0.988387	66.9305	15.4001
106	0.0724146	69.1273	3.41953	0.0571756	51.155	3.42688	1.367	1.06277	72.4146	15.5261
107	0.0780634	69.6192	3.53855	0.0583753	50.603	3.53541	1.3439	1.13434	78.0634	16.8204
108	0.0842058	70.4527	4.2992	0.0640608	50.8811	4.29804	1.40324	1.21776	84.2058	16.5745
109	0.0904077	70.1525	4.43189	0.0653752	50.3791	4.42986	1.37031	1.29268	90.4077	17.6806
110	0.0975916	70.7777	5.59482	0.0729452	50.8955	5.59303	1.45661	1.39123	97.5916	17.1419
111	0.105363	70.6313	6.53215	0.0786002	51.0379	6.52996	1.49632	1.49106	105.363	17.2832
112	0.113342	71.2549	8.17559	0.0873663	52.0037	8.17321	1.61057	1.6049	113.342	16.713
113	0.120553	71.3189	9.80616	0.0956478	52.8087	9.80359	1.71402	1.70799	120.553	16.1649
114	0.0229086	44.0397	0.436827	0.0245589	50.7978	0.437236	1.07233	0.36658	22.9086	7.97885E-07
115	0.0289404	51.2607	0.826922	0.0309953	52.8845	0.826915	1.14886	0.444139	28.9404	0.000000798
116	0.0351308	58.6229	1.35249	0.0375997	53.5388	1.35322	1.25213	0.523123	35.1308	0.2
117	0.0412999	61.4027	1.9408	0.0437699	53.8019	1.94102	1.33771	0.600731	41.2999	2.59916
118	0.047219	63.4463	2.2929	0.0471075	53.9217	2.29264	1.36218	0.672004	47.219	7.2
119	0.0530169	65.2185	2.58645	0.0497763	53.9439	2.58674	1.37251	0.740413	53.0169	9.99
120	0.0588579	66.5986	2.9346	0.0527539	53.9648	2.93467	1.38814	0.809448	58.8579	11.75
121	0.0646979	67.7653	3.23816	0.0553353	53.9509	3.23757	1.39317	0.878129	64.6979	13.3
122	0.0704818	68.8724	3.50275	0.0576858	53.9137	3.50197	1.39171	0.946001	70.4818	14.6
123	0.0763513	69.7985	3.80781	0.0604104	53.8738	3.80726	1.39378	1.01494	76.3513	15.5334
124	0.0822786	70.1492	3.86411	0.0614721	53.6485	3.86487	1.35788	1.08043	82.2786	16.8801
125	0.0887569	70.6541	4.62065	0.0670153	53.7967	4.62011	1.40799	1.15843	88.7568	16.7771
126	0.0953723	69.762	4.66018	0.067906	53.4836	4.65883	1.35661	1.22726	95.3724	18.0133
127	0.102834	70.2909	5.75029	0.0750212	53.7533	5.74894	1.4262	1.3196	102.834	17.6606
128	0.110985	68.4372	6.3341	0.078986	53.6401	6.33249	1.40831	1.40142	110.985	18.2198
129	0.120448	69.645	8.20476	0.0889449	54.5648	8.20306	1.52784	1.52092	120.448	17.6386
130	0.130798	69.9501	10.4954	0.0999942	55.3674	10.4932	1.65728	1.64978	130.798	17.0636
131	0.0260572	48.0522	0.643255	0.027982	51.8212	0.643354	1.11557	0.381994	26.0572	0.1
132	0.0327744	56.0317	1.1652	0.0351347	53.3132	1.165	1.21832	0.460937	32.7744	0.180046
133	0.03957	61.1007	1.75269	0.0415219	53.7343	1.75215	1.31428	0.539578	39.57	3.78005
134	0.0463777	63.1577	2.23958	0.0461719	54.1319	2.23895	1.35964	0.61646	46.3777	7.3103
135	0.0530804	65.0975	2.71621	0.0504095	54.2908	2.71606	1.39635	0.691724	53.0804	9.55
136	0.0593615	66.9043	2.68428	0.0505545	54.127	2.68383	1.34498	0.755178	59.3614	13.3256
137	0.0660188	68.0522	3.24007	0.0552555	54.3286	3.24808	1.38541	0.828815	66.0188	13.9367
138	0.0723539	68.8486	3.08331	0.0547573	53.9565	3.08574	1.31774	0.891376	72.3539	16.4443
139	0.0791182	69.8133	3.67618	0.0596216	54.135	3.67767	1.35574	0.966537	79.1182	16.65
140	0.08578	70.1218	3.96377	0.0622588	54.0269	3.96601	1.3464	1.03659	85.78	17.5
141	0.0925643	69.4696	4.26277	0.0649196	53.918	4.25855	1.3304	1.10467	92.5643	18.2328
142	0.099767	67.8495	4.54469	0.067501	53.7622	4.54367	1.3027	1.16788	99.767	18.9499
143	0.108182	67.7068	5.54459	0.0743418	53.905	5.54426	1.34609	1.25657	108.182	18.7966
144	0.116783	67.4979	6.64912	0.0813787	54.1438	6.64881	1.38848	1.34594	116.783	18.6497
145	0.125783	67.5009	8.08148	0.089561	54.8087	8.08059	1.45001	1.44214	125.783	18.3651
146	0.13638	68.0407	10.4928	0.101552	55.7539	10.4918	1.57935	1.57086	136.38	17.6494
147	0.149119	67.8636	13.7853	0.115917	56.6538	13.7835	1.73652	1.72728	149.119	16.9041
148	0.0307622	50.8496	0.754961	0.0297864	51.9861	0.754576	1.12103	0.397506	30.7622	8.5
149	0.0379425	58.3436	1.22907	0.0360141	53.448	1.22987	1.20137	0.471971	37.9426	9.36403
150	0.0452129	63.7703	1.65807	0.0407695	53.9244	1.65864	1.25811	0.545482	45.213	11.3113
151	0.0527376	65.6841	2.24371	0.0464683	54.3428	2.24269	1.31714	0.622122	52.7376	12.2
152	0.0601453	67.0766	2.70365	0.0506676	54.5045	2.69931	1.34274	0.695434	60.1453	13.6633
153	0.0673585	68.3399	3.07461	0.0540848	54.567	3.07002	1.35085	0.766882	67.3585	15.0362
154	0.0748	69.5574	3.74186	0.0593963	54.7743	3.72941	1.39691	0.842787	74.8001	15.4486
155	0.0825414	70.3276	4.48792	0.0651576	55.0331	4.49788	1.44076	0.920588	82.5413	15.708
156	0.0896352	70.1589	4.24176	0.0644316	54.5286	4.24259	1.35308	0.982915	89.6353	17.7532
157	0.0969113	69.2287	4.57356	0.0673354	54.4483	4.57239	1.334	1.05182	96.9113	18.4627
158	0.104379	67.2389	4.95096	0.0705185	54.3622	4.94951	1.30975	1.12213	104.38	19.0337
159	0.11229	65.1474	5.47606	0.0746865	54.314	5.47428	1.29336	1.19793	112.29	19.3796
160	0.120872	64.5591	6.50662	0.0815668	54.5765	6.50505	1.32179	1.28418	120.872	19.2281
161	0.130682	65.1969	8.17335	0.0910635	55.3533	8.17222	1.39575	1.38637	130.682	18.7873
162	0.141315	65.8892	10.5938	0.103539	56.2859	10.5925	1.51496	1.50526	141.314	18.008
163	0.151445	66.2651	13.2755	0.116318	57.1356	13.2736	1.64298	1.63256	151.445	17.1988
164	0.0357472	59.601	1.48578	0.0384882	53.3891	1.4872	1.28263	0.423574	35.7471	0.016216
165	0.0435368	61.9747	2.14966	0.045147	54.3659	2.14698	1.36179	0.499932	43.5371	5.08675
166	0.0513427	64.669	2.57583	0.049047	54.8573	2.56938	1.38328	0.571304	51.3431	9.40594
167	0.0593058	66.7455	2.89561	0.0520372	55.0482	2.88842	1.37841	0.641412	59.306	12.5169
168	0.0673516	68.3405	3.16324	0.0546935	55.085	3.1569	1.36289	0.7115	67.3514	14.7905
169	0.0753858	69.3561	3.42391	0.0573396	55.0423	3.41912	1.34479	0.781409	75.3858	16.4266
170	0.0834536	69.7525	3.69857	0.0601032	54.972	3.69469	1.32573	0.852122	83.4537	17.6425
171	0.0916276	68.8844	4.0256	0.0632174	54.943	4.02162	1.30438	0.924434	91.6275	18.5345
172	0.100529	70.2326	5.38999	0.0725173	55.5454	5.38871	1.40373	1.012	100.529	17.8481
173	0.108759	67.377	5.52672	0.0744695	55.3175	5.52529	1.33632	1.08358	108.759	18.8715
174	0.11704	63.9867	5.85324	0.077436	55.1681	5.85192	1.28603	1.15734	117.04	19.522
175	0.125931	61.793	6.64242	0.0828892	55.2855	6.64167	1.27586	1.24132	125.931	19.6835
176	0.136035	62.8573	8.44895	0.0932522	56.144	8.44772	1.35388	1.34432	136.035	19.1156
177	0.147064	63.8052	11.0299	0.106684	56.9822	11.0285	1.47274	1.46236	147.064	18.2456

Appendix C: Volkswagen SuperTurbo Modeling Data

	Engine Speed (cycle average); Part R4	Brake Torque; Part R4	Brake Power (kW); Part R4	BMEP - Brake Mean Effective Pressure; Part R4	Angle at End of Injection; Part in-1	Angle at Start of Injection; Part in-1	Valve-Open Timing Angle; Part IntakeValve1	Fuel Flow; Part R4	BSFC - Brake Specific Fuel Consumption; Part R4	Combustion Start; Part Cyl1	Average Inlet Temperature; Part Turbo-Comp
Index	RPM	N-m	kW	bar	deg	deg	nk Angle (4-str	kg/hr	g/kW-h	deg	K
1	1000	15.788	1.65331	0.999841	470.839	409.687	361.2	1.01074	611.343	-20.0087	295.453
2	1000	31.5792	3.30697	1.99989	464.339	403.249	365.63	1.37695	416.38	-19.8457	295.563
3	1000	47.3715	4.96073	3	463.387	402.377	368.927	1.73166	349.073	-18.8728	295.649
4	1000	63.1594	6.61404	3.99983	464.553	403.438	369.677	2.07574	313.839	-17.0804	295.718
5	1000	78.9543	8.26807	5.00011	468.376	407.291	369.465	2.42354	293.12	-15.2464	295.777
6	1000	94.7445	9.92162	6.0001	472.005	410.929	369.85	2.77874	280.069	-13.5444	295.829
7	1000	110.534	11.5751	7.00002	472.038	410.951	368.96	3.14964	272.105	-11.1889	295.876
8	1000	126.321	13.2283	7.99982	473.656	412.55	369.693	3.55536	268.769	-7.94047	295.92
9	1000	142.116	14.8823	9.00007	476.01	414.998	368.698	4.00209	268.916	-4.76196	295.953
10	1000	157.894	16.5346	9.99931	481.909	420.772	366.6	4.47787	270.818	-2.47488	295.829
11	1000	173.703	18.1902	11.0005	492.112	431.021	362.054	4.958	272.564	-0.911162	295.87
12	1500	15.7893	2.48017	0.999921	463.989	402.848	360.577	1.62244	654.164	-23.003	295.32
13	1500	31.5838	4.96117	2.00018	462.106	401.086	375.973	2.16314	436.015	-21.9791	295.374
14	1500	47.3701	7.44088	2.99991	463.168	401.937	388.583	2.66843	358.618	-21.9133	295.412
15	1500	63.1599	9.92114	3.99987	463.228	402.003	394.969	3.15853	318.363	-21.3006	295.441
16	1500	78.9531	12.4019	5.00004	463.242	401.998	395.284	3.63266	292.911	-19.8665	295.462
17	1500	94.7407	14.8818	5.99985	464.326	403.112	395.834	4.09985	275.493	-18.2339	295.478
18	1500	110.533	17.3624	6.99995	462.322	401.077	391.344	4.56722	263.052	-16.5707	295.488
19	1500	126.315	19.8416	7.99945	460.048	398.963	386.595	5.03124	253.57	-14.4812	295.493
20	1500	142.114	22.3232	8.99996	464.737	403.678	375.384	5.51221	246.927	-12.0063	295.496
21	1500	157.904	24.8035	9.99992	471.324	410.073	371.32	6.03391	243.269	-9.57078	295.492
22	1500	173.686	27.2826	10.9994	475.082	413.855	369.234	6.55941	240.425	-7.02616	295.424
23	1500	189.477	29.763	11.9994	476.001	414.972	366.238	7.16197	240.634	-4.05381	295.404
24	1500	205.28	32.2454	13.0002	475.534	414.388	364.758	7.80637	242.093	-1.09494	295.384
25	1500	221.055	34.7233	13.9993	474.066	412.987	366.546	8.4855	244.375	1.29686	295.353
26	2000	15.795	3.3081	1.00029	474.446	401.147	393.78	2.13256	644.647	-16.0573	294.478
27	2000	31.5758	6.61323	1.99967	473.896	400.841	396.008	2.81831	426.163	-28.6367	294.388
28	2000	47.3812	9.9235	3.00061	474.198	401.188	398.285	3.48129	350.813	-28.2418	294.314
29	2000	63.158	13.2278	3.99974	474.112	400.863	399.071	4.11431	311.036	-25.5407	294.184
30	2000	78.9504	16.5353	4.99987	474.441	401.139	397.768	4.76073	287.912	-24.1432	294.195
31	2000	94.7496	19.8443	6.00042	475.074	401.822	398.223	5.41157	272.701	-22.7955	294.097
32	2000	110.531	23.1496	6.99987	477.137	404.032	397.013	6.06116	261.825	-21.4149	294.049
33	2000	126.314	26.4551	7.99936	481.695	408.641	394.713	6.71536	253.84	-19.9652	294.037
34	2000	142.13	29.7676	9.00096	484.748	411.61	391.024	7.39674	248.483	-17.9681	293.967
35	2000	157.897	33.07	9.99952	485.904	412.59	383.664	8.15816	246.694	-15.0333	293.882
36	2000	173.705	36.3806	11.0006	484.883	411.533	378.934	9.0338	248.313	-11.7716	293.731
37	2000	189.479	39.6843	11.9995	481.566	408.328	373.71	9.87506	248.84	-9.61673	293.634
38	2000	205.284	42.9947	13.0005	477.292	404.117	370.139	10.6542	247.803	-8.59647	293.548
39	2000	221.061	46.299	13.9996	473.717	400.462	369.556	11.5054	248.501	-7.27913	293.467
40	2000	236.852	49.6061	14.9996	471.506	398.466	369.622	12.6075	254.153	-4.97951	293.339
41	2000	252.654	52.9157	16.0004	477.889	404.877	366.144	14.0704	265.901	-2.00817	293.166
42	2000	268.447	56.2233	17.0005	487.307	414.1	363.262	15.8339	281.625	1.1599	292.933
43	2000	284.235	59.5299	18.0004	484.659	411.351	363.149	17.7529	298.218	4.22116	292.709
44	2500	15.7893	4.13362	0.999922	475.212	397.073	395.136	2.82767	684.067	-30.837	294.595
45	2500	31.5811	8.2679	2	474.844	396.742	396.015	3.67532	444.529	-30.1814	294.529
46	2500	47.3664	12.4005	2.99968	474.838	396.501	397.642	4.48218	361.452	-29.0529	294.473
47	2500	63.1485	16.5322	3.99914	475.87	397.475	399.253	5.25412	317.811	-27.0631	294.424
48	2500	78.9601	20.6717	5.00048	478.085	400.078	399.101	6.02078	291.257	-25.0294	294.374
49	2500	94.7426	24.8036	5.99998	480.221	401.817	398.089	6.79374	273.902	-23.4307	294.324
50	2500	110.526	28.9356	6.99951	482.299	403.971	396.984	7.56603	261.478	-21.8193	294.267
51	2500	126.315	33.0692	7.99944	485.191	406.916	394.493	8.34539	252.361	-19.3517	294.203
52	2500	142.134	37.2106	9.00125	486.21	407.776	390.945	9.17032	246.444	-15.9149	294.155
53	2500	157.933	41.3467	10.0018	485.496	407.263	383.622	10.0333	242.661	-13.289	294.084
54	2500	173.704	45.4757	11.0006	484.11	406.076	376.765	10.888	239.424	-12.9806	294.009
55	2500	189.478	49.6052	11.9995	482.747	404.679	374.71	11.7366	236.6	-12.6736	293.933
56	2500	205.286	53.7439	13.0006	481.269	403.115	369.993	12.7342	236.943	-10.5353	293.846
57	2500	221.058	57.873	13.9995	478.524	400.367	368.844	13.9713	241.414	-7.72934	293.746
58	2500	236.851	62.0074	14.9996	476.27	398.014	369.161	15.4536	249.221	-5.38869	293.63
59	2500	252.655	66.1448	16.0004	482.109	403.987	364.204	17.0442	257.68	-3.58982	293.505
60	2500	268.444	70.2784	17.0003	486.227	407.928	361.057	18.6704	265.664	-2.04677	293.366
61	2500	284.226	74.4101	17.9998	485.647	407.439	362.414	20.3149	273.013	-0.554534	293.212
62	3000	15.7884	4.96008	0.999868	487.082	392.902	394.855	3.47253	700.097	-32.2332	294.543
63	3000	31.5803	9.92125	1.99996	486.7	392.444	396.013	4.45909	449.448	-30.9697	294.474
64	3000	47.3726	14.8825	3.00007	485.99	391.831	397.871	5.41865	364.095	-29.5789	294.413
65	3000	63.1624	19.8431	4.00003	489.3	395.229	398.919	6.3512	320.072	-27.5665	294.353
66	3000	78.9549	24.8044	5.00015	493.58	399.513	398.636	7.2683	293.025	-25.1988	294.292
67	3000	94.756	29.7685	6.00083	495.055	400.882	397.93	8.1934	275.237	-23.2709	294.227
68	3000	110.549	34.7299	7.00097	496.992	402.973	396.892	9.12608	262.773	-21.7012	294.158
69	3000	126.307	39.6806	7.99894	495.279	400.982	394.204	10.059	253.499	-20.3854	294.068
70	3000	142.118	44.6476	9.0002	495.152	401.084	389.518	10.987	246.082	-19.556	293.996
71	3000	157.896	49.6045	9.99942	497.141	402.73	384.283	11.9455	240.816	-19.2037	293.923
72	3000	173.687	54.5655	10.9995	497.462	403.348	374.896	12.9938	238.131	-17.7841	293.827
73	3000	189.497	59.5323	12.0007	497.169	403.084	365.626	14.2006	238.537	-15.1465	293.719
74	3000	205.284	64.4919	13.0005	496.951	402.468	364.05	15.6201	242.203	-12.6938	293.596
75	3000	221.06	69.4481	13.9996	496.266	401.915	364.132	17.229	248.084	-10.8103	293.461
76	3000	236.85	74.4086	14.9995	496.064	401.767	364.009	18.9558	254.752	-9.04531	293.308
77	3000	252.653	79.3734	16.0003	496.281	402.1	363.038	20.7965	262.008	-6.93526	293.125
78	3000	268.446	84.3348	17.0005	496.442	402.328	364.574	22.8161	270.542	-4.40047	292.905
79	3000	284.237	89.2958	18.0005	494.934	400.633	367.819	25.0061	280.037	-1.80091	292.639
80	3500	15.7898	5.78725	0.999953	494.414	383.199	365.981	4.10572	709.443	-29.7883	294.497
81	3500	31.5799	11.5747	1.99993	495.563	384.064	365.876	5.23481	452.265	-28.2944	294.424
82	3500	47.3698	17.362	2.99989	494.276	382.962	366.345	6.35856	366.235	-27.4246	294.352
83	3500	63.1681	23.1523	4.00038	498.165	386.999	365.796	7.46569	322.46	-26.3348	294.279
84	3500	78.9474	28.9357	4.99968	508.487	397.384	365.128	8.56197	295.896	-24.8466	294.2
85	3500	94.741	34.7244	5.99987	505.991	394.714	364.968	9.65864	278.152	-23.3221	294.112
86	3500	110.53	40.5112	6.99975	508.783	397.722	365.128	10.7543	265.465	-21.9596	294.023
87	3500	126.327	46.3014	8.00022	514.528	403.498	365.131	11.8562	256.065	-20.9009	293.925
88	3500	142.11	52.0862	8.99974	513.159	402.057	365.044	12.961	248.837	-20.2673	293.829
89	3500	157.923	57.8818	10.0011	512.323	401.071	364.94	14.1398	244.288	-19.0549	293.713
90	3500	173.686	63.6592	10.9994	512.085	401.04	364.238	15.5834	244.794	-17.091	293.563
91	3500	189.496	69.4537	12.0006	512.474	401.372	363.844	17.2384	248.199	-15.2972	293.412
92	3500	205.284	75.2406	13.0005	512.912	401.668	364.09	19.0132	252.699	-14.0542	293.249
93	3500	221.059	81.0225	13.9995	513.331	401.823	363.895	20.8512	257.351	-12.985	293.065
94	3500	236.85	86.8101	14.9995	513.04	401.858	362.27	22.7943	262.576	-11.4257	292.853
95	3500	252.64	92.5976	15.9995	513.148	401.835	361.087	24.9647	269.605	-9.13727	292.597
96	3500	268.43	98.3847	16.9995	513.305	401.932	360.999	27.3352	277.84	-6.77114	292.291
97	3500	284.233	104.177	18.0003	514.012	402.514	360.497	29.6749	284.851	-5.22553	291.967

Index	Engine Speed (cycle average); Part R4	Brake Torque; Part R4	Brake Power (kW); Part R4	BMEP - Brake Mean Effective Pressure; Part R4	Angle at End of Injection; Part in-1	Angle at Start of Injection; Part in-1	Valve-Open Timing Angle; Part IntakeValve1	Fuel Flow; Part R4	BSFC - Brake Specific Fuel Consumption; Part R4	Combustion Start; Part Cyl1	Average Inlet Temperature; Part Turbo-Comp
	RPM	N-m	kW	bar	deg	deg	nk Angle (4-str	kg/hr	g/kW-h	deg	K
98	4000	15.7753	6.60794	0.999036	508.536	381.237	363.359	4.93927	747.476	-31.066	294.445
99	4000	31.5834	13.2296	2.00015	509.123	382.086	365.064	6.19202	468.042	-29.2112	294.363
100	4000	47.3829	19.8477	3.00072	508.997	381.918	364.735	7.44208	374.959	-27.7746	294.279
101	4000	63.1723	26.4615	4.00065	509.297	382.054	364.48	8.68777	328.317	-26.2761	294.191
102	4000	78.9256	33.0603	4.99829	507.979	380.956	364.823	9.93032	300.37	-24.768	294.097
103	4000	94.7563	39.6914	6.00084	511.295	384.231	365.122	11.1736	281.511	-23.4163	293.995
104	4000	110.519	46.2939	6.99906	509.064	381.953	364.799	12.4033	267.925	-22.0759	293.883
105	4000	126.354	52.9269	8.00187	508.819	381.172	364.223	13.654	257.979	-20.5326	293.76
106	4000	142.084	59.5161	8.99808	513.279	386.079	363.933	14.9414	251.048	-19.5339	293.63
107	4000	157.88	66.1325	9.9984	517.871	390.807	363.898	16.3752	247.611	-19.2781	293.485
108	4000	173.706	72.7616	11.0006	522.56	395.263	363.91	18.126	249.115	-18.1028	293.302
109	4000	189.496	79.3759	12.0006	526.836	399.446	364.079	20.0687	252.832	-16.3707	293.111
110	4000	205.283	85.9889	13.0004	528.872	401.28	364.226	22.0856	256.842	-14.8522	292.903
111	4000	221.072	92.6023	14.0003	529.208	401.661	363.867	24.2166	261.512	-13.2055	292.662
112	4000	236.87	99.2201	15.0008	529.567	402.001	364.107	26.5562	267.65	-11.0126	292.375
113	4000	252.634	105.823	15.9991	530.069	403.025	362.916	29.1658	275.609	-8.58235	292.038
114	4000	268.432	112.44	16.9996	530.562	403.249	361.125	31.888	283.599	-6.73941	291.664
115	4000	284.231	119.058	18.0001	522.628	395.456	359.819	34.4709	289.53	-6.03479	291.289
116	4500	15.7894	7.44057	0.99993	537.333	381.951	365.088	5.79585	778.951	-27.9447	294.398
117	4500	31.593	14.8879	2.00076	537.168	382.009	365.008	7.16744	481.429	-26.0387	294.303
118	4500	47.3814	22.3279	3.00063	538.04	382.969	364.992	8.56401	383.556	-25.2181	294.201
119	4500	63.1865	29.776	4.00155	537.097	382.081	364.998	9.98114	335.208	-24.7181	294.087
120	4500	78.9606	37.2093	5.00052	537.185	381.926	364.747	11.3903	306.114	-23.8616	293.942
121	4500	94.7464	44.6482	6.00021	536.994	381.27	364.574	12.7855	286.361	-22.4486	293.847
122	4500	110.555	52.0977	7.00134	536.736	381.724	364.736	14.1927	272.426	-21.0061	293.709
123	4500	126.353	59.5422	8.00181	539.331	384.001	365.002	15.628	262.469	-20.2683	293.559
124	4500	142.134	66.9792	9.00126	543.71	388.137	365.088	17.1544	256.115	-19.7685	293.394
125	4500	157.918	74.4172	10.0008	547.443	392.019	364.948	18.8772	253.667	-19.1821	293.199
126	4500	173.708	81.8578	11.0008	549.316	393.667	364.704	20.8809	255.088	-18.4035	292.966
127	4500	189.495	89.2972	12.0005	547.996	392.763	364.468	23.0274	257.873	-16.6162	292.722
128	4500	205.291	96.741	13.0009	548.338	393.227	364.148	25.3762	262.31	-14.5445	292.453
129	4500	221.079	104.181	14.0008	554.258	398.958	363.161	27.9796	268.567	-12.3164	292.134
130	4500	236.845	111.61	14.9992	547.863	392.642	361.696	30.9453	277.262	-9.73043	291.751
131	4500	252.636	119.052	15.9993	542.115	386.525	361.114	34.3436	288.475	-6.81164	291.279
132	4500	268.429	126.494	16.9994	524.717	369.012	360.004	38.0677	300.945	-4.03664	290.718
133	4500	284.219	133.935	17.9994	515.531	360	362.206	41.766	311.838	-2.13457	290.094
134	5000	15.7933	8.26935	1.00018	565.318	382.012	364.903	6.72476	813.214	-27.0838	294.35
135	5000	31.5846	16.5377	2.00023	565.042	381.75	365.174	8.19033	495.253	-25.6545	294.242
136	5000	47.3797	24.8079	3.00052	562.572	379.284	365.113	9.66265	389.499	-24.5271	294.123
137	5000	63.1405	33.0603	3.99864	564.318	381.036	364.96	11.1904	338.485	-23.6549	293.991
138	5000	78.9478	41.337	4.9997	568.879	385.613	364.873	12.7594	308.669	-22.8719	293.85
139	5000	94.7273	49.5991	5.99901	564.82	381.602	364.787	14.3678	289.678	-21.7405	293.697
140	5000	110.561	57.8898	7.00176	563.85	380.683	364.629	16.0572	277.376	-20.5786	293.528
141	5000	126.34	66.1515	8.00101	565.059	381.913	364.408	17.8008	269.091	-20.6092	293.341
142	5000	142.085	74.3954	8.99811	565.01	381.891	364.177	19.6194	263.718	-20.8174	293.129
143	5000	157.908	82.6805	10.0002	568.671	385.544	364.005	21.5812	261.019	-20.058	292.868
144	5000	173.702	90.95	11.0004	561.786	378.743	363.961	23.7767	261.426	-19.0917	292.588
145	5000	189.484	99.2139	11.9999	547.14	363.423	364.064	26.2456	264.535	-17.1842	292.286
146	5000	205.262	107.475	12.9991	548.63	364.937	364.202	29.2326	271.995	-13.9369	291.912
147	5000	221.065	115.75	13.9999	548.308	364.629	364.018	32.5858	281.52	-12.2726	291.49
148	5000	236.859	124.019	15.0001	546.63	362.962	362.613	36.3185	292.846	-10.9519	291.003
149	5000	252.648	132.286	16	546.164	362.514	361.132	40.6377	307.196	-8.54358	290.379
150	5000	268.438	140.554	16.9999	547.472	363.848	360.593	45.5872	324.341	-5.1955	289.539
151	5000	284.229	148.822	18	548.287	364.694	358.535	51.0546	343.058	-1.54792	288.405
152	5500	15.7937	9.09649	1.0002	559.331	373.907	364.167	8.09173	889.544	-27.9659	294.273
153	5500	31.5806	18.1891	1.99997	559.675	374.264	364.427	9.62598	529.217	-25.5778	294.151
154	5500	47.3682	27.2821	2.99979	557.795	372.433	364.473	11.1933	410.28	-23.9241	294.012
155	5500	63.1614	36.3784	3.99996	553.338	368.004	364.273	12.8632	353.595	-22.9849	293.855
156	5500	78.9653	45.4807	5.00081	546.823	361.531	363.935	14.6419	321.936	-22.4108	293.681
157	5500	94.7539	54.5743	6.00069	550.016	364.82	363.587	16.5176	302.662	-21.5992	293.492
158	5500	110.532	63.6617	6.99989	551.044	365.906	363.307	18.5266	291.016	-20.9824	293.281
159	5500	126.298	72.7427	7.99838	547.027	361.936	363.115	20.6474	283.842	-20.9982	293.042
160	5500	142.111	81.8498	8.99975	545.54	360.471	363.001	22.8188	278.789	-20.4747	292.768
161	5500	157.909	90.9493	10.0003	545.039	360	362.955	25.0994	275.971	-19.0128	292.456
162	5500	173.698	100.043	11.0002	545.011	360	362.973	27.5249	275.131	-17.3258	292.114
163	5500	189.477	109.131	11.9994	546.209	360.389	363.036	30.398	278.546	-16.3343	291.727
164	5500	205.268	118.226	12.9995	545.932	360.116	363.056	33.8976	286.719	-14.9729	291.277
165	5500	221.073	127.329	14.0004	545.801	360	362.792	38.197	299.986	-11.9963	290.718
166	5500	236.872	136.429	15.0009	545.798	360	361.761	43.1106	315.994	-10.0992	290.044
167	5500	252.637	145.509	15.9993	546.236	360.423	358.977	48.1171	330.682	-9.85915	289.309
168	5500	268.453	154.618	17.0009	547.153	361.349	357.913	53.3795	345.235	-8.49233	288.396
169	6000	15.7845	9.91769	0.99962	568.896	372.198	361.039	9.37138	944.916	-27.8503	294.094
170	6000	31.5562	19.8274	1.99843	569.511	372.909	360.055	11.0784	558.743	-25.191	294.056
171	6000	47.4014	29.7832	3.00189	562.694	366.183	359.839	12.8631	431.89	-23.4387	293.894
172	6000	63.1759	39.6946	4.00088	556.576	360	360.253	14.7632	371.921	-22.5212	293.707
173	6000	78.9315	49.5941	4.99867	556.662	360.17	360.838	16.8114	338.98	-22.0226	293.495
174	6000	94.7264	59.5184	5.99895	556.24	360	361.324	19.003	319.28	-21.4269	293.26
175	6000	110.525	69.4452	6.99949	556.044	360	361.673	21.3573	307.542	-20.7262	292.998
176	6000	126.349	79.3876	8.0016	557.031	360.161	361.919	23.8881	300.904	-19.9848	292.705
177	6000	142.122	89.2979	9.00048	556.762	360	362.087	26.7651	299.728	-19.3658	292.343
178	6000	157.916	99.2217	10.0007	556.892	360.211	362.185	29.7051	299.381	-18.5413	291.944
179	6000	173.707	109.144	11.0008	556.743	360.125	362.202	32.7425	299.994	-16.8702	291.509
180	6000	189.494	119.063	12.0005	556.573	360	362.102	36.2445	304.415	-14.6371	291.005
181	6000	205.275	128.978	12.9999	556.754	360.183	361.784	40.5868	314.68	-12.9635	290.39
182	6000	221.08	138.909	14.0008	557.544	360.931	361.024	45.831	329.936	-11.935	289.641
183	6000	236.872	148.831	15.0009	558.27	361.616	359.436	51.841	348.32	-10.255	288.711

Index	Average Outlet Temperature; Part Turbo-Comp	Mass Averaged Temperature (Outlet); Part AfterCooler	Mass Averaged Temperature; Part SR-TV-23	Mass Averaged Temperature (Outlet); Part Exh_Manifold-1	Mass Averaged Temperature (Outlet); Part Exh_Manifold-2	Mass Averaged Temperature (Outlet); Part Exh_Manifold-3	Mass Averaged Temperature (Outlet); Part Exh_Manifold-4	Average Inlet Temperature; Part Turb80-1	Average Outlet Temperature; Part Turb80-1	Mass Averaged Temperature; Part Cat-IN	Mass Averaged Temperature; Part Cat-Out
Index	K	K	K	K	K	K	K	K	K	K	K
1	295.576	294.854	298.742	810.372	842.43	831.596	809.454	748.873	630.499	641.993	637.74
2	295.63	294.861	297.82	861.719	889.291	877.791	862.938	804.638	713.675	713.856	709.971
3	295.702	294.873	297.412	905.676	932.088	921.78	905.367	842.68	771.646	766.505	762.62
4	295.766	294.889	297.149	935.626	964.125	954.063	935.531	884.436	814.554	809.234	805.56
5	295.825	294.909	296.941	962.286	991.98	982.886	961.98	923.004	853.809	847.004	843.491
6	295.879	294.932	296.78	986.664	1017.8	1009.18	985.702	953.823	889.262	880.416	876.893
7	295.942	294.96	296.661	1016.71	1046.72	1038.39	1015.39	985.016	925.784	915.029	911.289
8	296.025	294.991	296.54	1053.68	1084.66	1076.52	1051.61	1022	966.853	954.407	950.398
9	300.362	295.247	296.56	1088.1	1120.79	1112.4	1086.32	1057.41	1005.17	991.32	987.337
10	316.509	296.079	296.972	1112.68	1147.23	1139.08	1110.36	1084.09	1033.54	1018.89	1015.38
11	331.762	296.994	297.577	1134.32	1167.86	1159.64	1130.31	1104.32	1054.49	1039.45	1036.74
12	295.402	298.031	299.619	876.419	900.527	893.073	879.181	820.82	737.381	740.088	738.238
13	295.429	298.001	298.974	924.398	948.816	938.914	924.76	870.193	811.239	805.365	803.054
14	295.458	297.961	298.775	943.058	967.174	958.306	942.248	892.155	844.743	836.771	834.531
15	295.484	297.914	298.664	954.881	979.39	970.852	954.259	914.617	867.705	859.437	857.157
16	295.51	297.869	298.568	968.929	993.18	985.177	967.646	936.265	889.999	881.373	879.009
17	295.565	297.874	298.517	983.109	1007.32	999.846	982.936	955.027	911.408	902.201	899.758
18	295.629	297.888	298.485	998.171	1022.5	1015.5	997.505	972.762	932.435	922.417	920.028
19	295.721	297.904	298.456	1015.94	1039.95	1033.27	1015.17	991.946	952.161	941.836	939.469
20	295.933	297.929	298.468	1035.74	1059.86	1054.04	1034.81	1013.34	972.923	962.342	960.017
21	305.192	298.525	298.91	1054.57	1080.7	1074.7	1053.35	1034.69	993.443	982.541	980.332
22	312.312	298.902	299.211	1074.89	1101.78	1096.63	1073.53	1056.11	1013.06	1002.06	999.974
23	324.248	299.621	299.768	1099.14	1129.15	1124.25	1097.86	1081.82	1036	1024.96	1023.05
24	334.339	300.283	300.288	1126.28	1157.59	1152.57	1125.06	1108.35	1059.07	1048.07	1046.33
25	346.55	301.116	300.928	1152.35	1183.13	1178.79	1150.51	1132.66	1079.27	1068.5	1066.93
26	294.557	299.935	300.183	1035.96	1054.64	1047.53	1039.43	965.861	902.308	891.639	889.484
27	294.454	299.799	300.052	1000.95	1021.52	1013.04	1001.63	944.777	903.892	890.202	888.106
28	294.36	299.632	299.926	1016.84	1039.85	1030.72	1016.14	966.047	935.039	920.489	918.305
29	294.257	299.59	299.881	1035.92	1060.52	1052.05	1034.83	995.844	965.924	951.356	948.983
30	294.239	299.626	299.893	1049.48	1075.4	1067.46	1048.68	1016.84	988.403	973.856	971.44
31	294.212	299.656	299.904	1063.18	1088.63	1081.69	1062.88	1033.81	1007.79	993.138	990.781
32	294.323	299.696	299.924	1077.04	1102.66	1096.57	1076.87	1050.25	1024.79	1010.14	1007.9
33	294.519	299.737	299.942	1091.7	1117.42	1112.06	1090.99	1066.96	1040.51	1025.97	1023.87
34	295.124	299.768	299.944	1109.97	1137.28	1132.36	1107.59	1086.77	1058.78	1044.25	1042.27
35	297.648	299.849	299.762	1133.34	1163.4	1159.36	1130.06	1111.56	1081.05	1066.54	1064.67
36	309.484	300.599	300.303	1162.73	1192.78	1189.49	1158.88	1139.56	1105.43	1091.09	1089.3
37	318.907	301.268	300.922	1186.36	1214.17	1211.72	1182.52	1161.18	1122.34	1108.62	1106.96
38	326.624	301.876	301.499	1200.94	1227.64	1225.73	1197.64	1174.4	1131.39	1118.44	1116.88
39	335.529	302.602	302.132	1217	1246.56	1245.32	1212.78	1190.31	1142.53	1130.33	1128.84
40	346.605	303.574	302.944	1234.21	1270.02	1270.65	1229.33	1208.83	1155.07	1143.8	1142.35
41	358.313	304.658	303.96	1250.52	1284.73	1286.85	1245.47	1222.11	1161.42	1151.47	1150.08
42	371.72	305.988	305.187	1266.53	1298.64	1302.21	1261.41	1234.4	1165.71	1157.28	1155.93
43	386.235	307.521	306.561	1285.22	1315.53	1320.6	1280.34	1249.13	1171.5	1164.66	1163.3
44	294.657	299.996	300.214	1010.25	1034.19	1024.94	1014.26	958.663	915.003	901.017	898.857
45	294.57	299.791	300.024	1031.59	1055.77	1047.41	1031.16	981.697	952.824	936.318	934.038
46	294.509	299.814	300.012	1044.78	1068.6	1060.3	1043.88	1001.21	976.83	960.964	958.61
47	294.455	299.851	300.056	1056.81	1078.8	1070.75	1055.83	1019.6	996.282	980.842	978.467
48	294.509	299.893	300.091	1069.16	1090.71	1083.57	1067.65	1036.6	1013.02	997.944	995.639
49	294.6	299.931	300.115	1080.72	1102.09	1095.48	1079.51	1050.98	1027.59	1012.73	1010.56
50	294.77	299.939	300.113	1092.37	1114.66	1108.83	1090.82	1065.34	1040.09	1025.72	1023.67
51	295.215	299.954	300.11	1107.75	1131.84	1126.66	1106.07	1083.5	1055.12	1041.26	1039.29
52	295.445	299.95	300.094	1130.98	1156.98	1152.72	1128.76	1108.44	1076.12	1062.64	1060.72
53	296.146	299.976	300.135	1154.44	1180.46	1177.17	1151.96	1132.12	1095.46	1082.49	1080.6
54	305.817	300.665	300.707	1161.26	1188.58	1185.94	1160.53	1140.79	1100.38	1088.34	1086.48
55	314.556	301.34	301.276	1167.94	1195.93	1194.28	1167.2	1148.32	1104.09	1092.99	1091.14
56	322.174	301.977	301.832	1186.84	1213.96	1213.12	1183.14	1165.33	1116.12	1105.83	1103.96
57	329.752	302.655	302.426	1200.59	1228.82	1229.12	1196.64	1178.9	1124.18	1114.92	1113.04
58	339.715	303.573	303.231	1207.82	1235.69	1237.13	1203.93	1185.51	1125.15	1117.16	1115.27
59	349.314	304.493	304.052	1210.68	1239.1	1241.72	1206.86	1188.12	1122.23	1115.55	1113.67
60	359.405	305.502	304.963	1214.9	1243.68	1247.38	1211.18	1191.75	1120.11	1114.7	1112.81
61	369.07	306.528	305.887	1222.68	1250.55	1255.16	1218.87	1197.96	1120.21	1116.02	1114.11
62	294.612	299.469	299.991	1076.86	1091.09	1083.59	1077.89	1028.97	994.715	980.366	977.85
63	294.511	299.447	299.871	1087.13	1103.52	1096.37	1086.66	1043.24	1019.78	1004.63	1002.18
64	294.445	299.488	299.843	1095.05	1110.69	1103.56	1094.75	1057.25	1035.89	1021.28	1018.84
65	294.376	299.525	299.825	1103.54	1119.27	1113.06	1102.67	1071.96	1050.86	1036.57	1034.16
66	294.335	299.554	299.823	1114.05	1132.02	1126.09	1114.16	1087.23	1065.24	1051.45	1049.12
67	294.329	299.543	299.804	1124.88	1144.21	1139.07	1124.98	1101.92	1076.5	1063.66	1061.41
68	294.402	299.528	299.789	1135.5	1155.96	1151.53	1135.63	1115.31	1086.23	1074.29	1072.11
69	294.687	299.527	299.791	1145.99	1167.44	1163.91	1146.36	1127.92	1094.98	1083.89	1081.77
70	295.106	299.533	299.809	1155.15	1177.37	1174.69	1155.56	1138.62	1101.75	1091.51	1089.43
71	300.917	299.955	300.168	1162.25	1184.39	1182.48	1162.35	1146.45	1105.55	1096.23	1094.2
72	309.44	300.639	300.745	1172.44	1197.34	1196.11	1170.9	1157.84	1112.28	1103.82	1101.83
73	316.781	301.28	301.305	1182.87	1213.04	1213.55	1180.82	1170.79	1119.93	1112.38	1110.42
74	323.824	301.941	301.872	1190.56	1220.22	1221.7	1188.16	1178.08	1121.8	1115.33	1113.41
75	331.716	302.711	302.544	1193.2	1222.21	1224.39	1190.6	1180.35	1118.66	1113.38	1111.51
76	340.561	303.605	303.333	1197.06	1225.52	1228.55	1194.31	1183.64	1116.1	1112	1110.19
77	349.947	304.596	304.218	1206.57	1234.73	1238.61	1203.64	1192.02	1117.71	1114.78	1113
78	360.416	305.75	305.261	1220.46	1248.37	1253.18	1217.75	1204.46	1122.33	1120.62	1118.87
79	371.649	307.043	306.443	1236.2	1262.96	1268.08	1232.73	1217.7	1127.17	1126.76	1125.03
80	294.536	298.43	299.853	1120.2	1132.73	1127.35	1122.69	1085.69	1058.57	1046.06	1043.33
81	294.458	298.465	299.465	1128.54	1142.24	1136.46	1129.92	1095.85	1078.2	1064.51	1061.89
82	294.376	298.498	299.255	1134.25	1147.23	1141.15	1135.81	1107.4	1091.86	1078.05	1075.46
83	294.294	298.521	299.15	1141.07	1153.3	1147.66	1142.9	1119.16	1100.21	1087.77	1085.25
84	294.462	298.514	299.064	1150.46	1162.85	1157.95	1152.27	1131.95	1109.23	1097.97	1095.52
85	294.538	298.505	299.003	1160.1	1174.77	1170.8	1161.7	1144.71	1117.89	1107.65	1105.28
86	294.575	298.496	298.955	1169.72	1187.74	1184.53	1171.01	1156.99	1125.81	1116.49	1114.2
87	295.292	298.539	298.962	1178.37	1199.44	1197.2	1179.51	1167.84	1132.11	1123.69	1121.48
88	295.47	298.543	298.952	1186.77	1207.99	1206.81	1187.82	1176.81	1136.51	1128.96	1126.82
89	297.073	298.649	299.025	1202.39	1218.01	1217.9	1201.48	1189.02	1143.66	1136.89	1134.82
90	308.069	299.581	299.818	1208.94	1224.43	1225.14	1207.05	1195.42	1144.56	1138.83	1136.84
91	316.288	300.341	300.467	1209.57	1225.63	1227.17	1207.85	1196.65	1140.25	1135.68	1133.78
92	322.698	300.986	301.025	1206.65	1222.88	1225.16	1205.06	1194.16	1132.37	1128.98	1127.18
93	330.356	301.783	301.727	1205.2	1221.38	1224.39	1203.64	1192.77	1125.29	1123.06	1121.34
94	338.602	302.69	302.537	1209.47	1225.8	1229.55	1207.86	1196.6	1122.54	1121.42	1119.78
95	347.865	303.761	303.5	1220.56	1236.91	1241.43	1218.93	1206.68	1124.63	1124.66	1123.07
96	357.575	304.939	304.571	1233.09	1249.74	1255.01	1231.4	1218.23	1127.49	1128.73	1127.2
97	366.457	306.067	305.604	1239.79	1256.52	1262.24	1238.08	1224.3	1125.82	1128.25	1126.78

Index	Average Outlet Temperature; Part Turbo-Comp	Mass Averaged Temperature (Outlet); Part AfterCooler	Mass Averaged Temperature; Part SR-TV-23	Mass Averaged Temperature (Outlet); Part Exh_Manifold-1	Mass Averaged Temperature (Outlet); Part Exh_Manifold-2	Mass Averaged Temperature (Outlet); Part Exh_Manifold-3	Mass Averaged Temperature (Outlet); Part Exh_Manifold-4	Average Inlet Temperature; Part Turb80-1	Average Outlet Temperature; Part Turb80-1	Mass Averaged Temperature; Part Cat-IN	Mass Averaged Temperature; Part Cat-Out
	K	K	K	K	K	K	K	K	K	K	K
98	294.446	297.808	300.041	1140.12	1159.9	1155.72	1141.31	1116.37	1102.54	1089.29	1086.48
99	294.387	297.84	299.043	1151.35	1165.72	1160.53	1151.06	1127.79	1115.2	1101.95	1099.22
100	294.296	297.862	298.7	1158.35	1170.32	1165.21	1158.14	1139.07	1123.05	1111.15	1108.51
101	294.199	297.841	298.516	1165	1177.09	1172.27	1165.18	1149.72	1129.76	1119.26	1116.68
102	294.327	297.837	298.414	1172.68	1185.68	1181.36	1173.07	1160.26	1136.1	1126.77	1124.27
103	294.318	297.827	298.352	1181.15	1193.59	1190.05	1181.84	1169.98	1141.34	1133.06	1130.65
104	294.517	297.836	298.325	1191.03	1201.59	1198.76	1191.85	1179.65	1146.27	1138.91	1136.61
105	295.021	297.872	298.334	1200.12	1211.36	1209.23	1200.89	1189.44	1150.97	1144.49	1142.29
106	295.699	297.923	298.375	1207.24	1222.75	1221.56	1207.76	1198.81	1155.15	1149.49	1147.4
107	297.227	298.033	298.436	1203.23	1221.24	1222.81	1203.3	1197.18	1148.82	1144.22	1142.24
108	307.487	298.974	299.226	1198.99	1215.85	1217.76	1198.81	1192.86	1139.18	1135.78	1133.92
109	316.121	299.829	299.964	1196.17	1212.94	1215.52	1195.96	1190.33	1130.74	1128.52	1126.77
110	322.499	300.517	300.569	1194.49	1211.32	1214.4	1194.3	1188.81	1123.02	1121.95	1120.29
111	330.502	301.409	301.365	1195.75	1212.74	1216.33	1195.48	1189.99	1117.37	1117.43	1115.85
112	338.731	302.38	302.24	1201.32	1218.79	1222.83	1201	1195.34	1114.85	1116.05	1114.55
113	347.891	303.512	303.269	1209.06	1227.01	1231.53	1208.58	1202.72	1113.46	1115.87	1114.44
114	356.697	304.658	304.321	1213.46	1231.6	1236.58	1212.62	1206.85	1109.16	1112.81	1111.45
115	364.781	305.745	305.324	1210.39	1228.55	1233.72	1209.77	1204.06	1099.52	1104.33	1103.03
116	294.428	298.663	300.102	1146.02	1185.07	1181	1147.58	1132.32	1120.75	1106.78	1103.89
117	294.323	298.705	299.56	1160.26	1185.81	1181.51	1161.82	1144.47	1130.27	1117.4	1114.69
118	294.21	298.686	299.274	1171.79	1185.57	1181.08	1173.34	1154.97	1136.78	1125.51	1122.88
119	294.441	298.681	299.148	1179.9	1188.64	1184.6	1181.81	1164.26	1141.58	1131.83	1129.28
120	294.559	298.676	299.096	1186.86	1195.59	1192.17	1188.61	1173.48	1146.05	1137.53	1135.09
121	294.48	298.661	299.063	1194.23	1205.18	1202.42	1195.52	1183.18	1150.74	1143.23	1140.91
122	295.096	298.704	299.084	1201.82	1215.7	1213.59	1202.88	1192.88	1155.07	1148.49	1146.29
123	295.54	298.739	299.111	1206.74	1225.96	1224.56	1207.34	1200.84	1157.45	1151.8	1149.73
124	296.659	298.829	299.19	1207.4	1227.23	1228.64	1207.4	1202.79	1153.89	1149.3	1147.33
125	299.936	299.09	299.414	1204.73	1221.61	1223.39	1203.68	1199.04	1144.54	1141.14	1139.3
126	311.459	300.22	300.404	1199.17	1214.87	1217.1	1198.15	1193.57	1132.9	1130.78	1129.05
127	318.828	301.019	301.109	1195.77	1211.14	1213.75	1194.86	1190.45	1123.18	1122.29	1120.66
128	326.405	301.885	301.884	1194.06	1209.41	1212.42	1193.19	1188.99	1114.51	1114.85	1113.3
129	334.543	302.862	302.772	1193.74	1208.93	1212.28	1192.77	1188.71	1106.34	1107.95	1106.47
130	343.598	304.002	303.818	1195.55	1211.37	1215.13	1194.59	1190.88	1099.58	1102.53	1101.11
131	353.227	305.28	304.998	1200.25	1216.7	1220.85	1199.25	1195.83	1094.45	1098.84	1097.48
132	363.534	306.709	306.315	1205.95	1223.33	1227.77	1204.75	1201.93	1089.94	1095.83	1094.51
133	373.194	308.103	307.589	1208.38	1223.99	1228.6	1207.79	1203.89	1082.39	1089.72	1088.45
134	294.374	299.527	300.748	1164.47	1175.27	1172.59	1165.76	1138.17	1124.96	1111.76	1108.96
135	294.269	299.544	300.352	1181.54	1193.2	1190.27	1181.95	1159.14	1142.51	1130.22	1127.56
136	294.161	299.508	300.119	1196.64	1209.22	1206.2	1196.7	1178.63	1156.99	1146.08	1143.47
137	294.769	299.527	300.018	1204.9	1218.57	1214.82	1206.28	1190.84	1163.75	1154.3	1151.79
138	294.136	299.464	299.893	1209.48	1223.61	1220.79	1211.29	1198.2	1165.5	1157.39	1155.01
139	294.341	299.468	299.863	1216.06	1230.11	1228.75	1216.52	1206.02	1167.41	1160.47	1158.22
140	294.89	299.508	299.875	1216.94	1231.1	1230.55	1217.03	1208.19	1163.55	1157.86	1155.74
141	295.441	299.554	299.913	1214.34	1228.64	1228.71	1214.29	1206.76	1156	1151.61	1149.61
142	297.478	299.714	300.086	1214	1225.1	1225.52	1212.26	1205.18	1147.97	1144.87	1142.97
143	304.466	300.384	300.672	1214	1223.01	1223.67	1212.02	1204.63	1140.45	1138.64	1136.82
144	315.906	301.598	301.748	1210.18	1219.8	1220.97	1208.62	1201.95	1130.48	1130.01	1128.26
145	323.406	302.465	302.499	1206.58	1216.44	1218.04	1205.37	1199.19	1120.08	1120.95	1119.28
146	331.824	303.49	303.426	1206.7	1216.71	1218.74	1205.53	1199.84	1111.66	1113.96	1112.35
147	340.551	304.603	304.441	1198.55	1208.3	1210.68	1197.39	1192.42	1095.72	1099.54	1098
148	349.663	305.816	305.56	1187.31	1196.42	1199.11	1186.21	1181.88	1076.87	1082.22	1080.76
149	360.349	307.292	306.93	1182.79	1191.7	1194.73	1181.71	1177.99	1063.13	1070.08	1068.67
150	372.949	309.108	308.625	1188.05	1196.84	1200.16	1186.84	1183.5	1056.76	1065.42	1064.06
151	389.291	311.515	310.884	1200.82	1209.58	1213.24	1199.43	1196.36	1056.33	1066.83	1065.49
152	294.371	299.277	300.572	1178.43	1174.62	1172.4	1179.73	1147.36	1131.68	1119.52	1116.88
153	294.14	299.232	299.931	1196.09	1193.36	1190.62	1196.82	1168.63	1148.57	1137.49	1134.93
154	294.043	299.2	299.623	1212.49	1209.77	1206.94	1213.26	1188.19	1162.36	1152.62	1150.13
155	293.929	299.173	299.48	1223.13	1220.98	1219.02	1224.14	1201.9	1169.69	1161.35	1158.96
156	293.951	299.161	299.443	1226.83	1226.18	1224.34	1227.66	1208.29	1169.49	1162.6	1160.32
157	294.063	299.164	299.473	1224.74	1225.46	1223.98	1225.73	1208.65	1163.25	1157.84	1155.71
158	294.712	299.223	299.569	1220.02	1221.7	1220.97	1220.96	1205.93	1153.73	1149.81	1147.77
159	295.634	299.311	299.722	1214.5	1217.39	1217.03	1215.15	1202.14	1142.83	1140.38	1138.45
160	301.102	299.811	300.309	1211.43	1214.48	1214.51	1211.32	1199.85	1133.08	1132.05	1130.18
161	313.637	301.142	301.459	1211.04	1214.6	1214.72	1211.09	1200.32	1125.46	1125.76	1123.99
162	322.004	302.113	302.317	1209.26	1213.03	1213.33	1209.33	1199.25	1116.35	1117.99	1116.28
163	330.08	303.107	303.217	1200.96	1204.71	1205.2	1201.13	1191.89	1101	1104.09	1102.43
164	338.535	304.198	304.216	1187.73	1191.14	1191.9	1187.87	1179.65	1080.68	1085.3	1083.73
165	347.903	305.463	305.386	1175.74	1178.83	1179.77	1175.96	1168.62	1060.53	1066.75	1065.26
166	358.422	306.931	306.762	1159.34	1161.86	1163.03	1159.7	1153.21	1036.35	1044.21	1042.82
167	369.368	308.494	308.251	1137.38	1138.98	1140.24	1137.44	1132.05	1008.1	1017.46	1016.15
168	381.42	310.282	309.938	1125.1	1126.06	1127.49	1125.16	1120.36	988.351	999.156	997.913
169	294.239	299.247	300.706	1186.06	1181.77	1176.89	1185.48	1155.56	1137.32	1126.1	1123.55
170	294.204	299.218	300.115	1200.45	1195.25	1190.4	1199.76	1172.81	1149.44	1139.53	1137.07
171	294.232	299.199	299.767	1213.19	1207.67	1202.7	1212.86	1188.38	1158.53	1150.09	1147.71
172	293.736	299.146	299.569	1221.51	1215.74	1211.08	1221.46	1198.95	1161.94	1155.02	1152.73
173	293.961	299.156	299.535	1223.86	1218.97	1214.91	1224.23	1203.72	1159.16	1153.81	1151.64
174	294.018	299.161	299.545	1221.36	1217.6	1214.25	1222.19	1203.54	1151.27	1147.53	1145.47
175	294.292	299.192	299.634	1215.81	1212.72	1210.04	1216.81	1199.82	1139.74	1137.59	1135.64
176	295.324	299.3	299.856	1208.28	1205.8	1204	1209.4	1193.98	1125.96	1125.39	1123.53
177	309.4	300.8	301.273	1201.74	1199.04	1197.75	1202.68	1188.42	1111.48	1112.54	1110.77
178	319.976	302.019	302.375	1195.7	1192.87	1191.72	1196.62	1183.2	1097.44	1100.03	1098.34
179	328.479	303.074	303.34	1190.13	1187.2	1186.27	1191.32	1178.49	1084.07	1088.08	1086.47
180	337.205	304.214	304.394	1182.93	1179.48	1178.73	1183.93	1171.89	1068.62	1074.09	1072.54
181	346.848	305.528	305.624	1168.78	1164.85	1164.35	1169.72	1158.67	1046.56	1053.61	1052.15
182	357.759	307.066	307.08	1147.75	1143	1142.72	1148.65	1138.64	1018.12	1026.82	1025.45
183	369.86	308.834	308.771	1127.46	1121.7	1121.59	1128.19	1119.1	990.153	1000.48	999.186

Index	Average Inlet Pressure; Part Turbo-Comp	Average Outlet Pressure; Part Turbo-Comp	Average Pressure (Outlet); Part AfterCooler	Average Pressure; Part SR-TV-23	Average Speed; Part Turbo-Comp	Average Inlet Pressure; Part Turb80-1	Average Outlet Pressure; Part Turb80-1	Average Pressure; Part Cat-Out	Air-Fuel Ratio (Inducted Air/Total Fuel); Part R4	Pressure; Maximum; Part Cyl1	Maximum Rate of Pressure Rise; Part Cyl1
	bar	bar	bar	bar	RPM	bar	bar	bar	No Unit	bar	bar/deg
1	0.982914	0.983163	0.983073	0.305469	3196.16	1.3851	0.832133	0.984513	14.2322	15.3773	0.794514
2	0.982844	0.982966	0.982833	0.378152	3957.02	1.26073	0.890032	0.985556	14.2394	20.0375	1.07612
3	0.982756	0.982855	0.982676	0.45329	4889.19	1.20432	0.924606	0.986832	14.2428	24.1192	1.30909
4	0.982652	0.982744	0.982516	0.530601	5818.66	1.18766	0.944472	0.988337	14.2467	27.3604	1.47258
5	0.982529	0.982626	0.982344	0.609592	6771.14	1.18062	0.960478	0.990103	14.2471	30.2614	1.61103
6	0.982385	0.982481	0.982141	0.689492	7753.7	1.1778	0.975629	0.992142	14.2478	32.9473	1.74349
7	0.982213	0.982307	0.981903	0.773391	8799.58	1.18093	0.991362	0.994586	14.2475	34.8124	1.81739
8	0.981993	0.982083	0.981609	0.862573	9972.67	1.19238	1.00851	0.997682	14.2463	35.5423	1.83362
9	0.98144	0.997645	0.997258	0.961887	19494.9	1.21151	1.02719	1.00144	14.2446	36.2981	1.86632
10	0.979916	1.08241	1.08303	1.08182	45846.3	1.23667	1.04561	1.00559	14.2457	37.8606	1.95316
11	0.979427	1.19017	1.19089	1.18954	65062.5	1.26561	1.06321	1.00993	14.2485	40.123	2.06696
12	0.977785	0.977949	0.977782	0.312084	4678.55	1.2343	0.906217	0.981953	14.2211	20.194	1.09502
13	0.977623	0.977732	0.977488	0.374066	6088	1.15069	0.952681	0.984048	14.2293	25.4769	1.4135
14	0.977431	0.977526	0.977201	0.469351	7463.35	1.13867	0.973299	0.98616	14.2365	31.0912	1.74408
15	0.977209	0.977304	0.976892	0.565732	8814.37	1.1447	0.989236	0.988559	14.2405	36.3954	2.04756
16	0.976959	0.97705	0.976546	0.644658	10134.5	1.15294	1.00402	0.991126	14.2421	40.8199	2.28886
17	0.976681	0.976774	0.976139	0.723242	11476.2	1.16301	1.01818	0.993881	14.241	44.6614	2.48703
18	0.976371	0.976462	0.975673	0.781565	12825.4	1.17429	1.03271	0.996885	14.2374	48.0546	2.64452
19	0.976031	0.976051	0.975099	0.837634	14193.6	1.19369	1.04445	1.00005	14.2319	50.5449	2.72904
20	0.975639	0.975722	0.974603	0.882585	15724.1	1.21782	1.05616	1.00355	14.2261	52.3806	2.74553
21	0.975063	1.01907	1.01798	0.95936	31806.6	1.24417	1.06846	1.0075	14.2234	53.8728	2.7486
22	0.972683	1.0611	1.06497	1.06226	45136.9	1.27555	1.08025	1.01175	14.2278	54.6261	2.71604
23	0.971841	1.15648	1.16	1.15699	62972.1	1.31562	1.09381	1.01698	14.2414	54.86	2.64594
24	0.970969	1.25708	1.26079	1.25747	77516.6	1.36232	1.10841	1.0229	14.2589	54.7926	2.58104
25	0.969894	1.3634	1.36666	1.36315	88834.6	1.41464	1.12317	1.02931	14.2573	55.2848	2.5801
26	0.978636	0.978801	0.978562	0.306262	6023.15	1.12282	0.948511	0.98487	14.2062	12.8907	0.565741
27	0.978372	0.978517	0.978167	0.394372	7866.11	1.08308	0.978396	0.98766	14.2166	23.0436	1.20599
28	0.97805	0.978154	0.977682	0.481306	9654.14	1.08599	0.997193	0.991216	14.2277	28.1578	1.4779
29	0.977682	0.977861	0.977221	0.562477	11430	1.09685	1.01425	0.995236	14.2363	31.4119	1.61293
30	0.977245	0.977325	0.976463	0.639138	13182.6	1.10999	1.03116	0.999681	14.2404	35.1579	1.78392
31	0.976745	0.976903	0.975782	0.721479	15040	1.12744	1.04822	1.00458	14.2389	38.6641	1.93437
32	0.976185	0.976689	0.97528	0.796132	16959.8	1.15113	1.06399	1.0098	14.2319	41.7769	2.06034
33	0.975557	0.975871	0.974162	0.86418	18933.6	1.18017	1.07899	1.01534	14.221	44.482	2.15476
34	0.974772	0.976403	0.974733	0.926907	21650	1.21396	1.09539	1.02153	14.2114	46.2955	2.18907
35	0.973076	0.976634	0.97927	0.975136	28629.2	1.25693	1.11411	1.02896	14.2092	46.8954	2.13327
36	0.9703	1.05255	1.05687	1.05138	46669.3	1.31041	1.13546	1.03794	14.2225	47.1409	2.06809
37	0.96859	1.13345	1.1376	1.13141	61678.7	1.36621	1.15371	1.04674	14.2514	48.3913	2.07923
38	0.967051	1.21526	1.21913	1.21238	73884.1	1.41676	1.16881	1.05473	14.2732	50.7487	2.16172
39	0.965571	1.30707	1.31085	1.30364	84793.2	1.47336	1.18475	1.06342	14.2288	52.5463	2.22998
40	0.96309	1.40973	1.41349	1.40548	95257.5	1.54399	1.20341	1.07395	14.0431	53.2139	2.25279
41	0.959716	1.52107	1.52524	1.51613	105436	1.62908	1.22401	1.08654	13.7109	53.3808	2.26859
42	0.955077	1.65427	1.65873	1.64825	116390	1.73083	1.24681	1.10135	13.3344	53.4889	2.30359
43	0.950634	1.80545	1.8106	1.799	126528	1.84863	1.27193	1.11831	13.0163	53.731	2.35082
44	0.979369	0.979504	0.979153	0.32343	7876.38	1.07994	0.978787	0.988483	14.2053	20.3396	1.02835
45	0.978947	0.979042	0.97853	0.407846	10162.8	1.06713	0.999334	0.992576	14.2058	26.0322	1.3227
46	0.978446	0.97854	0.97778	0.491287	12380.5	1.07969	1.01284	0.997017	14.2139	31.1444	1.58585
47	0.977875	0.977957	0.976902	0.573624	14512.3	1.09519	1.02596	1.00174	14.2254	35.3157	1.79076
48	0.977221	0.977235	0.975833	0.649204	16730.2	1.11735	1.03808	1.00685	14.2342	38.9659	1.9563
49	0.976474	0.976522	0.974718	0.720725	18977.1	1.14145	1.05071	1.01236	14.2366	42.5594	2.11505
50	0.97564	0.97579	0.973593	0.789957	21265.7	1.17092	1.06229	1.01818	14.231	45.7511	2.24363
51	0.974698	0.977138	0.974555	0.85102	23750	1.20573	1.0742	1.02459	14.2197	47.6171	2.27854
52	0.973592	0.974907	0.97196	0.910498	26250	1.2473	1.08829	1.03216	14.2095	47.927	2.19833
53	0.972193	0.973184	0.970236	0.961627	29500	1.29353	1.10342	1.0405	14.2107	48.9273	2.16157
54	0.97072	1.02862	1.02509	1.02008	41765	1.33679	1.11628	1.04824	14.2257	52.8097	2.31852
55	0.969188	1.10192	1.09802	1.09261	56269.5	1.38109	1.12886	1.05607	14.2319	56.4684	2.46818
56	0.967451	1.18102	1.17658	1.17071	69353.7	1.43695	1.14495	1.06587	14.166	57.3863	2.44059
57	0.965406	1.27146	1.26661	1.26028	81654.8	1.50086	1.16243	1.07692	13.9602	57.2652	2.36617
58	0.963036	1.36825	1.36293	1.3561	91435.2	1.56995	1.18	1.08871	13.6342	57.9291	2.3588
59	0.960448	1.46848	1.46261	1.45527	101255	1.64103	1.19705	1.10075	13.2948	59.2062	2.39476
60	0.957545	1.57189	1.56547	1.55761	109517	1.71735	1.21478	1.11359	13.014	60.6334	2.4434
61	0.954331	1.67692	1.66992	1.66151	118224	1.80035	1.23372	1.12752	12.7949	62.0149	2.49342
62	0.977053	0.977211	0.97674	0.331909	9678.79	1.07274	0.996812	0.990422	14.2276	21.1524	1.09719
63	0.976459	0.976554	0.975801	0.413084	12341.1	1.07351	1.01406	0.995719	14.212	26.5072	1.37572
64	0.975745	0.975841	0.974718	0.493269	14974.8	1.09388	1.02832	1.00148	14.2047	31.4391	1.63608
65	0.974919	0.975007	0.973439	0.570488	17546.8	1.1179	1.04304	1.00768	14.2084	35.5812	1.84298
66	0.973978	0.974059	0.971975	0.64378	20112	1.14626	1.05718	1.01436	14.2182	38.9045	1.98585
67	0.972897	0.972928	0.970326	0.716692	22729.7	1.18267	1.0698	1.0215	14.2281	42.0935	2.11835
68	0.971673	0.971735	0.968569	0.788512	25409	1.22147	1.08265	1.02908	14.2329	45.2075	2.2426
69	0.970299	0.971138	0.967352	0.854882	28200	1.26229	1.0956	1.03697	14.2323	48.205	2.36005
70	0.968762	0.969326	0.964811	0.915818	31050	1.30446	1.10844	1.04511	14.2294	51.4581	2.49834
71	0.966893	0.992494	0.987302	0.981135	37309.3	1.34882	1.12132	1.05365	14.2228	55.3562	2.68304
72	0.964927	1.05188	1.04619	1.03937	50388.9	1.39986	1.1358	1.06337	14.1856	57.8455	2.75165
73	0.9627	1.12283	1.11665	1.10918	62967.7	1.45821	1.1519	1.07445	14.0618	58.4592	2.68127
74	0.960148	1.2054	1.19873	1.19066	75495.9	1.521	1.16826	1.08622	13.8134	59.1608	2.63896
75	0.957382	1.29212	1.28488	1.2762	85871.3	1.58739	1.18464	1.09858	13.4939	60.5766	2.66055
76	0.954205	1.38403	1.3762	1.36687	95215.1	1.66113	1.20231	1.11219	13.197	62.0001	2.68803
77	0.950413	1.48416	1.47567	1.46563	104365	1.74781	1.22283	1.12807	12.9549	62.7087	2.68084
78	0.945837	1.5992	1.59001	1.57919	113608	1.851	1.24688	1.14689	12.7509	62.6821	2.64465
79	0.940289	1.72918	1.71929	1.70765	123283	1.96795	1.27353	1.16821	12.5699	62.6029	2.62338
80	0.976684	0.976779	0.976141	0.32194	11388.9	1.07918	1.01448	0.995078	14.2362	20.507	1.06677
81	0.975885	0.975981	0.974932	0.395086	14496.1	1.08397	1.03166	1.00178	14.2317	25.2372	1.30398
82	0.974908	0.974998	0.973426	0.466463	17579	1.10515	1.04919	1.00924	14.2173	29.9433	1.54805
83	0.973769	0.973855	0.971662	0.535476	20620.1	1.14161	1.06378	1.01725	14.2055	34.2419	1.76513
84	0.97246	0.973157	0.970356	0.603339	23800	1.18112	1.07878	1.02585	14.2046	37.9113	1.9368
85	0.970957	0.971789	0.968312	0.671191	26950	1.22399	1.09417	1.0351	14.2196	41.2559	2.07893
86	0.969261	0.969765	0.965539	0.739036	30100	1.26991	1.10979	1.04491	14.2428	44.4146	2.20444
87	0.967356	0.970233	0.96522	0.807256	33600	1.31843	1.12546	1.05518	14.2627	47.6543	2.34031
88	0.965285	0.966167	0.960327	0.872748	36832.5	1.36831	1.14083	1.06567	14.2558	51.1765	2.49809
89	0.962841	0.963882	0.957457	0.93911	41078.3	1.42323	1.15714	1.077	14.1839	53.7523	2.58847
90	0.95959	1.03176	1.02547	1.01579	52844.9	1.4858	1.17465	1.08982	14.0025	55.6308	2.61718
91	0.956445	1.11126	1.10427	1.09379	66460.7	1.55211	1.19215	1.10325	13.7124	57.5887	2.66318
92	0.953057	1.1908	1.18313	1.17185	78213.6	1.62018	1.20915	1.11687	13.3896	60.1025	2.75694
93	0.949202	1.27341	1.26508	1.25299	87542.3	1.69382	1.2269	1.13138	13.1092	62.714	2.85751
94	0.944812	1.36304	1.35393	1.34094	96893.1	1.77994	1.24733	1.14811	12.8787	64.3866	2.8978
95	0.939537	1.46527	1.45522	1.44125	106036	1.88612	1.27217	1.16845	12.6709	64.7695	2.86655
96	0.933257	1.57597	1.56496	1.54992	115011	2.00721	1.2998	1.19147	12.4697	64.8979	2.83661
97	0.926649	1.68238	1.67049	1.65444	122853	2.12424	1.32541	1.21359	12.279	66.1259	2.87834

	Average Inlet Pressure; Part Turbo-Comp	Average Outlet Pressure; Part Turbo-Comp	Average Pressure (Outlet); Part AfterCooler	Average Pressure; Part SR-TV-23	Average Speed; Part Turbo-Comp	Average Inlet Pressure; Part Turb80-1	Average Outlet Pressure; Part Turb80-1	Average Pressure; Part Cat-Out	Air-Fuel Ratio (Inducted Air/Total Fuel); Part R4	Pressure; Maximum; Part Cyl1	Maximum Rate of Pressure Rise; Part Cyl1
Index	bar	bar	bar	bar	RPM	bar	bar	bar	No Unit	bar	bar/deg
98	0.976137	0.976154	0.975237	0.33578	13556.6	1.0693	1.03303	1.00084	14.1363	22.5646	1.18098
99	0.975069	0.975155	0.973671	0.40503	17108.1	1.09223	1.04835	1.00903	14.2091	27.4819	1.45725
100	0.973778	0.973869	0.971682	0.474034	20597.9	1.13039	1.0646	1.01818	14.2346	32.2318	1.71377
101	0.972278	0.972371	0.969489	0.54111	24045.5	1.17191	1.08152	1.02803	14.2311	36.5856	1.95244
102	0.97056	0.971197	0.967538	0.606615	27597.9	1.21654	1.09882	1.03853	14.2225	40.5778	2.16659
103	0.968594	0.968645	0.964117	0.6724	31119.5	1.26465	1.11645	1.04971	14.2301	44.3753	2.34947
104	0.966384	0.966648	0.961167	0.738413	34755.1	1.31618	1.13428	1.06149	14.2583	47.9038	2.51573
105	0.963904	0.965202	0.958696	0.804779	38565.8	1.37187	1.15252	1.074	14.2738	50.9485	2.64245
106	0.961239	0.962149	0.954614	0.868316	42408.9	1.42957	1.17046	1.08671	14.215	54.2467	2.79013
107	0.958182	0.959541	0.951374	0.927178	47046.1	1.48595	1.18656	1.09897	14.0304	58.55	3.01519
108	0.954398	1.02109	1.01291	0.999983	57068.8	1.55154	1.20418	1.11291	13.7365	62.0023	3.16956
109	0.950445	1.09961	1.09052	1.07662	69738.9	1.6255	1.22318	1.12827	13.4078	64.3981	3.24531
110	0.946141	1.17799	1.16806	1.15312	81212.5	1.70523	1.24277	1.14448	13.1088	66.7432	3.32064
111	0.941167	1.26196	1.25115	1.23514	90459.7	1.79538	1.26415	1.16243	12.847	68.6333	3.36424
112	0.935287	1.35416	1.34241	1.32525	100174	1.90183	1.28875	1.18324	12.5994	69.334	3.32506
113	0.928425	1.4553	1.44243	1.42396	109074	2.02581	1.31652	1.20712	12.35	69.4296	3.25116
114	0.920888	1.55884	1.54483	1.52504	117852	2.15423	1.34409	1.23155	12.105	70.3096	3.24491
115	0.913431	1.65323	1.63817	1.61719	124713	2.26982	1.3674	1.25321	11.8823	72.9527	3.35198
116	0.97454	0.974634	0.973403	0.352828	15659.3	1.07393	1.04052	1.00497	13.8757	22.9207	1.28543
117	0.973157	0.97325	0.971264	0.423446	19647.3	1.11108	1.05796	1.01495	14.0827	27.796	1.59738
118	0.971449	0.971543	0.968735	0.493512	23691.3	1.1555	1.07707	1.02616	14.2099	32.931	1.90408
119	0.969436	0.970382	0.966662	0.562308	27906.4	1.20411	1.09672	1.03824	14.2631	38.1233	2.22527
120	0.967177	0.968821	0.964104	0.628793	31950.1	1.2559	1.1164	1.05088	14.265	42.8796	2.51519
121	0.964677	0.964726	0.958926	0.693343	35820.2	1.3111	1.13621	1.0641	14.2457	46.918	2.79145
122	0.961883	0.963877	0.956915	0.757943	39992.5	1.37071	1.1563	1.07798	14.2206	50.6365	2.99879
123	0.958801	0.959911	0.951674	0.822331	44114	1.43383	1.17624	1.0923	14.1696	54.8352	3.29004
124	0.955408	0.956821	0.947275	0.885339	48589.9	1.49871	1.19514	1.10661	14.0467	59.2686	3.55638
125	0.951353	0.971854	0.961864	0.94685	54784.1	1.56755	1.21358	1.12136	13.8291	63.8226	3.78065
126	0.946568	1.04436	1.03398	1.01724	66264.5	1.6461	1.23329	1.13771	13.5417	68.3955	4.08181
127	0.941543	1.11887	1.10764	1.08945	77717	1.73173	1.25391	1.15509	13.228	71.111	4.21921
128	0.936011	1.1999	1.18753	1.16809	87752.4	1.82849	1.27624	1.17427	12.9104	72.9632	4.27818
129	0.929519	1.28845	1.275	1.25416	97663.8	1.93884	1.30064	1.19564	12.5871	74.1436	4.29432
130	0.921796	1.38645	1.37169	1.34933	107138	2.06931	1.32862	1.22048	12.254	74.3266	4.22803
131	0.912424	1.49581	1.47943	1.4554	116958	2.22525	1.36135	1.2499	11.9219	73.617	4.0958
132	0.90142	1.61245	1.59395	1.56828	126077	2.40237	1.39774	1.28318	11.6151	72.9847	4.0051
133	0.889438	1.72208	1.70154	1.67418	134391	2.57856	1.43246	1.31602	11.3584	73.825	4.01004
134	0.974869	0.97496	0.973365	0.363693	17695.7	1.09349	1.04882	1.01102	13.5322	23.4937	1.28241
135	0.973154	0.973278	0.970793	0.434149	22105.6	1.13665	1.06939	1.02291	13.8745	28.3358	1.56261
136	0.971054	0.971234	0.967787	0.504452	26557.8	1.18893	1.09117	1.03622	14.118	33.0719	1.84144
137	0.968554	0.970584	0.966024	0.575538	31387.4	1.24669	1.11314	1.05049	14.2422	37.8522	2.10433
138	0.965732	0.965807	0.960011	0.644497	35568.3	1.30794	1.13473	1.06521	14.2514	42.5049	2.3839
139	0.962631	0.962973	0.955845	0.710261	39994.8	1.37311	1.15638	1.08047	14.1738	46.6091	2.63336
140	0.959151	0.960682	0.952092	0.776051	44573.8	1.44205	1.17749	1.09611	14.0477	50.5601	2.83127
141	0.955273	0.955439	0.945186	0.841183	49216.1	1.51451	1.19799	1.11202	13.9087	55.6843	3.13841
142	0.950859	0.950976	0.938811	0.900549	54716.1	1.59308	1.21888	1.12875	13.7638	61.3299	3.47073
143	0.945465	0.999608	0.987342	0.967635	63497	1.68039	1.24093	1.14686	13.589	65.8995	3.72122
144	0.939713	1.079	1.06554	1.0447	75762.5	1.77616	1.26358	1.16612	13.3483	70.1441	3.95749
145	0.933531	1.15415	1.13925	1.11716	85801.7	1.88103	1.28718	1.18669	13.0291	72.6685	4.06533
146	0.925951	1.24333	1.22694	1.20313	96230.1	2.01	1.31541	1.21152	12.6414	72.6096	3.94869
147	0.917488	1.3361	1.3181	1.29258	105965	2.14388	1.34223	1.2365	12.2078	74.8168	4.04419
148	0.907871	1.43564	1.41601	1.3888	115502	2.28686	1.36937	1.26269	11.7607	77.344	4.13191
149	0.895783	1.55298	1.53138	1.50223	125329	2.46452	1.40363	1.29546	11.3403	77.6067	4.0506
150	0.879881	1.69229	1.66821	1.63675	136181	2.69109	1.44843	1.33794	10.9835	75.9791	3.85604
151	0.859097	1.86516	1.83808	1.80412	149159	2.96731	1.50399	1.39081	10.7109	73.9777	3.66484
152	0.973682	0.973965	0.971728	0.378648	20891	1.12385	1.06269	1.01943	13.244	27.4446	1.64297
153	0.97155	0.971611	0.96839	0.44656	25549.3	1.17404	1.08522	1.03312	13.649	32.3579	1.98043
154	0.968944	0.96914	0.964753	0.515452	30389.2	1.23428	1.10901	1.04838	13.9382	37.2462	2.29379
155	0.96584	0.965926	0.960181	0.585167	35322.8	1.30211	1.1335	1.06494	14.0745	42.4167	2.61985
156	0.962301	0.962313	0.955049	0.653918	40282.9	1.37447	1.15734	1.08186	14.0592	47.7517	2.96882
157	0.958402	0.958424	0.949507	0.722284	45164.6	1.44976	1.18005	1.099	13.9275	52.8241	3.3047
158	0.954024	0.955591	0.944843	0.790872	50259.4	1.53035	1.20262	1.11661	13.7287	58.0745	3.62072
159	0.94907	0.950961	0.938093	0.860321	55578.6	1.61794	1.22546	1.13533	13.5193	63.9807	4.02716
160	0.943395	0.971479	0.95671	0.935293	62919.5	1.71305	1.24897	1.15485	13.3338	69.4371	4.35
161	0.936966	1.04953	1.03342	1.0104	74779.1	1.8199	1.274	1.1763	13.1628	73.7985	4.62426
162	0.929982	1.12723	1.10989	1.08529	85527.7	1.93225	1.2989	1.19818	12.9437	77.4101	4.84459
163	0.922177	1.20995	1.19111	1.16465	95640.6	2.05355	1.32366	1.22088	12.6103	81.9423	5.0639
164	0.913225	1.29754	1.27701	1.24851	105312	2.18735	1.34929	1.24556	12.1525	85.7743	5.29
165	0.90227	1.39559	1.37313	1.34235	115320	2.34739	1.37895	1.27428	11.6206	86.0975	5.18458
166	0.889347	1.50566	1.4811	1.4479	125264	2.52175	1.40994	1.30572	11.0891	88.0198	5.20647
167	0.875581	1.62368	1.59706	1.56154	134707	2.68686	1.43684	1.33456	10.6227	93.118	5.4801
168	0.858909	1.74743	1.71822	1.68005	144876	2.88071	1.47047	1.36947	10.257	95.7134	5.5757
169	0.971405	0.971821	0.968989	0.391819	23860.8	1.15312	1.07558	1.02694	13.0416	29.6311	1.7104
170	0.9688	0.969261	0.965253	0.460494	28963.3	1.21072	1.09992	1.04241	13.3857	34.6711	2.03932
171	0.965613	0.966575	0.961168	0.529383	34284.8	1.27966	1.1257	1.05964	13.6088	39.8404	2.37837
172	0.961842	0.961891	0.954861	0.598301	39506	1.35711	1.15198	1.07816	13.6932	45.3039	2.71984
173	0.957485	0.958247	0.949377	0.668181	45050.8	1.4417	1.17817	1.09761	13.647	51.0484	3.06946
174	0.952605	0.953155	0.942236	0.738004	50510.8	1.53173	1.20365	1.11751	13.4942	56.7152	3.43049
175	0.947175	0.947389	0.93417	0.808467	56041.2	1.62745	1.22858	1.13786	13.2646	62.2676	3.77035
176	0.941106	0.942989	0.927084	0.881438	61861.9	1.73012	1.25331	1.15889	12.9909	67.7095	4.12539
177	0.933661	1.00636	0.988179	0.964116	72993.5	1.85163	1.28077	1.18295	12.709	73.8314	4.50897
178	0.925561	1.09124	1.07138	1.04522	84648.9	1.97955	1.30792	1.20746	12.4417	79.4757	4.83408
179	0.916847	1.1748	1.1533	1.1251	95223.7	2.11337	1.3349	1.23241	12.1698	83.4603	5.0614
180	0.906892	1.26287	1.23961	1.20926	105519	2.2611	1.36321	1.25935	11.8285	86.095	5.14034
181	0.894985	1.3609	1.33565	1.30294	115904	2.42621	1.39272	1.28876	11.376	89.3425	5.26929
182	0.880794	1.47023	1.44278	1.40753	126191	2.60637	1.42286	1.32026	10.8515	93.6302	5.44503
183	0.863655	1.5945	1.56464	1.52662	137074	2.80812	1.45642	1.35576	10.3395	96.2735	5.52926

	Crank Angle at Maximum Pressure; Part Cyl1	Fuel Mass Trapped at Cyl. Cycle-Start; Part Cyl1	Throttle Angle; Part Throttle-1	Average Map pressure Ratio; Part Turb80-1	Average Map Pressure Ratio; Part Turbo-Comp	Average Pressure Drop Across Boundary; Part Throttle-1	IMEP720 - Net Indicated Mean Effective Pressure; Part R4	IMEP360 - Gross Indicated Mean Effective Pressure; Part R4	FMEP - Friction Mean Effective Pressure; Part R4	PMEP - Pumping Mean Effective Pressure; Part R4	Average Mass Flow Rate; Part Turbo-Comp
Index	deg	mg	deg	No Unit	No Unit	bar	bar	bar	bar	bar	kg/s
1	14.6471	8.43036	2.06742	1.66007	1.00025	0.677544	1.85937	2.55357	1.03431	-0.694201	0.00399573
2	14.7892	11.4835	3.11719	1.41418	1.00012	0.604594	2.85965	3.48378	1.03437	-0.624132	0.00544657
3	15.7373	14.4429	4.02996	1.30377	1.0001	0.529271	3.85661	4.40766	1.03442	-0.551046	0.00685098
4	17.3901	17.3109	5.00648	1.26272	1.00009	0.451773	4.83336	5.31022	1.03446	-0.476857	0.0082147
5	19.2225	20.2082	5.93014	1.23811	1.0001	0.372569	5.8096	6.21095	1.0345	-0.401349	0.00959138
6	20.8662	23.1703	7.06076	1.2195	1.0001	0.292416	6.78813	7.11347	1.03453	-0.325333	0.0109976
7	23.0588	26.2619	8.75866	1.20706	1.0001	0.208221	7.76198	8.00798	1.03456	-0.245995	0.0124651
8	26.3515	29.6433	11.9017	1.20215	1.00009	0.118674	8.72259	8.88509	1.03457	-0.162503	0.0140695
9	29.537	33.3644	19.4948	1.20374	1.0165	0.0348814	9.70209	9.77535	1.03458	-0.0732627	0.0158356
10	31.8603	37.3234	90	1.21156	1.10445	0.000451607	10.7784	10.735	1.0346	0.0434226	0.0177196
11	33.5488	41.321	90	1.22357	1.21479	0.000510492	11.8663	11.7212	1.03463	0.145014	0.0196231
12	5.91644	9.01643	3.77402	1.35538	1.00017	0.665557	2.00355	2.70543	1.12928	-0.701879	0.00640955
13	6.78659	12.02	5.27204	1.20695	1.00011	0.603219	3.02069	3.65926	1.12934	-0.638564	0.00855018
14	6.99004	14.8333	6.4842	1.17299	1.0001	0.507606	4.01046	4.55383	1.12942	-0.543369	0.0105526
15	7.44714	17.5652	7.59986	1.1648	1.0001	0.41086	4.99026	5.45098	1.12948	-0.460722	0.0124942
16	8.44608	20.1976	8.85998	1.16052	1.00009	0.331506	5.9706	6.36376	1.12954	-0.393158	0.0143713
17	9.80439	22.7896	10.5495	1.15865	1.0001	0.252421	6.94984	7.27716	1.12959	-0.327323	0.016218
18	11.2025	25.3851	12.5071	1.15795	1.00009	0.193526	7.92759	8.19352	1.12964	-0.265931	0.0180625
19	12.8673	27.9601	14.6952	1.16778	1.00002	0.136765	8.88993	9.10048	1.12967	-0.210552	0.0198901
20	14.9048	30.6306	17.3665	1.18226	1.00009	0.0911784	9.84253	10.0108	1.12969	-0.168221	0.0217825
21	17.0014	33.5257	21.2047	1.19817	1.04503	0.0576455	10.8561	10.9559	1.12971	-0.0997933	0.0238397
22	19.373	36.445	90	1.21867	1.09048	0.00105559	11.8502	11.8591	1.12972	-0.00894935	0.025924
23	22.2283	39.7934	90	1.24509	1.18892	0.00117983	12.8755	12.8012	1.12972	0.074258	0.0283326
24	25.0309	43.3732	90	1.27567	1.29275	0.00131206	13.8816	13.7209	1.12972	0.160667	0.0309193
25	27.3416	47.1464	90	1.30995	1.40269	0.00139474	14.9073	14.6569	1.12973	0.250416	0.0336058
26	19.8676	8.89018	5.1941	1.18215	1.00017	0.672067	2.14451	2.83704	1.22409	-0.692525	0.00841566
27	9.3561	11.748	6.8263	1.10925	1.00015	0.583481	3.16083	3.77947	1.22422	-0.618638	0.0111296
28	9.81688	14.5108	8.33743	1.09485	1.00011	0.495988	4.15418	4.70274	1.22428	-0.548564	0.0137587
29	11.876	17.1492	9.692	1.09132	1.00018	0.414257	5.14117	5.62499	1.22433	-0.48382	0.0162688
30	13.0338	19.8424	11.2616	1.09055	1.00008	0.33669	6.12785	6.54669	1.22438	-0.418838	0.018832
31	13.9387	22.5551	13.4	1.09344	1.00016	0.253498	7.11121	7.46576	1.22442	-0.354553	0.0214026
32	15.3056	25.2615	15.43	1.10354	1.00052	0.178151	8.08265	8.37417	1.22446	-0.291521	0.0239601
33	16.4592	27.9864	18.8	1.11918	1.00032	0.108763	9.04295	9.27437	1.22449	-0.23142	0.0265248
34	18.2398	30.823	27.296	1.13778	1.00168	0.0462929	9.99771	10.1727	1.22452	-0.175037	0.0291989
35	20.8893	33.993	90	1.16252	1.0037	0.00163743	10.9446	11.0804	1.22452	-0.135775	0.0321998
36	23.946	37.6406	90	1.19382	1.08416	0.0022729	11.9523	12.0342	1.22452	-0.0819154	0.0356894
37	26.0185	41.1461	90	1.22856	1.16861	0.00258173	12.9369	12.9636	1.22454	-0.0266612	0.0390928
38	27.2698	44.393	90	1.2602	1.25382	0.00282529	13.9209	13.8912	1.22456	0.0296186	0.0422412
39	28.3565	47.9395	90	1.29517	1.34925	0.00302759	14.9083	14.8152	1.22459	0.0931039	0.0454747
40	30.837	52.532	90	1.33813	1.45695	0.00341089	15.8995	15.7408	1.22459	0.158719	0.0491808
41	34.0219	58.6276	90	1.38935	1.57461	0.00392972	16.8797	16.6557	1.22459	0.224021	0.0535878
42	37.3495	65.98	90	1.44926	1.71626	0.00460873	17.8609	17.5611	1.22459	0.2998	0.0586481
43	40.6808	73.9806	90	1.51612	1.87641	0.00513259	18.8409	18.4579	1.2246	0.383017	0.0641868
44	5.61081	9.42456	6.83803	1.10737	1.00014	0.655344	2.26729	2.96885	1.3191	-0.701555	0.0111582
45	5.80828	12.2508	8.73602	1.07474	1.0001	0.570184	3.27122	3.90661	1.31917	-0.635381	0.0145033
46	6.58275	14.9408	10.4661	1.07741	1.0001	0.485881	4.25708	4.83135	1.31924	-0.574264	0.0176972
47	8.08455	17.5145	12.0207	1.08384	1.00008	0.402511	5.2395	5.75659	1.31929	-0.517099	0.0207618
48	9.56114	20.07	13.7538	1.09722	1.00002	0.325642	6.21467	6.67999	1.31934	-0.46532	0.023806
49	10.5749	22.6465	15.3509	1.11167	1.00005	0.252753	7.18273	7.59664	1.31938	-0.413912	0.0268662
50	11.5829	25.2208	17.646	1.13182	1.00016	0.182112	8.13904	8.5041	1.31942	-0.365067	0.0299071
51	13.5042	27.8186	21.0838	1.1561	1.0025	0.121693	9.08468	9.40407	1.31944	-0.319392	0.0329627
52	16.645	30.5686	28.9628	1.18407	1.00136	0.0592171	10.0148	10.2905	1.31944	-0.275693	0.0361962
53	18.8715	33.4452	53.9103	1.21444	1.00105	0.00580662	10.9331	11.1716	1.31944	-0.238479	0.0396055
54	19.0387	36.2939	90	1.24325	1.05919	0.00188296	11.9247	12.1281	1.31949	-0.203411	0.0430245
55	19.3124	39.1224	90	1.27236	1.13559	0.00204818	12.9137	13.075	1.31953	-0.161341	0.0463988
56	21.3704	42.4479	90	1.3073	1.21813	0.00222974	13.8772	13.9968	1.31954	-0.119558	0.0501087
57	23.8371	46.5715	90	1.3466	1.3126	0.00242205	14.826	14.9007	1.31953	-0.0746633	0.0541789
58	26.1604	51.5123	90	1.38869	1.41403	0.00263255	15.7973	15.8272	1.31954	-0.0298932	0.0585273
59	28.1349	56.8145	90	1.43133	1.51929	0.00284	16.7694	16.7513	1.31955	0.0181316	0.0629438
60	29.7743	62.2353	90	1.47587	1.62828	0.00305952	17.7458	17.6825	1.31957	0.0632657	0.0674934
61	31.3522	67.7171	90	1.52267	1.73939	0.00329153	18.7119	18.6096	1.31959	0.102325	0.0722022
62	5.1067	9.66619	8.32314	1.08289	1.00016	0.644278	2.36947	3.08938	1.41403	-0.719908	0.0137236
63	6.18238	12.4029	10.4299	1.06879	1.0001	0.561997	3.36613	4.0254	1.41409	-0.659275	0.0176036
64	6.95647	15.0634	12.3451	1.07906	1.0001	0.480573	4.34739	4.9536	1.41415	-0.606217	0.0213804
65	8.42995	17.6517	13.9662	1.09236	1.00009	0.401859	5.3231	5.88165	1.4142	-0.55855	0.0250669
66	10.0225	20.1983	15.3271	1.10997	1.00008	0.326788	6.2899	6.80219	1.41424	-0.512282	0.0287063
67	11.4642	22.7675	17.2765	1.13606	1.00003	0.251874	7.24073	7.71291	1.41427	-0.472175	0.0323828
68	12.4657	25.3577	20.1915	1.16343	1.00007	0.177891	8.1821	8.61653	1.4143	-0.434423	0.0360809
69	13.5091	27.9472	25.1067	1.19176	1.00087	0.109843	9.11401	9.51111	1.41433	-0.397107	0.0397658
70	14.3001	30.523	34.5337	1.22051	1.0006	0.0458115	10.0429	10.4015	1.41436	-0.358559	0.043426
71	14.7591	33.1843	90	1.25034	1.02627	0.00235448	11.0026	11.323	1.4144	-0.320429	0.0471945
72	16.0556	36.0944	90	1.28368	1.08908	0.00262522	11.9752	12.27	1.41443	-0.294818	0.0512018
73	18.2158	39.4461	90	1.3207	1.16395	0.00289168	12.9293	13.2011	1.41444	-0.271822	0.0554688
74	20.5247	43.3894	90	1.35994	1.25106	0.00314256	13.874	14.1212	1.41444	-0.247183	0.0599349
75	22.293	47.8584	90	1.40071	1.34273	0.00339806	14.8241	15.0486	1.41445	-0.224523	0.0645803
76	23.9734	52.6551	90	1.44468	1.44026	0.00367038	15.7768	15.9812	1.41447	-0.204428	0.0694889
77	26.1425	57.7684	90	1.49427	1.54699	0.0039729	16.7179	16.9056	1.41447	-0.187691	0.0748374
78	28.5449	63.3812	90	1.55079	1.67006	0.00429976	17.6472	17.8204	1.41447	-0.173167	0.0808124
79	31.1099	69.47	90	1.6121	1.80982	0.00465373	18.5705	18.7302	1.41447	-0.159749	0.0873121
80	7.88206	9.79276	9.67507	1.0721	1.0001	0.653384	2.46708	3.24218	1.50894	-0.775101	0.0162363
81	8.7831	12.4801	11.9871	1.06316	1.0001	0.578781	3.46212	4.17716	1.50898	-0.715044	0.0206943
82	9.3702	15.1545	13.9713	1.07124	1.00009	0.505658	4.44594	5.1057	1.50903	-0.659755	0.0251118
83	10.2533	17.7871	15.3417	1.09649	1.00009	0.434627	5.40978	6.02676	1.50908	-0.616979	0.0294597
84	11.2589	20.3936	16.7619	1.1236	1.00071	0.36507	6.36336	6.94428	1.50911	-0.580917	0.0337826
85	12.4868	23.003	18.6592	1.15274	1.00086	0.294698	7.30655	7.85736	1.50914	-0.550819	0.0381502
86	13.7669	25.6105	21.3815	1.18354	1.00052	0.223538	8.23832	8.76454	1.50917	-0.526214	0.0425471
87	14.5904	28.2328	25.5186	1.21559	1.00296	0.154391	9.16482	9.67096	1.5092	-0.506142	0.0469716
88	14.8301	30.8629	32.4005	1.24794	1.00095	0.0832915	10.0795	10.5725	1.50923	-0.49296	0.0513211
89	15.7752	33.669	52.8992	1.28266	1.00119	0.0130114	10.9932	11.4792	1.50926	-0.485969	0.0557091
90	17.7532	37.1051	90	1.32168	1.07404	0.00378601	11.9642	12.4401	1.50927	-0.475894	0.0606133
91	19.4078	41.0453	90	1.36237	1.15857	0.00412372	12.9141	13.385	1.50929	-0.47097	0.0656603
92	20.6048	45.271	90	1.40343	1.24337	0.00446548	13.847	14.317	1.50932	-0.46998	0.070716
93	21.6606	49.6469	90	1.44666	1.33195	0.00481174	14.7858	15.2579	1.50935	-0.472069	0.0759295
94	22.8964	54.273	90	1.49523	1.4284	0.00519767	15.7136	16.1925	1.50937	-0.47888	0.0815451
95	25.0739	59.4408	90	1.55237	1.53883	0.00562613	16.6208	17.114	1.50937	-0.493251	0.0878684
96	27.4356	65.0846	90	1.6147	1.65928	0.00608722	17.5129	18.028	1.50937	-0.515159	0.0946846
97	29.301	70.6557	90	1.67296	1.77594	0.00652911	18.4132	18.9509	1.5094	-0.537686	0.101216

Index	Crank Angle at Maximum Pressure; Part Cyl1	Fuel Mass Trapped at Cyl. Cycle-Start; Part Cyl1	Throttle Angle; Part Throttle-1	Average Map pressure Ratio; Part Turb80-1	Average Map Pressure Ratio; Part Turbo-Comp	Average Pressure Drop Across Boundary; Part Throttle-1	IMEP720 - Net Indicated Mean Effective Pressure; Part R4	IMEP360 - Gross Indicated Mean Effective Pressure; Part R4	FMEP - Friction Mean Effective Pressure; Part R4	PMEP - Pumping Mean Effective Pressure; Part R4	Average Mass Flow Rate; Part Turbo-Comp
	deg	mg	deg	No Unit	No Unit	bar	bar	bar	bar	bar	kg/s
98	5.09249	10.2963	11.3316	1.04435	1.00002	0.638299	2.57492	3.36073	1.60388	-0.785805	0.0193954
99	6.2158	12.905	13.7523	1.05654	1.00009	0.567178	3.5597	4.29764	1.60391	-0.737941	0.0244398
100	7.4149	15.5087	15.3263	1.08239	1.00009	0.495882	4.52783	5.22967	1.60396	-0.701837	0.0294264
101	8.04932	18.1031	16.8863	1.11005	1.00009	0.426302	5.48545	6.15994	1.60401	-0.67449	0.0343437
102	9.4211	20.6913	18.5159	1.1394	1.00065	0.358352	6.43146	7.08668	1.60404	-0.655214	0.0392323
103	10.362	23.2805	20.7401	1.17067	1.00006	0.288536	7.37068	8.01367	1.60407	-0.642992	0.0441678
104	11.4845	25.8421	23.904	1.20375	1.00029	0.218877	8.29551	8.93127	1.6041	-0.635752	0.0491277
105	12.4641	28.4477	28.8741	1.2389	1.00136	0.149246	9.21479	9.84935	1.60412	-0.63456	0.0541375
106	13.1272	31.1291	35.4422	1.27465	1.00101	0.0807169	10.1204	10.7613	1.60415	-0.640903	0.0589976
107	13.4112	34.1165	52.9643	1.30969	1.00158	0.0173024	11.0343	11.6898	1.60419	-0.655536	0.0638123
108	14.2234	37.7637	90	1.34992	1.0685	0.00514432	12.0037	12.6694	1.60423	-0.665673	0.0691625
109	15.6904	41.8111	90	1.3941	1.15281	0.00555246	12.9492	13.6296	1.60426	-0.680424	0.074743
110	17.0756	46.0129	90	1.44044	1.23731	0.00599757	13.8683	14.5704	1.60428	-0.702079	0.08042
111	18.6847	50.4526	90	1.49107	1.32837	0.00646186	14.7898	15.5189	1.6043	-0.729074	0.086419
112	20.5192	55.3265	90	1.54838	1.42891	0.0069596	15.6911	16.4565	1.60431	-0.765405	0.0929431
113	22.7104	60.7633	90	1.61225	1.53987	0.00753527	16.5761	17.3868	1.60432	-0.8107	0.100054
114	24.79	66.4343	90	1.67603	1.65422	0.00811742	17.4608	18.3188	1.60433	-0.857987	0.107224
115	25.1309	71.8162	90	1.73227	1.75936	0.00864013	18.371	19.2722	1.60436	-0.901197	0.113778
116	4.72476	10.733	12.8228	1.04375	1.0001	0.619103	2.67006	3.47493	1.69879	-0.804867	0.022339
117	6.46697	13.274	14.9072	1.06767	1.00009	0.54595	3.64444	4.4181	1.69883	-0.773661	0.0280388
118	7.00446	15.8603	16.7415	1.09686	1.0001	0.472978	4.60569	5.3587	1.69888	-0.753013	0.0338037
119	7.11691	18.4847	18.5727	1.12856	1.00097	0.401659	5.55776	6.29927	1.69893	-0.741514	0.039545
120	7.76583	21.0941	20.597	1.16196	1.00169	0.331951	6.49666	7.23547	1.69896	-0.738807	0.045132
121	8.4883	23.6777	23.4432	1.19697	1.00007	0.261443	7.42406	8.16765	1.69899	-0.743587	0.0505946
122	9.37915	26.2837	27.4245	1.23423	1.00208	0.193958	8.34463	9.09986	1.69902	-0.75523	0.0560623
123	9.83964	28.9414	32.5951	1.27311	1.00121	0.123304	9.25293	10.0261	1.69905	-0.773117	0.0615116
124	10.3312	31.7681	43.0889	1.31287	1.00161	0.054644	10.1573	10.9544	1.6991	-0.797028	0.0669326
125	10.5688	34.9583	90	1.35483	1.02126	0.00599928	11.0687	11.8986	1.69915	-0.829953	0.072515
126	11.516	38.6689	90	1.40184	1.1005	0.00678301	12.0327	12.8976	1.6992	-0.86488	0.0785449
127	12.9719	42.644	90	1.45145	1.18184	0.00742046	12.9567	13.8609	1.69923	-0.904214	0.0846119
128	14.3586	46.9935	90	1.50565	1.27043	0.00796994	13.8699	14.8187	1.69924	-0.948836	0.0910044
129	16.543	51.8147	90	1.56527	1.36784	0.00858907	14.7716	15.7724	1.69925	-1.00088	0.0978297
130	18.7303	57.3067	90	1.63265	1.4764	0.00926486	15.6553	16.7203	1.69926	-1.06504	0.105335
131	21.371	63.6006	90	1.70891	1.5986	0.0100047	16.5141	17.6597	1.69925	-1.14562	0.113734
132	23.866	70.4983	90	1.79059	1.73038	0.0107422	17.3582	18.5926	1.69925	-1.23435	0.122823
133	25.6279	77.352	90	1.86813	1.85637	0.0114901	18.2118	19.5461	1.69926	-1.33424	0.131778
134	6.24048	11.1991	14.0355	1.05766	1.00009	0.607888	2.75513	3.60373	1.79373	-0.848599	0.0252781
135	6.95947	13.644	16.03	1.08423	1.00013	0.53439	3.72367	4.55316	1.79373	-0.829486	0.0315658
136	7.74113	16.0996	18.0556	1.11826	1.00018	0.460627	4.67725	5.49969	1.79377	-0.822443	0.0378939
137	8.21072	18.6473	20.1111	1.15598	1.00209	0.387192	5.61736	6.44328	1.79381	-0.825916	0.0442707
138	8.97863	21.2636	22.6299	1.19555	1.00008	0.311368	6.54278	7.38245	1.79384	-0.83967	0.0505118
139	9.62838	23.9448	26.1112	1.23668	1.00037	0.240466	7.45827	8.31961	1.79387	-0.861339	0.0565714
140	9.9779	26.7616	30.7023	1.27975	1.00162	0.169805	8.36783	9.25813	1.7939	-0.890301	0.0626573
141	10.0639	29.6679	37.3118	1.32443	1.00028	0.0964048	9.26387	10.1904	1.79395	-0.926563	0.0687777
142	10.1064	32.6998	51.5026	1.37178	1.00043	0.0284696	10.1558	11.1342	1.794	-0.978364	0.0750104
143	10.4475	35.9693	90	1.42284	1.05572	0.00805102	11.0761	12.1087	1.79405	-1.03265	0.0814651
144	11.5526	39.6287	90	1.4775	1.14289	0.00857732	12.0226	13.105	1.79411	-1.08235	0.0881594
145	12.7322	43.7436	90	1.53539	1.22596	0.0091139	12.9284	14.0717	1.79413	-1.14328	0.0949858
146	15.8519	48.7221	90	1.60327	1.32492	0.0098612	13.8107	15.035	1.79413	-1.22433	0.102648
147	17.1008	54.3105	90	1.6724	1.42865	0.0106071	14.6998	16.0077	1.79415	-1.30784	0.110502
148	18.5284	60.5317	90	1.74383	1.54073	0.0113451	15.5893	16.9821	1.79418	-1.39279	0.11865
149	20.7018	67.7308	90	1.82651	1.67404	0.0121923	16.4548	17.9537	1.7942	-1.49886	0.128011
150	23.7342	75.9801	90	1.9229	1.83452	0.0132129	17.2858	18.9247	1.79416	-1.6389	0.139084
151	27.3576	85.0924	90	2.02915	2.03593	0.0143219	18.1188	19.9156	1.79415	-1.79682	0.151898
152	3.13285	12.2623	15.4528	1.07729	1.00029	0.590566	2.83315	3.73638	1.88866	-0.903226	0.0297683
153	4.80012	14.5871	17.6036	1.10857	1.00006	0.518768	3.79332	4.69398	1.88869	-0.900657	0.0364962
154	5.29348	16.9619	19.8139	1.14753	1.0002	0.445681	4.73682	5.64872	1.88873	-0.911907	0.0433374
155	6.19765	19.4918	22.1573	1.19114	1.00009	0.37066	5.66377	6.59939	1.88876	-0.935624	0.0502907
156	6.40764	22.1862	25.1165	1.23723	1.00002	0.295758	6.57792	7.54743	1.8888	-0.969513	0.0571811
157	6.62566	25.0286	29.4949	1.28456	1.00005	0.220617	7.48078	8.49151	1.88883	-1.01073	0.0638984
158	7.09584	28.0719	34.0403	1.33417	1.00167	0.145953	8.3735	9.43318	1.88887	-1.05969	0.0706513
159	7.18695	31.2851	44.8035	1.38679	1.00209	0.0679917	9.25372	10.3693	1.88892	-1.11562	0.0775382
160	7.38535	34.5743	90	1.44205	1.02908	0.00889229	10.1573	11.3312	1.88899	-1.17394	0.0845176
161	8.5788	38.0304	90	1.50197	1.11562	0.00956879	11.1014	12.3489	1.88905	-1.24747	0.0917725
162	9.68437	41.7054	90	1.56289	1.20212	0.0102516	12.0125	13.3392	1.88909	-1.32664	0.0989651
163	10.0625	46.0585	90	1.6274	1.29463	0.011074	12.9151	14.3282	1.88915	-1.4131	0.10648
164	11.514	51.3606	90	1.69656	1.39345	0.0119788	13.8136	15.3237	1.8892	-1.51011	0.114428
165	13.7057	57.8752	90	1.77571	1.50526	0.0129922	14.693	16.3205	1.8892	-1.62752	0.123297
166	15.487	65.3202	90	1.85825	1.6318	0.0140799	15.5815	17.3322	1.88923	-1.7507	0.132793
167	15.4252	72.9057	90	1.93493	1.76786	0.015128	16.5059	18.3601	1.8893	-1.85414	0.141981
168	17.0331	80.8789	90	2.01739	1.91344	0.0163141	17.4251	19.4108	1.88933	-1.98566	0.152087
169	3.00712	13.0189	16.7943	1.09611	1.00043	0.573997	2.91083	3.87639	1.98363	-0.965554	0.0339452
170	3.80588	15.3887	19.1287	1.13248	1.00047	0.501002	3.86257	4.84207	1.98363	-0.979494	0.0411935
171	4.7479	17.867	21.5544	1.17693	1.00099	0.427402	4.80071	5.81041	1.98367	-1.0097	0.048626
172	5.5021	20.5057	24.1964	1.22636	1.00005	0.351324	5.71422	6.76883	1.98371	-1.05461	0.0561561
173	5.50407	23.3501	27.8174	1.2794	1.0008	0.274643	6.61323	7.7248	1.98375	-1.11157	0.0637321
174	5.88704	26.3938	32.0322	1.33469	1.0006	0.19614	7.50027	8.6774	1.98379	-1.17713	0.0712347
175	6.46334	29.6633	38.6362	1.3921	1.00031	0.115793	8.37615	9.6258	1.98384	-1.24965	0.0786984
176	7.22325	33.1784	52.5472	1.45206	1.00213	0.0333828	9.2458	10.5737	1.9839	-1.32791	0.0862016
177	7.00885	37.1741	90	1.5205	1.07501	0.00986362	10.1834	11.6043	1.98396	-1.42085	0.0944865
178	7.19396	41.2574	90	1.58989	1.17009	0.0107839	11.0986	12.6204	1.98403	-1.52179	0.10266
179	8.3713	45.4756	90	1.65966	1.26439	0.0116904	11.9977	13.6262	1.98408	-1.62843	0.110685
180	10.1644	50.3393	90	1.73383	1.36471	0.0126443	12.889	14.6358	1.98412	-1.74689	0.119087
181	11.6637	56.3706	90	1.81432	1.47745	0.0136908	13.778	15.657	1.98416	-1.87893	0.128256
182	12.4899	63.655	90	1.89943	1.60451	0.014835	14.6793	16.7002	1.98421	-2.02091	0.138149
183	13.9049	72.0028	90	1.98921	1.75042	0.0160795	15.585	17.7598	1.98424	-2.17486	0.148891

	Average Efficiency; Part Turbo-Comp	Average Power; Part Turbo-Comp	Average Mass Flow Rate; Part Turb80-1	Average Efficiency; Part Turb80-1	Average Power; Part Turb80-1	Average Mass Flow Rate; Part Throttle-01	Average Torque; Part ST_TQ-01	Average Gear Ratio; Part SupTurb_CVT-01	Average Input Torque; Part SupTurb_CVT-01	Average Output Torque; Part SupTurb_CVT-01	Average Output Power; Part SupTurb_CVT-01
Index	%	kW	kg/s	%	kW	No Unit	N-m	No Unit	N-m	N-m	W
1	21.0476	0.000408265	0.00427667	80	0.362505	3.99573	-0.216126	3.18951	2.75944	-0.865163	-289.568
2	20.4106	0.000282049	0.00583616	80	0.361492	5.44657	-0.174289	3.95514	2.75683	-0.697025	-288.83
3	20.2871	0.000289932	0.00732603	80	0.367931	6.85098	-0.143565	4.88859	2.8074	-0.574277	-294.026
4	20.2282	0.000322621	0.00879098	80	0.415844	8.21471	-0.13636	5.81735	3.17296	-0.545431	-332.346
5	20.204	0.000397541	0.0102646	80	0.465451	9.59138	-0.1311	6.77074	3.55257	-0.524695	-372.047
6	20.2027	0.000503793	0.0117694	80	0.510072	10.9976	-0.125432	7.75329	3.89133	-0.501894	-407.52
7	20.2523	0.000795422	0.0133399	80	0.564454	12.4651	-0.122295	8.79896	4.30455	-0.489211	-450.802
8	20.3789	0.00148912	0.0150573	80	0.646085	14.0695	-0.123431	9.97183	4.92364	-0.493755	-515.646
9	31.3606	0.0705114	0.0169471	80	0.757967	15.8356	-0.0673307	19.4948	5.25119	-0.269363	-549.905
10	41.0913	0.370442	0.0189634	80	0.898509	17.7196	-0.022002	45.848	4.03368	-0.0879793	-422.39
11	46.9886	0.712767	0.0210006	80	1.06133	19.6231	-0.0102407	65.0609	2.6649	-0.0409601	-279.075
12	20.4901	0.000445784	0.00685969	80	0.39059	6.40955	-0.159147	3.11676	1.98465	-0.636766	-311.974
13	20.2584	0.000400734	0.00915061	80	0.337809	8.55018	-0.105684	4.05802	1.71764	-0.42327	-269.849
14	20.1855	0.000432442	0.0112937	80	0.369078	10.5526	-0.094278	4.97554	1.87677	-0.377199	-294.803
15	20.158	0.000511824	0.0133712	80	0.431774	12.4942	-0.09341	5.87608	2.19576	-0.373678	-344.919
16	20.1652	0.000696158	0.0153804	80	0.493491	14.3713	-0.092849	6.756	2.50957	-0.371458	-394.223
17	20.2799	0.00146419	0.0173574	80	0.558738	16.2181	-0.0927876	7.64845	2.83562	-0.370744	-445.553
18	20.4158	0.00265414	0.0193318	80	0.628831	18.0625	-0.0931921	8.54838	3.18869	-0.373017	-500.988
19	20.6263	0.00472415	0.0212876	80	0.746022	19.8901	-0.0998085	9.46293	3.77571	-0.399001	-593.054
20	21.121	0.00982794	0.0233137	80	0.899475	21.7825	-0.108106	10.4822	4.53182	-0.432333	-711.89
21	38.4562	0.233724	0.0255158	80	1.08163	23.8397	-0.0509326	21.2047	4.3182	-0.203643	-678.292
22	43.9851	0.443054	0.0277458	80	1.30752	25.924	-0.036596	30.0932	4.40266	-0.146301	-691.525
23	52.2764	0.826843	0.0303218	80	1.61289	28.3326	-0.0238536	41.9828	4.00291	-0.0953463	-628.753
24	58.1664	1.21883	0.033088	80	1.98772	30.9193	-0.0189823	51.6766	3.91914	-0.0758398	-615.631
25	58.9937	1.74195	0.0359626	80	2.42789	33.6058	-0.0147792	59.2242	3.49649	-0.0590382	-549.217
26	20.3951	0.000590802	0.0090036	80	0.33034	8.41566	-0.104087	3.0106	1.2601	-0.418554	-263.999
27	20.2711	0.000688228	0.0119181	80	0.261794	11.1296	-0.0635515	3.93292	0.995466	-0.253111	-208.497
28	20.1573	0.000614882	0.0147248	80	0.292188	13.7587	-0.0571336	4.82715	1.11642	-0.23128	-233.82
29	20.2301	0.00124178	0.0174134	80	0.343899	16.2672	-0.0572459	5.715	1.30828	-0.22892	-274.005
30	20.1328	0.000936586	0.0201541	80	0.399062	18.832	-0.057684	6.59176	1.5209	-0.230727	-318.513
31	20.2992	0.00267577	0.0229073	80	0.472226	21.4012	-0.0596115	7.52	1.79315	-0.23845	-375.556
32	20.6344	0.00695015	0.0256453	80	0.591991	23.9587	-0.0659109	8.4799	2.23563	-0.263638	-468.229
33	21.0702	0.0133672	0.0283931	80	0.760849	26.5247	-0.0755312	9.45809	2.85576	-0.301938	-598.659
34	22.6267	0.0348507	0.0312542	80	0.975503	29.1984	-0.0830463	10.825	3.59473	-0.332077	-752.879
35	27.5009	0.124222	0.0344679	80	1.27786	32.1998	-0.0770621	14.3122	4.40984	-0.308118	-923.753
36	43.0125	0.569296	0.0381991	80	1.69497	35.6894	-0.0461444	23.3329	4.3046	-0.184486	-901.62
37	53.0341	0.99915	0.0418355	80	2.18415	39.0928	-0.0367571	30.841	4.53021	-0.146889	-948.756
38	59.6519	1.41196	0.0452011	80	2.66632	42.2412	-0.0324977	36.9407	4.79875	-0.129904	-1005.08
39	62.835	1.9326	0.0486702	80	3.2356	45.4747	-0.0294188	42.3977	4.98349	-0.117542	-1043.71
40	63.1309	2.64757	0.0526824	80	3.98592	49.1808	-0.0269095	47.6298	5.12011	-0.107498	-1072.33
41	63.0703	3.52895	0.0574966	80	4.95062	53.5878	-0.0258463	52.7174	5.44357	-0.10326	-1140.12
42	62.9696	4.67166	0.063047	80	6.1705	58.6481	-0.0246992	58.1937	5.74168	-0.0986649	-1202.56
43	62.6402	6.07131	0.0691191	80	7.65126	64.1864	-0.0239615	63.264	6.05316	-0.0956808	-1267.77
44	20.2527	0.000644487	0.0119429	80	0.26804	11.1582	-0.0646752	3.14999	0.816074	-0.259072	-213.685
45	20.1364	0.000589235	0.0155238	80	0.248778	14.5033	-0.0465304	4.06456	0.756847	-0.186206	-198.169
46	20.1115	0.00071603	0.0189419	80	0.320289	17.6972	-0.0492287	4.9524	0.975881	-0.197052	-255.474
47	20.0943	0.000823539	0.022221	80	0.40884	20.7618	-0.0536582	5.80465	1.24595	-0.214646	-326.204
48	20.3273	0.00353166	0.0254782	80	0.546712	23.806	-0.0620034	6.69371	1.65975	-0.247956	-434.414
49	20.5981	0.00799463	0.0287538	80	0.713352	26.8662	-0.0710338	7.58847	2.15615	-0.284135	-564.655
50	20.9972	0.0159437	0.0320106	80	0.944636	29.9068	-0.0834718	8.50359	2.83905	-0.333865	-743.499
51	21.836	0.0347387	0.0352816	80	1.24354	32.9621	-0.0972927	9.5	3.69576	-0.389027	-967.548
52	22.3515	0.0487431	0.0387434	80	1.62773	36.1962	-0.114994	10.5	4.82754	-0.459766	-1263.85
53	23.8004	0.0848093	0.0423926	80	2.08817	39.6054	-0.129816	11.8	6.12487	-0.519057	-1603.49
54	40.8139	0.514518	0.0460493	80	2.55499	43.0245	-0.0934141	16.7041	6.2395	-0.373532	-1633.69
55	52.6221	0.966648	0.0496585	80	3.05858	46.3988	-0.0710844	22.5094	6.39614	-0.284154	-1674.38
56	60.1765	1.43217	0.0536464	80	3.71712	50.1087	-0.0630156	27.7402	6.98896	-0.251943	-1829.79
57	66.0477	1.96634	0.0580594	80	4.50954	54.1789	-0.0595705	32.6629	7.77739	-0.238111	-2036.05
58	66.4564	2.71853	0.0628193	80	5.41032	58.5273	-0.0563195	36.5754	8.23257	-0.225085	-2155.21
59	66.9571	3.54011	0.0676788	80	6.37863	62.9437	-0.0536508	40.5013	8.68489	-0.214435	-2273.74
60	66.6333	4.49218	0.07268	80	7.45144	67.4934	-0.0517278	43.806	9.05585	-0.206726	-2370.85
61	66.5103	5.52014	0.0778453	80	8.65068	72.2022	-0.0506995	47.2894	9.58029	-0.202589	-2508.12
62	20.2389	0.000929711	0.0146891	80	0.276725	13.7236	-0.0544734	3.22366	0.700893	-0.217422	-220.369
63	20.1137	0.000723546	0.0188419	80	0.297854	17.6035	-0.0459669	4.11218	0.75585	-0.183807	-237.545
64	20.0945	0.000886121	0.0228862	80	0.4149	21.3804	-0.0528138	4.9909	1.05438	-0.21126	-331.29
65	20.0735	0.000946835	0.0268307	80	0.565433	25.0669	-0.0614651	5.84801	1.43779	-0.245859	-451.766
66	20.1127	0.00184073	0.030725	80	0.772917	28.7063	-0.0732636	6.70383	1.96419	-0.292996	-617.084
67	20.2113	0.00425462	0.0346582	80	1.08431	32.3828	-0.0908086	7.57815	2.75143	-0.363074	-864.207
68	20.4171	0.0101917	0.0386158	80	1.45445	36.0809	-0.108648	8.46824	3.67944	-0.434499	-1156.13
69	20.9179	0.0267373	0.0425614	80	1.88026	39.7649	-0.125642	9.4	4.72244	-0.502388	-1483.6
70	21.5802	0.0513364	0.0464794	80	2.35318	43.4253	-0.141715	10.35	5.86467	-0.566634	-1842.44
71	30.2986	0.336134	0.0505122	80	2.88297	47.1945	-0.130491	12.4384	6.489	-0.52169	-2038.25
72	46.2309	0.808771	0.0548106	80	3.52548	51.2018	-0.103087	16.7981	6.9223	-0.412089	-2174.47
73	56.4475	1.29096	0.0594129	80	4.29913	55.4688	-0.091357	20.9902	7.66571	-0.365204	-2408.14
74	64.3693	1.82477	0.0642744	80	5.17294	59.9349	-0.0848283	25.1639	8.53415	-0.339142	-2681.23
75	67.6937	2.48554	0.0693653	80	6.13754	64.5803	-0.0813381	28.625	9.30655	-0.325119	-2923.61
76	68.5902	3.30153	0.0747539	80	7.24545	69.4889	-0.079232	31.7393	10.0515	-0.316691	-3157.69
77	68.9801	4.27336	0.0806147	80	8.58608	74.8374	-0.0790603	34.7877	10.994	-0.31603	-3453.92
78	69.059	5.48007	0.0871507	80	10.2301	80.8124	-0.0800101	37.8687	12.1103	-0.319798	-3804.65
79	69.123	6.92557	0.0942589	80	12.1503	87.3121	-0.0811096	41.0935	13.3216	-0.324178	-4185.18
80	20.1225	0.000661775	0.0173763	80	0.302795	16.2363	-0.050625	3.25432	0.659398	-0.202622	-241.656
81	20.0978	0.000857885	0.0221488	80	0.33888	20.6943	-0.0445367	4.14113	0.737828	-0.17817	-270.468
82	20.0754	0.000973828	0.0268774	80	0.456017	25.1118	-0.0494414	5.02143	0.993349	-0.197822	-364.164
83	20.0615	0.00109476	0.0315326	80	0.721457	29.4597	-0.0667375	5.89028	1.57267	-0.266994	-576.528
84	20.4364	0.00997187	0.0361618	80	1.06095	33.7826	-0.0843878	6.8	2.29455	-0.337434	-840.997
85	20.64	0.017979	0.0408333	80	1.48119	38.15	-0.103744	7.7	3.19478	-0.414906	-1170.95
86	20.7743	0.0259844	0.045535	80	1.98146	42.5468	-0.124165	8.6	4.26995	-0.496506	-1565.02
87	21.722	0.0679757	0.0502658	80	2.55794	46.9712	-0.141659	9.6	5.43745	-0.566401	-1992.93
88	22.0856	0.0895378	0.0549257	80	3.19306	51.3212	-0.161102	10.516	6.77673	-0.64442	-2485.58
89	24.5529	0.195689	0.0596388	80	3.93255	55.7091	-0.173922	11.7334	8.16043	-0.695487	-2991.78
90	40.8638	0.891537	0.0649415	80	4.82493	60.6133	-0.142304	15.1	8.59043	-0.568901	-3148.24
91	54.978	1.51545	0.0704494	80	5.81905	65.6603	-0.123828	18.9875	9.40067	-0.495098	-3445.76
92	64.2064	2.09415	0.0759982	80	6.88115	70.716	-0.117042	22.3454	10.457	-0.46797	-3832.92
93	67.602	2.84173	0.0817208	80	8.06466	75.9295	-0.114091	25.0131	11.408	-0.456082	-4181.09
94	69.3892	3.73846	0.0878762	80	9.48288	81.5451	-0.11338	27.6847	12.5476	-0.453234	-4598.79
95	70.3198	4.86002	0.0948027	80	11.2745	87.8684	-0.115692	30.2961	14.0119	-0.462497	-5135.59
96	70.836	6.17787	0.102277	80	13.3717	94.6846	-0.119618	32.861	15.7138	-0.478191	-5759.28
97	71.2368	7.52525	0.109459	80	15.4436	101.216	-0.123281	35.1007	17.2988	-0.492834	-6340.39

Index	Average Efficiency; Part Turbo-Comp	Average Power; Part Turbo-Comp	Average Mass Flow Rate; Part Turb80-1	Average Efficiency; Part Turb80-1	Average Power; Part Turb80-1	Average Mass Flow Rate; Part Throttle-01	Average Torque; Part ST_TQ-01	Average Gear Ratio; Part SupTurb_CVT-01	Average Input Torque; Part SupTurb_CVT-01	Average Output Torque; Part SupTurb_CVT-01	Average Output Power; Part SupTurb_CVT-01
	%	kW	kg/s	%	kW	No Unit	N-m	No Unit	N-m	N-m	W
98	20.0182	0.00014124	0.0207673	80	0.231018	19.3953	-0.0325321	3.38983	0.440934	-0.130075	-184.661
99	20.0745	0.000910496	0.0261594	80	0.367011	24.4398	-0.0408698	4.27714	0.699201	-0.163474	-292.873
100	20.0646	0.0011469	0.0314933	80	0.635677	29.4264	-0.0588438	5.14907	1.21201	-0.235385	-507.726
101	20.0569	0.00137598	0.0367569	80	0.985722	34.3437	-0.0782122	6.01109	1.8804	-0.312821	-787.697
102	20.3517	0.010822	0.04199	80	1.42198	39.2323	-0.0976935	6.90282	2.69582	-0.390539	-1128.68
103	20.4627	0.0169559	0.047271	80	1.95141	44.1678	-0.118783	7.78188	3.6957	-0.474911	-1547.66
104	20.7964	0.03507	0.0525699	80	2.57573	49.1278	-0.139681	8.69373	4.8543	-0.558368	-2032.21
105	21.451	0.0739631	0.0579303	80	3.30472	54.1375	-0.160116	9.64145	6.17298	-0.640254	-2585.73
106	22.3977	0.130352	0.0631478	80	4.10988	58.9976	-0.179347	10.6024	7.60363	-0.717161	-3184.94
107	24.8789	0.251198	0.0683693	80	4.94523	63.8122	-0.190758	11.7513	8.96808	-0.763159	-3759.82
108	37.7997	0.997148	0.0741982	80	5.96145	69.1625	-0.16629	14.2657	9.48609	-0.664957	-3973.93
109	52.6581	1.73523	0.0803184	80	7.14957	74.743	-0.148425	17.4333	10.3468	-0.593508	-4334.42
110	62.4037	2.39036	0.086556	80	8.47024	80.4201	-0.143136	20.3014	11.6195	-0.572349	-4867.57
111	66.0425	3.27507	0.0931472	80	10.0016	86.419	-0.142175	22.6132	12.8557	-0.568503	-5385.38
112	68.7283	4.30422	0.100319	80	11.8511	92.9431	-0.144025	25.0444	14.4216	-0.57584	-6040.68
113	69.9378	5.57116	0.108157	80	14.0531	100.054	-0.14869	27.2683	16.2095	-0.594446	-6789.85
114	70.9524	6.93723	0.116081	80	16.3764	107.224	-0.153121	29.464	18.0371	-0.612175	-7555.1
115	71.2671	8.30425	0.123351	80	18.4905	113.778	-0.156143	31.1801	19.4638	-0.624236	-8152.47
116	20.0889	0.000907703	0.0239492	80	0.266713	22.339	-0.0324251	3.47922	0.45131	-0.129716	-212.713
117	20.0696	0.00112281	0.0300292	80	0.513117	28.0388	-0.0497606	4.36574	0.869268	-0.199111	-409.664
118	20.0587	0.00137786	0.0361829	80	0.872702	33.8037	-0.0702542	5.26364	1.4794	-0.28106	-697.296
119	20.5063	0.0158829	0.0423177	80	1.34188	39.5449	-0.0907694	6.20248	2.25135	-0.362976	-1060.74
120	20.7727	0.0307924	0.048298	80	1.91521	45.1301	-0.112681	7.10015	3.19971	-0.450654	-1507.8
121	20.7746	0.0362977	0.0541453	80	2.59289	50.5946	-0.136375	7.95867	4.34127	-0.545477	-2046.13
122	21.5087	0.0841126	0.0600064	80	3.38972	56.0622	-0.157952	8.88486	5.61326	-0.631778	-2645.89
123	22.1036	0.131039	0.0658528	80	4.29351	61.5116	-0.180301	9.80288	7.06847	-0.721061	-3331.02
124	23.5614	0.232269	0.0716995	80	5.27901	66.9326	-0.19848	10.7955	8.57001	-0.793854	-4039.38
125	28.1339	0.508127	0.0777591	80	6.37553	72.515	-0.204651	12.1737	9.96394	-0.818482	-4695.62
126	42.5168	1.47225	0.0843457	80	7.67279	78.5449	-0.178818	14.7245	10.5301	-0.715142	-4962.52
127	54.7336	2.22319	0.0910095	80	9.12769	84.6119	-0.169797	17.2687	11.7265	-0.679062	-5526.55
128	61.4285	3.09568	0.0980536	80	10.8108	91.0044	-0.168021	19.5002	13.1025	-0.671915	-6174.5
129	65.4111	4.14203	0.105601	80	12.7701	97.8298	-0.168821	21.7038	14.6523	-0.675104	-6904.51
130	67.5815	5.43593	0.11393	80	15.129	105.335	-0.172907	23.8088	16.4614	-0.691398	-7757.08
131	69.1815	6.9912	0.123273	80	17.9968	113.734	-0.179841	25.9914	18.6904	-0.719099	-8807.4
132	69.8723	8.84833	0.133397	80	21.3035	122.823	-0.188811	28.018	21.1525	-0.754962	-9967.6
133	70.0543	10.8025	0.143378	80	24.6183	131.778	-0.196479	29.8655	23.4631	-0.785625	-11056.4
134	20.076	0.000996593	0.0271462	80	0.400525	25.2781	-0.0431198	3.53832	0.610497	-0.172539	-319.729
135	20.083	0.0016913	0.0338413	80	0.726677	31.5658	-0.0626378	4.42006	1.10772	-0.250611	-580.14
136	20.1003	0.00294273	0.0405781	80	1.21088	37.894	-0.0868679	5.31153	1.84558	-0.347466	-966.345
137	20.9659	0.0372717	0.0473782	80	1.84471	44.2706	-0.110002	6.27595	2.76176	-0.440055	-1446.41
138	20.3794	0.0184417	0.0540565	80	2.60746	50.5118	-0.139004	7.11517	3.95625	-0.55603	-2071.05
139	20.7104	0.0423907	0.0605587	80	3.49701	56.5713	-0.164975	8.00463	5.27938	-0.659541	-2762.32
140	21.3356	0.0941028	0.0671179	80	4.51182	62.6573	-0.189353	8.91434	6.75098	-0.757316	-3534.97
141	22.0036	0.157455	0.0737174	80	5.64124	68.7777	-0.212834	9.84922	8.38099	-0.850929	-4385.6
142	24.4913	0.348064	0.08046	80	6.91891	75.0104	-0.229445	10.9435	10.042	-0.917618	-5257.82
143	33.1981	0.970773	0.0874568	80	8.38738	81.4651	-0.223131	12.7036	11.3343	-0.892208	-5932.64
144	48.0886	2.07506	0.0947656	80	10.0453	88.1594	-0.201032	15.1503	12.1817	-0.804059	-6379.27
145	56.5969	2.9655	0.102279	80	11.9032	94.9858	-0.199083	17.1574	13.6616	-0.796247	-7154.38
146	62.0971	4.08971	0.110771	80	14.2342	102.648	-0.201477	19.2429	15.5065	-0.805828	-8120.48
147	65.1131	5.39054	0.119552	80	16.6902	110.502	-0.203763	21.1951	17.2688	-0.814753	-9040.99
148	67.0395	6.89577	0.128736	80	19.3391	118.65	-0.205853	23.1028	19.0161	-0.823106	-9955.74
149	68.1232	8.84221	0.139301	80	22.6702	128.011	-0.210869	25.0638	21.1369	-0.843325	-11068.1
150	68.5544	11.4065	0.151749	80	26.9789	139.084	-0.21855	27.2341	23.8035	-0.874032	-12464.4
151	67.7844	15.0088	0.166083	80	32.3057	151.898	-0.221638	29.8297	26.4402	-0.886371	-13845
152	20.2012	0.00362134	0.032018	80	0.63545	29.7683	-0.0577507	3.79804	0.877629	-0.231074	-505.521
153	20.0348	0.000959814	0.0391687	80	1.08304	36.4962	-0.0808573	4.64574	1.50286	-0.323492	-865.508
154	20.0954	0.00366585	0.0464431	80	1.72603	43.3374	-0.108232	5.52602	2.39219	-0.432895	-1377.62
155	20.1526	0.00749743	0.0538562	80	2.56228	50.2907	-0.138182	6.42099	3.54834	-0.552616	-2044.12
156	20.3423	0.0212905	0.0612515	80	3.56152	57.1811	-0.167892	7.32209	4.91754	-0.671604	-2833.1
157	20.5921	0.0451315	0.0684839	80	4.68776	63.8983	-0.196361	8.21038	6.4492	-0.785494	-3715.09
158	21.2579	0.113904	0.0758001	80	5.96664	70.6512	-0.222461	9.13807	8.1304	-0.889728	-4682.77
159	22.1741	0.220061	0.0832698	80	7.41674	77.5383	-0.247385	10.1047	9.99791	-0.989428	-5758.65
160	27.8067	0.733989	0.0908575	80	9.04319	84.5176	-0.252364	11.4397	11.5429	-1.00902	-6648.34
161	42.9141	1.96993	0.0987422	80	10.9194	91.7727	-0.228653	13.5962	12.4335	-0.914487	-7161.21
162	53.0564	2.97182	0.106608	80	12.931	98.9653	-0.222478	15.5505	13.8363	-0.88976	-7969.08
163	59.1321	4.07879	0.114927	80	15.136	106.48	-0.220917	17.3891	15.3626	-0.883462	-8848.28
164	62.6894	5.37585	0.123843	80	17.589	114.428	-0.221666	19.1478	16.9668	-0.886095	-9772.12
165	64.9326	6.97859	0.13391	80	20.5706	123.297	-0.225133	20.9676	18.8848	-0.900669	-10876.7
166	66.1267	8.95008	0.144769	80	23.8152	132.793	-0.226755	22.7752	20.6533	-0.906836	-11895.6
167	66.7897	11.1621	0.155347	80	26.8672	141.981	-0.222789	24.4917	21.821	-0.890953	-12568.2
168	66.5327	13.8418	0.166914	80	30.483	152.087	-0.219496	26.3408	23.1215	-0.877783	-13317.2
169	20.2596	0.00605394	0.0365525	80	0.902289	33.9404	-0.0717324	3.9768	1.14111	-0.286942	-716.98
170	20.237	0.0081605	0.0442694	80	1.48788	41.1935	-0.0975139	4.83224	1.8836	-0.389798	-1182.27
171	20.4193	0.0199639	0.0521984	80	2.30966	48.626	-0.127518	5.71696	2.91512	-0.509907	-1830.72
172	20.1138	0.00693265	0.0602553	80	3.35634	56.1561	-0.161912	6.58584	4.2648	-0.647571	-2679.04
173	20.4865	0.0380244	0.0683987	80	4.61224	63.732	-0.193901	7.5122	5.82462	-0.775356	-3657.9
174	20.7026	0.0662932	0.0765089	80	6.04396	71.2346	-0.226017	8.42339	7.61236	-0.903717	-4780.2
175	21.0854	0.119775	0.084625	80	7.64294	78.6983	-0.256362	9.34667	9.58059	-1.02503	-6015.5
176	22.0322	0.252584	0.0928378	80	9.41911	86.2016	-0.283086	10.3094	11.6726	-1.13223	-7334.78
177	34.9566	1.64745	0.101923	80	11.5733	94.4865	-0.2598	12.1631	12.6398	-1.0392	-7943.47
178	48.0724	2.90113	0.110913	80	13.8814	102.66	-0.24783	14.107	13.9832	-0.991224	-8786.61
179	55.6022	4.09299	0.119781	80	16.325	110.685	-0.24543	15.8697	15.5777	-0.981599	-9788.31
180	60.0373	5.47052	0.129156	80	19.0487	119.087	-0.245862	17.5858	17.2921	-0.983302	-10865.4
181	62.7614	7.1619	0.139529	80	22.1088	128.256	-0.24634	19.3182	19.0337	-0.985271	-11958.7
182	64.1333	9.26301	0.15088	80	25.4443	138.149	-0.24495	21.0319	20.6069	-0.979794	-12947.7
183	64.9417	11.8344	0.163292	80	29.1869	148.891	-0.241838	22.8456	22.0983	-0.967287	-13884.8

Appendix D: Comparison of SuperTurbo test data to modeling data

Parameter	Engine Speed	BMEP	Torque	Power	IMEP(720)	IMEP(360)	PMEP	FMEP
UNIT	RPM	bar	N-m	kW	bar	bar	bar	bar
Test Data WG closed	2707	13.40	211.5	60.0	14.1	14.7	-0.54	0.73
TestData WG open	2707	13.30	210.0	59.5	14.3	14.7	-0.38	0.99
SuperTurbo Model	2707	13.40	211.6	60.0	14.5	14.8	-0.32	1.36
Stock Model	2707	13.40	211.5	60.0	14.8	15.0	-0.21	1.36

Parameter	Atmospheric Pressure	Atmospheric Temperature	Compressor Outlet Pressure	Turbine Inlet Temperature	Turbine Outlet Temperature	Turbine Inlet Pressure	Turbine Outlet Pressure	Catalyst Inlet Pressure
UNIT	bar	K	bar	K	K	bar	bar	bar
Test Data WG closed	1.00	302	1.34	1117	980	1.72	1.10	1.06
TestData WG open	1.00	302	1.33	1114	980	1.54	1.10	1.06
SuperTurbo Model	1.00	302	1.39	1152	1102	1.69	1.17	1.17
Stock Model	1.00	302	1.39	1155	1114	1.61	1.19	1.17

Parameter	Catalyst Outlet Pressure	Lambda	BSFC	Fuel Injection Rate	Inlet Air Mass Flow Rate	Wastegate Flow	WastegateSingnal	Turbine Speed
UNIT	bar	No Unit	g/kW-h	g/s	g/s	g/s	%	RPM
Test Data WG closed	1.01	0.97	248	1.03	58.6	0	100	90486
TestData WG open	1.01	0.97	250	1.03	58.6	NA	29	89562
SuperTurbo Model	1.09	0.96	245	1.02	56.1	0	NA	90486
Stock Model	1.10	0.96	248	1.03	56.8	11.6	NA	90276

Parameter	50% Burned Crank Angle	Ignition Timing	CVT Torque added to Crankshaft	Calculated Gear Ratio
UNIT	deg	deg	N-m	No Unit
Test Data WG closed	14.55	-13.19	4.31	33.427
TestData WG open	14.57	-13.21	0.46	33.085
SuperTurbo Model	12.90	-13.19	4.51	33.427
Stock Model	12.90	-13.19	NA	33.349