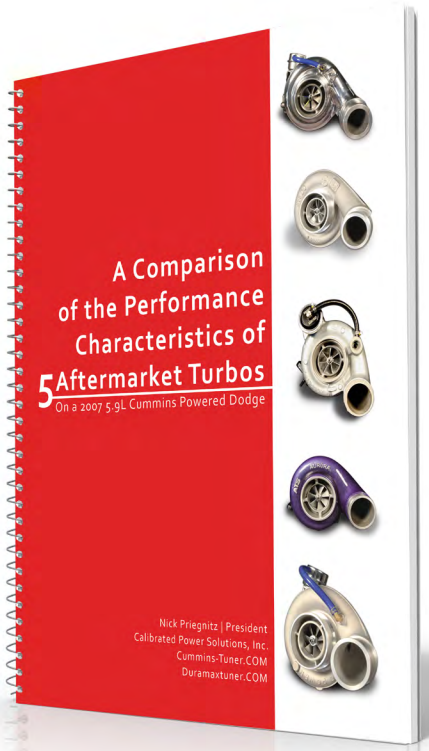
A Comparison of the Performance Characteristics of 5 Aftermarket Turbos

On a 2007 5.9L Cummins Powered Dodge

Nick Priegnitz | President
Calibrated Power Solutions, Inc.
Duramaxtuner.COM

TABLE OF CONTENTS



Download a printer friendly version of this article here.

Five aftermarket turbochargers are comparison tested against the factory turbocharger on a mildly modified 2007 Dodge 2500 equipped with the 5.9L Cummins and 48re automatic transmission.

The turbochargers in this test are the stock **Holset HE351CW, BD Killer B**, **Industrial Injection 62/80SB**, **Fleece Holset Cheetah**, **Engineered Diesel 63mm Billet S300**, and **ATS Aurora 3000**. The turbochargers were selected because of their popularity in the aftermarket, their price point, and the blind recommendation of the manufacturers' sales staff to our buyer. The goal of the test is to offer a broad scope of performance characteristics by collecting data under a variety common truck usages. Specific tests were designed to best characterize the driveability, towing utility, and peak power potential of each unit tested in a quantitative way. The tests focus on turbocharger responsiveness (lag time), exhaust gas temperature control in towing scenarios, and peak horsepower/torque output. The tests were carried out in a dyno cell where operating conditions could be held constant, and turbocharger type could be made the only variable. Data sets for these tests are presented and analyzed in a way that clearly defines the strengths and weaknesses of each unit. This analysis allows buyers to match their performance goals to the strengths of the turbos tested.

The Cummins Powered Dodge 2500 and 3500 series trucks have enjoyed substantial aftermarket power-train support.

This support allows owners to customize their vehicles engine, transmission, etc. to best suit the intended use. Many of the owners of these trucks use them for hauling heavy loads or for various performance oriented events like drag racing and sled pulling. While towing, extra weight behind the truck lowers its ability to hold speed on steep grades without overheating, and slows acceleration. In competitive applications, the benefit of added power improves the odds of winning. The output of the engine can be raised substantially by adding to the amount of fuel delivered per combustion cycle. This is achieved through a variety of methods including installation of larger fuel injectors, engine programming changes which increases injector duration and pressure, and also by adding injectables like propane, LNG, and water/methanol to the intake stream. Regardless of the method used to uprate the engine, the user will eventually realize the limitations of the factory turbocharger, which supplies the requisite air needed for efficient combustion of the fuel.

Limitations of the factory turbocharger are evidenced by an increase in exhaust gas temperature, increased intake temperature, increased particulate matter in the exhaust due to richer than stoichiometric combustion, and a horsepower plateau as the engine runs out air. These symptoms will compromise the use-ability of the vehicle, and may depending on the severity and duration, lead to engine failure. To overcome the factory HE351CW turbocharger's airflow limitations, the performance aftermarket offers a variety of larger turbochargers which can be mounted in place of the factory unit. Most of these units are similar in size and appearance, and are priced between $1500 and $2000 retail. Most of the manufacturers claim improved power, lower EGTs and quicker spool up in their marketing of these aftermarket units.

Our goal in this study is two-fold.

The first goal is to establish a simple, yet robust test procedure that simulates and quantifies the elements of truck performance that owners are most interested in. We aim to establish a standard by which other groups of turbochargers may be compared in future studies. The standard needs to provide a clear and repeatable way to test the broad scope performance of the turbocharger in its intended environment. Furthermore, the test results need to be understandable. Results should be easily compared by buyers. Buyers should know what to expect from their purchase. Also, manufacturers should be able to set performance goals for future products using these standards.

Our second goal is to offer the most complete review of entry-level aftermarket turbocharger upgrade options ever compiled on the 2003-2007 Cummins 5.9L engine. This review is to verify the usefulness of the test procedure, and to highlight the potential for standardized testing to benefit the customers and the manufactures representatives within the industry. Our hope is that as new turbocharger models are designed and released, potential customers will not have to rely on local anecdotal reviews when considering which turbocharger best fits their needs.

The test method can be broken into three sections per turbocharger based on the three major tests performed.

We test drive-ability using the 'Spool Up Test'. Towing performance is tested on the 'Towing Test'. We test drive-ability using the 'Spool Up Test'. Towing performance is tested on the 'Towing Test'. Peak power output is tested using the 'Power Test'. We used three separate tests to give a clear perspective on how the units compare quantitatively. All three tests are performed on the dual eddy current load cell dyno at Calibrated Power Solutions facility. The room is ventilated and the front of the truck is cooled using a high capacity 15 horsepower blower to best simulate real world driving conditions on the intake, intercooler, and radiator. All tests are performed in direct drive with the torque converter clutch manually engaged. This is done to minimize driveline idiosyncrasies and vehicle wear. Expect similar results in drive and overdrive testing regardless of transmission type (manual or automatic).

CPS conducted its turbo testing on its on-site 4WD Mustang Dynamometer.

SPOOL UP TEST

The 'Spool Up Test' is designed to measure throttle response by calculating how quickly the engine can deliver power once the accelerator is depressed. In this test we command the dyno to hold the engine at a constant RPM using dynamic load cell control. We then measure how quickly the truck can go from delivering 60 horsepower (HP) to delivering 300 HP. The original test design was conducted at 1700 RPM and measured the time interval to go from 30 HP to 250HP. This test was useable and repeatable on the stock turbocharger, Aurora 3K, and Fleece Cheetah, but proved unusable on the rest of the turbochargers in the shootout. Those turbochargers could not make 250HP at 1700RPM. As a result the test RPM had to be raised along with the starting HP and ending HP. The second test style is performed at 2000 RPM, measuring the time to increase output from 60HP to 300HP. Each test is performed five times consecutively. The last three attempts are recorded and averaged for comparison. Because two of the turbochargers (Fleece and Stock) could not be tested on the 2000 RPM Spool Up test, their comparison data for the 2000RPM table was an estimate that was calculated by normalizing data to the ATS turbocharger data sets which were run at both 2000RPM and 1700 RPM. The 45% over Exergy Injectors and Calibrated Power Tow tune remain constant for each and every Spool Up Test.

For those attempting to duplicate this test on other turbochargers, be advised that verifying the consistency and viability of the test on the largest (slowest to spool) turbocharger is a good way to ensure there won't be any need to alter the protocol halfway through. If the test delivers good data on the largest turbocharger, it will probably work well on all smaller units.

TOWING TEST

Because towing involves laboring with heavy loads and climbing hills for extended periods of time, the 'Towing Test' is easily the most grueling in our array. The goal of this test is to accurately measure each turbochargers ability to control exhaust gas temperatures across a wide range of engine/vehicle speeds. We do this by measuring the maximum achievable horsepower output while staying within a 1200 Deg F exhaust gas temperature limit. Using dynamic load cell control, constant test points at 1400, 1700, 2000, 2300, 2600, and 3000 RPM are commanded by the dyno operator as the truck accelerator is pushed until exhaust temps stabilize at 1200. The horsepower number is then recorded and the truck is allowed to cool back down to 185 Deg F (engine coolant temp) before moving on to the next test RPM.

This test generates a tremendous amount of heat in the dyno cell. It's important to be deliberate to avoid ambient air temps that cause cooling fan engagement. Each tow test is started at 185 Deg F coolant temp and completed before 205 Deg F. We only count tests where the cooling fan did not engage, as fan engagement could cost as much as 20-30HP in decreased performance. The 45% over Exergy Injectors and Tow tune are used in each and every towing test.

Most performance diesel shops that operate dynos have the ability to supply their customers with peak horsepower and torque numbers. Peak power numbers for trucks equipped with these turbochargers exist on the Internet for those willing to look. What does not exist, however, is a controlled test where each of these turbochargers is tested on the same truck with the same tune-up on the same dyno in a scientific way. Our peak performance protocol is straight-forward. We run the truck at full throttle against the dyno brake at the start RPM until engine power peaks, then proceed through the test window, allowing a 7 second acceleration period to reach the end RPM. The Dyno computer dynamically alters the load to make sure the test takes 7 seconds. The stock turbo, Aurora 3000 and Fleece Cheetah are tested from 1700RPM to 3200RPM, the remaining turbochargers in the test are tested from 2000 RPM to 3200. The variance here is due to the inability of the larger turbochargers to reach full boost at 1700 RPM, requiring a 2000 RPM start instead.

Peak power tests are performed in sets of 3 to verify consistency. After each test, the truck is allowed to cool down to 185 Deg F before re-running the test. After the first round of testing with '45% over' injectors from Exergy, we realize that there is a grouping of turbochargers that peak at 645-648HP. It is determined that some of the turbochargers in the group require more fuel to achieve their peak numbers. For this reason, any turbocharger that achieves over 645 HP during the testing with '45% over' injectors qualifies for a secondary run with '100% over' injectors. '100% over' injectors insure that we reach the power limit of every turbocharger. Aside from peak power and torque, peak manifold pressure and exhaust gas temperature data are also collected on each test. We do this so that buyers know what to expect when operating their truck at these levels.

The test vehicle is setup to broadly resemble the type of vehicle owned by those interested in this test. There are a wide variety of aftermarket parts combinations available in the 5.9L Cummins aftermarket. To duplicate all or even most of them would be cost prohibitive. We settle on a fairly run-of-the-mill, yet slightly overbuilt example of the 2007 5.9L Dodge Cummins. The truck is owned and maintained by Calibrated Power Solutions Inc. It has about 160,000 miles. Most of the critical driveline parts are upgraded to handle the stresses of this test. The engine and transmission modifications are spelled out below. Essentially, the factory engine and transmission have been modified to reliably hold 750+ HP.

Engine modifications

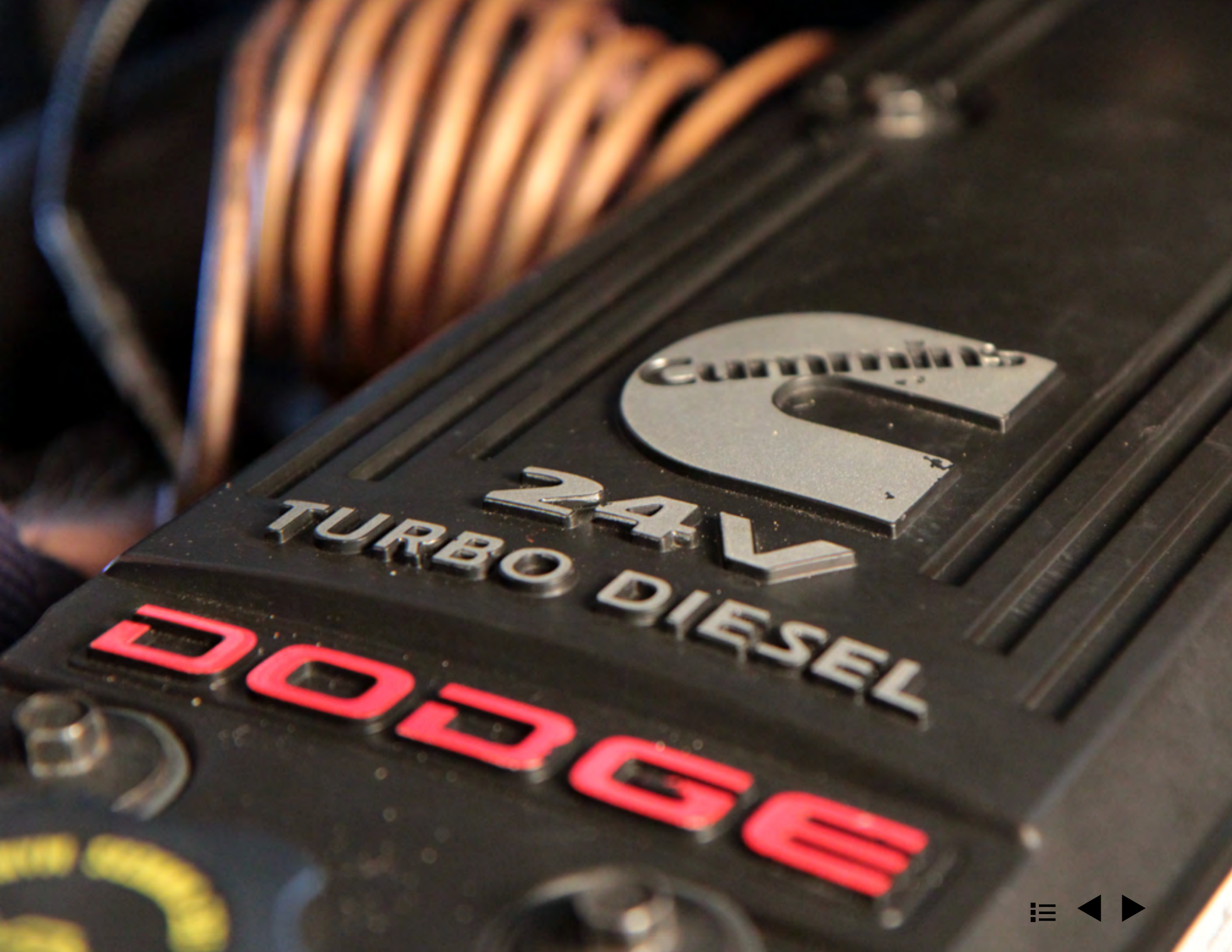
- Head studs and O-ringed head
- 110Lb valve springs
- 12mm Exergy High pressure pump (CP3), S&B Intake system
- 5 inch stainless exhaust
- FASS 150 lift pump
- S&B Intake horn
- 45%/100% over injectors depending on which test

Transmission and Driveline

- 4 speed 48re
- Upgraded valve body by Goerend Transmission Inc.
- 3 disk billet lockup style torque converter by Midwest
- TCC manual Lockup switch
- 4.10 Gears
- 31 inch tire

Electronics and Gauges

- Engine and transmission tuning via SPADE Tuner by Calibrated Power
- Edge Products ‘CTS’ monitor with 0-100 psi boost and drive pressure pickups, and expandable EGT probe


Cummins
24V
TURBO DIESEL
DODGE

The turbochargers tested in this meet the requirements of being popular, fairly simple to bolt in, and available in the retail aftermarket for less than $2000. A member of the Calibrated Power Solutions team calls each manufacturer and poses as a buyer, delivering the following line:

Each manufacturer's suggestion is recorded. The next day all manufacturers are contacted and asked if they'd be willing to participate in the test. They are only allowed to submit the turbo they suggested previously to our posing buyer. Turbochargers are supplied to Calibrated Power Solutions Inc. for testing free of charge. See figure T-1 for a list of the turbochargers in the test in alphabetical order along with the retail price and manufacturer.

Turbocharger Name	Retail Price	Manufacturer
ATS Aurora 3000	$1,568	ATS
BD Performance Killer B	$1,638	BD Diesel
Engineered Diesel 63mm	$1,950	Engineered Diesel
Fleece Performance Cheetah	$1,847	Fleece Performance
Industrial Injection 62SB	$1,941	Industrial Injection
Stock HE351cw	$1,000	Holset

Figure T-1

"I have a 2007, 5.9L Cummins with a built transmission and tuning. I want to upgrade my turbo to something with a little more power. I'd like something that's not too laggy, and also something that's going to keep the EGT's down when towing. What would you recommend?"

Figure T-2 gives a much more technical look at the turbochargers. Compressor and exhaust wheel measurements as well as blade count allow us to more accurately understand the dynamics and relate turbo theory to the test results. The turbochargers in this test range from the ATS Aurora 3000 which offers a smaller than stock 57x83.5mm compressor wheel to Engineered Diesel's 63x91.5mm Billet compressor. Exhaust wheel size shows a wider range, stock is the smallest 65x58mm, while Industrial Injection uses a mammoth 79.5x73mm wheel to drive their unit. All of the turbochargers except Engineered Diesels 63mm use a 7 blade compressor wheels. On the exhaust, most of the manufacturers use either a 10 or 11 blade turbine while the factory stock unit uses a 12 blade.

Physical Dimensions	Comp Ind *	Comp Exd	CW Blades	Exh Exd	Exh Ind	Exh Blades	TRBN: DMP Ratio
ATS Aurora 3000	57	83.5	7	73.5	64	11	0.98
Stock HE351cw	58	85	7	65	58	12	0.86
Industrial Injection 62SB	60	87.5	7	79.5	73	10	1.03
BD Performance Killer B	61.5	91	7	73.5	64	11	0.90
Engineered Diesel 63mm	63	91.5	6	76	67.5	10	0.93
Fleece Performance Cheetah	63	91	7	73.5	64	11	0.89

Figure T-2 Turbine to Compressor Ratio is defined as (Exh Exd + Exh Ind)/(Comp Ind + Comp Exd)

* Compressor wheel smallest diameter measure

SPOOL UP TEST RESULTS AND ANALYSIS

Spool up testing highlights the difference in the response time among the turbochargers in the test. It clearly defines how drivable the aftermarket turbocharger is relative to the stock turbo and the others tested by showing how quickly it responds to throttle input from the driver. The first spool up test was conducted at a constant Dyno mandated 1700RPM engine speed. The results of this test can be seen in figure SU-1. The factory Holset HE351cw is the quickest to respond to throttle input by a significant margin during the 1700RPM test, averaging just 2.142 seconds to increase output from an 'off-boost' 30HP to a hard charging 250HP. The Fleece Cheetah and Aurora 3000 are the only other turbochargers able to complete the 1700RPM test. The Fleece unit averages 3.596 seconds over three tests and the Aurora averages 3.810. Much to our surprise, these turbos were 70% and 78% slower than stock to respond to throttle input respectively. There is a clear advantage to the factory turbocharger with regard to low RPM throttle response.

Because many of the turbochargers are unable to complete the 1700RPM spool up test, a 2000RPM test was conducted. The Dyno is held steady at 2000RPM and the time interval necessary to bring output from 60HP to 250HP is measured. The results of this test can be seen in figure SU-2. It's important to note that that the test results for the Cheetah and Stock turbo are not observed data, rather they are calculated using a multiplier from the Aurora A3K tests. Repeating these tests for all turbochargers at 2000RPM was not possible within our time constraints. We still feel the calculated values for the Cheetah and Stock HE351cw are reliable based on our experience testing at 1700RPM.

The results in figure SU-2 show a surprisingly wide variety in spool up time intervals across the turbo offerings. The top aftermarket performer in this category was the Fleece Performance Cheetah, taking 70% longer than stock to come to life, while the Engineered Diesel 63mm and Industrial Injection 62SB show the downside to their wheel size by taking 115% and 145% longer than stock to spool up respectively. There's clearly a correlation between the size of the turbine wheel and the spool up interval. All else equal, a larger turbine simply takes longer to respond to throttle input. During these intervals the driver may experience extra smoke out of the tailpipe and a general unresponsiveness.

A noteworthy case is the ATS A3K. We expected this turbo to outperform the Fleece Cheetah in this test, but were disappointed when it placed just behind the Cheetah despite having a smaller compressor wheel and equally sized turbine. The difference we suspect, must be in the exhaust housing design. The A3K ships with a .85 A/R exhaust housing, which appears to be bigger than the machined HE351cw exhaust housing used by the Cheetah. We would like to test the A3K with ATS's tighter .76A/R exhaust housing, and

speculate it will spool up faster with that housing. However, we do not have the data to back up that suspicion at this time.

In summary, the spool up test all-but kills the idea that any of these turbochargers spool as-fast-as, or faster than stock. In fact, the stock HE351cw does an outstanding job responding to throttle input. The Fleece Cheetah, Aurora 3000, and BD Killer B are a distant second, third, and fourth. ED's 63mm, and II's 62SB are poking a long ways behind the second and third place finishers. There's a lot of room for improvement here with regard to the aftermarket offerings. Compromising driveability can be embarrassing and even dangerous in daily driving situations. It can be a tough sell for potential customers.

The EDGE CTS monitors horsepower, torque, boost and engine gas temperatures.

Spoolup Test 1700 RPM 30HP-250HP*

Turbo	Avg Spool Up Time
Stock He351	2.142
Cheetah	3.596
Aurora 3000	3.810
BD Killer B	NA
ED 63mm	NA
Industrial Injection 62SB	NA

Figure SU-1

* Calibrated Power Light Tow/45% Exergy Injectors

Spool Up Test 2000 RPM 60HP -300HP*

Turbo	Avg Spool Up Elapsed Time	% Longer than stock
Stock He351**	0.839	0%
Fleece Cheetah**	1.426	70%
ATS Aurora 3000	1.493	78%
BD Performance Killer B	1.552	85%
Engineer Diesel 63mm	1.808	115%
Industrial Injection 62SB	2.056	145%

Figure SU-2

* Calibrated Power Light Tow/45% Exergy Injectors

** Calculated Values

TOWING TEST RESULTS AND ANALYSIS

Putting into numbers a truck's ability to labor at gross vehicle weight while climbing a grade requires a grueling test. This type of test produces an incredible amount of heat and stress on driveline components. Engineering limits are tested. For each turbocharger six RPM constants were tested. The trucks are fed throttle until the exhaust gas temperatures (EGTs) reached 1200 Deg F in the manifold (as measured using the Edge CTS) and stabilized. This test procedure requires quite a bit of practice operating a dyno cell. If the recording is not made quickly, the engine coolant temp will climb high enough to engage the cooling fan. If engine fan comes on, horsepower will suffer and the results will be inconsistent.

Figures TT-1 and TT-2 tell the story here. There are six lines on the graph, each line represents a turbochargers ability to sustain power at a given RPM while maintaining and exhaust gas temperature of 1200 Deg F. The results are surprising. We expected most of the turbos in the shootout to outperform stock across the board. We also expected fairly tight groupings. In testing, the stock turbocharger is well above the curve of aftermarket offerings at the 1400RPM and 1700RPM test points. It demonstrates a strong ability to lug at low RPM without pushing EGTs into unsafe territory. However, as RPMs climb many of the aftermarket turbos start to outpace the stock unit. BD's Killer B and ED's 63 maintain a slight edge on the stock unit at 2000RPM, the ATS A3K and Industrial 62SB start to stretch their legs ahead of the field while Fleece's Cheetah lags behind, as the only turbo underperform stock at 2000RPM.

The 2300RPM data represents a test area where the driver elects to drop out of overdrive and is trying to accelerate or maintain speed on a grade using direct drive (3rd if automatic, 5th if manual trans). It's unlikely for a truck to be towing in overdrive for a significant length of time at this RPM. At this point all of the aftermarket turbochargers are performing above of the stock turbo. A clear trend has is appearing with regard to which turbo is the most effective at controlling EGT's in high load conditions (above 2000 RPM). The Industrial 62SB is well ahead of the field at 350HP, with the Aurora A3K close behind at 333HP. The ED, BD and Fleece are stacked 17, 16, and 6HP above stock respectively.

As test-RPM continues to climb to the 2600 and 3000RPM data points, the story is much the same as at 2300. Notable exceptions include the ED's 63mm compressor catching up to and surpassing the A3K by 3000RPM, and BD continuing to open up its margin on the Fleece unit as RPM climbs. We expect these trends to continue as RPM climbs to the red line. It's clear that as the operating RPM rises, this test favors a larger compressor wheel and larger turbine. These components simply move air and can be driven more efficiently at higher engine speeds. The tradeoff with larger

wheels is that while towing at low engine speeds they're less efficient that stock.

The takeaways from this test are as follows. First, each turbocharger has an engine speed where it operates most efficiently. It appears that this engine speed is correlated to a combination of compressor and exhaust wheel size. The larger the wheels, the higher in the rev range to expect peak efficient power. Secondly, there's something to be said for the ratio of compressor to exhaust wheel size when gauging peak useable power. The turbochargers in this test with the highest 'Turbine to Compressor Ratio' (Figure T-2 II62SB-1.03, A3K-.98) led the field in useable horsepower over their efficient operating ranges.

The standouts in this test are the Stock turbo, the Industrial 62SB, and the A3K. A buyer should carefully consider the mean operating range of the engine while towing before selecting which turbo best fits. If the loads and grades are light enough to require only 220HP or less to maintain speed in overdrive, then the stock turbo will allow the lowest operating RPM and best efficiency. On the other hand, if the load requires 300+ HP and downshift then the 62SB or A3K would be the best choice. The deciding factor will be the performance of these turbos in the other tests.

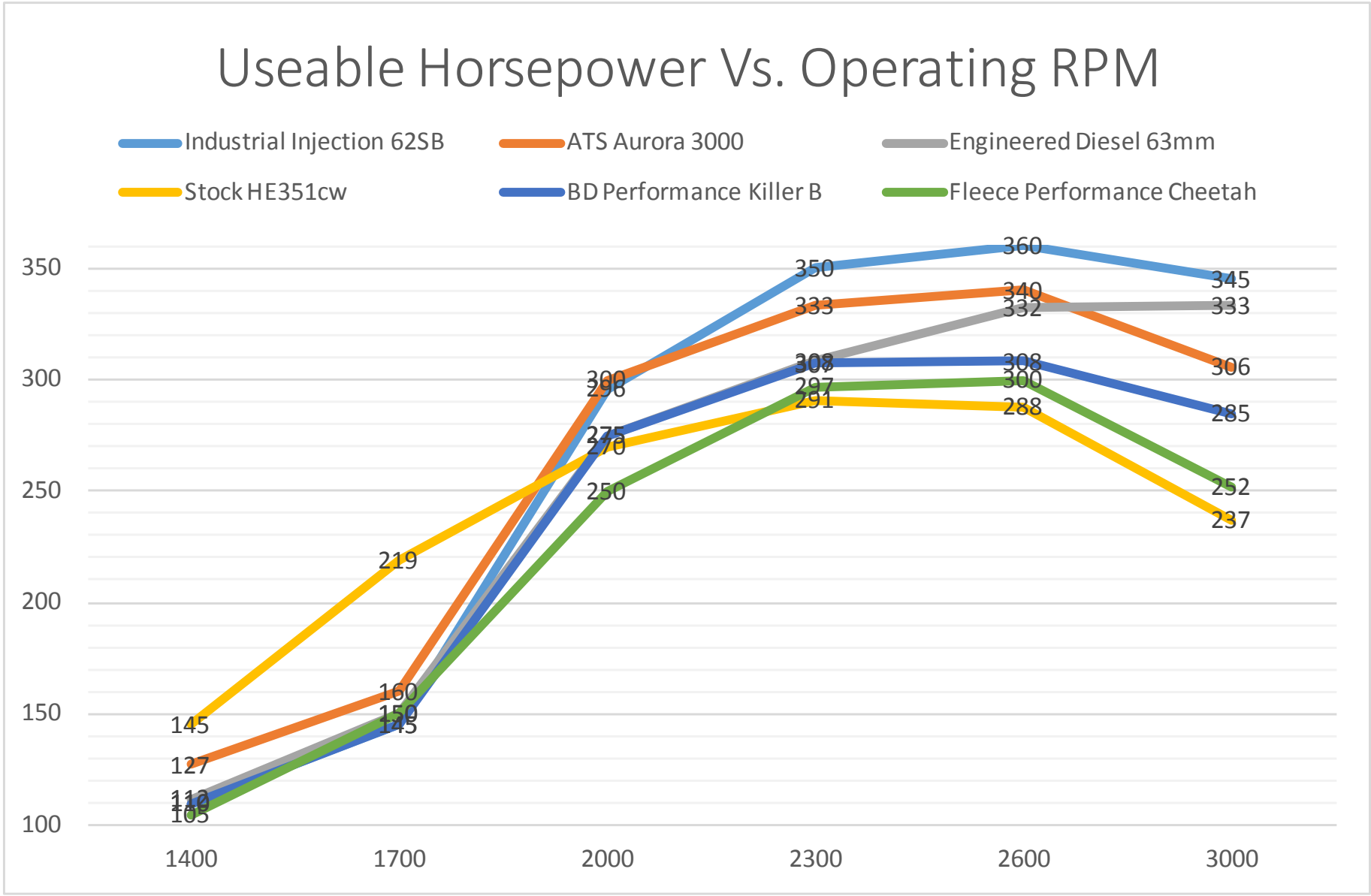
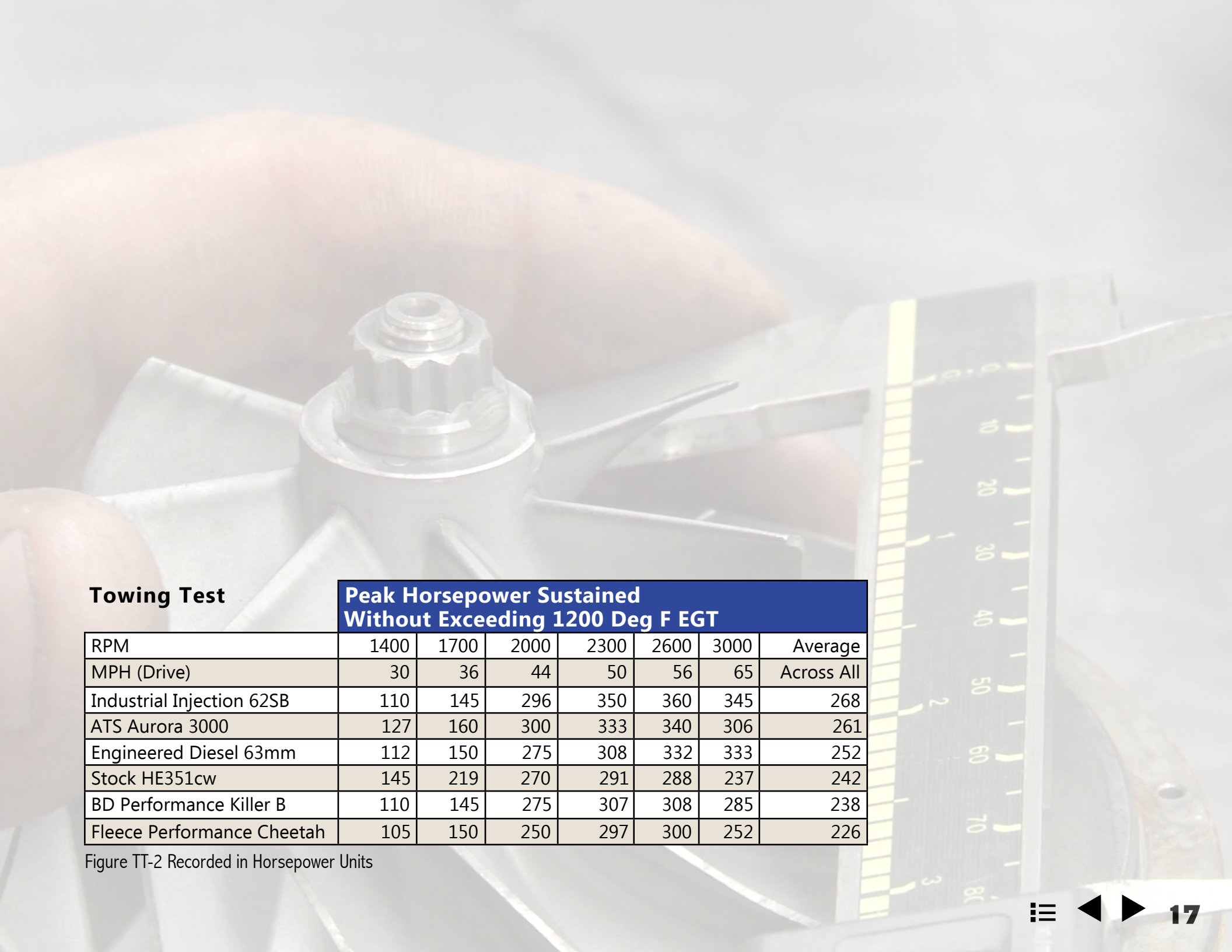


Figure TT-1: 1200 Deg F Exhaust Manifold Temperature Limit



Towing Test	Peak Horsepower Sustained Without Exceeding 1200 Deg F EGT						
RPM	1400	1700	2000	2300	2600	3000	Average
MPH (Drive)	30	36	44	50	56	65	Across All
Industrial Injection 62SB	110	145	296	350	360	345	268
ATS Aurora 3000	127	160	300	333	340	306	261
Engineered Diesel 63mm	112	150	275	308	332	333	252
Stock HE351cw	145	219	270	291	288	237	242
BD Performance Killer B	110	145	275	307	308	285	238
Fleece Performance Cheetah	105	150	250	297	300	252	226

Figure TT-2 Recorded in Horsepower Units

PEAK POWER RESULTS AND ANALYSIS

A peak power test is the most typical quantitative comparison mode used magazine style tests. We're looking to find out just how much tire shredding power is available for the dollar assuming there's have enough fuel to feed it. Each turbo in this test is run on Calibrated Power's 'Max Effort Tune' using Exergy Engineering's 45% over injectors. Runs are duplicated in sets of 3 for consistency. Peak power, torque, drive pressure, manifold boost pressure, and peak exhaust gas temperature are all sampled in order to help give a clear picture of each turbocharger's peak potential. The Data from these tests can be seen in figure PT-1.

Running the tests with the '45% over' injectors show 3 of 6 turbochargers lodged at the same power level (~648). For this reason we elect to move up to a much larger set of 100% over Exergy injectors that we have available and then re-run each turbo that made over 645HP. Of the three turbochargers re-tested with 100% over injectors, two pick up power. The ED 63mm picked up an additional 40HP and the II62SB picked up 16HP. The BD Killer B made the same 648HP as the previous test with 45% injectors. From this, we learn that Exergy 45% injectors have a safe ceiling of about 650HP regardless of turbo size. Another surprise, is the stock HE351 power output. We had not tested one with this size fuel system in the past and were expecting numbers lower than 570HP. The rest of the results were fairly predictable.

Turbochargers with large compressor wheels and large exhaust wheels do well, while smaller units produced lower numbers. Engineered Diesel's 63 has the largest compressor/turbine combination and easily posts the highest number at 688HP/1566FtLb. Industrial's 62SB is second, 24HP behind the ED unit. Noteworthy, is the lower drive pressure recorded on the II62SB test as compared to the BD and ED tests. We speculate this is due to the II62SB's oversized turbine compared to the smaller sized BD and ED turbines. The obvious underdog in this test is the Aurora 3000, with a compressor wheel smaller than stock we're surprised it is able to come out even 10HP ahead of the factory turbo.

It's important to maintain realistic goals while reviewing this data. These numbers are not promised to anyone who bolts said turbocharger onto their truck. To achieve these results, it's critical to have the other supporting modifications made – specifically a fuel pump, injector combination that's able to meet the needs of the tuning. Choosing a turbocharger because it's capable of making 650HP, only to bolt it on a truck that has 500HP worth of fuel and tuning is a recipe for disappointment.

Power Test

Turbo	Peak HP C	Peak Tq C	Peak Temp	Peak Boost	Peak DP	Injector Used
Engineered Diesel 63mm	688	1566	1516	50.0	64	100%
Industrial Injection 62SB	664	1592	1540	51.5	53	100%
BD Performance Killer B	648	1534	1590	49.5	67	100%
Fleece Performance Cheetah	638	1435	*	53.0	*	45%
ATS Aurora 3000	583	1404	1530	43.0	56	45%
Stock HE351cw	573	1339	*	43.0	*	45%

Figure PT-1

* Data not collected due to data logger malfunction

ATS Aurora 3000

The Aurora 3000 is the smallest and most modestly priced turbo in the test. It was also the only turbocharger tested that was not equipped with a waste gate. It was easy to install because of its size, properly machined compressor inlet/outlet, and lack of waste gate. The A3K performed strong in the towing test, hanging almost toe to toe with the much larger Industrial 62SB. It also was a close contender to the Fleece Cheetah in the spool up test making it one of the most drive-able units tested. However, its size clearly cost it points in the peak power test, where it was barely able to edge out the stock HE351cw.

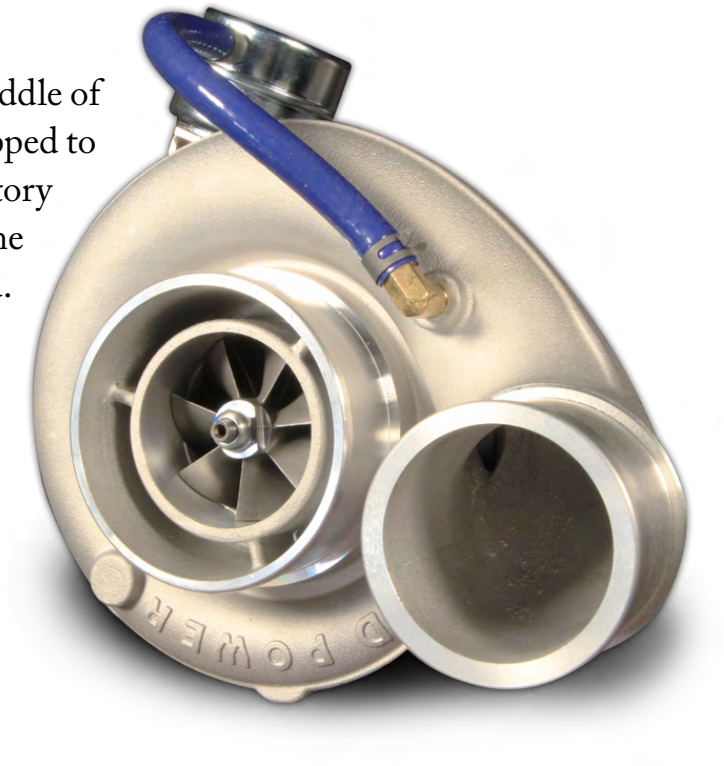
Spool Up: 3rd Quickest 78% Slower than stock
Towing: 2nd Highest Average useable 261HP
Peak Power: 5th Highest Peak power potential 583HP/1339FT Lbs
Price: $1568

Manufacturer's Rebuttal | Clint Cannon

The ATS Aurora 3000 is designed to be a street-able turbo that shines while towing, the focus is on maintaining low EGTs at RPMs that are used for heavy towing applications. The A3K turbo that was supplied for this test was equipped with a .85 A/R exhaust housing. If quicker spool up is desired, we have a .76 A/R exhaust housing option. Of course, we can also improve on the peak power number by stepping up to the Aurora 4000 which maintains strong towing performance while improving on the peak power number. The ATS turbo lineup represents one of the few aftermarket companies that designs, casts and builds turbochargers from start to finish in house. All Aurora turbo kits come complete with an electronic boost signal modifier to allow the ECM to support the higher boost levels over stock and eliminate De-Fueling and setting a check engine light.

BD Performance Killer B

The BD Killer B is the lowest price S300 frame turbo in the test. It's a middle of the road performer that offers strong bang for the buck. The Killer B shipped to us equipped with large diaphragm style waste gate mechanism that is factory preset to just 40psi boost pressure. This mechanism increased install time by requiring removal and reinstallation of the factory exhaust manifold. It also required we adjust the waste gate setting to achieve the final 49.5psi necessary to make 648HP. However, the BD kit was the only one that supplied a downpipe and V-band. Had we not adjusted the waste gate we would have been stuck at 615HP.



*Requires waste gate adjustment

Spool Up: 4th Quickest 85% Slower than stock

Towing: 5th Highest Average useable 238HP

Peak Power: 3rd Highest Peak power potential 648/1534FT Lbs*

Price: $1638

Manufacturer's Rebuttal | Brian Roth

The BD Killer B is designed as a strong bolt on turbo for a 5.9 driven street driven and towing applications that's after performance and driveability without causing any on or off throttle surging. The turbo has a 12 month warranty and a 6 pad thrust bearing to improve durability for high turbo speeds. Fine tuning of turbo boost pressure is accomplished easily with the turnbuckle adjustment. BD offers a wide range of turbochargers on either side of the Killer B. If the goal is quicker spool up, the Super B would be the choice. For higher volume of air the Super B Special 64.5 Turbo and the larger Track Master Turbos with or without the Turbine Diverters are geared more toward the 'peak performance' crowd.

Engineered Diesel 63mm Billet S300

Engineered Diesel's 63mm Billet S300 was the highest priced turbo in the test. In broad scope, it was also one of the largest. It was also one of the easiest to install on account of its simple waste gate actuator that required no removal of the exhaust manifold. Not surprisingly it took home the highest horsepower trophy by putting 688HP to the rear tires. However it paid a penalty for those big numbers by finishing in the back of the pack on the spool up test, taking 115% longer than stock to respond to the driver. Towing performance was middle-of-the-pack while lugging under 2000RPM, but improved as the truck moved higher in the rev range.

Spool Up: 5th Quickest 115% Slower than stock
Towing: 3rd Highest Average useable 252HP
Peak Power: 1st Hi ghest Peak power potential 688/1566FT Lbs
Price: $1950

Manufacturers Rebuttal | Chris Beardsley

I appreciate the test being performed the way it was. The method is far and away more substantial and fair than anything I've seen before. Our Billet 63mm turbo gets rave reviews from people who buy it. For operating at between 625 and 650 I'd suggest keeping this turbo. If a guy's running from 650-700 RWHP I would step him up to a larger turbine and when running above 700 it would be smart to step up on the compressor. This turbo ships with the waste gate set at 52psi. I would recommend not exceeding 52-54psi.

Fleece Performance Cheetah

Fleece's Holset Cheetah is a fairly recent addition to the marketplace. It's an interesting piece that starts life as a factory stock Holset HE351CW. Fleece performance then performs the appropriate machine work to fit the oversized exhaust and compressor wheel into the turbo, before mounting their own waste gate actuator. This buying process requires you send your stock turbo back to Fleece or pay the requisite $300 core charge. The upside to this process that you get a turbocharger that is visually very close to stock appearing (minus waste gate actuator) and installation is simple. It's the easiest to install turbocharger that we worked with. Where this turbo shines is the spool up test. It comes to life faster than any of the other turbos we tested, reporting a 70% slower spool than stock. It also packs a decent punch. Beating the stock turbo by 66HP in the peak performance test on its way to delivering 638HP to the wheels. Towing performance left something to be desired. This turbo is best suited to an unloaded truck.

Spool Up: 2nd Quickest 70% Slower than stock
Towing: 6th Highest Average useable 226HP
Peak Power: 1st Highest Peak power potential 638/1435FT Lbs
Price: $1847

Manufacturer's Rebuttal | Chase Fleece

This is a stock turbo on steroids. If you're towing boat or lighter load and want great driveability, then this is a great upgrade. It really shines on spool up. It's able to spool up earlier in the rev range during dyno tests, coming to life at 1500RPM during their testing in house. Chase advises an 8% difference between CPS dyno numbers and the numbers they report. This statistic is meant to help with comparison, not to suggest one dyno is right or wrong.

Industrial Injection Silver Bullet 62/80

Industrial Injection's Silver Bullet 62/80 is very popular turbocharger in the 5.9L aftermarket. It combines a reasonably sized compressor with a large turbine in a polished package. It shipped to us with a diaphragm style waste gate which (like the BD) required us to remove the exhaust manifold to complete installation. The waste on this turbo allowed us to reach 51.5psi, enough air to register 662HP to the tires. The ability of this turbo to control EGTs in the towing test was impressive. From 2000RPM up the Silver Bullet ran away from the competition. However, the large turbine assembly that proved itself in the tow test was less than impressive during the spool up test where the 62/80SB took nearly 145% longer than stock to come to life. This turbo does well in front of a trailer, and it appreciates being above 2000RPM.

Spool Up: 6th Quickest 145% Slower than stock
Towing: 1st Highest Average useable 268HP
Peak Power: 2nd Highest Peak power potential 662/1592FT Lbs
Price: $1941

Manufacturer's Rebuttal | Brady Williams

The Silver 62 is built to be a strong, reliable towing turbo. It features extreme duty bearings and a 360* thrust. One turbo can't do it all, that's why II maintains a wide selection and continuously tests new products. On either side of the SB6280 is the SB66 more to the racing side and the Phat Shaft 62/70 which offers much quicker spool up. II continues looking to the future to improve their results, testing is going well on the new Borg Warner EFR products with dual ceramic ball bearing and ceramic turbine wheel.

Holset HE351CW

It's easy to see why Cummins elected to use this turbocharger for original equipment on the 5.9L. It makes for a responsive truck that has solid towing power across the power band. This turbo spools up so much faster than the competition that its borderline embarrassing to report. Replacing the HE351CW with a larger turbo will decrease throttle response. Upsizing turbochargers over the HE351CW will also decrease the user's ability to lug in high gear. No other turbocharger was able to come close to controlling EGTs at 1400 and 1700RPM like the factory Holset. With regard to peak power, as expected the HE351 is at the back of the pack. It was never designed to make the 570HP that we pushed it to, and we would never expect it to last at that level. If you're okay sacrificing spool up and low RPM towing power in search of improved peak power and high speed EGT control then certainly you're a candidate to upgrade beyond the factory HE351CW.

Spool Up: 1st Quickest 145% Slower than stock
Towing: 4th Highest Average useable 242HP
Peak Power: 6th Highest Peak power potential 572/1339FT Lbs*
Price: Factory Equipment ($600-1000 Replacement Cost)

Founded in 2007, Calibrated Power Solutions, Inc., is a nationally recognized, market leading developer of performance calibrations for '01-'15 GM Duramax and '06-'15 Dodge Cummins common rail design engines

CPS calibrations optimize drivability, reliability, and power through programing adjustments to the engine computer or engine control module, also known as the ECM. All calibrations undergo extensive road and laboratory tests to dial-in the intended programming design. CPS owns an in-house 4WD Mustang Dynamometer for measuring engine horsepower and torque. The Dynamometer also simulates engine loads found with road conditions not otherwise available, including steep inclines.

CPS customers include every day drivers of diesel powered Chevrolet, GMC, and Dodge trucks in need of more power to tow heavy equipment, improve mileage, or enhance performance. Other customers include drivers who participate in the competitive motorsports of sled pulling and drag racing.

In addition to engine calibrations, CPS sells and installs modifications to enhance engine performance through improved airflow, fuel combustion, and exhaust systems. These engine modifications allow the truck to maximize its potential when combined with CPS calibrations.

Calibrated Power Solutions, Inc.
950 Greenlee St.
Marengo, Illinois 60152

815-568-7920

www.calibratedpower.com

www.facebook.com/calibratedpowersolutions

www.duramaxtuner.com

www.facebook.com/duramaxtuner

@duramaxtuner

ABOUT THE AUTHOR

Nick Priegnitz, founder of Calibrated Power Solutions Inc., has been into the performance automotive scene since high school. Before common rail diesel tuning he tinkered in LS1 tuning and even twisted a few distributors. After graduation from Winona State University with an undergraduate degree in Chemistry, Nick worked five years as a lab technologist in transfusion medicine while finishing an MBA at the Carlson School of Management.

Nick says his interest in quality control and standardization stems from his past work experience and graduate studies. He notes that his interest in engine calibrations is rivaled only by his interest in small business and entrepreneurship. If he's not thinking about tuning, he's thinking about how to further improve the business.

Nick says nothing would be possible without the love and support of his wife Beth, and his two young children William and Rosalie.