Volume 2020

TURBO DIESEL

Buyer's Guide

What you should know about the
2020 Ram Turbo Diesel truck.

A Publication of the ***Turbo Diesel Register***

Turbo Diesel Buyer's Guide

A WORD ABOUT THIS BUYER'S GUIDE

Recently my wife and I spent much time looking for a "new" used car. I fired up my computer, studied comments and users' experiences in forum-based websites, and downloaded archived articles from Car and Driver and Edmunds.com. There was a lot of miscellaneous and helpful information, free and for the taking. I figure this sort of web search is pretty typical for prospective vehicle purchasers today. As it turned out, we didn't make a purchase, but my experience in searching for a suitable used car made me more aware of issues of value and economy in owning a Turbo Diesel today.

As a writer it is tempting to tell the long story of "information being worth the price that you paid for it." I will refrain. Many thought-provoking articles on the state of the publishing business versus the free-for-all of the interweb (pun intended) have been written and my opinion is not likely to change anyone's point of view.

Back to the subject at hand—you are a prospective or new owner. You want more information. You want it now. You want it at no charge.

Since the late 90s we have compiled information on the Dodge/Cummins Turbo Diesel truck. Each year we update the book. We call the data the Turbo Diesel Buyers Guide, which you have successfully downloaded.

The price of this book has been discussed many times over. It is offered to you at no charge. Our hope is that its value will lead you to purchase a subscription to the Turbo Diesel Register magazine. Thanks for your consideration.

Robert Patton
TDR Editor

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A WORD ABOUT THE TURBO DIESEL REGISTER

How did the Turbo Diesel Register get its start? First off, I'm an automotive enthusiast. An automotive enthusiast that was in search of a tow vehicle for my admittedly small collection of automobiles. As you can imagine, the search for the right tow vehicle took me in the direction of the Ram Turbo Diesel. My search was aided by the fact that my previous job was in the diesel engine profession as a Cummins distributor product support representative. Do I have a good knowledge of the Turbo Diesel engine? Well, maybe. I'll let you be the judge.

Back to the "story." As an automotive enthusiast, I am a member of a handful of car club/register type publications. In addition, I subscribe to just about every car and truck monthly publication in hopes that I can learn something more about my vehicles. The only vehicle I owned that didn't have its own club was the Turbo Diesel. The light goes on. Why not start a Turbo Diesel club? The light flickers. I know the immediate answer: not enough time, no money, and who would write the articles? Needless to say, the idea got put on the back burner. Another great idea, but…

Looking back, that was many long years ago. Prior to our first magazine (Fall '93) I took time to talk to other Turbo Diesel owners who wanted to know more about their truck and specifically the Cummins engine. At the time I knew the Turbo Diesel Register would work. I also knew it would be a lot of hard work with an up-front monetary investment and the commitment to publish the magazine.

Positive discussions with other club/register publishers and an unofficial "good luck" or two from the manufacturers, and well, I was still hesitant. Back to the all-important concerns: time, money and writing skills. Time? In the initial two-career-days it was nothing to stay up until 2:00 a.m. Money? What the heck, we took out a second mortgage. And writing skills? You've heard the saying, "if it is to be, it is up to me." Thus, we started the TDR way back in the summer of 1993.

Robert Patton
TDR Editor

PS. We hope you'll learn something from the following collection of tips and Ram technical data. Please realize this booklet is just the "tip of the iceberg." The TDR and its members provide a wealth of information. How to join? Please fill-out and mail the order form or register on-line at www.turbodieselregister.com.

WHY A DIESEL?

by Robert Patton

As the editor of a club news magazine (the *Turbo Diesel Register* for Dodge/Cummins owners), I am frequently asked, “Why is a diesel engine more fuel efficient than a gasoline engine of comparable displacement and horsepower?”

Let’s see if I can provide a simple, no-nonsense answer. At the close of this article we’ll do a quick diesel-payback example. Armed with a better understanding of why diesel provides a better payback on fuel consumption, you will be equipped to wring the most mileage from your tankful of diesel fuel.

How would you respond to, “Why is a diesel more fuel efficient?”

You may respond with one of the common clichés, such as, “It’s the design of the diesel, it’s built to be more efficient.” How about, “The compression ratio is higher, there is more power?” Or, maybe a little more helpful, “The Btu content of diesel fuel is greater;” or perhaps, “It’s in the injection system.”

All of the above are correct, but the answers are pretty intuitively obvious.

When working with diesel powered generators, I encountered similar queries and responded with the same partial answers. I’ve seen the same “you didn’t answer my question” body language from interested parties. It took being embarrassed in front of a large crowd before I vowed to get the complete answer.

Let’s see if I can tie it all together and give you an answer you’ll be able to use with your acquaintances. We will examine the diesel’s design, compression ratios, fuel Btu’s, and the fuel injection system to lead us to a concise answer, one that’s easy to recall.

The Diesel’s Design

“It’s the design of the diesel; it’s built to be more efficient.”

The diesel engine was designed and patented in 1892 in Europe by Rudolf Diesel.[1] In the early part of the last century, Mr. Clessie Cummins, founder of Cummins Engine Company, refined the diesel design and developed engines to be used on-highway in the USA. Clessie’s son, Clessie Lyle Cummins Jr., is a diesel historian. A passage from his book Diesel’s Engine provides an historical perspective on Rudolf Diesel’s early struggle to perfect his revolutionary engine and bring it to market.[2]

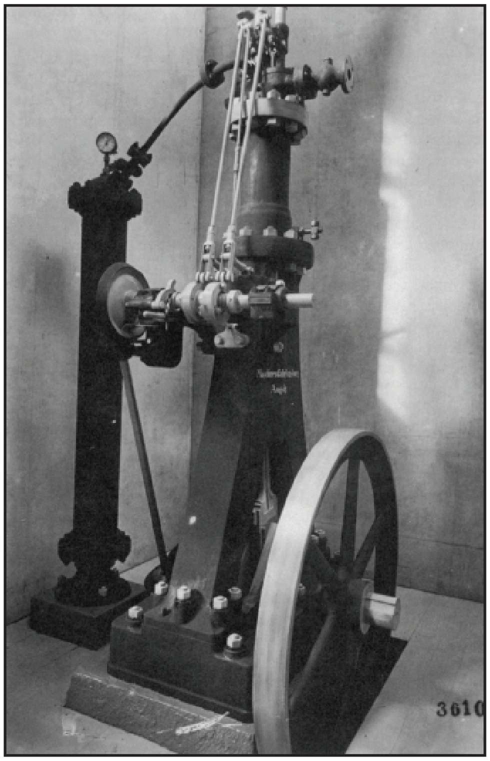
> After a ten-year search Rudolf Diesel was convinced he had found the way to design an engine with the highest thermal efficiency. He believed the most difficult days were over and transforming ideas into reality should prove a simpler task: License a qualified manufacturer to develop and build the engine under his guidance and then await the forthcoming royalty check. One company finally agreed to evaluate a test engine built to his design, but gave him no financial support. Because of this limited commitment he continued to promote his theories through the book based on his studies. Gift copies went to influential professors and companies deemed possible licensees. A few favorable academic endorsements resulted, but no new firms showed any interest. Meanwhile, when Diesel came to realize that his patented combustion process was unsuitable for a real engine he quietly substituted another. The path of his endeavors still failed to follow his optimistic, short range plan.

Diesel continued to seek the “highest thermal efficiency,” or what he called a “heat engine,” until his suicide in 1913. But the design principle is remarkably simple. From Mr. Clessie Cummins’ book My Days With the Diesel,[3] I’ll let the senior Mr. Cummins explain.

> As the term “heat engine” implies, the diesel differs in principle from the gasoline engine, in that [diesel] combustion is obtained by the heat created by compression of air in the cylinder. The diesel needs no electrical (spark) ignition system. Furthermore, it burns low-grade oil rather than the highly refined, more expensive fuels required by the gasoline engine.
>
> Adjudged practical only for heavy-duty, stationary, or marine power applications, diesels, when I first encountered them, weighed as much as 400 pounds per horsepower and ran at very slow speeds. Entering the industry some eight years after introduction of the diesel in this country, I undertook a personal campaign, with the crudest of experimental facilities, to reduce this pound-per-horsepower ratio, despite all textbook rules to the contrary. These efforts culminated in the invention of the high-speed, light-weight automotive diesel.
>
> For two decades, while struggling with the engine developments, I battled equally big odds to build a highly specialized business. Cummins Engine Company was incorporated in 1919, but it took the better part of eighteen years for our bookkeeper to need any black ink. Then success arrived with a rush, after the initially skeptical long distance truckers finally accepted our new engine.
>
> Today Cummins Inc., of Columbus, Indiana, is the world’s largest independent producer of automotive diesel engines. It provides jobs for ten thousand persons, with sales of more than $250 million annually (the publish date of Clessie Cummins’ book was 1967).

Note: 2005 sales were 9.92 billion.

Considering the level of technology in machined parts in the late 19th century, it is no wonder that Rudolf Diesel was unable to build his heat engine and prove its practicality. But in time, technology would catch up with the simplicity of Diesel's informing concept; and so the seemingly offhand answer that the design of the diesel is built to be more efficient is a true statement. Let's look further at the components that make the diesel different.



Diesel's first engine at the start of an 1893 test (photo courtesy of C. Lyle Cummins).

HIGHER COMPRESSION RATIO

"The compression ratio is higher, there is more power."

Technically speaking, the compression ratio of an engine is the comparison of the total volume of the cylinder at the bottom of the piston's stroke divided by the volume of the cylinder remaining at the top of the piston's stroke. Since we are familiar with gasoline engines, let's quickly discuss their compression ratios and a condition that spells disaster in a gasoline engine, detonation, or pinging.

The Gasoline Engine

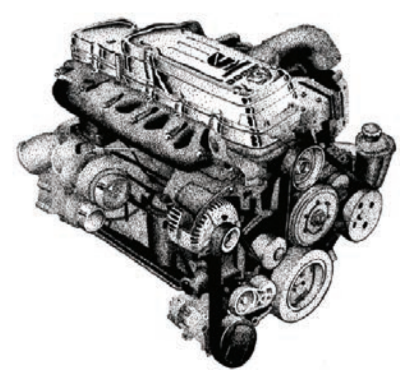
Serious damage to a gasoline engine can result if you attempt to run a high compression ratio with low octane fuel. Detonation or pinging is the ignition of the fuel due to the high temperature caused by a high compression ratio/high pressure developed by a given design. Premature ignition of the fuel, i.e., coming before the spark of the spark plug, results in rapid uncontrolled burning. When timed properly, the approximate maximum compression ratio for a gasoline engine in race trim is 14:1. Most non-racing low octane compression ratios used in automobiles and trucks are less than 9:1.

The Diesel Engine

Remember, the diesel is a "heat engine" using heat energy developed from the compression of air. High compression ratios (ratios range from 14:1 to 20:1) are possible since air only is compressed. The hot compressed air is sufficient to ignite the diesel fuel when it is finally injected near the top of the compression stroke. A high compression ratio equals a greater expansion of the gases following ignition and a higher percent of the fuel's energy is converted into power! The diesel compression ratio is higher, there is more power! However, I've provided yet another incomplete answer that is a true statement, but not the complete story.

Thus far we've covered the principle of diesel operation and the high compression ratios needed to make the heat for diesel engine combustion. The high compression ratio requires the designers to test and manufacture the block, heads, head bolts, crankshaft, connecting rods, rod bolts, pistons, piston pins, etc., with greater structural capacity. Diesel engines are heavy in comparison to their gasoline brothers. Take, for example, the B-Series engine used in the Dodge pickup. It is 970 pounds for the 359 cubic inch Turbo Diesel engine versus 540 pounds for the 360 cubic inch Dodge Magnum V-8 gasoline engine. With the greater structure and a diesel's need for air, the turbocharger (introduced in the 1950s) was a natural fit for diesel engines.

Looking back, the first engine designed by Clessie Cummins in the 1920s was a monster at 400 pounds per horsepower produced. The year model 2005, 325 horsepower Cummins Turbo Diesel pickup truck engine is 3 pounds per unit of horsepower. I'd say diesels have made some progress in 85 years.



The Cummins engine used in today's Dodge pickup.

Fuel BTU's

"The BTU value of diesel is greater."

Quite true, the BTU, or British Thermal Unit, for diesel fuel is 130,000 per gallon, with a weight of 7.0 lbs./gallon. The value for gasoline is 117,000 BTUs at a weight of 6.3 lbs./gallon. If we go back to our basic physics rules for energy, you'll note the fuel in the tank has potential for work if it is injected into the cylinders and, when combined with the compressed heated air, ignited. The piston is forced downward, the crankshaft rotates, and the wheels turn. True as all this is, the BTU value is not the major contributing factor to the diesel's miles-per-gallon superiority. So, what is the key answer?

The Injection System

"It's in the injection system."

Rudolf Diesel designed the heat engine to use the injection of fuel at the last moment to ignite the compressed air. Understanding the heart of the diesel, the fuel pump, is the key to answering the fuel efficiency question.

The Gasoline Engine

A gasoline engine is what engineers call "stochiometric." Stochiometric describes the quantitative relationship between two or more substances, especially in processes involving physical or chemical change. With a gasoline engine there is a stochiometric equation of 14 parts of air to one part of fuel. Remember, always 14:1. Whether at idle or full throttle, the fuel and air are mixed outside the cylinders in a carburetor or injection manifold, and the mixture is introduced to the combustion chamber via the intake valve, 14:1, always.

The Diesel Engine

Fuel and air in the diesel design are not premixed outside the cylinder. Air is taken into the cylinder through the intake valve and compressed to make heat. Diesel fuel is injected near the top of the piston's stroke in an amount or ratio corresponding to the load on the engine. At idle the air-to-fuel ratio can be as high as 85:1 or 100:1. At full load the diesel still boasts a miserly 25:1 or 30:1 ratio! It is in the injection system where we find the key to the diesel's fuel mileage superiority.

The Fuel Pump is the Key

The fuel pump used on early '90s vintage diesel pickup trucks typically was a rotary style fuel pump. Think of this pump as a mini automobile-spark-distributor. A rotary head sends fuel pulses through the high-pressure fuel lines to the injectors. The pressure opens the injector valve, and fuel is injected.

As exhaust emissions standards tightened in 1994, there was a need for higher fuel injection pressures and more timely delivery of fuel into the combustion chamber. Pickup truck leader, Ford, used an injection system developed by Caterpillar called HEUI (hydraulically-actuated, electronically controlled, unit injection). The Dodge/Cummins engine used a Bosch P7100 in-line fuel pump. Think of it as a mini in-line six cylinder engine, and it's easy to understand its principle of operation. Six plunger pumps actuated by the pump camshaft send fuel pulses through six high pressure fuel lines to the injectors. The pressure opens the injector valve, allowing fuel to pass into the combustion chamber. With the Bosch P7100 fuel pump the metering of the fuel (at idle, 85:1; or at full load, 25:1) is controlled by a fuel rack and gears that rotate a metering helix to allow fuel into the six plunger pumps.

C. Lyle Cummins Jr. poses in front of a '02 Dodge/Cummins Turbo Diesel pickup.

Future Considerations

Further exhaust emission legislation in 1998 and again in 2002 has forced the diesel engine manufacturers to introduce electronic fuel injection controls. Key legislation dates were 1988, 1994, 1998, and 2002. Thus the progression from simple mechanical (vintage 1988-1993) to more complex mechanical (vintage 1994-1997) followed by simple electronics (vintage 1998-2001) and now advanced electronics (2002 and newer) has been the norm that the diesel industry has followed. Stay tuned as the 2007 emissions legislation has brought another dramatic decrease in exhaust emissions for diesel engines in pickups and big-rigs.

1. We capitalize "Wankel" when referring to a rotary engine. When did we stop capitalizing the "D" in diesel?

2. I found Lyle Cummins' *Diesel's Engine* to be a complete history of Rudolf Diesel's engineering efforts. For information on how to order this book, please see this story's source table. I'll bet that if you request it, Mr. Cummins will autograph your copy! A must for your automotive library.

3. The senior Cummins' book, *My Days with the Diesel* is no longer in print (publication date, 1967). Lyle Cummins remembers his father in his recent book, *The Diesel Odyssey of Clessie Cummins.* Copies of the latter book are available. Again, please see the source table for complete information.

Sources:
Diesel's Engine (760 pages, $55) and *The Diesel Odyssey of Clessie Cummins* (400 pages, $37) are books written by diesel historian Clessie Lyle Cummins Jr. Published by Carnot Press. The books can be ordered at (503) 694-5353.

DIESEL VERSUS GASOLINE DO THE MATH

My own experience has been with a 2002 Dodge 1500 with its 360 cubic inch (5.9 liter) gasoline engine and a 2003 Dodge 2500 with the 359 cubic inch (5.9 liter) Cummins diesel engine. Overall numbers in around-town driving equated to 13.5 mpg gasoline, 18.5 diesel.

In our example, let's figure that I travel 20,000 miles per year.

Gasoline usage: $\frac{20{,}000}{13.5} = 1{,}481$ gallons used

Diesel usage: $\frac{20{,}000}{18.5} = 1{,}081$ gallons used

It used to be that the price of diesel fuel was less than that of regular gasoline. Lately in my area that has not been the case. However, for comparison sake, let's assume the numbers are equal at $3 a gallon.

Gasoline expense: $\$3 \times 1{,}481 = \$4{,}443$

Diesel expense: $\$3 \times 1{,}081 = \$3{,}243$

Diesel net yearly fuel savings = $1200

Estimated sticker price for the optional diesel engine – $7,000

Years (assuming 20K per year) and miles to payback – 5.8 years or 116,000 miles

If you subscribe to the adage, "Figures don't lie, but liars figure," you can easily make the previous example work for a shorter or longer payback period. In this short, down-n-dirty comparison we're not going to consider maintenance or resale values. And don't lose track of the obvious: as the diesel engine option in pickup trucks continues to price-creep upward, the payback is longer; however, as fuel prices rise, the payback is quicker.

To close the do-the-math example, remember that "your mileage may vary based on driving conditions." Don't ya love the clichés of automotive doubletalk?

Robert Patton
TDR Staff

The Chrysler 360 gasoline engine delivers around-town fuel mileage of 13.5 mpg.

The Cummins Turbo Diesel engine delivers around-town fuel mileage of 18.5 mpg.

CUMMINS 6.7-LITER FOURTH GENERATION POWER RATINGS

MODEL YEAR	HP@RPM	TORQUE @RPM	TRANSMISSION	COMMENTS
2010 6.7 Pickup	350@3000	610@1600	6 Manual	All States DOC/NAC/DPF
		650@1600	68RFE Automatic	
2010 3500 Cab/Chassis	305@2900	610@1600	6 Manual	All States
			Aisin Automatic	
2010 4500/5500 Cab/Chassis	305@2900	610@1600	6 Manual	All States
			Aisin Automatic	
2011 6.7 Pickup	350@3000	610@1400	Manual	All States DOC/NAC/DPF
		650@1600	68RFE Automatic	
2011 Cab/Chassis	305@2900	610@1600	Manual	All States SCR System
			Aisin Automatic	
2011.5 6.7 Pickup (HO)	385@3000	850@1600	Aisin Automatic	All States DOC/NAC/DPF
2012 6.7 Pickup	350@3000	610@1400	Manual	All States DOC/NAC/DPF
		800@1600	68RFE Automatic	
	385@2800 HO	850@1700	Aisin Automatic	
2012 Cab/Chassis	305@2900	610@1600	Manual	All States SCR System
			Aisin Automatic	
2013 6.7 Pickup	350@2800	660@1400	Manual	All States SCR System
	370@2800	800@1600	68RFE Automatic	
	385@2800 HO	850@1700	Aisin Automatic	
2013 Cab/Chassis	320@2800	650@1600	Manual	All States SCR System
	325@2400	750@1600	Aisin Automatic	
2014 6.7 Pickup	350@2800	660@1400	Manual	All States SCR System
	370@2800	800@1600	68RFE Automatic	
	385@2800 HO	850@1700	Aisin Automatic	
2014 Cab/Chassis	320@2800	650@1600	Manual	All States SCR System
	325@2400	750@1600	Aisin Automatic	

CUMMINS 6.7-LITER FOURTH GENERATION POWER RATINGS

MODEL YEAR	HP@RPM	TORQUE @RPM	TRANSMISSION	COMMENTS
2015 6.7 Pickup	350@2800	660@1400	Manual	All States SCR System
	370@2800	800@1600	68RFE Automatic	
	385@2800 HO	865@1700	Aisin Automatic	
2015 Cab/Chassis	320@2800	650@1600	Manual	All States SCR System
	325@2400	750@1600	Aisin Automatic	
2016 6.7 Pickup	350@2800	660@1400	Manual	All States SCR System
	370@2800	800@1600	68RFE Automatic	
	385@2800 HO	900@1700	Aisin Automatic	
2016 Cab/Chassis	320@2800	650@1600	Manual	All States SCR System
	325@2400	750@1600	Aisin Automatic	
2017 6.7 Pickup	350@2800	660@1400	Manual	All States SCR System
	370@2800	800@1600	68RFE Automatic	
	385@2800 HO	900@1700	Aisin Automatic	
2017 Cab/Chassis	320@2800	650@1600	Manual	All States SCR System
	325@2400	750@1600	Aisin Automatic	
2018 6.7 Pickup	350@2800	650@1400	Manual	All States SCR System
	370@2800	800@1600	68RFE Automatic	
	385@2800 HO	930@1700	Aisin Automatic	
2018 Cab/Chassis	320@2800	650@1400	Manual	All States SCR System
	325@2400	750@1500	Aisin Automatic	
2019 6.7 Pickup	320@2800	650@1400	Manual	All States SCR System
	325@2400	750@1500	68RFE Automatic	
	400@2800 HO	1000@1800	Aisin Automatic	
2019 Cab/Chassis	320@2800	650@1400	Manual	All States SCR System
	360@2800	800@1800	Aisin Automatic	
2020 6.7 Pickup	370@2800	850@1150	68RFE Automatic	All States SCR System
	400@2800	1000@1250	Aisin Automatic	
2020 Cab/Chassis	360@2800	800@1800	Aisin Automatic	

2019 RAM INTRODUCTION

ISSUE 104 – TDREVIEW

by Robert Patton

INTRODUCTION – BUSY NEW YEAR

Wow! The beginning months of 2019 were busy with Heavy Duty pickup truck announcements. Ram had their HD consumer truck (2500/3500), model year 2019, announcement at the January North American International Auto Show (NAIAS) in Detroit, and their HD commercial truck (3500/4500/5500), model year 2019, announcement was three weeks later at the Chicago Auto Show.

At the Chicago show the folks at GM and Ford announced their 2020 line-up of HD consumer trucks.

And, there may be more to come—the March NTEA (National Truck Equipment Association) show in Indianapolis is just around the corner. Will GM introduce their 4500/5500/6500HD trucks?

It has been busy and we have reports on the Ram truck announcements by Greg Whale, Andy Mikonis and me. In this TDReview we have the following titles:

- NAIAS Report: Background/Introduction
- NAIAS Report: 2019 Ram HD Consumer – Greg Whale Reports
- Chicago Auto Show Report: Ram HD Commercial – Andy Mikonis Reports
- More From Chicago: Ram HD Commercial – Greg Whale Reports
- First Driving Impressions: Ram HD Consumer – Greg Whale Reports
- First Driving Impressions: Ram HD Consumer – Andy Mikonis Reports

NAIAS REPORT: Background/Introduction

On Monday, January 14, the Ram folks unveiled their 2019HD consumer truck lineup at Detroit's North American International Auto Show.

I was fortunate to attend the show. (Due to a flight delay, I missed the 9:15AM presentation.) Afterward I had a chance to visit with some friends. Did you realize the 400horsepower/1000torque rating is 2.5 times the original 1989 trucks 160/400 rating? We wondered "just what kind of number(s) does it take to get the attention of the press." Maybe it was just a cold Monday morning (Ram should have served double-shot expresso?), but I expected more industry "buzz." (Perhaps it was just the NAIAS; you can read about the show on page 44.)

2019 Ram HD – A nice looking truck!

FCA's Bob Hegbloom (leader of Ram Brand International) talks with television host Danny Koker of "Counting Cars," a History Channel show.

NAIAS REPORT: 2019 RAM HD Consumer – GREG WHALE REPORTS

(This article was previously posted at our website on 1/14/19.)

Ram and Cummins have skipped the nickel-and-diming for the 2019 ratings war, going straight to 1,000 pound-feet and a top tow rating in excess of 35,000 pounds. There's plenty of other stuff too, but you're going to hear those numbers a lot.

The new 6.7-liter Cummins is built on a CGI (compacted graphite iron) block—lighter, stronger, quieter and proven. Bore and stroke are 4.21x4.88, the compression ratio on the standard output is 19.0:1 while the HO is 16.2:1. Virtually everything else is different: rotating parts, pistons, head with improved exhaust braking performance, injectors, high-pressure pump, entire air-handling system, and turbo. The display wasn't marked, but it sure looked like an EGR cooler top right side. There's more aluminum where it makes sense—water pump housings, brackets, etc.—and it runs on a dual-core processor.

Standard output is 370 horsepower (at 2800 revs) and 850 torque (@1700), the HO engine is 400 and 1,000 respectively (peak torque occurs 100 rpm higher than the standard engine), and Chassis Cab trucks will get the updated engine, so expect an increase (the Chicago show announcement: 360/800). Those are the only ratings… there's no manual gearbox rating because no manual is offered. Ram noted an ever-declining sales percentage (less than 4% recently), and fiscal responsibility said don't spend resources developing a new manual gearbox, though I'm sure Cummins has the ability to deliver a "de-rated" engine package that could match the current manual gearbox capacity.

Both the 68RFE and AS69RC have been lightly upgraded, with much work around engine integration with the dual-core processor aimed at better drivability. Both these transmissions are diesel-only and run by column shifter; all gasoline HD trucks run the 6.4-liter and a ZF eight-speed automatic with the rotary shifter. Power Wagon still has a transfer-case lever on the floor, and the eight-speed gives it a crawl ratio of 50:1.

The Max Tow package returns and brings with it larger rear rotors, a 12-inch ring gear, and bigger bearings and shafts. The latter require a larger bolt circle; so whether or not you get Max Tow, every dually will have a different bolt pattern than SRW trucks. With Cummins power, only the MegaCab 4x4 2500 has a tow rating of less than eight tons.

Of course the cooling is upgraded too, the radiator taller, 39 inches wide and the grille opening 30% larger. Despite the added cooling, aero drag has dropped by eight percent, in large part from the airdam and active grille shutters (all engines).

Everything else underneath will look familiar but not identical. The new rails are fully boxed, crossmembers are stouter, 63 ksi steel is used for the gooseneck mount, axles and brake calipers are larger, springs are a bit further outboard, shocks are monotube frequency selective dampers (except Power Wagon's Bilsteins) hydro C-pillar body mounts and active mass dampers from the 1500. Exhaust hangars are different, the basic claims being stronger, quieter, and more refined. If I didn't hear "capability" once a minute, I didn't hear it at all.

Though it's all been massaged, suspension configurations parallel the current truck, with the full-air 2500 and auxiliary-air 3500 options.

Last year's bed and cab structures get a new tailgate, bumpers, front clip and mirrors, but the mirror mounts remain the same. There are at least four styles of lights and grilles, at least seven new wheel designs and a factory bed step option. Those mirrors now offer cameras (for the aerial 360 image), LED rear facing spotlights and power convex sections on the towing units—linked to the driver memory system if you get it.

Those bodywork changes plus active grille shutters on every powertrain, yield a claimed 8% aero improvement, with the bumper/airdam area getting credit for almost half that. The coefficient of drag on a 2WD Quad Cab short bed is 0.409, and, thanks to an aluminum hood, revised bumpers and some other changes, the truck is 143 pounds lighter. A co-pilot without exceeding GVWR.

Inside, the cabin is virtually lifted from the 2019 1500 model, including the real leather, wood and metal trims, a unique key fob for Limited trim, and the 12-inch tablet screen to echo a pair of stacked 8.4s. The Ram comes with active noise cancellation on all drivelines and is said to be 10 dB quieter than the old one, all the better for sampling the 17-speaker, 750-watt optional Harman/Kardon sound system. Headrests are now four-way adjustable—though I missed checking the center rear, multiple type-C USB ports allow charging at least three phones at once, Uconnect supports Waze and Google maps, the Power Wagon has a forward camera for trail use, and there's trailering reverse guidance, a trailer-mount backup camera with independent 12-way connector and tire-pressure monitoring for up to 12 tires on four different trailers.

Ram attributed the early availability of uncamouflaged tester photos to three items. One, it helps build awareness and interest. Two, it saves thousands of dollars on camo. Three, it lead to more than one-million miles of real-world testing and loads. They also pointed out that Ram 3500 has the highest rated resale value, while an article I read en route names Ram 3500 reliability "well below average." Damn statistics.

Expect 2019 HD Rams to roll into dealerships in April or May so you can find out yourself.

G.R. Whale
TDR Writer

CHICAGO AUTO SHOW REPORT: Ram HD Commercial – ANDY MIKONIS REPORTS

If you follow the industry, it sounds like the Auto Show business is on the ropes. The Detroit show keeps losing brands, and is now moving to June to try to reinvent itself. Automakers are finding different venues to introduce new models. However, you wouldn't know it in Chicago.

The Chicago Auto Show lays claim to being the largest, best attended and longest running auto show in the country. At the show there are one-million square feet of show space on one level, four indoor test tracks and several outdoor driving opportunities. I wouldn't say it's quite a bucket list car event, but it's a can't-miss event for any car and truck buff in the region. Or for shoppers. The thing about the Detroit show is it's a lot of industry people attending. The Chicago Auto Show staff are happy to tell you they get the most real consumers. Sure, the weather can be pretty rough this time of year, but the Chicago staff says that's part of the appeal: it's an indoor event where you can spend the day during a slow time of year.

Next year the Detroit folks might be finding themselves competing with a lot of other events in their new time slot. Some will say the Chicago Show can be light on news, but at this year's show two events acknowledged the 30th anniversary of the debut of the Mazda Miata and of the Acura NSX concept car, both world debuts on the same day. It's been an especially popular place to introduce new trucks over the years. Ram and Dodge have done Heavy Duty introductions here in the past and Thursday, February 7 was no exception.

Before rolling out the new Ram Chassis Cabs for 2019, Jim Morrison, Vice President of Ram Brand for North America, showed the long-awaited new multifunction tailgate on the Ram 1500. You can open it the traditional way and it has a 2000-pound rating. Or you can open it up barn door style to get closer when loading things in or with a forklift. He got a good dig in on GMC's MultiPro tailgate, noting the Ram's is "trailer friendly." The GMC tailgate will hit the trailer tongue or bare hitch if some of its special features are deployed. I've had some time with a couple GMCs with the MultiPro tailgate and it's gimmicky compared to Ram's simpler solution.

Ram's barn-door tailgate.

GMC's MultiPro tailgate. To get the heavy, heavy, (okay, it has power assist) tailgate to this position (i.e. butt-cheek-only seat or a step) you have to do several "open-this-close-that" things. Ridiculous.

Next came what Morrison called "the commercial workhorses of our lineup," the Ram 3500, 4500 and 5500 Chassis Cabs. Not surprisingly, he said these trucks "continue the reputation for upfitter friendliness" and have most of the improvements we've seen roll out in the 1500 and 2500 trucks. With the new Cummins compacted graphite iron block, a 97% high-strength steel frame, and an aluminum hood, engineers shaved off about 120 pounds. They come with either the 6.4-liter gas V-8 or the Turbo Diesel with 360hp/800 torque. Maximum GCWR went up 4500 pounds to 43,000 and maximum towing to 35,220. Morrison said "every configuration will out tow every truck in its class." (Later in the day Chevrolet claimed 35,500 for the Silverado 3500HD diesel dually, and also announced the return of Class 4, 5, and 6 trucks.) Ram's payload goes up to 12,510 pounds.

In the tech department, Chassis Cabs get a configurable gauge cluster and the available 12-inch touch screen. Available "segment exclusive" adaptive cruise control and forward collision warning with automatic braking works even with a 35,000-pound trailer in tow. Also available is a 270-degree surround view camera.

Then came the ultimate: a Chassis Cab 5500 Limited with Ram's full blown luxury interior.

I had a chat with Dave Sowers, head of Ram Commercial. He reiterated the "upfitter friendliness." He said the feedback he gets from upfitters is that they would rather work on a Ram.

The Ram guys are headed to the annual Work Truck Show next month where they meet with upfitters and exchange information. Ram keeps wiring diagrams and structural schematics on the Body Builder Guide section of the Ram website make their job easier, and also has an email address and 800 number for help. Some of it is simpler things they've been doing for a while, like locating the DEF tank under the cab, and fuel filler right behind it so those things don't have to be relocated. Now they have a Vehicle System Integration Module as a "safe gateway" to connect the upfit to the truck. It has 73 circuits—inputs and outputs—as an easy access to the truck's electrical architecture without splicing wires. Some examples he gave were you could wire an upfit with remote door locks to work with the truck's power locks. In the reverse, a bucket truck can be set up so the truck can't be driven away with the bucket up.

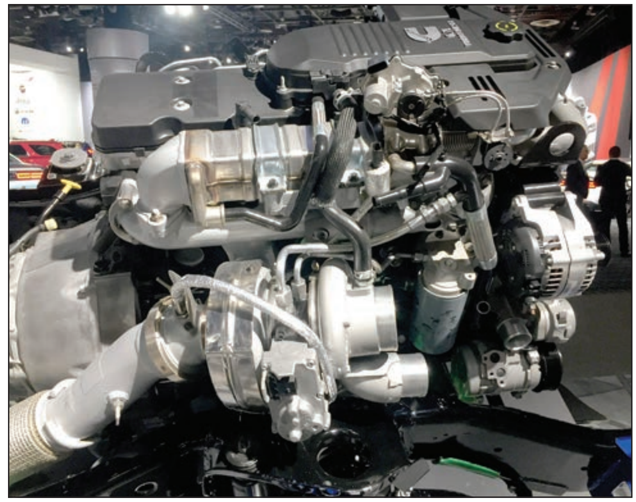
Andy Mikonis
TDR Writer

MORE FROM CHICAGO: Ram HD Commercial – GREG WHALE REPORTS

(This article was previously posted at our website on 2/6/19.)

In early February at the Chicago Auto Show Ram introduced the 2019 Chassis Cab trucks. They will be offered as regular or Crew Cab in Tradesman and SLT trim, plus Laramie and Limited Crew Cab, on one of six wheelbases (143.5 to 204.4 inches)—eight if you include the inch difference between 3500 and 4500/5500 60- and 84-inch CC trucks. Unique to Ram is a Class 2 10,000 GVW Chassis Cab.

All the styling, powertrain and interior updates applied to the HD trucks that debuted at NAIAS in January are included here: from the tablet-size Uconnect to grille shutters. The top trims now come with color matched front fender flares. Apparently this is a big deal in medium-duties, though I shouldn't be surprised now that work rigs have heated and ventilated seats. I'm wagering this will be the quietest inline-diesel-engine commercial vehicle any of us have been in.



The cabin-removed models give you a great look at the Cummins engine.

For CC the diesel is rated 360 horsepower at 2800rpm and 800 lb-ft at 1800rpm, paired to the updated AS69RC. The 3500's 6.4 Hemi is the same 410/429 as the pickups, with the 8HP75 eight-speed auto, while the 4500/5500 gets 370hp and the AS66RC six-speed. Axle ratios are 3.73:1 or 4.10:1 on 3500, 4.10:1 and 4.44:1 diesel with 4.89:1 optional on gas 4500, and 4.44:1 or 4.89:1 on all 5500 setups. Alternators include single 180A and 220A units, or duals for 380A or 440A, while fuel is carried in a 52-gallon rear tank, 22-gallon midship, or the combination of both.

Features and options parallel trims much as you'd expect, some of it adjusted for the no-box configuration, such as the surround view camera that's only 270 degrees. Lane departure warning, automatic emergency braking with trailer brakes, adaptive steering and adaptive cruise control/forward collision warning are available on Tradesman, but all-around or cargo cameras, trailer tire pressure monitoring and trailer reverse guidance require Big Horn or better.

So how big can your new fifth-wheel or hot-shot rig be? With a single-rear Crew Cab 4x4 19,980 pounds; 25,130 for a dually. Those trucks' rear GAWR leave about 4100 pounds and 5200, respectively, for pin weight, neither of which exceeds the total payload rating. On the 4500 peak tow for a Crew 4WD 60-inch CA is 28,770 pounds. Take off about 90 pounds for the 84-inch CA and about 400 for 4WD. The towing charts list 5500 4WD diesel as regular cab only, with tow ratings from 34,450-34,800 pounds. A Crew 2WD, 60- or 84-inch CA only, falls in a similar window, while the short-wheelbase regular cab is the braggart at 35,200. Diesel GCWR runs from 27,500 on single-rear trucks to 43,000 on Max Tow 5500. Bring on the CDL!

The ratings war continues. GM posted a tow rating of 35,500 pounds with a GCWR more than 43,000 and Ford will have their own announcement at Chicago. GM's pickup has a new 6.6-liter gasoline V-8 and a ten-speed transmission they call Allison, but it isn't built by

Allison—the only way to get a real Allison from GM is in the 4500/5500/6500 medium-duty, all built on the same frame. Meanwhile Ford, also adding a 10-speed, continues to say that competitors have to use an outsider engine or transmission and only they build both in-house, apparently not getting the "Allison-*branded*" memo yet.

GM ups the ante at the Chicago Auto Show with a tow rating of 35,500 pounds GCWR.

In a world where assembly plants bolt together items from myriad suppliers, all you need is a decent "vehicle integration engineer"—the guy or gal who makes everything cooperate in the truck—to make it work. If Ram chooses to let Cummins and Aisin spend the development dollars, so be it. You have to wonder if in-house is always best, why are so there so many B-series engines in trucks, busses, motorhomes and boats around the world?

The only question left is what will be the next benchmark? A 40,000-pound tow rating? 1100 or 1500 torque? 500 horsepower? $125,000 fully optioned? Time will tell.

G.R. Whale
TDR Writer

FIRST DRIVING IMPRESSIONS: RAM HD CONSUMER – GREG WHALE REPORTS

It was a full six minutes from when we got an unloaded 2500 at the private test facility and the editor, facing a long, arrow-straight, desolate section of highway the likes of which don't exist anywhere remotely near TDR headquarters in surburban Atlanta, Georgia, matted the throttle in a standard diesel. In no time flat he'd confirmed an indicated 100mph around 2250rpm, and two mph later the throttle went dead pedal at what I surmised was a tire—and perhaps other hardware or common sense—imposed speed limiter.

The editor chooses a 2500 in Big Horn trim.

Listening to the Eagles "Take it to the Limit," the editor did as instructed. (Notice the "102," that was not the outside temperature.)

And it was scarcely any louder than it was at 72mph.

You may not care for the new style, might be not concerned about a scissor-gear cam drive or hydraulic lash adjusters, or simply don't need ten-plus tons of towing capacity; but few will complain about how quiet and comfortable a Ram HD is rolling down the highway. It is quiet, dare I use "isolated," and sitting that far off the road will find you quickly pacing faster than intended... and this was Big Horn trim (which supplants SLT) and not one of the higher-trim trucks. The Big Horn MegaCab 4x4 2500 running empty recorded almost 18mpg on a roughly even mix of highway miles and a circuitous, tortuous slog through Vegas suburban traffic. I can't say I noticed the additional pound-feet here either, but it was a comfortable ride. The wife will love it, too.

My drive began in a Crew dually Max Tow Limited, with an MSRP of $87,710 and a tandem-dually gooseneck dump trailer. The weight tab pegged the trailer at about 8500 pounds and there were five bins of gravel payload in it listed at about 6400 pounds. But none of that gravel was forward of an axle so tongue weight was perhaps a quarter of rated payload…and the few sandbags in the bed had no effect.

Effortless towing, but the editor did like the pogo-effect.

That, and the trailer itself, made for a fairly rocking-horse ride. ***(Editor's note: really, the load behind the truck was distracting. Can you say, pogo stick?)*** There was no noise or clanking, but you knew something was behind you and happy to follow its own direction were it not tied to the truck. This was the worst-case ride there, save the flatbed regular cab 5500, and I'd have been happier if at least one of the gravel bags was in the bed. The load-in-tow did little to showcase the capabilities of the truck. Since it was all effortless.

That said, steering, braking and general composure are excellent. With a big fifth-wheel you'll have a hard time finding a more relaxing way to pull it, and maxing out the new receiver hitch ratings (20K on 2500, 23K on 3500) will be equally stress-free. When the stereo is off and you don't even notice wind noise before 70mph, and towing with the mirrors out, you know it's quiet, though the lower frequencies—think organ pipes and string bass—do get a little lost at road speed towing, so don't be shy with unleashing all 700-plus-watts of the high-zoot sound system. But cover the dog's ears first, just in case.

At 1700 miles I'd not expect it fully broken in and we never observed fuel economy in double digits. With 60mph indicated showing about 1700 revs on 4.10:1 gears, the trip computer display of 7.6mpg appears initially miserable, but the course was stop-and-go, with plenty of elevation change and cool temperatures. Traffic conspired to limit highway speeds for much of it, although I did see high 9s on a few hundred yards of highway, and considering how much time we spent climbing grades at an estimated 24,000 combined and the aero toll of that trailer I can't fault fuel economy. It'll be up to you to gather the real-world data.

Could I notice the fifteen horsepower (385 to 400) and gain in peak torque (930 to 1000)? Nope. And I'll wager unless you routinely tow heavy and back-to-back you wouldn't be able to either. On the open road it's everything else—upgraded cooling package and fan, revised powertrain calibrations, the lighter weight and the 8% aero improvement—that will deliver as much performance or economy gain as the HO motor.

Since our truck was a full-boat Limited, it carried active cruise control, which works with a trailer, and yeah, it worked as intended. The truck also had blind-spot warning but unlike the 1500 this does not work with trailers. Yet. I figure it's coming (not least because competitors have talked about it) but with dually fenders and trailer lengths potentially longer than the 39.5 feet the 1500 "recognizes," it's not a simple carryover from half-ton to HD. Note also that while power adjustment for the convex elements on towing mirrors is available, a Big Horn tester had trailer mirrors with power fold and main elements, but the wide-angle was still manual.

The Limited: a beautiful interior.

For those with a gasser in the fleet the biggest powertrain difference is the launch grunt from the deeper first gear. The resulting crawl ratio in a Power Wagon adds another 10 degrees to descent slope for engine braking…and it has variable-speed hill descent if you're worried. The Power Wagon's winch is 20 pounds lighter, synthetic rope and faster line speed now.

The Power Wagon was available for testing at the ride-and-drive.

All HD pickups (except Power Wagons and those with the off-road packages that are all Bilstein monotube) get frequency selective damping shocks. But the ride has been further improved on the coil-sprung 2500 using progressive springs—the rate is 25% lower at empty and 40% heavier for loaded conditions, and when an observer even mentions a Porsche Panamera in the same discussion about highway-speed cruising manners you know it's good.

Pricing runs from $33,395 for a gasoline, regular cab, 2WD Tradesman 2500 to more than $67,000 for a 3500 MegaCab Limited 4x4, plus freight. Roughly speaking, the step from 2500 to 3500 is $1400-1500. A Cummins is $9100, the HO/Aisin (available on any 3500) is $11,795, the bump from Crew to MegaCab is $1500 and 4WD adds about $2900. Frequent upgrade choices include the Safety Group (blind-spot, forward-collision warning and mitigation braking, adaptive cruise, LED headlights, rain-sensing wipers at $2195 for a Tradesman to $795 on a Limited; Tow technology group ($2425) and the 12-inch Uconnect is $1995 over an 8.4A and $1295 over the 8.4AN. Just get the CarPlay/Android Auto and use that.

G.R. Whale
TDR Writer

FIRST DRIVING IMPRESSIONS: RAM HD CONSUMER – ANDY MIKONIS REPORTS

Las Vegas, Nevada – Luckily I picked a later wave to drive the new 2019 Ram 2500 and 3500 Turbo Diesels after a freak February snowfall had melted away. The media drive consisted of on-road legs to and from Las Vegas, out to a central location at the Eldorado Canyon Mine where we spent a few hours driving trucks with a variety of trailers and loads, as well as off road driving. For bookends to the event I started with a 2500 Limited Mega Cab 4x4 and ended with a 2500 Tradesman. Ram PR guy Nick Cappa suggested I take the decked-out 2500 Limited. It was used in the product presentation for an interesting demonstration. Ram is really pushing the new camera setups and how they help with trailering, in this case by making hookups easier. This Limited had the air suspension, which has the ability to change the ride height by 1.9 inches. They had it hooked to a gooseneck trailer, so they showed how you could crank the legs of the trailer down, drop the tailgate, unhook the lights and chains, then get back in the cab and lower the air suspension and drive right out from under it. Then to hook it up you can back up to it, drop the tailgate with the push of a button inside, use the camera to line up the ball, then raise the air suspension to engage the gooseneck. Considering they call it the "Auto Level Rear Air Suspension," I figured auto leveling is its main function. So, I wonder if this particular use is something they thought of later, rather than an engineering consideration. Still, this definitely takes some steps out of the hooking/unhooking process and could be useful to someone who has a hard and level place to park their trailer. Impressive!

The 2500 Limited in black. My ride out to Eldorado Canyon. Nice truck.

The new Heavy Duty trucks look great. As you would expect, they follow a similar design theme to the 2019 Ram 1500 pickups. Though the 1500s are growing on me, I was lukewarm on the styling at first. There's just something about the big front end of the Heavy Duty that really works with the new look. Chief engineer Red Romain pointed out some interesting things about the design. Though the front of the new truck is bigger, mostly due to a 30% larger radiator, its aerodynamics are 8% better than the outgoing truck, and best-in-class. He said this was primarily achieved with active grille shutters (which also help with faster warmup) and a lower air dam. You can remove the air dam but he said it does not compromise the approach angle.

Getting out on the road in the Limited was a real treat. I keep saying with each generation that it's amazing how refined heavy duty pickups keep getting, but this is a giant leap forward. Of course, it's hard not to like this heavily optioned Limited, but some of the refinements can be seen across the lineup. The Turbo Diesel engine is noticeably quieter. Matt Whitton of Ram Heavy Duty powertrain engineering explained that it's because of new scissor timing gears and hydraulic lifters. Wait. Hydraulic lifters? If hydraulic lifters are okay, I wonder why it took them so long to use them. Whitton added that the whole cab is quieter with new mounts including a hydraulic mount at the C-pillar, and active noise cancellation. He said they even added weight to the exhaust hangers to reduce vibration and noise, though they still shaved 143 pounds total versus the old truck.

Back to this particular example: it had the awesome Limited interior straight out of the Ram 1500. Ram continues to kill it in the interior department. For comparison I have been in all the current half-ton pickup high-end interiors except Toyota's, and Ram has them all beat in quality. So, we'll see if others follow suit.

Another option that helped out the ride was the air suspension. Nevada's roads were mostly smooth, but there were a couple deteriorating sections to prove the ride wasn't 100% carlike, but impressive nonetheless. This one would be perfect for a cross-country cruise. Of course all this came at a price, that being $65,700 base and $83,915 out the door including $1695 destination. This would not be the most expensive truck I drove—two 3500 Longhorns with the HO motor would exceed that.

2500 Limited interior.

For the towing portion of the program, I drove five trucks with various loads starting with a 2500 with 10,150 pounds of trailer and cinder blocks on the receiver hitch. The rest were goosenecks. I did the same run with each, 11 miles one-way down a grade and then back up the same way. The Ram guys called it 5%. I'm an English major but I came up with closer to 3% based on their numbers; but, whatever, it was a decent run to get a feel.

You shouldn't be surprised to hear the trucks handled the trailers just fine. They redid the brakes so stopping was confident with great feel. The exhaust brake works well, too, with a full-on or auto settings. Most interesting was moving from a 3500 Crew Cab with the HO Turbo Diesel pulling a 12,400-pound RV, right to another one hitched to a 8440-pound trailer with a 12,720-pound loader borrowed from their friends at Case. There I could feel a difference. The Turbo Diesel wasn't straining, but was noticeably louder. Still, by the time I got back to the end of the run I barely noticed it any more.

3500 HD Turbo Diesel and its 21K load.

Ram had one more 3500 Regular Cab hooked to a trailer with some cinder blocks and a Case backhoe maxed out to 35,100 pounds. They weren't letting us drive it due to licensing requirements—hadn't thought of that—but were giving rides with a qualified driver. No drama from the passenger seat. The guy was driving it with a couple fingers on the wheel most of the time.

Maximum load

After a juicy off-road session in a Power Wagon (gas, of course) I requested a Tradesman Turbo Diesel for the drive back and got a 2500 Regular Cab 4x4 Long Box with a load of lumber. Nice to see that they still build a two-door truck. Yes, that's sarcasm. All the marketing guys—for all the brands—would have you think everyone is buying leather-lined crew cabs. A few years ago a friend of mine with a manufacturing company told me he had trouble finding a two-door 2500 Turbo Diesel in base trim. He had to fly from Michigan to Oklahoma to pick one up. I mentioned that to Jeff Johnson, head of Ram Heavy Duty Marketing, and he was taken aback. That was before Ram Commercial really started ramping things up. I don't think they are going to risk missing out on a customer like that now.

My ride back to Las Vegas.

So, rest assured you can still get a work truck with rubber carpet and manual windows (but not manual transmission). With some chrome bits, fifth wheel/gooseneck towing prep group and Tradesman "Level 2" Equipment Group, this one rang up at $51,010 including freight, up from a base price of $36,295. That Level 2 Group for $995 gives you cloth, carpet, power windows and a list of other things to make the Tradesman more comfortable. Though, as with the last generation, the work truck interiors are nicely put together.

The different trucks I drove had a mix of different interiors. The Longhorn package is more over-the-top than ever (in a good way). Then I drove a Laramie, which they think is going to be the biggest seller. The only one they didn't have out was the Big Horn. But I did see some. Real ones! Three of them were running along the road during one of my tow runs.

Andy Mikonis
TDR Writer

2019 RAM INTRODUCTION – OKAY, THAT'S BETTER

ISSUE 105 – TDREVIEW

by Robert Patton

Looking back at Issue 104 in the “TDReview” write-up on the 2019 Ram I see that I made the comment, “I expected more industry ‘buzz’ about the Ram/Cummins 400/1000 power rating.”

Perhaps my comment was just a little too early in the cycle of press stories. Because, yes, the press did react to the new 2019 Ram Turbo Diesel.

What did the writers have to say?

First: The Truth About Cars

First, on February 28 there was the website, The Truth About Cars and their story “2019 Ram HD First Drive,” by Matthew Guy:

“The new Ram Heavy Duty pickups are equally as desirable as their half-ton brethren, particularly in the spiffy new cabin. What does 1.000 lb-ft of torque feel like? Can it haul the mail?

“You bet your Golden Nugget poker chips it can.

“Developing an engine cranking out 1,000 lb-ft of torque was no mean feat. Your author fully expected Ram to be the first manufacturer to break the four-digit torque ceiling in a consumer-grade truck. That’s not wholly surprising. What is surprising is the speed and alacrity in which it appeared, not to mention the drivability of a machine that could pull a house off its foundation.

Matthew Guy at Truth About Cars is impressed with the 2019 Ram Heavy Duty.

“How did Ram manage to enter Club 1000? It’s important to note not all Ram HDs are created equal. The Cummins Turbo Diesel in the new 2019 Ram 2500 and 3500 Heavy Duty is offered in two variants. Standard output checks in at 370 horsepower at 2,800 rpm and “only” 850 lb-ft of torque at 1,700 rpm. The high output mill, installed in the 3500 truck and grabbing all the headlines, is the one which makes 400 horsepower at 2,800 rpm and 1,000 lb-ft of torque at 1,800 rpm.

“What about the big guns? The halo number of 35,100 lbs that Ram keeps throwing out there? To find out, we hitched up to an 11,500 lb gooseneck and then loaded it up with 15,810 lbs worth of backhoe and 7,790 lbs of cinder blocks. Presto: 35,100 lbs.

“Headed down a 6 percent grade, descending 1,801 feet in 5.4 miles, the exhaust brake exhibited similar tendencies to rein in the massive amount of downhill momentum created by this truck and trailer.

“At a turnaround near the grade’s end, stepping out into the crisp Nevada air revealed nary a hit of burnt brake fluid or overcooked rotors. Climbing back in the saddle and pointing the Tradesman up the hill, the contractor-white dualie dragged its load up the gradient with dogged determination. Burying the loud pedal right into the vinyl during the steepest sections of the course resulted in a steady 35 mph speed. With 35,100 lbs in tow, it gained speed as the terrain levelled out.

“Technology like automatic emergency braking, once the domain of luxury sedans, has found its way onto the Ram HD. This system remains functional even when a loaded trailer is connected, as the emergency braking integrates the trailer brakes so a full-on panic stop is available even while hauling. Adaptive cruise is part of the deal and helps reduce driver fatigue.

“In fact, most of what Ram engineers have built into the new HD pickups is designed to just that—reduce fatigue. An alert and rested driver is a safer driver, so the thinking goes, and it is difficult to argue that assertion.

“Prodigious power, bold looks, and a sumptuous interior—perhaps it shouldn’t be a surprise if Ram overtakes GM for second place in the truck market, as is their goal.”

Next: Automotive News

Next, we have the March 4 edition of Automotive News, “Ram Hopes to Capture Evolving HD Audience,” by Vince Bond Jr.:

“Ram knows it has a solid base of hardworking farmers and construction laborers who buy its heavy-duty trucks.

“But in a quest to shake up the ranks of pickup brands, Ram is using its redesigned truck to present a fresh profile of who a heavy-duty buyer can be.

"But the pickup segment, and Ram buyers, 'have grown beyond the traditional users,' commented Jim Morrison, VP of Ram North America.

"Around a third of heavy-duty buyers want a work truck, Morrison says, while another third want a vehicle to haul items such as luxury RVs and horse trailers. Then there's a contingent that wants both, for handling work during the week before a family excursion on the weekend.

"The luxury enhancements didn't happen overnight. Ram tested plusher interiors in its heavy-duty line over the years with its Limited trim and the Tungsten edition, which drew positive consumer reactions and assured the brand that it was going in the right direction.

"Meanwhile, the design team had to create HD trucks that exude luxury as well as job site capability.

"The starkest difference for the 2019 models is the more imposing grille, which is 30 percent larger than on the outgoing trucks. The larger grille was needed for the cooling requirements that come with a 35,100-pound towing capacity, said Mike Gillam, Ram's exterior design manager. He called the towing prowess 'a landmark that sets up everything else' with the design.

"For style hunters, the heavy-duty Rams offer updated sport and blacked-out appearance packages—and Gillam said more options could appear down the line that cater to the wide spectrum of truck buyers.

"Said Morrison: 'They're badass looking trucks.'"

Ram 2018 Grille.

Ram 2019 Grille.

The First Magazine Article

The April issue of Car and Driver arrived at my house. The magazine's Andrew Wendler had this to say about the new 2019 Ram HD:

"Forget the muscle-car wars. A higher-stakes arms race is happening in the heavy-duty truck segment, and Ram just drew a 1000 lb-ft line in the sand. Ram was also wise enough to update the HD lineup with plush interiors and new technology to appeal to modern truck customers, many of whom missed the memo about not mixing work with pleasure.

"Essentially new from the ground up, the frame makes extensive use of high-strength steel—98.5 percent of it is formed from the stuff, according to Ram. Numerous improvements to the front and rear axles enhance capability and durability. The 3500 has rear leaf springs while the 2500 retains the coil setup and offers optional air springs."

I continued to watch for Ram/Cummins HD truck articles in the press. Then the floodgates opened...

ACCOLADES FROM THE PRESS – RAM HD

My collection of Ram HD-related information.

Got it, the floodgates opened: Now it is a challenge to your editor to find some comments that are insightful, entertaining and/or new to the audience. After all, we've been following the truck's introduction, well, since the first Forth Generation HD truck was available back in the fall of 2009. We've seen all of the facts and figures, what new can be told, what might we have overlooked?

Here goes:

March 2019, MotorTrend, “First Look, Ram HD”

MotorTrend mentioned: “The optional rear suspension gets a ‘Bed Lowering’ mode for easier loading. Payload—a best in class 7680 pounds with a gasoline-powered 3500, 6910 pounds with the Cummins.”

May/June 2019, Truck Trend, “Top of the Class”

Truck Trend commented: “These stouter body elements (hydroformed front-end structures and tailgate reinforcements) contribute to a tougher body shell less prone to noise, vibration, and harshness, but Ram took that a step further in a variety of ways. Revised engine and exhaust mounts reduce the amount of vibration transferred to the frame. Active Tuned Mass Modules (ATMM) on the framerails apply a cancelling vibration to the truck whenever shaky nuisances are detected.

“One unique feature has been retained for ’19: Ram’s class-exclusive Mega Cab body configuration. Featuring luxurious reclining rear seats and a massive amount of storage behind them, the Mega Cab boasts more than double the interior storage capacity of competitors’ trucks. To borrow the old hot rodder’s maxim, there’s no replacement for displacement, and this newly redesigned interior still displaces a lot more than its competition.”

May 2019, MotorTrend, “Strength in Numbers”

More from Motor Trend: “However, if you actually use your truck to move stuff around, the 2500 Tradesman is a great, low-dollar, high-capability alternative to a half-tonner. Ram hasn’t announced pricing yet, but you’ll be able to slide into the Tradesman gasoline-powered, with a vinyl-skinned interior for about $35,000 with no options.

“On the other end of the pricing spectrum sits the full-fat 3500 Mega Cab dually with the aforementioned optional 1,000-lb-ft engine, in either Laramie Longhorn or Limited trim with the Max Tow package—which can set you back over $90,000.”

July/August 2019, Truck Trend, “Heavy Hitter”

From Truck Trend: “Yep, you’ve read this before, but it bears repeating: “First and foremost, this truck is quiet—almost too quiet. Ram engineers went to great lengths to tune out unwanted sound from the cabin, and the result was a nearly 50% reduction in noise. Cruising down the road feels more like driving a ½-ton pickup than a Heavy Duty. Thankfully, there’s still a bit of the familiar Cummins engine hum that continues to make its way to the occupant’s ears.

“We’ve already spent a year raving about the wonderful interior of the 2019 Ram 1500, so we’ll spare you here. We’ll just say this: It’s just as amazing in the Heavy Duty as it is in the light duty. From the highest trim to the lowest, these trucks are very well-appointed and overflowing with useful technology. The seats are comfortable, audio quality is incredible, and uConnect is one of the best infotainment systems available today. And with the amount of real leather, wood, and metal used in the higher trims, these work trucks are putting many luxury brands on notice.”

ACCOLADES FROM THE PRESS – RAM 1500

My collection of Ram 1500-related information.

And, for our little brother, the Ram 1500 gasoline-powered truck there were more than several write-ups and comparisons:

January 2019, Car and Driver,
“Full Size Pickup Battle”

In this article the Ram, Ford and Chevrolet 1500 series trucks were compared. All had four-wheel drive, all had Limited-type trim. The engines varied in size (Ram 5.7, Ford 3.5 turbo, Chevy 6.2).

The summary: “It’s a little cliched to say of a tow vehicle that you don’t even feel the trailer, but we were shocked by how literally true that is in the Ram.”

“...the Ram is far and away the most thoughtfully executed full-size pickup in existence. For starters, it looks like a Mercedes S-class exploded inside.”

“The Ram is a gooey puddle of luxury sedan with a tow hitch poking out from the rear bumper. It’s a toy hauler that is itself a toy. It’s our new favorite full-size pickup. And it’s worth the money.”

Motor Trend’s “Truck of the Year” spotlights only new-introduction vehicles. As such the only Ford entry was their F-150 diesel. GM had five variations of the new Chevy and GMC 1500 series trucks. Ram had five variations of their new 1500.

The verdict: “Where Ram makes the biggest value argument is surprisingly in its two most expensive trims: the $52,685 1500 Laramie Longhorn and $55,285 Limited. These two deluxe trucks simply blow the competition out of the water. They offer the tech that contractors and civilians alike require and expect, and quite a few luxury automakers could learn a thing from the way Ram matches colors, textures, and materials in these cabins.”

"No segment is more competitive or more important to Detroit's automakers and blue-collar American workers than half-ton pickups. Theses trucks are the face of their brands–purchased, driven, and loved by millions. They're dependable commuters, tools, and toys that form the backbones of our families. With such a diverse skill set needed, it's easy to just miss the target. But the Ram 1500 hits the bulls-eye. No pickup in the segment better balances capability, efficiency, value, and quality."

"The Ram 1500 retains its old-school appeal while being refreshingly modern in style and substance. It's refined and sophisticated without surrendering its dirty-fingernails roots. For that, Ram is our 2019 Truck of the Year."

February 2019, Car and Driver,
"10 Best Trucks and SUVs for 2019"

In this Car and Driver article, the C&D Staff chooses a "segment" winner.

For example, Chrysler's Pacifica was the segment winner for Best Van, a Hyundai Kona was the best Subcompact SUV, etc, etc. The half-ton, full-size pickup category had entries from Ram, Ford and GM.

Their comments: "Nobody spends more pennies on its interiors than Ram. In the 1500's upper trims, Laramie Longhorn and Limited, the detailing and material richness exceed not only those of any other current pickup, but the standards established by any domestic vehicle in many decades. These are Duesenbergian works in the age of plastic. No American vehicle today–not a Cadillac, not a Lincoln, not a Tesla–can hold a candle to the top-level Rams' cabins."

"In it's comfort, composure and capability, the Ram 1500 is America at its best."

March/April 2019, Truck Trend,
"Pickup Truck of the Year 2019"

In the Truck Trend comparison they invited all-new or significantly updated for the '19 model year trucks. There were two Rams, two Fords, two Chevys and two GMC 1500 series trucks in the evaluation. This comparison was interesting as they used score cards and totalled the values:

Ram	149.37
GMC	142.93
Ford	137.12
Chevy	132.57

"While we try not to play favorites, it's clear that the Ram lineup is what most of us wanted to take home at the end of the test, and that's no accident. After years of steady improvement and evolution, ram has finally build a world-class, no-compromises pickup that's ready for anything."

June 2019, Motor Trend,
"Who Makes the Best Work Truck"

Wow, a base-engine 4x4, crew cab, base interior comparison. Let's get to the nitty-gritty: the winner is, Ram 1500.

Their comments: "With the best ride quality and fuel economy, excellent utility, and a snappy interior for a base truck, our current Truck of the Year hauls home a bedload of gold medals. Its smart packaging and superior body control when towing or hauling heavy stuff make it the best half-ton work truck you can buy today. It does cost a bit more to get the features you want, but it's worth it."

Robert Patton
TDR Staff

CUMMINS 2019 6.7 CGI OVERVIEW - 2.5 IS THE NUMBER

ISSUE 104 – TECHINCAL TOPICS

by Robert Patton

While I was at the NAIAS in January I talked to some of the Cummins folks in attendance. It wasn't long in the discussion that I realized the new 400/1000 rating was 2.5 times the original output of the first Turbo Diesel truck in 1989.

Over the past 30 years we've noted changes to the engine were typically driven by ever-tightening emissions legislation. At the same time performance numbers also moved higher. Oh, the difficult job of the Cummins and Ram engineering staffs.

Further on in the discussion I realized that the updates to the 2019 engine were based on meeting performance goals. (For now and the future?) Emissions were no longer the driving force.

With performance in mind, let's take a look at the notable power increases in past years and the hardware changes to the engine that provided the structure and support to handle the higher output(s).

	Horsepower	Torque
1989	160	400
1994-'95	160/175	400/420
1996-'98	180/215	420/440
Bosch P7100 fuel injection, turbocharger changes.		
1998.5-'00	215/235	420/460
2001-'02	235/245	460/505
Bosch VP fuel injection, turbocharger changes, 24-valve cylinder head.		
2003-'04	235/305	460/555
2004.5-'07	325	600 or 610
Bosch CP3 high pressure, common fuel rail injection, turbocharger changes.		
2007.5-'12	350	610/800
2011.5 High Output	385	850
Completely new 6.7-liter engine, variable geometry turbocharger, nitrogen adsorber catalyst diesel aftertreatment system.		
2013-2018	350/370	660/800
High Output	385	850

Small engine hardware changes, diesel exhaust fluid (DEF) and selective catalyst reductions (SCR) exhaust aftertreatment.

Now, if you want the details on the hardware changes that allowed Ram and Cummins to give us higher ratings over the 30 year lifespan of their partnership, the TDR reference sources are as follows:

- Issue 80: TDReview, pages 58-63
  "What's New for 2013? Emphasis on the Cummins Engine"
- Issue 78: TDReview, pages 46-55
  "The 5.9-liter Engine Introduction in 2003"
  "The 6.7-liter Engine Introduction in 2007.5"
- Issue 50: Technical Topics, pages 50-56
  "Diesel Exhaust Emissions for 2007"
- Issue 40: Technical Topics, pages 32-40
  "Diesel Exhaust Emissions. What Does It Mean to Me?" This article was a recap of 1989-2002 hardware changes. Also featured was a look at the new 5.9HPCR engine and the changes forthcoming in 2004 to a lower NOx number. (Revised down from 4.0 to 2.4ppm.)

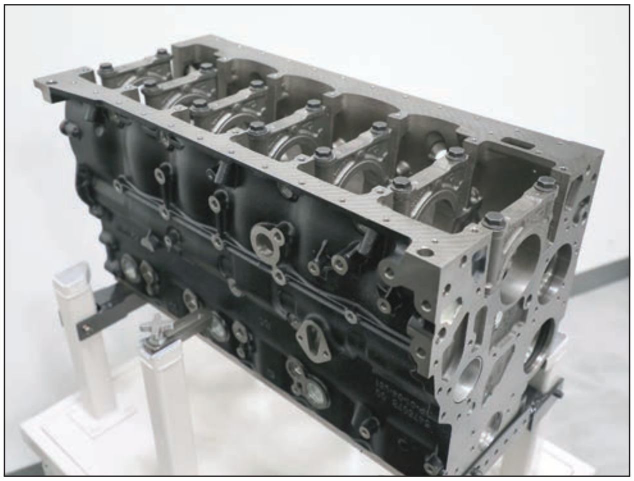
We've covered engine updates over the years.

LET'S LOOK AT THE UPDATES

With a power rating of 400/1000 I wanted to know more about the Cummins 6.7 compacted graphite iron (CGI) engine. I was travelling to meet with Cummins to discuss the June TDR Rally and the folks at the Columbus MidRange Engine Plant (CMEP) invited me to take a close look at the engine. The following is my report.

The Block

Just like the Ram folks have to provide higher strength steel to the chassis to give you higher load capabilities, bigger brakes, stronger transmissions, etc., Cummins had to give us a higher strength block. Compacted graphite iron (CGI) is the technology.



Cummins' compacted graphite iron engine block.

I went on a search to find out more about CGI. There was an abundance of information on the internet. The best description of CGI that I found was written by Mike Mavrigian for The Shop magazine (a trade publication for automotive shop owners) back in August 2009. I called Mike and asked if we could pay him for his research and reuse parts of his story.

To the point, Mike tells us the following: "CGI engine blocks offer greater strength and superior stability with no weight penalty. In theory, a CGI block can be produced at near-aluminum-weight while maintaining needed strength. One benefit is that cylinder walls can be made thinner without sacrificing stability or strength.

"CGI, or Compacted Graphite Iron, features a molecular makeup that creates a tightly-interconnected graphite during the casting process. CGI casts much like gray iron, but offers more hardness, more fatigue strength, superior ductility and greater tensile strength, sort of a happy medium between gray iron and ductile iron. The compacted graphite molecular shape, often referred to as "semi-nodular," makes it less brittle and more stable than gray iron.

"CGI blocks offer greater stability and strength, which is of particular benefit in engines that produce high cylinder pressures.

"CGI is up to 75% stronger than gray iron. Although relatively "new" in the automotive field, CGI was actually conceived and patented way back in 1949, but its use was delayed until production manufacturing and machining techniques were developed to handle this stuff.

"Although not as strong as ductile iron, CGI is 500% more fatigue resistant than aluminum and 200% as resistant to fatigue compared with gray iron. In other words, it's ideal for racing engine blocks that need to withstand tremendous pressures and thermal levels. Also, because of its increased strength, a block can be machined to reduce weight by as much as 22% compared with gray iron, if the builder so chooses.

"CGI blocks are very popular in Pro Stock and NASCAR Cup applications. The blocks are more stable and offer much lower wear characteristics. Several OEMs are using CGI for their blocks.

"For example, Audi V8 diesel blocks are cast from CGI, and since the material has such excellent strength characteristics, the main bearing caps are actually cast in place as part of the block, then laser-etched and fractured off to achieve a perfect cap-to-block fit (the same approach used in powder metal rods with fractured caps). Other OEMs (to name but a few) currently using CGI for their engine blocks include BMW, Jaguar, Rolls-Royce, GM/Opel, Suzuki and Aston Martin. The CGI 5.8L blocks used in Toyota's NASCAR truck program, as another example, weigh a mere 195 lbs. and feature 3mm-thick cylinder walls."

Editor's note: the first use of CGI blocks in a production vehicle was in 1999.

"By the way, in terms of producing the block castings, CGI is only slightly higher in cost per pound than conventional gray iron, with very similar casting techniques, so raw CGI blocks do not carry a big cost penalty.

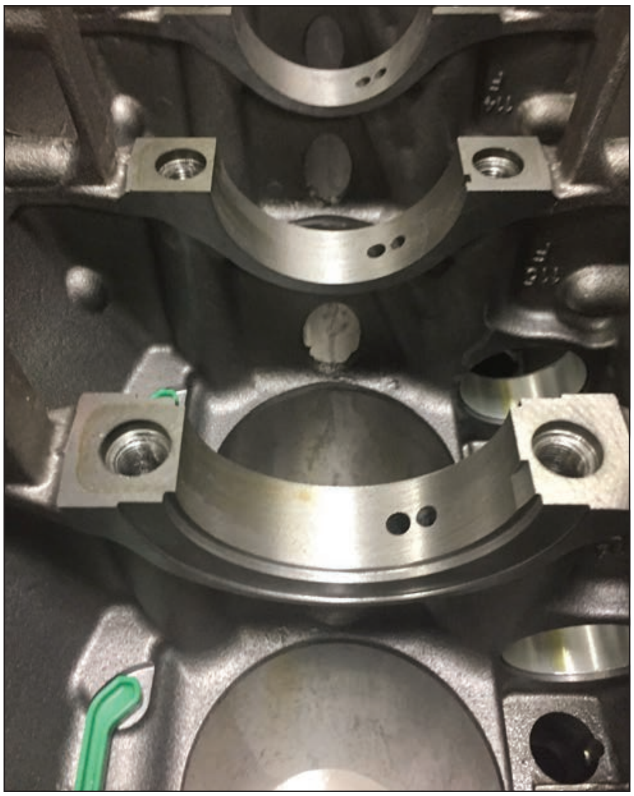
"When you compare the cost difference (in base material) between aluminum and CGI, compacted graphite iron becomes even more enticing when you consider that CGI is more fatigue resistant at extreme temperatures. In slang terms, CGI is often referred to as the "titanium" of cast iron because of its additional strength and rigidity without the detriment of added weight.

"Engine blocks made of compacted graphite iron present their own unique challenges in terms of machining. In a nutshell, you need to run at half of your normal cutting speed and half of your normal feed rate. Also, CGI is both abrasive and "gummy" and requires the use of CBN tooling.

"According to Sunnen's engineering whiz Tim Meara, CGI blocks tend to hone more like steel than gray iron. It's a much tougher material. Tim noted that CBN tooling was actually developed to handle CGI. If traditional stones are used for honing, a fairly coarse 150-grit stone is needed, yet soft to allow free-cutting because the material is so much harder than gray iron. With abrasive stones, you'll see a smoother finish (usually 3 to 5 points smoother) than you would with gray iron. If you use diamond tooling for honing, you'll notice very little difference in the final finish. CBN inserts must be used for boring and decking procedures. If tooling and tool operation technique is correct, CGI machines extremely well.

"Since the compacted graphite iron makeup is not as brittle as that of gray cast iron (tight matrix instead of big molecular flakes), the material doesn't fracture and tear as tooling begins its attack and as pressure is added (compared with gray iron). This means a more consistent machining operation and, in theory, more consistent and more tightly held results in terms of tolerance. In this regard, CGI machines more closely to the characteristics of steel. However, CGI material is very abrasive, so if you're drilling or tapping, it will wear your drills and taps faster (although drills are being developed specifically for CGI to reduce tool wear)."

One final note on the engine block: The Cummins folks pointed out that the main bearing caps were larger. As I took a photograph of the main bearing cap area I noticed something odd. Here is the photograph, do you notice anything peculiar?



The main bearing cap area is larger. What else do you notice?

Wait, is that a casting flaw, an oval hole under the main bearing bridge?

Actually, it is not a flaw, it is an open space over the bearing bridge in a non-critical area the engine was pictured from below. Weight savings—every little bit counts. (More on weight savings later in the article.)

Pistons

The 2019 pistons have a much larger connecting rod pin bore. Like the previous 6.7 piston, the 6.7CGI piston skirt has a coating on the side to prevent cylinder wall wear.

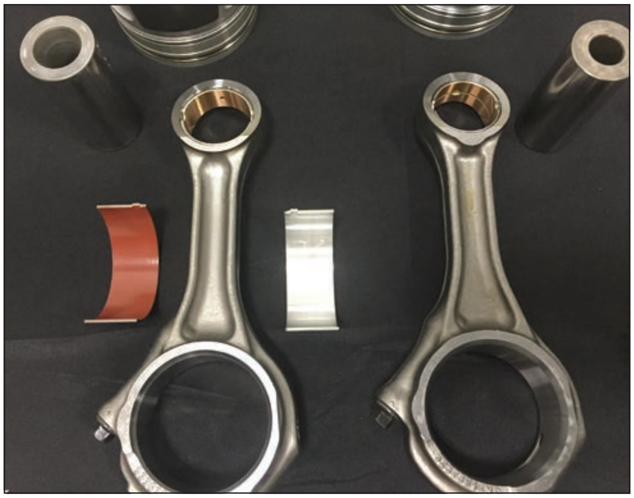
The 2019 piston, piston pin (larger diameter) connecting rod, and upper connecting rod/crankshaft bearing (coated with Teflon) are on the left.

In previous TDR engine updates we have talked about the importance of air intake "swirl." Recap: Hours and hours are spent in the emissions lab to perfect the intake air flow. In the 2004.5 engine, Cummins used a deep swirl technology to keep from having to use exhaust gas recirculation from 2004.5-2007. "Swirl" was improved for 2019 with the new piston helping to minimize exhaust gas recirculation.

Almost impossible to see, but the 2019 piston (on the right this time) has a small lip under the index finger.

Connecting Rods

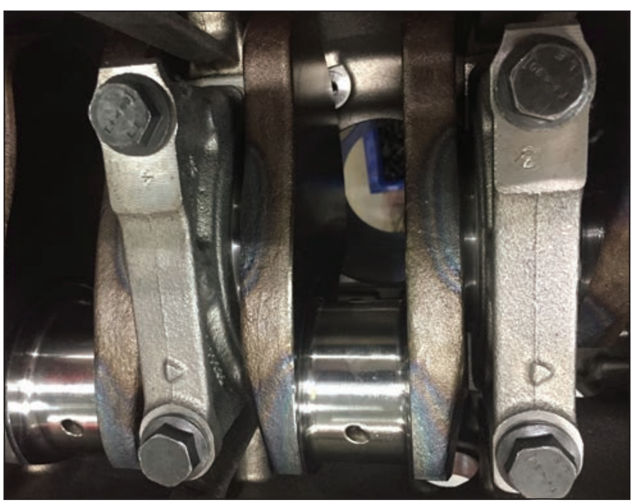
The connecting rod is still a forged unit. As noted in a previous photograph, it has a larger piston pin diameter.



The 2019 connecting rod is on the left.

Crankshaft

Sorry, I don't have a side-by-side picture of the 2019 crankshaft and the older 6.7 crankshaft. However, you've noted that bearing tolerances are tighter and you can read the good 'ole Junior Johnson story. (See side bar at the end of this discussion.) In order for Cummins to get the super-fine tolerances, the crankshaft material is different and the crankshaft journal and rod surfaces of the crankshaft are heat treated for additional harness.



Notice the blue "heat" marks that correspond to the heat treating of the crankshaft journal and rod surfaces.

Flex Plate

Additionally, the new higher-strength alloy crankshaft has a 10-bolt crankshaft flange that corresponds to a stronger 10-bolt transmission flex plate.

The new 10-bolt flex plate on the left.

Closer Bearing Tolerances

When the Cummins folks discussed the new crankshaft and the new rod bearings, I was quick to put two-plus-two together and realize that they would be able to use a thinner lube oil and thereby realize a performance and fuel economy benefit. Yes, all of the small, incremental changes add up. This is another example.

Camshaft

Hey, I read somewhere that the camshaft is now hollow. (In fact, it is.) Is that a concern? Okay, don't go around dropping your camshaft. (Seriously, hollow or not, they're brittle. Have you ever dropped one? I have, *they're brittle*.)

The cam is hollow (durability—not a factor; weight savings—important). The new camshaft goes hand-in-hand with the hydraulic valve lash adjusters (HLA).

The new camshaft on the right.

The Cylinder Head

A new cast iron cylinder head containing high-temperature capable exhaust valves actuated by all-new hydraulic lash adjusters (HLA) in the block eliminates the need for valvetrain adjustment service intervals. While the hydraulic lash adjusters are nothing new (Clessie Cummins tried them on his 1934 engine) the HLAs eliminate the need to do a valve adjustment and they reduce unwanted noise. The HLA components are more expensive than the old-school, push rod design that used tappets to follow the movement of the camshaft.

Rocker Arms

We have already noted that the 2019 engine has hydraulic valve lash adjusters. So, here is a picture of the 2019 rocker arm and the previous rocker arm.

Wow, no adjustment screw.

The Turbocharger

A new larger Cummins Holset variable geometry turbocharger is optimized with heavy duty bearings. A new compressor-side housing is a key ingredient in the new ratings, pumping 33 pounds per square inch (psi) of fresh air into the engine.

The new Holset turbocharger.

The Exhaust Manifold

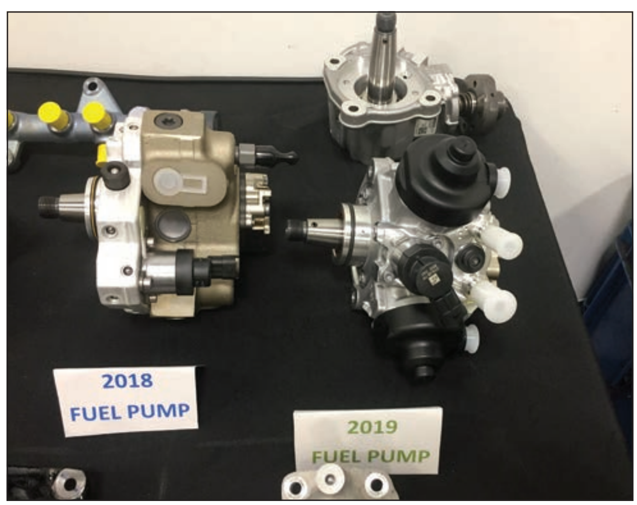
Have you heard the one about exhaust manifolds that crack the mounting flanges? (If you haven't, just talk to an owner who has hot-rodded their engine. Often the number 6 casting ear will break.)One solution is the slip-joint manifold, but they are expensive and, over time, prone to leak.

The solution for the 2019 6.7CGI engine: lateral elongated bolt holes in the flange of the exhaust manifold. Simple. Cost-effective.

Notice the elongated bolt holes?

The Fuel Pump

The new fuel-delivery system includes a new 29,000psi (2,000 bar) fuel pump and fuel rail with Cummins Filtration "filter in filter" NanoNet technology. This Bosch "CP4" used by Cummins is not the same as the Bosch unit used by Ford or GM.



The new Cummins CP4 fuel pump.

Other Performance Criteria

Performance is not just the stronger, strong; or the bigger, big; performance can also be measured in the lighter, light.

Seriously, have you ever witnessed a race driver that wanted a heavier car? The search for lighter components is the key to the truck engineer offering a truck with a greater payload.

But, you already knew that.

Here are some components on the engine that suffer no penalty for being lighter weight

- CGI block – 47 pounds lighter

Editor's note: It is my conclusion that the investment in the CGI block technology is intended to support future engine generations. As mentioned, the CGI block is the key component for higher performance.

- ECU bracket – 1.1 pounds lighter
- Water inlet and outlet – 7 pounds lighter
- Water pump – 1.5 pounds lighter
- Fuel pump – 6 pounds lighter

All Total: About 62 pounds lighter

Final Note(s): It's Another Racing/NASCAR Analogy

Short story: As a part of the Ram Heavy Duty press introduction you have a chance to meet those engineers and product support personnel that are behind the scenes. It doesn't take long to pick up on a theme and a purpose. With this engine (and truck) the purpose is performance: planning for even more performance; lower maintenance cost; better fuel economy; lighter weight. As always, cost is mentioned, but it was just that, mentioned.

Taking a different point of view and you might say "it's been a long time coming." The use of hydraulic lash adjusters for the valves, ditto the use of aluminum-cast parts/components to save weight, these items could have been addressed in prior years. However, The take-away from my discussions: the clean slate has given them the latitude to make changes and, like the NASCAR guys (or any racing endeavor), maximize the potential of the component.

I know that this is vague, and I know it sounds too rah-rah. But if the racer doesn't trim the aerodynamics, adjust the suspension, spend time on the dynomometer, etc., the racer is not the winner. It is all the little details that add up to the best-in-class.

This engine and truck: Winners.

Robert Patton
TDR Staff

2021 CUMMINS 6.7 CGI ENGINE UPDATE

ISSUE 111 – TECHINCAL TOPICS

by Robert Patton

2019-2020 Recap

In our Issue 104 magazine, the TDR covered the 2019 truck/engine introduction with a six-page article on the engine and a nine-page article on the truck. Looking back at those many pages, one was immediately impressed by the horsepower and torque ratings of the new-for-2019 Cummins 6.7-liter compacted graphite iron (CGI) engine. At the introduction I noted that many components were redesigned, reinforced, and upgraded to match the higher power ratings.

As the different TDR writers reviewed the 2019 Turbo Diesel truck and Cummins 6.7 CGI engine, we all had a moment of revelation: the new high output 400 horsepower/1000 torque rating was 2.5 times the original engine's power ratings in 1989. Another revelation: this engine was new, almost entirely new.

Wow!

Performance Timeline

As a quick recap, over the past 30 years we've noted changes to the engine were typically driven by ever-tightening emissions legislation. At the same time performance numbers also moved higher. Oh, the difficult job of the Cummins and Ram engineering staffs.

Further on in the discussion I realized that the updates to the 2019 engine were based on meeting performance goals and ongoing revisions to emissions standards.

With performance in mind, let's take a look at the notable power increases in past years and the hardware changes to the engine that provided the structure and support to handle the higher output(s).

	Horsepower	Torque
1989-'93	160	400

Comments: New to the pickup truck market. Bosch VE style fuel pump.

	Horsepower	Torque
1994-'95	160/175	400/420
1996-'98	180/215	420/440

Comments: Bosch P7100 fuel injection, turbocharger changes.

	Horsepower	Torque
1998.5-'00	215/235	420/460
2001-'02	235/245	460/505

Comments: Bosch VP fuel injection, turbocharger changes, 24-valve cylinder head.

	Horsepower	Torque
2003-'04	235/305	460/555
2004.5-'07	325	600 or 610

Comments: Bosch CP3 high pressure, common fuel rail injection, turbocharger changes.

	Horsepower	Torque
2007.5-'12	350	610/800
2011.5 High Output	385	850

Comments: Completely new 6.7-liter engine, variable geometry turbocharger, nitrogen adsorber catalyst diesel aftertreatment system.

	Horsepower	Torque
2013-2018	350/370	660/800
High Output	385	850

Comments:Small engine hardware changes, diesel exhaust fluid (DEF) and selective catalyst reductions (SCR) exhaust aftertreatment.

	Horsepower	Torque
2019-2020	370	850
High Output	400	1000

Comments: Completely new 6.7-liter compacted graphite iron (CGI) engine.

Now, if you want the details on the hardware changes that allowed Ram and Cummins to give us higher ratings over the 30 year lifespan of their partnership, the TDR reference sources are as follows:

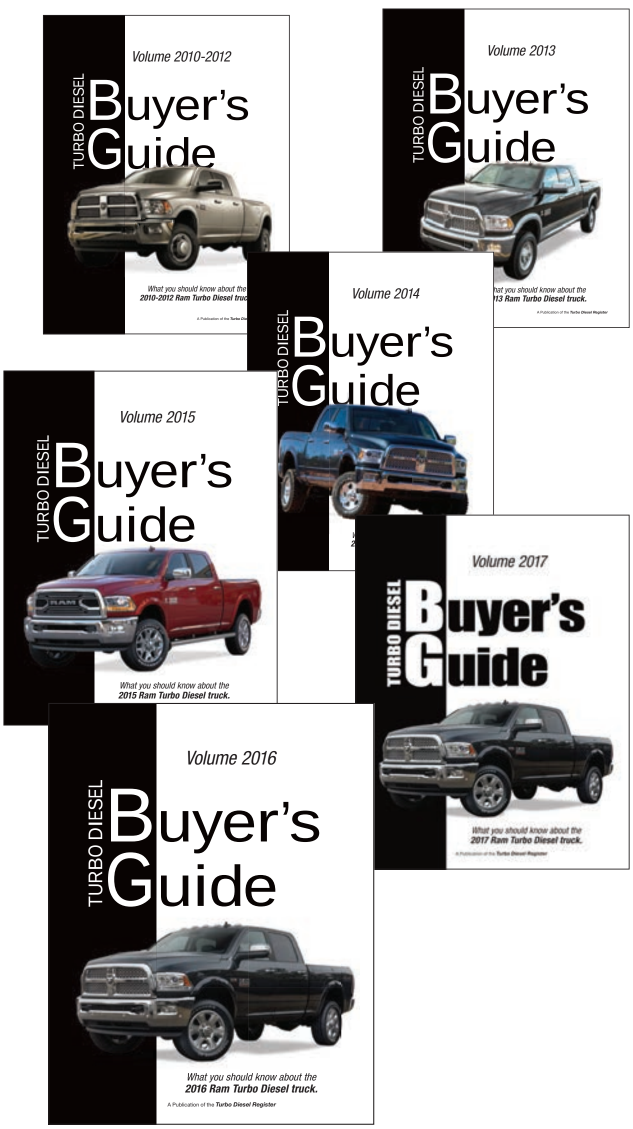
- Issue 40: Technical Topics, pages 32-40

"Diesel Exhaust Emissions. What Does It Mean to Me?" This article was a recap of 1989-2002 hardware changes. Also featured was a look at the new 5.9HPCR engine and the changes forthcoming in 2004 to a lower NOx number. (Revised down from 4.0 to 2.4ppm.)

- Issue 50: Technical Topics, pages 50-56
  "Diesel Exhaust Emissions for 2007"

- Issue 78: TDReview, pages 46-55
  "The 5.9-liter Engine Introduction in 2003"
  "The 6.7-liter Engine Introduction in 2007.5"

- Issue 80: TDReview, pages 58-63
  "What's New for 2013? Emphasis on the Cummins Engine"



More on the 2019 Cummins 400/1000 Engine: A New Engine

In June of 2019, the folks at Cummins' Columbus MidRange Engine Plant (CMEP) opened their doors and hosted the TDR membership for plant tours, seminars, and driving events. Looking back, it was one of those once-in-a-lifetime events for the true Turbo Diesel enthusiast. Thank you, Cummins, CMEP and Ram!

At the open house the Cummins engineers extended the members the same courtesy that I had received when doing the Issue 104 article. But, rather than repeat the text, let me give you the pages for your reference: pages 54-59. The following new components were a part of the 2019 6.7 CGI introduction:

- Compacted graphite block

  Advantage: Greater strength, no weight penalty, fatigue resistant at extreme temperatures

  Disadvantage: Slightly higher in cost, more difficult to machine

- Main bearing caps: larger than previous
- Pistons: piston skirt is coated, larger connecting rod pin bore, increased air swirl
- Connecting rods: forged with a larger piston pin diameter
- Crankshaft: journal and rod surfaces are heat treated for additional hardness and closer bearing tolerances
- Flexplate: to go with the higher strength crankshaft there is now a 10-bolt flexplate
- Camshaft: redesigned to go with new hydraulic valve lash adapters
- Cylinder head: high-temperature exhaust valves and hydraulic valve lash adapters
- Exhaust manifold: elongated bolt holes in the flange(s) area to allow for expansion

Now, if you want the pictures and a full description/explanation: Issue 104, pages 54-59.

HOLSET HE351 VARIABLE GEOMETRY TURBINE

ISSUE 70 – TECHNICAL TOPICS

by Jacques Gordon

Why are there wires connected to my turbocharger?

by Jacques Gordon

Engines generate power by making gases expand in a confined space and then converting gas pressure into mechanical motion. In a given space, more gas expansion makes more power, and one way to increase gas expansion is to increase the amount of gas in the combustion chamber. This is done by forcing more air into the chamber than the engine can normally inhale at atmospheric pressure. Known as "supercharging" because the air charge is above (super) atmospheric pressure, the technique was initially used in the late 1800s on large stationary engines. Those superchargers were so big and heavy that they had to be driven by their own smaller engine. In November of 1905, Swiss engineer Alfred Büchi patented the exhaust gas turbine-driven supercharger, a forced-induction device that could theoretically be made small enough for mobile engines. Thus, the turbocharger was officially born: See TDR Issue 50, page 58, for a history lesson on turbochargers, as we acknowledged the 100 year anniversary of Büchi's patent in that magazine.

Like so many other ideas that were first described in the earliest days of automotive technology, it took a while to develop the materials needed to turn theory into fact. For detailed information about the development of those metals and of the turbocharger itself, take a look at Kevin Cameron's articles in TDR Issues 42, 47 and 50 that can be found at the TDR's website listed as the "Cameron Collection". Here we'll just say that by the 1920s, nickel alloys became available that could withstand repeated heat cycles without becoming distorted. Engineers began designing precision turbines, and some of the first "production" turbochargers were built for large ship engines.

The first widespread use of turbochargers was on aircraft engines in the 1930s. Turbochargers are ideally suited for flight because they enable the engine to produce sea level power at higher altitudes where the air is thin. Near the end of piston aircraft engine development in the 1950s, even the biggest engines with huge mechanically-driven superchargers were fitted with two or even three exhaust-driven turbochargers for high-altitude flight. They are still used on small aircraft engines today.

Turbochargers are also well suited to Diesel engines. Unlike gasoline engines, Diesels make their power with low-rev torque rather than high-rpm horsepower. In a slow-turning engine, power output depends more on displacement, but as noted earlier, a turbocharger increases the engine's specific power output, the amount of power it can make for a given displacement. A turbocharger also recovers heat energy from the exhaust that would otherwise be wasted. Both of these qualities make a turbocharged Diesel engine more economical to operate, and Diesel engines are all about economy.

How They Work

Although there is a wide variety of types and sizes, turbochargers all have the same basic design and operating principles. A turbine wheel and a compressor wheel are attached to opposite ends of the same shaft. Engine exhaust flows through the turbine, spinning the shaft and turning the compressor. The compressor draws air in through the center, stuffs it into a carefully-shaped housing at the outer circumference of the wheel, and sends it to the intake manifold under pressure. In less technical terms, imagine a double-sided pinwheel. Air blowing through the wheel on one side causes the other wheel to turn too. Air moving one wheel causes the other wheel to move air. The flow volume and pressure generated by the compressor wheel are determined primarily by its rotational speed, but also by its size and the design of the compressor and the housings.

Turbochargers for modern Diesel engines are typically designed to flow 2.5 times the engine's displacement at maximum turbine rpm. Turbine speeds have been climbing over the past several years, and today 140,000 rpm is not uncommon, reflecting the industry trend towards smaller turbochargers. Peak boost pressure depends on the application; 90 psi or more is possible, but for the average road-going engine, boost is usually limited to less than 20 psi.

Big industrial engines are operated in a very narrow speed/load range, so they have big turbos that move lots of air at relatively low turbine speeds. Road-going engines operate at varying speeds and loads, so they need a turbo that responds quickly to changes in load but can also spin fast enough to provide full boost at rated rpm. One way to accomplish this is with two different turbochargers operating in sequence, a smaller one for low-speed operation and a larger one for higher engine speeds. TDR performance enthusiast/writer Doug Leno has been experimenting with exactly that by adding a second turbocharger to his early-2004 5.9-liter engine. Technically called compound turbocharging (but often called 'twins'), Leno learned that it's an effective way to generate high boost pressures at every engine speed, providing the instantaneous throttle response we all love.

Another less complex solution is to use one fast-acting turbocharger and control its speed over a wide range to control boost pressure. But as we'll soon see, this is easier said than done.

Turbine Speed

The way to control turbine speed is to control the exhaust gas flowing through it. For most applications, this can be easily accomplished with a "wastegate," a valve on the turbine housing that allows some of the exhaust gas to bypass the turbine, "wasting" the exhaust gas energy. On the aircraft turbochargers mentioned earlier, the wastegate is operated by electronic engine controls using an actuator and a sensor that converts air pressure to a control signal. To avoid over-boosting at low altitudes, the wastegate is wide open and turbine speed is almost zero. As altitude increases and atmospheric pressure decreases, the wastegate gradually closes to send more exhaust energy to the turbine, spinning it faster to make more boost pressure.

On road engines that operate at varying speeds, the wastegate is used in a different manner, primarily to limit boost pressure according to engine speed and load. Boost is needed throughout the engine's speed range, but most especially just above idle. As engine speed and intake manifold pressure increase, the pressure acts against a spring-loaded diaphragm. At a pre-set pressure, the diaphragm pushes a rod that opens the wastegate. It's simple, reliable and easily applied to different engine/ turbocharger combinations. Using electronic controls with sensors and actuators, the wastegate can also be operated by the Powertrain Control Module (PCM) to manage the boost over a wider speed range. But there are limits.

Even with electronic controls, a wastegate limits boost by controlling the volume of exhaust gas flowing through the turbine. This is okay for shaping the engine's power curve, but today's engines must also meet strict new emissions regulations. A different kind of boost control is needed. Could a variable-geometry turbocharger be the answer to the engineers' desire to meet the new emissions regulations?

Up on a pedestal (and rightfully so), this Holset HE351 VGT is the key to managing intake air pressure for economy, power and emissions.

Emission Control

Diesel engines are now equipped with Exhaust Gas Recirculation (EGR), which is used to control Nitrogen Oxide (NOx) emissions. In sunlight, NOx becomes ground-level ozone, aka smog. NOx is formed when nitrogen and oxygen combine chemically. Even though air is made up of 78 percent nitrogen and 21 percent oxygen, it's a simple mixture of gasses, not a chemical compound. The molecules can only combine chemically when combustion (oxidation) takes place under pressure, such as in an engine.

NOx can be reduced by controlling peak temperature in the combustion chamber. It can also be reduced by making sure there's no extra oxygen in the chamber after combustion. Since a Diesel combustion chamber contains a lot of excess oxygen (and we're stuffing in even more with a turbocharger; see the sidebar to understand why), EGR flow in a Diesel must be much higher than in a gasoline engine to be effective at controlling NOx. TDR has covered the emissions story since our first issue back in 1993. The most recent coverage of emissions regulations is in Issue 49.

The exhaust gas for EGR is taken from the exhaust manifold before it reaches the turbocharger. To make sure the exhaust flows towards the intake manifold, pressure in the exhaust manifold must always be higher. This requires extremely precise control, because if too much exhaust gas is recirculated, there won't be enough oxygen in the combustion chamber to burn all the fuel, and particulate emissions (soot) increase. It's a fine balance.

To manage both manifold pressure and exhaust backpressure across the engine's entire operating range, the Holset turbocharger on the Cummins 6.7-liter engine has a Variable Geometry Turbine (VGT). Instead of controlling exhaust gas *flow volume*, the VGT controls exhaust gas *pressure* in the turbine housing. At low engine speeds when exhaust flow is low, the flow from the turbine housing to the blades on the turbine wheel is restricted. This increases backpressure in the exhaust manifold, which increases the pressure of the exhaust gas striking the turbine blades. This makes the turbine spin faster at low exhaust flow. It's the same principle as putting your thumb over a garden hose; flow may decrease a little but pressure increases a lot.

As engine speed increases, so does exhaust flow, so the restriction is opened to reduce backpressure in the exhaust manifold. By reading a turbine speed sensor and pressure sensors in both manifolds, the PCM can adjust the restriction quickly to control backpressure and boost at any speed or load. Some versions of the Holset VGT turbocharger also have a wastegate to limit maximum boost pressur e.

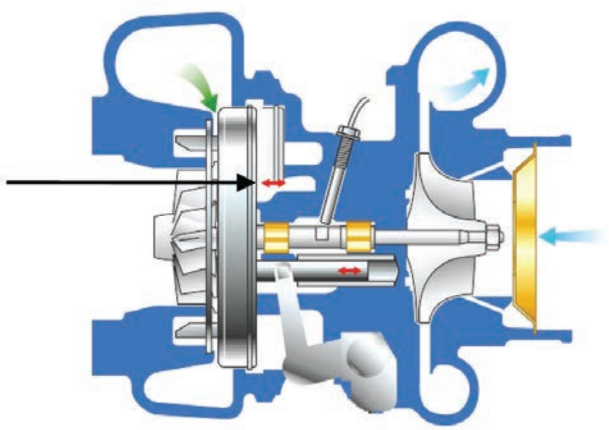
Simple and Direct

Compared to a wastegate, or even an electronically controlled wastegate, the VGT is a complex piece of machinery. The restriction device is in the collector ring of the exhaust turbine housing. That means there are moving parts in the hottest, dirtiest part of the turbocharger. Early models suffered soot-related seizure, proving that keeping things moving properly requires advanced materials, extremely precise engineering and sophisticated controls.

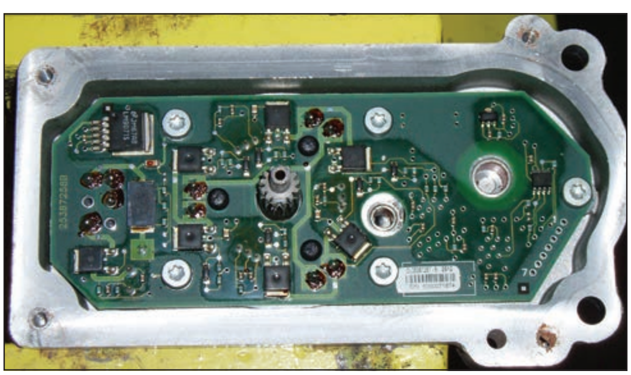
Precision is easier when the machine is simple: to that end the Holset VGT has only one moving part in the turbine's hot section. It is a high-temperature alloy sleeve with vanes at one end, and it moves axially, parallel to the turbine shaft. When the sleeve is fully retracted, exhaust gas flows freely from the exhaust collector through the turbine wheel. When fully extended, the vanes block off the exhaust flow. This creates exhaust back pressure (the exhaust cannot escape) and the turbo acts like and exhaust brake.

The sleeve is operated by an electronically-controlled brushless motor, so the sleeve position is infinitely variable. This provides the critical feature of the VGT turbocharger: infinite and continuous control at any engine speed/load. The motor and electronic controls are in a housing mounted on the center section of the turbocharger housing. To help deal with the heat, coolant is circulated through part of the motor/control housing, but truly advanced electronics are required to withstand that kind of heat and vibration. The following pictorial will, literally, show you how the HE351 VGT operates.

The Holset Variable Geometry Turbocharger

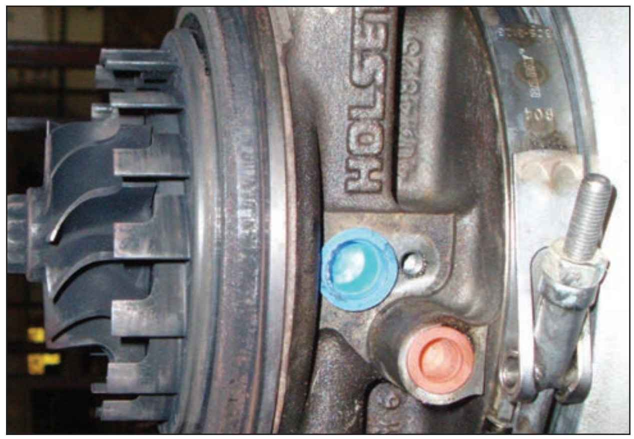


In this picture the vane is closed. Exhaust gas flow is restricted and, thus, the turbocharger is acting like an exhaust brake. Allow the vane to move to the right and the exhaust gas flow is "full-on" allowing the turbine (exhaust) blades of the turbocharger to spin faster and ceate more boost.

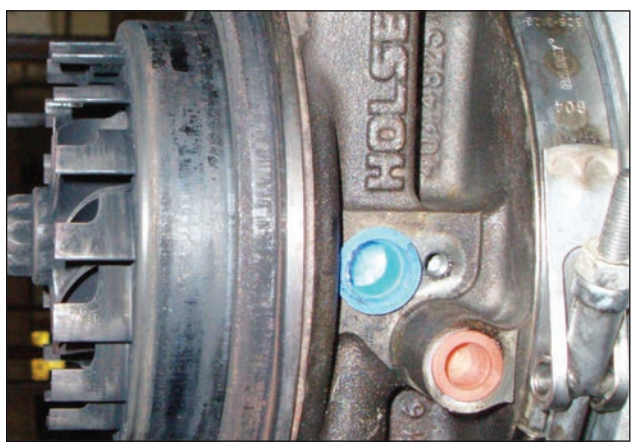


The motor is below this circuit board inside the motor housing. The visible gear engages a position sensor that sends information to the engine control computer. The electronics remain accurate over a 300-degree temperature range, but additional cooling is needed for this application.

The gear rack on the left connects to the linkage that moves the vane sleeve. The two holes to the right of the gear are coolant passages.



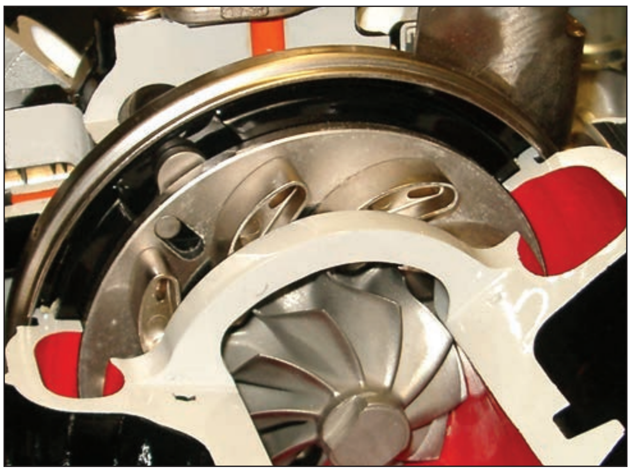
With the sleeve totally fully retracted, the vanes are open to exhaust flow. Exhaust flows freely and the prssure on the turbine blades builds intake air boost/pressure.



With the sleeve fully extended, the vanes are closed to exhaust flow. This creates exhaust gas back pressure (the exhaust cannot escape) and the turbo acts like an exhaust brake.

Other Methods Work Too

The Honeywell/Garrett turbo on the Ford PowerStroke engine is another example of a variable geometry turbocharger. Called the Variable Nozzle Turbine™ (VNT), it was introduced along with cooled EGR to help the 6.0-liter engine meet 2004 NOx emission standards. It operates on the same principal as the Holset VGT, but instead of moving axially, the vanes rotate like slats in a window blind to open and close the flow area. A pin in the center of each vane fits into the turbine housing, and each vane pivots around this pin. Behind the vanes is a plate with slots, and a pin on the end of each vane projects into a slot. When the plate rotates, it causes the vanes to pivot. The plate is rotated by a crank that's operated by a control piston and oil pressure.



On this Ford turbocharger, the vanes are pinned to the (white) turbine housing. When the plate behind the vanes rotates, the vanes pivot around the pins like slats in a window blind. Note the slot for the crank; the plate rotates only a few degrees.

In addition to controlling the exhaust gas energy acting on the turbine wheel, this system also controls backpressure in the exhaust manifold. With the right software, it can also be used as an exhaust brake.

As noted before, road-going engines work best with a small high-speed turbocharger that spools up quickly to generate boost anywhere above idle rpm. But the turbo also has to be big enough to provide boost at full load. The Honeywell Dual Boost turbocharger on Ford's new 6.7-liter Diesel engine has an interesting solution. In addition to the variable nozzle turbine, it also has what they call a single-sequential compressor. Two sets of compressor blades are cast back-to-back on the same shaft, and each set spins in its own inlet housing. The name is somewhat of a misnomer, because the air from both compressors is fed to the same outlet housing, effectively adding their volumes together at the same time rather than in sequence. Maximum boost pressure is about 30 psi at 150,000 rpm, which is not difficult to achieve with a single compressor wheel, but this double-sided compressor wheel has a much smaller diameter. A smaller compressor spins up quickly, so boost builds almost instantly when the driver presses the accelerator pedal.

The Dual Boost turbo has a set of blades on each side of the compressor wheel, each set spinning in its own inlet housing, but feeding air to the same outlet housing.

The upper and lower openings are both compressor inlets, the tube pointing to the right sends the output of both compressor wheels to the intercooler.

General Motors also began fitting the Garrett VNT™ Turbocharger to the 6.6-liter Duramax engine to meet emissions regulations in the 2004 model year. Compared with the Holset VGT, the Garrett VNT™ has more moving parts in the turbo's hot section. However the control system is much simpler; oil pressure moves a piston that operates the crank that rotates the vane positioning plate. Oil pressure on the piston is precisely controlled with a pulse-width-modulated solenoid valve. Although this valve is mounted directly on the housing, it's far more tolerant of extreme temperatures than the Holset's control motor and electronics, so no additional cooling is needed.

Living With a Turbocharged Engine

Proper lubrication is critical to so many parts of the engine, but nothing in the engine must survive as much heat or move as fast as the turbocharger. Anything that impedes the flow of clean, cool and correct oil to that bearing will impact the service life of the turbocharger. Of course cool is a relative term, but if there's an oil temperature gauge in your truck, know that the turbocharger is the first thing to suffer if the temperature stays higher than normal for an extended period.

While oil has changed a lot in recent years, the definition of the correct oil hasn't really changed at all. There are good reasons to think one oil performs better than another, but there's only one oil that's been subjected to lab testing by the manufacturer, and that's the factory-fill, manufacturer-recommended oil. According to Cummins, the 6.7-liter Turbo Diesel engine requires low-ash oil because it is equipped with exhaust after-treatment equipment. The oil must meet CES 20081 standards and have a maximum of one percent by mass of sulfated ash. While this oil is specifically engineered to prevent damage to the catalytic converters, as we'll see in a moment, that's just as important to turbocharger life.

At high loads the turbocharger can get hot. Excess heat cooks the oil in the bearing housing to a hard carbon deposit that restricts oil passages. Holset recommends idling the engine for two or three minutes before shutdown to circulate coolant and oil through the bearing housing. Some owners idle longer because turbine housing temperature actually increases immediately after shutdown.

Holset also recommends allowing the engine to idle for one minute after a cold start, just to make sure of proper lubrication before asking the turbo to go to work.

Excess idling causes different problems. Holset says idling more than about 20 minutes can cause oil mist to leak past the shaft seals into the turbine and compressor housings. Although no real harm is done to the turbocharger, as load and temperatures increase, the oil will start to cook and cause blue smoke. On engines with EGR and a Diesel Particulate Filter (DPF), burning oil can clog the DPF, generating higher exhaust backpressure and therefore, higher EGR flow. This will send soot into the whole air intake system, resulting in a clogged turbocharger. Repairs can be expensive, and Chrysler has issued several service bulletins (11-001-09, 11-001-08, 11-002-08) that describe "desoot" procedures. On some models, the procedure can be done with the vehicle not moving, but others require driving the truck, and all require a scan tool to command the desoot process.

Fuel quality also has an influence on soot formation. While the problem should be all but eliminated since ultra low-sulfur fuel was mandated back in January 2007, some fleets that use off-road fuel (intended for construction equipment, etc) in their on-road trucks have traced failed turbochargers and clogged DPFs to misfueling.

The Future is Variable

Variable Geometry Turbochargers were originally developed for gasoline engines in the late 1980s. Again, the moving parts are in the hottest part of the turbocharger, so the advanced materials and precision engineering needed to keep things moving smoothly make VGTs expensive. But the ability to control boost and exhaust backpressure separately from engine speed and load is the only way to meet today's Diesel emissions standards, so it looks like their time has come. We can expect to see VGT turbochargers on a wider range of engines over the next decade, especially on small engines from Europe. There's even talk of using them on small gasoline engines too, but that market would (at least initially) be limited to high-priced models.

The Variable Geometry Turbine is the most significant advance in turbocharger technology in the past 100 years. It has added a whole new dimension to engine management strategy, and although it's been around for 20 years, for engineers and tuners who understand the possibilities, the fun is just getting started.

Jacques Gordon
TDR Writer

SIDEBAR

Fuel must be mixed with air to burn. If there is not enough air to burn all the fuel, that's called a rich mixture. In a lean mixture, there will be air left over after all the fuel burns. The perfect mixture, the one that produces the most power and the least amount of pollution, will have just enough air to burn all the fuel.

When fuel is injected into a Diesel combustion chamber, each droplet of fuel burns the moment it comes into physical contact with oxygen in the air. However, most of the air in that chamber is far away from the fuel injector, and each successive droplet of fuel will travel farther into the chamber before it finds oxygen. This creates local areas of rich air/fuel mixture, while the mixture in most of the combustion chamber is lean.

The chamber's shape, injector spray pattern, injection pressure and a few other factors all have an influence on air/fuel mixing, but a perfectly even mixture throughout the chamber has only been achieved in laboratory engines. To avoid making smoke instead of power, Diesel engines run lean.

While the air/fuel mixture in the chamber is uneven, the density of the air is the same everywhere in the chamber. If we increase that density by stuffing in more air with a turbocharger, there is more oxygen close to the injector, so we can burn more fuel and make more power.

Jacques Gordon
TDR Writer

UPDATE: WHAT IS A VARIABLE GEOMETRY TURBOCHARGER?

ISSUE 110 – TECHNICAL TOPICS

by Robert Patton

Go ahead, give me some mumbo-jumbo talk. Okay, save the embarrassment and admit that you don't know.

I've often told the story of being an embarrassed speaker in front of a crowd as I tried to explain why a diesel engine is more efficient than a gasoline engine for a given size of engine displacement.

Can you explain the answer to this very basic question?

"The diesel fuel has a higher BTU content." Really?

"It can be turbocharged." Really?

"The diesels have injectors and fuel pumps." Really?

"The diesel has a higher compression ratio." Really?

Really, if you want the long answer it is found at the start of each Turbo Diesel Buyer's Guide books that we've published. The article is titled "Why a Diesel?" The simple answer is that the gasoline engine mixes 14 parts of air to 1 part of fuel and ignites the mixture with a spark plug. The design of a diesel (big robust block and cylinder heads, fewer revolutions per minute, higher compression ratio) makes use of the fact that compressed air is hot. Using a fuel pump and injectors, we can vary the amount of fuel that is injected into the diesel's cylinder of hot compressed air in order to make it ignite. In an idle situation it's 85 parts of air to one part of fuel. At full load it's 20 parts of air to one part of fuel. With a diesel you can vary the air to fuel ratio based on the load factor. As mentioned, with the gasoline engine it is always 14 parts of air to one part of fuel and the ignition is initiated by a spark plug. Got it?

Back to the story: What is a Variable Geometry Turbocharger (VGT)? Better yet, what advantage does the Holset variable geometry turbocharger design give Ram/Cummins over the competitive Ford and Chevy guys? (How about the Ram 1500 EcoDiesel, doesn't it have a variable geometry turbocharger?)

Like many topics, this one has been covered before in the TDR. However, the audience is forever changing and often we old-timers need an update to bring us into sync with the different VGT designs that are being offered in the marketplace.

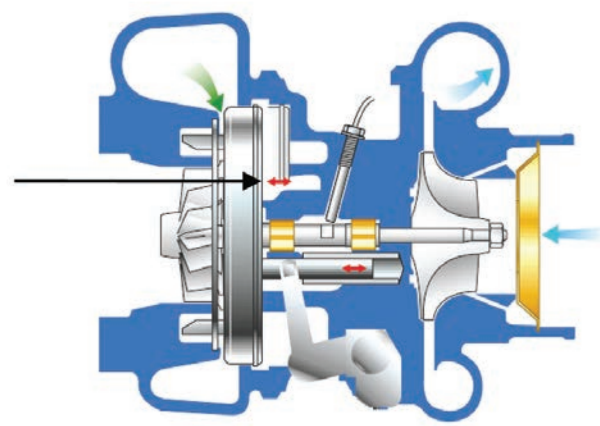
What? There are different definitions of "variable" in the variable geometry turbocharger? Yes, VGT is not a one-size-fits-all product.

Let me see if I can keep this easy to understand and then I'll add some technical stuff for the gearheads in the audience.

The basics: Holset turbochargers are a division of Cummins and the Holset folks have a *patent* on the sliding vane design of "variable" geometry. Here is a picture of how the sliding vane operates.

The Holset Variable Geometry Turbocharger

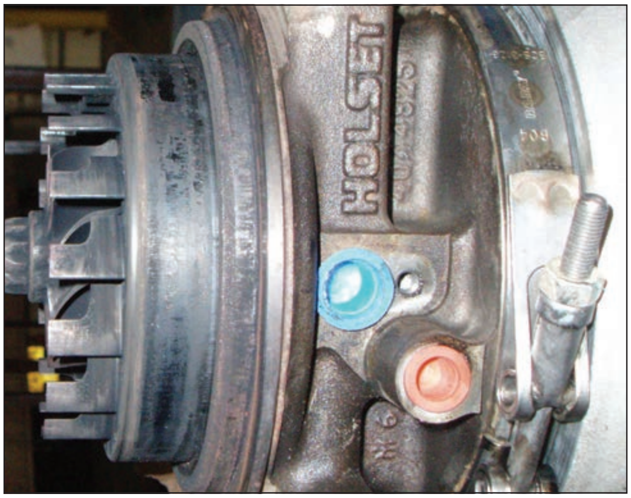
Up on a pedestal (and rightfully so), this Holset HE351 VGT is the key to managing intake air pressure for economy, power and emissions.



In this picture the sliding vane is closed. Exhaust gas flow (small red arrow, top left) is restricted and, thus, the turbocharger is acting like an exhaust brake. Allow the vane to move to the right and the exhaust gas flow is "full-on" causing the turbine (exhaust) blades of the turbocharger to spin faster and ceate more boost.

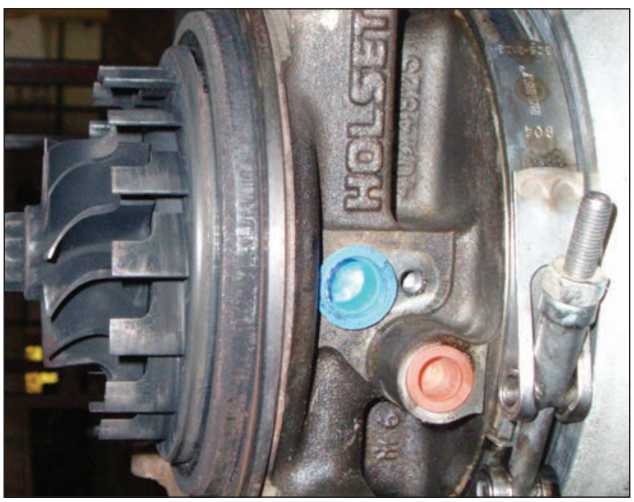
Okay, aren't line diagrams great to give you the "big picture." We are fortunate to have a Holset HE351 turbocharger from a 6.7-liter engine. Here are some photographs of the exhaust side of the turbocharger and the sliding vane.

Closed



With the sliding vane fully extended, the turbo blades are closed to exhaust flow. This creates exhaust gas back pressure (the exhaust cannot escape) and the turbo acts like an exhaust brake.

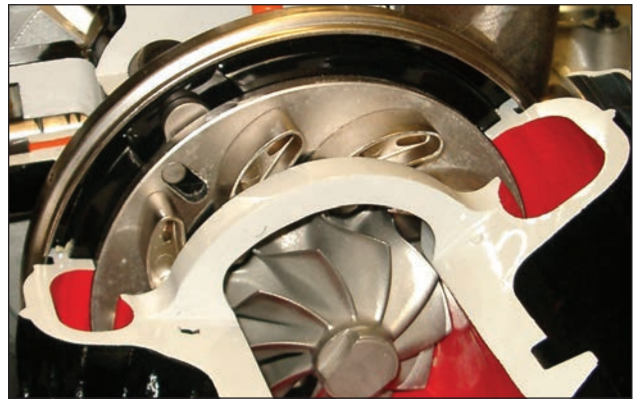
Open



With the sliding vane totally fully retracted, the turbo blades are open to exhaust flow. Exhaust flows freely and the pressure on the turbine blades builds intake air boost/pressure.

Everyone Else

Everyone else (Honeywell/Garrett, Borg Warner/Switzer, Mitsubishi) uses a rotating vane design of "variable" geometry. Think of this as a set of blinds that open and close. Here are some pictures:



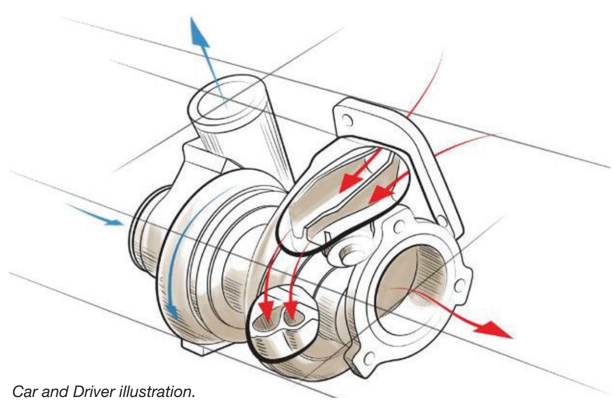
On this Ford turbocharger, the vanes are pinned to the (white) turbine housing. When the plate behind the vanes rotates, the vanes pivot around the pins like slats in a window blind. Note the slot for the crank; the plate rotates only a few degrees.

Car and Driver on Turbochargers

Interestingly, in June 2016, Car and Driver magazine had a pictorial showing various turbocharger designs that are used in *automotive* applications. As you might imagine, the Holset sliding vane/variable geometry turbocharger was not included.

However, the C&D article gave the audience a picture example of the rotating vane/variable geometry turbo that we've already pictured. For the sake of education, I'm going to reprint their pictures of the twin scroll, twin turbos and sequential turbos so that you'll know the terminology that is used in the business.) By the way, the term "twins" is all-too-often used incorrectly by folks who actually have sequential turbos, so beware.)

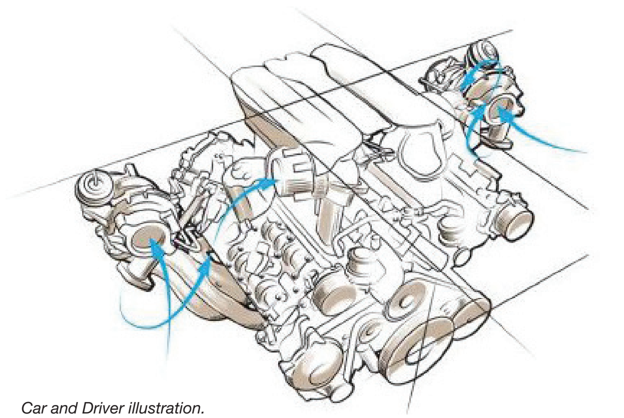
Twin Scroll Turbocharger



Car and Driver illustration.

The exhaust manifold and turbine housing split the exhaust into two segregated streams. This optimizes the timing of the exhaust pulses delivered to the turbine wheel, improving response when the throttle position changes abruptly.

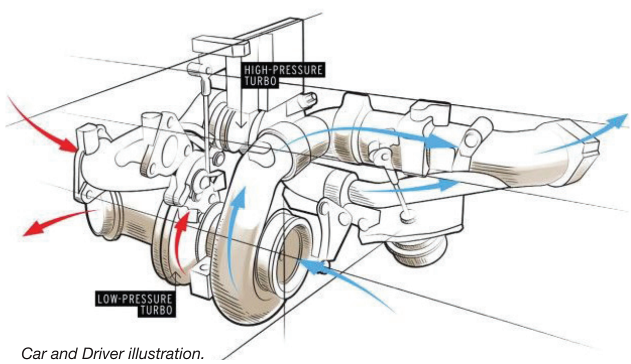
Twin Turbochargers



Car and Driver illustration.

The exhaust manifold and turbine housing split the exhaust into two segregated streams. This optimizes the timing of the exhaust pulses delivered to the turbine wheel, improving response when the throttle position changes abruptly.

Sequential Turbochargers



Car and Driver illustration.

Here, a smaller turbo spools quickly for low-end responsiveness while a larger unit boosts top-end power with higher volumes of exhaust. Sequentail setups have fallen out of favor because they require complex controls and bulky packaging, and recent advances have reduced spool-up lag in single- and twin-turbo setups.

Now, Which Design is Better? Holset's Sliding Vane?

Which design is better? What are the features and benefits of these various turbocharger designs?

The balance of the article cannot be answered with a simple Wikipedia search. Also, in my research of YouTube and manufacturer websites, there was too much mumbo-jumbo. So, let's go right to the source: Cummins/Holset's John Clark for some guidance and understanding. I interviewed John and asked him to take off his "coporate colors" and help the audience. The following are excerpts from the conversation:

The Bottom Line

John was quick to get right to the bottom line. John said, "Look closely at Holset's patented sliding vane design and picture when the vane is in the closed position, it blocks the flow of exhaust! If the exhaust is blocked, the engine is working against itself: stalled out, if you will. With the driveline directly connected (maual transmission or lock-up torque converter) the engine slows the truck. All the other VGT guys' turbochargers do not block the exhaust flow. Big advantage Cummins/Holset."

John continued: "The rotating vane design used by everyone else in the business does not have this feature."

End of interview.

Seriously, John went on to tell me that Holset first implemented a sliding vane design turbocharger in 1998 for a medium duty diesel engine used in Europe. The next application was in 2002 on Cummins' 15-liter ISX big-rig engine. It was first used on the B-Series engine in the 2007.5 Ram truck with the 6.7-liter engine, as it gave Ram/Cummins an advantage over the competitive diesel pickups in the North American marketplace (read: Ford and GM). Today, 10 years later, Ram/Cummins still enjoy that competitive advantage. Cummins uses the Holset sliding vane turbocharger in engines from 2.8-liters up to 15-liters in displacement.

Conclusion

Short and sweet: Ram/Cummins owners have a distinct advantage with the '07.5-current 6.7-liter engine's sliding vane turbocharger and its exhaust brake feature.

Go ahead, walk around with the smugness of superiority.

Robert Patton
TDR Staff

SIDEBAR

TURBOCHARGER FAMILY TREE

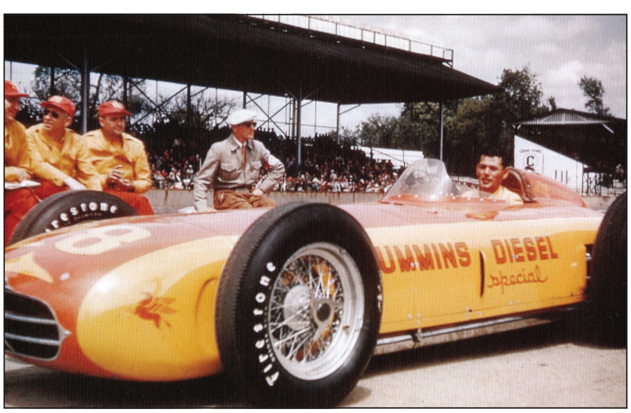
From the turbocharger article we learned that Holset uses a patented sliding vane technology and "everyone else" uses a rotating vane design. And, BINGO, the sliding vane is what gives our 6.7-liter engine a distinct advantage over competitive engines. Also, several major manufacturers were mentioned and that made me reflect on a previous TDR article that talked about early turbocharger development.

I'll save you from looking back to find it. Here is a quick refresher with that history/family tree lesson from Issue 104. In our discussion of the Cummins-powered diesel race car that was in the 1952 Indianapolis 500. we learned that: "turbochargers were nothing new. After all, TDR Issue 50, November 2005 (pages 58-60), had a 3-page write-up that discussed the 100-year anniversary of the patent for the first turbocharger developed in 1905 by Dr. Alfred Buechi, chief engineer at Sulzer Brothers Research and Development, Winterhur, Switzerland. Our own Kevin Cameron gave us a turbocharger (and gas turbine) history lesson back in our Issue 42 magazine. Therein, Cameron describes the metallurgical challenges of building turbocharger wheels to withstand high operating temperatures. Paraphrasing from Cameron: research to build the fighter planes of World War II paved the way for the turbochargers to be used in diesel applications. (Research to build fighter planes also led to the development of turbojet aircraft engines—by 1957 all Boeing 707 aircraft were jet-powered.)

At the end of his 'Exhaust Note' column Cameron noted, 'Almost as a footnote to all this, the resulting fall in the price of high performance refractory metals made reliable truck engine turbocharging common at last.

Cummins' First Test of Turbochargers

Now, back to the story: It is still 1952 and Cummins has yet to perfect the turbocharger concept. Researching 'diesel turbocharger history' I learned that the European truck/diesel maker MAN introduced a turbocharged diesel engine in a truck in 1951, but it was not put into production. Finally, in 1954, turbocharged diesel-engine trucks were introduced in Europe by MAN and Volvo.



The #28 Cummins indy car.

Interestingly, in my research I noted that turbocharged diesel-engine development took two paths: Caterpillar was experimenting with turbos and turned to J.C. 'Cliff' Garrett in Los Angeles to help them develop their turbo diesel engines. (Garrett Automotive is now a division of Honeywell.) Cummins turned to Elliott and Schwitzer (Schwitzer of nearby Indianapolis, Indiana) to help them perfect the technology. The first commercial Cummins engines outfitted with the Schwitzer turbochargers were the 1954 products offered by Cummins in their VT12, NT, NTR and JT diesel engines.

Now, here is another business link for you: the Holset/Cummins Turbo Technologies website tells us 'in the late 60s a close licensee agreement between Holset and Schwitzer was formed, Holset would design and manufacture turbochargers for the European market where Schwitzer did not have manufacturing facilities.' Today, Schwitzer is a division of Borg Warner and Holset is a division of Cummins, Inc.

Now, let's go back to 1952 for a look at a Cummins "first": turbocharger testing on an Indianapolis 500 rce car

The restored 1952 Cummins Indy Car and several of the Cummins folks that worked on the restoration: (Left to right) Ben Shulte; Randy Watts; Dan Walters; Steve Wilson; Greg Hines; Tim Diehn; Steve Butler; Bruce Watson.

This 1952 race car was covered in our Issue 104 magazine (pages 12-17). It is one of my favorite stories. In lieu of reprinting something that is only 1.5 years old, for those that may have missed it I'm going to repost the article at our website. Enjoy.

Robert Patton
TDR Staff

LUBE OIL UPDATE

ISSUE 76 – TECHNICAL TOPICS

by Robert Patton and John Martin

A New Inquiry

Last October I received an e-mail from TDR member Desmond Rees:

I am looking for supplemental information following up John Martin's article from Issue 57 on engine oil. The August 2007 article is somewhat dated. With the switch to the new API requirements for EGR/DPF diesel engines, are there plans to revisit this topic regarding the best engine oils meeting the API CJ-4 requirement? John's article only looked at a handful of the CJ-4 oils and they ranked at the bottom of the pile when compared to the previous generation of oils. Thanks.
Desmond Rees

My response: Prior to Desmond's letter, there were no plans to revisit the topic. However, it has been five years and oils do change. I will purchase and test the CJ oils and John can comment on the data. We will see if John's previous conclusion holds: "If it meets a spec, it becomes a commodity. Low price can be the purchase criteria. Change the oil based on the Owner's Manual recommendations."

Thanks to Desmond for the letter.

Background Information

It seems like just yesterday that I met lube oil expert John Martin and we collaborated on a series of articles about lube oils.

Ouch! As Desmond reminded me, "yesterday" was Issue 54 of the TDR, which was published in December of 2006. The four-part series that we wrote took a year to complete.

The reason behind the year-long series of articles was the forthcoming change from lube oil category CI+4 (an industry specification that was implemented in 2002) to the new category CJ. The CJ formula of oil was developed for the lower diesel exhaust emissions engines that were being implemented starting 1/1/2007.

I wondered how the lube oil would change. John Martin was the guy to tell me. (More about John in just a minute.)

In a lengthy telephone conversation he shared his opinion about the forthcomming CJ lube oil specification. Bottom line: John felt that the CI+4 oils were some of the best to come out of the respective refineries. In his discussions with those in the oil business, he had formed the opinion that the new CJ oils would not necessarily be new-and-improved.

As I noted, the CJ formula was developed for the new lower emissions diesel engines. From John I understood that the CJ oil would not necessarily be new-and-improved. Without analysis of the lube oils, I asked John what were the proposed changes from the highly acclaimed CI+4 to the new CJ oils. His response: "Robert, this is a lengthy topic, but it is very important for the audience to understand what is happening in the oil business." So, I looked back to Issue 54 and made a couple of tweaks to its contents. The following is the updated text that gives you the insight that you need to understand the CI+4 to CJ change.

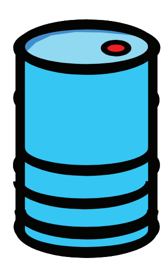
A Little Lube Oil History

Before we talk about what the additive industry and the oil companies have done to meet the EPA's latest directive, we need a brief lube oil history lesson. Years ago diesels were operated on refined crude oils containing virtually no additive chemistry. As power density increased oil companies found they needed to add specific chemical compounds to the oil to provide performance attributes that crude oils couldn't deliver. The additive industry was born.

Traditionally, each new diesel engine oil specification was issued because available oils couldn't provide the lube oil performance needed. For example, API CE was issued to create oils which solved an oil consumption problem in Cummins NTC-400 engines. For fifty years each new diesel engine oil specification meant a better performing diesel engine oil was available—all the way from API CD to API CI+4.

Today diesel engine oils look like the example shown in figure 1. From 20 to 30% of modern diesel engine oil is additives designed to improve performance in key areas. These additives are carefully engineered mixtures of compounds formulated to pass the various diesel engine tests which define a new lube oil specification like the CI+4 or the new CJ.

Typical Diesel Oil Composition



Base Oils:	69-80%
Performance Package	15-20%
Viscosity Modifier:	5-10%
Pour Point Depressant	0-1%

Pour point depressants are used to keep the oil fluid at very low temperatures. (They inhibit wax crystal formation.) Viscosity modifiers are used to make the oil thin out less as it is heated. This makes an oil which we call "Multigrade" and it simply means the multigrade oil acts like a thinner oil at low temperatures and a thicker oil at high temperatures. Multigrade diesel engine oils were a key part of the solution to the excessive oil consumption problem addressed by API formulation CE.

The performance additive package (see figure 2) is a mixture of 8-12 specialty chemicals, each of which is intended to impart specific properties to the oil's performance. The important thing to remember here is that most additive chemicals (particularly detergents) deplete or wear out in service. This is one of the reasons why the oil must be changed. Life *was* good.

Typical Diesel Oil Performance Package

- **Detergents**
  Neutralize Combustion Acids
  Minimize Wear
  Inhibit Rust Formation
  Oxidation Inhibitor
- **Dispersants**
  Prevent Agglomeration of Soot Particles
  Suspend Contaminants in Oil
- **Oxidation Inhibitors**
  Retard Oil Decomposition
  Slow Deposit Formation
- **Anti-Wear Agents**
  Create Sacrificial Film Between Metal Parts
  Minimize Valve Train Wear
- **Foam Inhibitors**
  Prevent Oil Foaming

What Did the EPA Do To Us/Why Do We Need CJ-4 Oils?

First, let's discuss why this new oil was developed. The EPA tightened their exhaust emissions thumbscrew on diesel engines starting January 1, 2007, to reduce particulate matter (PM) and oxides of Nitrogen (NO_x) emissions even further. To meet those requirements most diesel engine manufacturers resorted to the use of diesel particulate filters (DPFs). A DPF differs from the catalytic converters we have used for years on gasoline engines in that a DPF actually filters the *entire* diesel exhaust stream.

On the surface you wouldn't think this would be a big deal—Europeans have been using DPFs for years. The difference is that Europeans don't accumulate mileage like Americans and they will tolerate much more frequent service intervals. Our EPA has decreed that the new DPFs must go 150,000 miles before needing removal for cleaning. This means the soot collected in the DPF must be burned off in the exhaust system frequently if trap life is to exceed 150,000 miles without removal and cleaning.

Now, don't take me wrong—I'm for a cleaner environment like everyone else is. The problem with the EPA is that they just decree which emissions will be reduced without once considering the cost, the technology needed or its effect on your operation. They refer to that as "Technology Forcing Legislation." In the case of diesel engine oils, the EPA forced the adoption of a low-sulfate ash, phosphorus, and sulfur (low SAPS) oil whose technology hasn't yet been proven extensively in the field.

I don't have to tell you that diesel exhaust is relatively dirty. It consists of lots of soot (That's what turns your oil black!) and unburned residues from both the fuel and the oil. Sulfur in the fuel can significantly hamper DPF performance. That's why the ultra low sulfur diesel (ULSD) fuel was implemented 1/1/2007. Phosphorus and sulfur in the lube oil can shorten DPF cleaning intervals considerably. Phosphorus (P) can "glaze over" and plug the tiny holes in the DPF, making the openings effectively smaller and quicker to plug. Sulfur (S) can "mask" the DPF, making it temporarily less effective. Sulfated Ash (SA) in the lube is thought to build up deposits on the DPF over time. These deposits that originate from diesel fuel and lube oil then make the DPF effectively smaller and quicker to plug.

What does this mean to you?

Low P means the Feds placed a limit on the amount of Zincdithiophosphate (ZDP) additive which can be utilized. ZDP is the most effective oxidation inhibitor and anti-wear agent currently available. Additive manufacturers are now forced to use more expensive and less effective ashless oxidation inhibitors and anti-wear agents.

Low S means the new oils can't rely on some of the least expensive Sulfur-based oxidation inhibitors used in the past. And, once again, many of the new ashless oxidation inhibitors haven't been thoroughly field proven in heavily loaded trucks. Low S also means more highly refined base oils, which is a positive thing. Average base oil quality is now significantly improved.

Low SA (less than 1 percent weight) effectively places a limit on the amount of detergent which can be used in these oils. But diesels love detergents. In over 25 years of inspecting various diesel engines in the field, I've yet to see one which didn't perform better on oils with higher levels of detergency.

So, What Oil Should I use?

If you have a diesel engine equipped with a DPF, you should probably use API CJ-4 oils. You really don't have a choice unless you want to clean your particulate trap more frequently. Pay particular attention to oil change intervals.

I know that the major oil marketers are telling their customers that CJ-4 oils are backward compatible (you can use them in pre-2007 engines), and that is somewhat true. But if you use less detergent in an oil, your oil change interval should be shortened accordingly. Oil marketers don't care if you have to change your oil more frequently—in fact, they love it! Remember oil companies are really in the business of moving as much base oil as possible. They love short oil change intervals.

In closing, remember to change your oil as frequently as possible, so we all can generate some more profits for those poor oil companies.

John R. Martin
TDR Writer

More About the Previous Series of Articles

Way back in Issue 54 I asked John how we might test the CI+4 oils and the new CJs. His response: "That's easy: You spend the $25 for a complete oil sample evaluation. Be sure the test includes total base number (TBN) and viscosity—and send me the results. Don't tell me what is what. Let's see if there is an obvious difference and let's see who makes the best lube oil(s). Who knows what we will find. Will purchasing a lube oil be as easy as purchasing a commodity? You know, as long as it meets a specification then it is 'good,' therefore you can shop for your lube oil based on price."

Answers to these questions gave me the basis for an excellent article. So, the oil analysis kits were purchased, $25 x 22 kits ($550) and I went on a shopping spree for oil, $15 x 22 oils ($330). A cool $880, just so John and Robert would know about lube oils.

Earlier I stated that John was the oil expert. Prior to retirement he was an engineer at Lubrizol, one of the companies that makes and sells the additive packages to the oil manufacturers. And, at John's stage in life, he was/is not beholden to anyone in the industry.

So, what conclusions could one draw from the year-long Martin and Patton examination of 22 different diesel lube oils? I've talked to many TDR members about the series of articles and each one has shared with me their own unique conclusion. Didn't we all read the same article?

I have often stated that, "changing a person's opinion about lube oils is like trying to change their opinion about religion. It is not going to happen." My take-away from the year long, $880 expenditure (oops… perhaps John Martin has brainwashed me) is as follows:

Back in 1999, it took a series of oil analyses samples before I was comfortable changing my 3,000 mile change-the-lube-oil/guy-on-TV mentality. Then again, it took a series of 22 oil samples to change my mentality concerning lube oil by brand name versus lube oil as a commodity.

I'm on the same page as John Martin; if it meets the specification you can purchase oil like a commodity. Change the oil based on the Owner's Manual recommendations.

LUBE OILS – VERSION 2012

Questions for 2012

So, the long answer to Desmond Rees has thus far taken 2.5 pages! However, I felt the background data was necessary before we just jumped into "Lube Oils—Version 2012." The following are the questions I wanted John to help me answer:

Q1 Could I find the good stuff, an old CI-4 specification oil?

Q3 Who has the best "John Martin" oil for 2012?

Q2 How would the CJ-4 oils blended today compare with the same oil that we sampled back in the summer of 2007?

Q4 What has changed in the world of John Martin in these past five years?

The Oil Analysis for 2012

As mentioned, back in 2007 we tested 22 different brands of lube oils: everything from Amsoil to Walmart; Caterpillar to John Deere; Red Line to Liqui Moly. The prices ranged from low of Walmart's Super Tech at $7.68 per gallon to the high of Red Line Diesel Synthetic at $35 per gallon. If you want the complete list of CI-4 plus and CJ-4 oils that were tested you'll want to look back at Issue 58, pages 52 and 53.

Why 22 oils back then and only 10 oils for 2012? Remember my comment about lube oils, religion and the change of opinion? Well, my opinion has been changed! How so? A look back at Issue 56 gives you some insight into my mindset prior to the testing of the 22 lube oils. Here is the recap:

"When new lube oil is analyzed you can get a good idea of the quality of the additive package that, as learned from Martin's experience, makes up 20–25% of the lube oil blend. Maintaining viscosity at higher temperatures, maintaining high alkalinity (total base number); and protecting against wear with the right blend of molybdenum, zinc, phosphorus and boron are important lube oil attributes. Readings for calcium are a way to measure dispersion detergency.

"In the blind-sampling-from-the-bottle done by Trailer Life magazine in January 2005, I was greatly disappointed to see that Walmart Super Tech 15W40 diesel oil stood toe-to-toe with other very respected brand names.

"Why disappointment? First, consider what John Martin said, 'Consequently there is less and less difference between engine oil that barely passes the API certification test and one that is designed to pass by a significant margin. Therefore, oils meeting a given performance spec are approaching commodity status.'

"Second, I am not a big fan of Walmart. I could go into a long tirade, but I will refrain.

"Third, for all of my vehicle ownership years (let's see, that is about 37 years) had I been duped? Had I fallen for the marketing hype? I did not want to believe that lube oil is just a commodity. Yet the Trailer Life grid did not lie."

What story did the forthcoming TDR grid tell?

Had I fallen for the marketing hype?
I did not want to believe that
lube oil is just a commodity

The previous 22 brand oil test did give me an education. For 2012 I did not feel the need to test every lube oil in the marketplace. As a matter of fact, I only went to two places for the various oils, Autozone (where each oil was priced at $17.99) and Walmart. The following is the blind sampling data:

Sample Description	Viscosity @ 100°	TBN	Calcium	Magnesium	Phosphorus	Zinc	Boron	Molybdenum
1	14.1	8.84	1050	777	975	1110	82	0
2	15.5	8.17	2183	9	1053	1152	3	1
3	15.1	8.69	1135	783	1020	1172	0	40
4	14.7	9.27	1299	837	941	1069	64	48
5	16.5	8.19	1412	395	1084	1250	503	89
6	15.5	9.15	1171	970	1088	1202	0	43
7	15.0	9.03	2209	10	1039	1156	35	0
8	15.1	9.09	2305	10	1077	1169	58	0
9	15.5	8.7	1134	787	1017	1169	0	40
10	14.3	9.22	770	1119	994	1171	60	58

Product Identification Chart			
Item	Product	Viscosity	Price
1	Mobil 1 (Syn)	5W40	$26.33
2	Motorcraft	15W40	20.99
3	Walmart	15W40	10.97
4	Mobil Delvac	15W40	17.99
5	Chevron Delo	15W40	17.99
6	Valvoline	15W40	17.99
7	Shell Rotella	15W40	17.99
8	Castrol Tection	15W40	17.99
9	Warren	15W40	14.99
10	Shell Rotella (Syn)	5W40	27.99

And now, the answers for Lube Oils – Version 2012:

A1) I could not find any CI-4 lube oil.

A2) I'll turn this answer over to John Martin. John's response:

Robert and TDR audience, remember my often-used statement, "Diesels Love Detergents"? It appears from the oil analysis data that Samples 4, 5, 6, 7, 8, and 10 all have total base numbers (TBN) in excess of 9, which suggests to me that these oil marketers are trying to provide as much TBN as possible given the 1.0% weight sulfated ash limitation imposed by the API CJ-4 specification. They are doing this to satisfy those fleets whose oil change intervals are based on TBN depletion.

Samples 2 and 5 have the least amount of detergency of the oils tested. Sample 5 uses either a borated detergent or a boron-containing oxidation inhibitor. Borated detergents are thought by some to be more effective than traditional detergents. It is also possible that data in the last two columns for sample 5 has been transposed. *(Editor's note: the 503 and 89 numbers are as printed by the lab.)*

My field test experience has taught me that calcium (Ca) detergents are more effective than magnesium (Mg) detergents, so, to answer question 2, "Who has the best oil for 2012?" I think oils 7 and 8 would be the best of the oils you surveyed. Oils 4, 6, and 10 also have high TBN values for CJ-4 oils, but they depend heavily on magnesium detergents, so I don't think they would yield diesel performance as good as oils 7 and 8.

Oils 1, 4, 5, 7, 8, and 10 all contain boron, but I'm certain that the additive chemistry in sample 5 is different than the others (or the last two columns of data for sample 5 have been transposed). Boron oxidation inhibitors are evidently being utilized to improve the high temperature performance of these CJ-4 oils.

Now, if you allow me to look at the number-to-product identification report I can tell you that oil 5 has been completely reformulated, and I know why. Chevron Delo 400 is the most widely used oil in big trucking fleets. When CJ-4 came about, fleet operators told Chevron they preferred the old CI-4 oil, particularly when they found out that Chevron was going to ask more money for their CJ-4 oil. Neither Chevron nor the fleets would budge off their positions, and big marketers like Chevron only want one oil in their distribution systems. Chevron went back to the drawing board, reformulated, and retested until they could pass the API CI-4 tests with a CJ-4 oil. Then they dropped both earlier oils out of their systems and offered only the new, improved CJ-4 oil. I wonder if the big fleets paid them more money for the new oil?

Mobil and Shell also supply a lot of oil to truckers. If you compare sample 1 (a consumer oil, Mobil 1 synthetic) with sample 4 ((Mobil Delvac) you can see that Mobil added more detergency to oil 4 (Ca and Mg) to give their big fleets increased TBN and keep them happy. Fleets wouldn't use the Mobil oil in Sample 1. The Shell samples (7 and 10) are also very interesting. Shell is using different additive chemistry in their 15W40 (Rotella mineral, sample 7) than in their 5W40 (Rotella synthetic, sample 10). I'm guessing that the big fleets are mostly purchasing oil 7. I do not know why the chemistry is so different in oil 10, other than perhaps another additive supplier was able to pass the tests, allowing Shell to get the credentials they desired.

So, once again, my picks are oils 7 and 8. If you religiously adhere to your manufacturer's recommended oil change intervals, oil 3 would be the best performer on a cost per mile basis. Oils 1, 2, and 10 offer the highest cost per mile, so I would avoid them altogether.

A3) Now, let's compare the 2007 oils to the 2012 oils. I asked Robert to save you from going back to Issue 58 and present a comparison chart for you.

The CJ-4 Lube Oils Tested in Issue 58 were:

Shell Rotella T	15W40
Castrol Tection	15W40
Chevron Delo 400 LE	15W40
Cummins/Valvoline Premium Blue	15W40

The following chart gives you the "Then and Now" candidates:

Price	Description	Viscosity @ 100°	TBN	Calcium	Magnesium	Phosphorus	Zinc	Boron	Molybdenum
$10.96	**Shell Rotella T**	15.7	8.77	2488	8	1108	1147	37	2
17.99	**Same 2012**	15.0	9.03	2209	10	1039	1156	35	0
10.80	**Castrol Tection**	14.7	7.74	2011	6	876	1035	0	0
17.99	**Same 2012**	15.1	9.09	2305	10	1077	1169	58	0
12.99	**Chevron Delo 400 LE**	15.7	7.82	1593	416	1156	1268	83	570
17.99	**Same 2012**	16.5	8.19	1412	395	1084	1250	503	89
9.98	**Cummins/Valvoline**	15.6	8.42	1109	827	994	1041	0	41
17.99	**Same 2012**	15.5	9.15	1171	970	1088	1202	0	43

Now, to compare the 2012 results to the 2007 table, it appears that Shell has dropped their ZDP content by 10% in oil 7. Before interpreting data from this type of analysis remember that repeatability of these numbers is no better than 10%. Looking at the data in that light, two things could have happened in the last five years. Either the ZDP level could have been dropped 10% to enable Shell's additive supplier to put more detergent in the oil to increase TBN levels, or the data is on the outer edge of the repeatability limits. When comparing today's Shell oils, it looks to me like Shell may be using a different ZDP than they did in 2007.

But, audience, did you notice from your 2007 to 2012 comparative data that all of the oils cost more in 2012? Whether or not the oil marketer changed his initial CJ-4 formulation, he has managed to use the new credentials as a vehicle to raise the selling price of their oils significantly. As I said before, I don't know if oil marketers are getting more for their CJ-4 oils at major fleets, but they are certainly getting more from retail consumers. ***(Editor's note: I looked back to November 2007 and a barrel of crude oil was $88, today it is $106.)*** You and I get to pay for everything!

A4) What has changed in John Martin's world in the last five years?

For one thing, I spend much more time researching alternate fuels than diesel lube oils these days. Everyone wants to just jump into the future, be green and reduce our dependence on foreign sources of crude oil without even considering what these moves will do to the poor people who design the vehicles and systems that will have to make that happen.

For example, the public is finally beginning to discover that corn-based ethanol containing fuels (one of the worst jokes of the modern era) are actually worse than gasoline regarding greenhouse gas (GHG) emissions. It has taken the do-gooders billions of our tax dollars to discover what they've been told long ago by fuels researchers. The California Air Resources Board (CARB), a bastion of the most radical environmentalists in the world, has actually had their low carbon fuel standard (LCFS) overturned by a Federal judge.

Secondly, remember how the do-gooders tell us we should all be driving the Toyota Prius (Pious)? The latest GHG emissions research has shown that power plants are responsible for more GHG emissions than transportation vehicles. Where did the do-gooders think that electricity was coming from? Was it magic? Left-wing environmentalists never let facts get in the way of a good story. These are the same radicals who are currently stalling the Keystone pipeline project which could bring much needed crude oil from the North to refineries on the Gulf Coast. After the OPEC countries, China, and Hugo Chavez purchase all that valuable Canadian crude, we will decide to build the pipeline. Our environmentalists are getting to the point where they are very destructive. (My political rant is over. Don't send the editor hate mail.)

Our next new diesel lube oil spec (currently called PC-11) will occur sometime around 2015. The Federal government recently decreed that diesel trucks must provide significantly better fuel economy by 2016. The Engine Manufacturers Association (EMA) has already asked the lube oil industry for some improved fuel economy (FE) oils by 2015 so they can be field tested prior to production. Since the major fuel economy differences are observed by lowering oil viscosity, expect to see some very thin (5W30, 5W20) diesel oils in 2015. Very thin oils probably won't work well in current engines. (More about that in future TDR magazines?) This, too, won't be as easy as the EPA activists think it will be, but, as long as your tax money will hold out, they will be asking you to finance this research.

John Martin
TDR Writer

CUMMINS ENGINE LUBE OIL QUESTIONS

ISSUE 84 – IDLE CLATTER

by Robert Patton

As we have mentioned, the 2013 and newer Heavy Duty 2500-5500 Cummins-powered trucks come from the factory with a fill of 5W-40 synthetic diesel rated engine oil (API CJ-4 specification). Oil additions and changes should be made using this lubricant or 15W-40 petroleum based oils. Your Owner's Manual clearly spells this out.

So, here is the obvious question: (Actually, it is close to a $2 million, or more, dollar question. The math: 150,000 engines per year; three gallons of lube oil at a cost estimate of $4/gallon premium for a synthetic oil 150,000 × 3 × $4 = $1,800,000.) Why is the factory fill a 5W-40 synthetic?

Answer, Chrysler's cold start testing criteria dictates that 5W-40 be used. I wish I could tell you how Chrysler's test relates to the requirement at Ford, Chevy, Mercedes-Benz, BMW, Audi, etc., but I do not know. Let's simply enjoy the fact that your 2013-newer truck has the synthetic 5W-40 lube oil.

The next obvious question: do I have to continue with 5W-40 synthetic. The short answer, no. Documentation for this response is, again, found in your Owner's Manual. Quoting from the 2014 book:

> "In ambient temperatures *above* 0°F, we recommend you use 15W-40 engine oil such as Mopar, Shell Rotella and Shell Rimula that meets Chrysler Materials Standard MS-10902 and the API CJ-4 engine oil category is required. Products meeting Cummins CES 20081 may also be used. The identification of these engine oils is typically located on the back of the oil container.
>
> "In ambient temperatures *below* 0°F, we recommend you use 5W-40 *synthetic* engine oil such as Mopar, Shell Rotella and Shell Rimula that meets Chrysler Materials Standard MS-10902 and the API CJ-4 engine oil category is required."

For what it is worth, the 2012 and 2013 books had this extra little diddy: "Failure to use SAE 5W-40 synthetic engine oil in ambient temperatures below 0°F could result in severe engine damage."

This leads to question number three: What do I recommend on lube oils? For the answer to this I'm going to leave it to the experts and to you to do some research. TDR writer and oil guru John Martin did an article on the new CJ-4 lube oils in TDR Issue 77. One takeaway from Martin's article (and the editor's response, too) is to find a mineral-based 15W-40 that meets the CJ specification and then purchase and use the least expensive oil that you can find. Cheapskates! Change the oil based on your Owner's Manual/EVIC recommendation. For me, I'll stick with the 5W-40 synthetic, CJ specification oil.

Some owners have called wishing to know if the initial fill of engine oil should be run for a full oil change interval, or should it be changed early? Answer: Cummins recommends using the oil for a full oil change interval. The computer EVIC display will tell you when it is time for an oil change based on driving conditions.

Along with engine oil, use of the proper oil filter is essential. Your writer personally recommends the Fleetguard Stratapore oil filters for all model years of Cummins diesel engines. The complete story on lube filters is found in TDR Issue 71, pages 60-67. Fleetguard's Stratapore filter (LF16035) uses a synthetic filter media that is typically $4-5 higher than the Fleetguard LF3972 or Mopar M285 (same filter, different paint on the outer shell) filters that are paper cellulose media. These filters (Stratapore or standard-type) are available in the Geno's Garage catalog at competitive prices, and at any Cummins distributor. They really are superior in quality and filtration against other brands, thus helping to make your engine last longer.

Here is a photo from Issue 71 showing writer Jim Martin's two favorites – the Fleetguard and Wix filters that use StrataPore filter media.

"Step 7: Wipe your tools carefully, put them away and then go into the house. Throw all your clothes—including the running shoes—into the washer and then take a shower. Put on clean clothes and return to the workshop to have a beer and ponder the evening's work. Now, you're done.

Peter Egan
Cycle World

A "Zen" moment as the editor-dude changes the oil in his EcoDiesel. (Like it's big brother, it holds almost three gallons.) The unattended drain bucket almost overflowed.

As mentioned, I wish I could tell a story like that. The best I can do is to add a footnote to his yarn. From TDR's Greg Whale: "Dear Mr. Egan, please add steps 3a and 3b.

"3a: As you are pouring fresh oil into the engine make a note that the fresh oil ($8/quart) is leaking from the location of the oil drain plug. Oops, it's not leaking, it is pouring. STOP ADDING FRESH OIL!

"3b: Rush to install the oil drain plug."

Now, in fairness to the folks at Cycle World and to Peter Egan, I have to give credit where the credit is due. You can find all of Egan's books from his Cycle World days and from his Road & Track editorials by doing a quick search at Google for your favorite place to shop for books or go directly to Amazon.com.

The "Zen" quotes came from Egan's book "Leanings 3: On the Road and in the Garage with Cycle World's Peter Egan.

While you have your computer fired-up, take a few minutes to log onto www.cycleworld.com and start a new subscription! You'll not be disappointed.

Enjoy Mr. Egan's writing. Buy one (or all) of his books. Subscribe to Cycle World. I'm hopeful my endorsements prompt you to make a purchase. Again, some great reading material, you won't be disappointed!

Robert Patton
TDR Staff

While we're on the subject of lube oil...

The Motojournalism thing, combined with excerpts from Mr. Egan and Greg Whale tie-in give you a humorous look at the mundane oil change(s) that we all have to endure. I can only imagine those of you guilty of Steps 3a and 3b, myself included.

Now, let's move on to the serious look at oil in the news, the new lube oil specifications that will be introduced in December. In the update that follows, our oil-guru, John Martin, tells us about the new CK-4 and FA-4 oils.

Robert Patton
TDR Staff

PC-11 UPDATE
or
You're Getting Something Besides Red Socks for Christmas

by John Martin

If you readers will recall, I thoroughly discussed the upcoming new engine lube oil performance category, PC-11, in October of last year, TDR Issue 89. I mentioned that the API (American Petroleum Institute), the ASTM (American Society for Testing of Materials) and the SAE (Society of Automotive Engineers) were feverishly working to develop two new diesel engine oil performance categories as requested by the EMA (Engine Manufacturers Association) to improve diesel engine fuel economy. This is part of our nation's greenhouse gas (GHG) reduction effort.

Well, folks, on December 1, 2016, it's finally going to become a reality. This will be a major change for the diesel engine oil market for several reasons.

First, there will be two new performance categories, API CK-4 (PC-11A) for existing diesel engines and API FA-4 (PC-11B) for new/post 2017 engine designs which will tolerate lower viscosity oils. (Viscosity is still the most important parameter influencing both fuel economy and horsepower.)

API CK-4 is no big deal, other than the cost and time it takes to develop a new diesel engine oil. Current estimates are that it costs over one million dollars to develop a new oil even if it passes all the required laboratory tests the first time out. And that doesn't count the time and money it takes to field test the new product in a variety of engines in different types of service. In this day and age, you need at least two to three years of field testing to feel comfortable about the performance of any new diesel engine oil.

Now, the new FA-4 oil is creating quite a stir for several reasons. Oil marketers get very nervous when someone suggests putting an FA-4 oil in an older engine design with looser engine clearances, yet having to spend millions of dollars to develop a product to be used on only 2017 and later engine designs doesn't fully justify the tremendous expenditures involved.

So both end users and oil marketers will want to see how many other engines the FA-4 oils can safely be used in to maximize their investment. In the end it will probably be up to each engine manufacturer to determine which of their engines can tolerate FA-4 oils without sacrificing engine service life. Big Oil will want you to put this oil in everything to simplify logistics, but most end users will want to make sure FA-4 oils don't void their warranties. It's a shame oil marketers didn't better educate the end users ahead of time so they could make more intelligent selections.

Due to the extremely high costs associated with developing and marketing two completely new oils, many oil marketers are taking a closer look at product line simplification. ConocoPhillips, for example, currently markets four diesel engine oils under its brand umbrella, Conoco, Kendall, Phillips, and 76 Lubricants. To minimize developmental and marketing costs, they have decided to drop the Conoco and 76 Lubricants brands from their diesel engine oil lineup.

I'm sure other oil marketers are either reducing product lines or having a brand represent only one of the new oils. For example, Shell, which has both their Rimula and Rotella brands, also owns Pennzoil and Quaker State. Will they eliminate some oils from this complicated lineup? I predict that both Rimula and Quaker State won't offer the full range of FA-4 products to minimize expenditures.

It's going to be fun with a lot of to-ing and fro-ing. Take the time to carefully read the API label on the container (see examples). Note that the FA-4 label will be shaded to make it stand out a little. API CJ-4 oils will continue to be produced and marketed for at least a year before that performance category is obsoleted. The CK-4 oils shouldn't pose any problems for you.

Who knows, once there is product available (both CK-4 and FA-4), I might have the TDR guy go on a spending spree so we can check the composition of all these new-fangled oils and see what is really best for your truck.

John Martin
TDR Writer

ADD OIL HERE/PC-11 AND CK-4 UPDATE

ISSUE 83 – TDREVIEW

ADD OIL HERE

by Robert Patton

Every now and then you'll stumble across an automotive writer that clicks with you. (See Motojournalism Connection, pages 4-7.)You find that their stories convey what you would say if you had their literary talent. Some of my favorite writers: the TDR's very own Greg Whale (all things automotive, Whale's "been there, done that"); Kevin Cameron (Kevin can make a nut and bolt into a fascinating story) and Mark Barnes (Mark's writings have reinforced that I'm not the only one that enjoys the solitude of a workshop); Peter Egan from Road & Track and Cycle World (Egan's writings can make a trip to the 7-11 store into an adventure); and Peter DeLorenzo from Autoextremist.com (his automotive rants/insights challenge the norm).

A quick story about Greg, Kevin, and Mark.

Back in the early days of the TDR (think 1994 for Greg Whale, 1996 for Kevin Cameron, 1998 for Mark Barnes) I was on the lookout for writers that could bring their insight to our new member/club organization. To reach these writers, I sent a request to their respective editors asking if I could contact them. As I have come to learn, automotive and freelance writing is not the glamor job you might envision, and the editors were willing to grant me access to these talented writers. After all, the TDR did not compete with the titles that Greg, Kevin or Mark were writing for. So, now you know the TDR writer story.

Oops, I'm a little off track.

I have here before me a story from Cycle World written by Egan that reminded me of the oil change woes that many of us have encountered with the 2013-and newer Turbo Diesel trucks. However, unlike the TDR's Donnelly, Roberts, Redmond or Langan that give you the steps to perform the task, Egan tells the oil change story of the average Joe, complete with a handful of mistakes.

Here are just a few excerpts from the story that will help me transition into a humorous story that was told to me by our very own Greg Whale.

Egan's original article in Cycle World was titled "Zen and the Art of the Oil Change." He starts the story with a long introduction and then a question from a CW reader:

"These days, a lot of younger, less experienced riders come up to me and say, 'Mr. Egan, you have an almost legendary reputation for being able to change the oil and filter on your motorcycles without spilling more than about 30 percent of the oil onto the garage floor or your own clothing. How the heck do you do it?'"

Next Egan gives the audience the step-by-step process that he used to tell this tale:

"Step 1: Place a 'suitable container' under the sump or oil reservoir—which, in the Buell's case, is in the hollow swingarm above the end of the muffler—and remove the plug. A stream of scalding hot oil will run down over the rear of the muffler and cascade into the pan, like Niagara Falls in a nightmare. Some will run down to the far end of the muffler and onto the floor. Or trickle warmly down your forearm and into your sleeve.

"Step 2: While oil is dripping from the drain hole and muffler, remove the small chin fairing and place another pan under the oil filter. Remove the filter with a web-type tool and stand back as oil from the engine and filter run over the front of the muffler and into the pan. Much of the oil will follow the bottom of the muffler and run onto the floor. Expect some to drip off the filter wrench onto your blue jeans. Accidentally drop the slippery, hot filter into the pan for a nice splash effect.

"Step 3: Carefully fill the new filter with oil, spilling hardly any at all, then screw it into the engine and put the drain plug back in. Here's where you give the drain pan an accidental kick so that a small tidal wave of oil flops onto the floor. Then refill the reservoir using a funnel with too small an opening so that it overflows immediately and burps oil onto the swingarm. Before putting the chin spoiler back on, use massive amounts of contact cleaner/degreaser to clean up the muffler and floor, along with ecologically friendly piles of oil-soaked paper towels.

"Step 4: Carry the main oil drain pan across the workshop and dump it down a large funnel into a disgustingly filthy, oil-streaked, red-plastic five-gallon gas can with the words 'DRAIN OIL' scrawled across it so people don't accidentally drink from it.

"Step 5: Check to make sure this can isn't already almost full. Otherwise, about two quarts of dirty drain oil will well up around the sides of the funnel and run onto the floor, as mine did. Expect some oil to run down the back side of the pouring spout on the drain pan and drip onto your running shoes.

"Step 6: Mop up the oil spill with more paper towels and wring them out over your drain pan. Clean the whole area with half a spray can of contact cleaner, but don't breathe any of the fumes. When everything is cleaned up, start the bike and check it for oil leaks. Mine was fine; not a sign of a drip.

LUBE OIL MATTERS

ISSUE 110 – BACKFIRE

by Robert Patton

Introduction

TDR members, isn't it interesting to go behind-the-scenes? Here is the directive given to the writers for Issue 110:

"Looking back at previous directives, I see, 'no tires and no lube oil.' This issue I would like to add two more items to that list, no waxes or polishes, and stick to talking about the Turbo Diesel truck in your garage. There is no particular theme for TDR Issue 110. You will note, however, that the word, C____-_9, was not to be found in TDR Issue 109 and it will not be found in this issue. I think we all get enough of that problem elsewhere. Thank you for your support of these directives."

Easy to understand, but difficult for the editor (that's me) to comprehend. I'm sorry, I can't refrain: lube oil matters. Here is the story.

Backfire: EcoDiesel Lube Oil

Just a scant three issues ago (#107) there was an article where I ignored the directive "no lube oil articles," and John Martin and I talked about the latest energy conserving, diesel specification, FA-4 lube oils. This category of oil is not recommended in either the EcoDiesel or Cummins diesel Owner's Manuals (O&M). At the end of the article John and I reemphasized the technical service bulletin (TSB 18-078-16) for the EcoDiesel audience that did recommend a change in lube oil from that found in the 2014-2016 O&M books. A recap of the discussion:

"Ram TSB 18-078-16 was issued on 7/27/16 and it informed the audience to change from the previously specified/hard-to-find/expensive 5W30/MSI1106/European 3 specification to good 'ole Shell Rotella T, 5W40, synthetic. Issue 94 comments by John Martin sum up the actions by Ram: 'As you may have concluded by now, the switch from SAE 5W-30 to SAE 5W-40 produces one key effect—higher oil pressure at engine operating temperatures (200°F). EcoDiesel owners, I would make the change to 5W-40 in short order.'"

Additionally the TSB involved a reflash to the ECU that would take the engine to a higher rpm before shifting: higher rpm equates to faster oil pump speed, more oil flow and more pressure.

Further, John commented, "Let's see if I can summarize: The EcoDiesel tried the thin oils (before FA-4) to realize a fuel economy benefit. Long term, they went back to a thicker diesel specification."

Got it, thicker oil for the EcoDiesel.

Backfire: Cummins Lube Oil, 1989-2018

Okay, how about lube oil discussion on the Cummins Turbo Diesel engine? Looking back, the most recent conversation was found in Issue 101, August 2018, pages 60-63, "Please, Please, Please Read Your Owner's Manual and the TDR."

Therein, John and I talked about the Ram TSB 18-078-16 and that the Shell Rotella T, synthetic, 5W40 requirement is not to be taken lightly.

In that article, for the Cummins audience I took some time to review the O&M books from 1989-2018. Here is a brief summary:

"Since the introduction of the Cummins B-Series engine into the Ram pickup in 1989, we are fortunate that the lube oil recommendation for viscosity has not changed. To this day, the viscosity specification is 15W40, and for lower ambient temperature conditions, a synthetic 5W40. As you know, throughout these many years, the SAE certification has changed and each specification (save for our debate about CI oils versus CJ oils) has been an improvement that brings us to the current classification CK."

* Temperature range and viscosity will be addressed on the 2019-2020 6.7CGI a little *later* in this article.

More Recap for 1989-2018 Owners

Further into the article John and I talked about the different "generations" of Cummins engines and the O&M book's recommended oil change intervals versus his real-world experience, different lube oils, trucking fleets and oil analysis. Briefly, here are John's recommendations:

"It is your truck. It no longer has a warranty. Like I mentioned in previous magazines (most recently Issue 76, "Lube Oils – Version 2012"), if the oil meets the latest API specification you can purchase oil like a commodity.

"Now, I know we do want the best value for the dollar, so in Issue 76 we evaluated 10 different lube oils that met the API specification. At the time it was CJ-4. Online you can pull up Issue 76 and you'll see that my favorites were "oil 7 and 8" which happened to be Shell Rotella (mineral oil 15W40) and Castrol Tection 15W40. My recommendation for oil change interval was to follow the Owner's Manual recommendations."

Further, I asked John to discuss the oil change interval. For example, the '94-'98 O&M suggests a 3000mile or 3-month interval for "Schedule B" type operation. Again, John gives his opinion:

"With my experience in trucking, some major trucking fleets run 35 to 45,000 miles before changing oil. But, you must remember that these engines have at least 10 gallon sumps and line haul service is relatively easy on the oil. I'm comfortable with 10,000 mile intervals in the service our readers subject their vehicles to, but I (and I'll bet our readers also) would feel much safer after they do some oil analysis. So go ahead: test the new oil sample, test again at 10K miles, and test again at 15K or 20K miles. Make sure the viscosity is in-grade (12.5-16.3 for 40 grade). Make sure the total base number (TBN) is at least as high as the total acid number (TAN). When these two numbers are equivalent, change the oil.

"Also notice that the wear metals, soot content, and other contaminants build linearly with mileage, so the concentrations at 20K should be double those at 10K. Also be sure to change oil if there is evidence of coolant contamination or silicon levels are more than 25 ppm higher than the new oil.

"We also both agree on the engines in use from '07.5-current: follow the Owner's Manual recommendation. On these engines the exhaust aftertreatment really taxes the lube oil."

So, John sets the Cummins into two categories: before aftertreatment '89-'07, and after '07.5 to current. John and I feel strongly, the title "Read Your Owner's Manual" really applies to these '07.5-current engines. Here is the discussion:

Recap: 2007.5-2012 6.7-Liter Owners Take Note

"*Mileage-wise* owners of Cummins 6.7-liter engines in model years '07.5-'12 (NOx adsorber emissions catalyst) should be very mindful of the oil change interval. I went back to the OM for '07.5 and it reads:

'Your vehicle is equipped with an oil change indicator system. The system will alert you when it is time to change the oil with a message on the electronic vehicle information center (EVIC). The oil change interval is duty cycle based.

'Under no circumstances should oil change intervals exceed 7500 miles or 6-months, whichever comes first.'

"There is sound logic in the short oil change requirement. This emissions system used an extra squirt of diesel fuel into the cylinder (after the combustion event) to fire up the NOx adsorber catalyst when the catalyst needed a regeneration. (Think self-cleaning oven.) This unburned fuel and the amounts of exhaust gas that are recirculated to the air intake are two reasons the oil would need a shorter oil change interval, *especially* if the truck was frequently idled. But, every 6-months? This short time period goes back to 1989 and is also suggested on 2013-current trucks."

Ram Owner's Manuals: Great "suggested" reading materials.

Recap: 2013-2018 Owners Take Note

"Now, in 2013 the exhaust aftertreatment changed to the selective catalyst reduction (SCR) system that uses the diesel exhaust fluid (DEF) as an emissions cleaning agent. The DEF is injected into the exhaust aftertreatment system way downstream of the combustion event. We still have exhaust gas recirculation to contaminate the oil, but the Ram/Cummins engineers are confident in giving you a longer 'do not exceed' mileage (15,000 miles) than was allowed on the '07.5-'12 6.7-liter engine.

"However, the O&M specifies time requirement oil change interval is still *6-months*. Here is the verbiage from a 2016 O&M:

'Change engine oil every 15,000 miles, *6-months*, 500 hours or sooner if prompted by the oil change indicator system."

"One word comes to my mind about this 6-month time requirement: Ridiculous.

"Yet, I am not in charge of protecting your warranty. However, I am in charge of giving you some common sense suggestions. So, again I called on the TDR's oil guru, John Martin, to ask his opinion of the six-month change-the-oil requirement. The following is his response:

"I agree, over time, oil doesn't go "bad." Okay, given some extreme temperature and humidity conditions, it can be water contaminated. (Yes, I observed as much with a 55-gallon drum stored outside for a year or two, but that's another story.)

"I think a better change interval would be one year. But if the vehicle is indoors, not prone to big temperature changes, I'm okay with three years. (Robert says five.) Condensation accumulates in an engine even when it isn't operated, and condensation (especially when mixed with ethanol) wreaks havoc on oil, so at least change your oil even if you don't change your filter.

"However, bottom line, I'm not your warranty administrator."

New: 2019-2020 6.7-Liter CGI Engine Owners Take Note

Seriously, owners take note.

This engine is different.

This engine has a different lube oil specification than we are accustomed to:

- Above 0°F (-18°C) the oil viscosity should be 10W30
- Below 0°F (-18°C) the oil viscosity should be 5W40 *synthetic*

Here is the actual, factual text from the 2019-2020 Owner's Manual:

"In ambient temperatures above 0°F (-18°C), we recommend you use 10W30 engine oil such as Mopar, Shell Rotella and Shell Rimula that meets FCA Material Standard MS-10902 and the API CK-4 engine oil category is required. Products meeting Cummins CES 20081 may also be used. The identification of these engine oils is typically located on the back of the oil container.

"In ambient temperatures below 0°F (-18°C), we recommend you use 5W40 synthetic engine oil such as Mopar, Shell Rotella and Shell Rimula that meets FCA Material Standard MS-10902 and the API CK-4 engine oil category is required."

Discussion: Old Habits Die Hard

Did the above 0° temperature recommendation of 10W30 surprise you?

Yes? Me too. The staff at Geno's Garage was asked, "What is the recommendation for 2019-2020 engines?" In response they voiced the old-habit answer of "15W40."

Truthfully, you would not think a difference in viscosity of the old-habit 15W40 to 10W30 in warm weather would make a difference. I agree. But, remember, I am not the Owner's Manual, nor your warranty administrator. *Use the correct oil: 10W30.*

Now, here is a scenario to consider: In those cold climates where the 2019-2020 6.7 CGI engine owner does not heed the "5W40 synthetic" recommendation (compounded with an incorrect choice of 15W40 in the crankcase from the summertime oil change), you now have a recipe for bad mojo. Wait, do you immediately "hammer" the engine after the cold start? More bad mojo.

Conclusion

Surprise! I don't have one.

On second thought, well, here goes: The EcoDiesel engines moved to a specification for higher viscosity for better oil pressure in high temperature, high-rpm conditions.

Conversely, the Cummins 6.7CGI engine needs the lower viscosity 5W40 synthetic in the winter and 10W30 in the summer months for initial low-rpm start up. Let the engine warm up a bit. Don't "hammer" the engine right out of the gate.

On page 43 you'll see that Ram has written an "Information-Only" technical service bulletin (09-011-20) that discusses lube oil viscosity for the 2019-2020 6.7CGI engine. Also, on page 49 you'll note a recall on '19-'20 Cab and Chassis 3500, 4500, 5500 (W57) that is a software update to allow the engine adequate warm-up time.

Postscript: Why is the 6.7 CGI Engine Different?

Good question. Remember, the staff at Geno's Garage and I could not correctly answer the 2019-2020 oil recommendation question. (It is 10W30, dummy; 5W40 synthetic in the cold.) I was not going to make a guess at an incorrect answer to "Why is the CGI engine different?"

So, I went back to Issue 104 in search of further data. Therein, I found an explanation: In our discussion of the new 6.7 CGI crankshaft, you may have "noted that bearing tolerances are tighter. In order for Cummins to get the super-fine tolerances, the crankshaft material is different and the crankshaft journal and rod surfaces of the crankshaft are heat-treated for additional hardness."

"When the Cummins folks discussed the new crankshaft and the new rod bearings, I was quick to put two-plus-two together and realize that they would be able to use a thinner lube oil and thereby realize a performance and fuel economy benefit. Yes, all of the small incremental changes add up. This is another example."

The Bottom Line for 2019-2020 Owners

Now, let's put four-plus-four together. Tighter bearing tolerance and thinner oil are helpful in performance and fuel economy. But, the 6.7 CGI is not as tolerant of "misbehavior." Again, use the proper temperature lower viscosity oils for better initial start oil flow and don't "hammer" the engine immediately after start up.

Really, it is that simple.

However, since I don't want to talk any further about lube oils, I'm going to turn it over to Kevin Cameron to give you a "big picture" view of the topic. Turn the page for his fascinating story!

MORE FROM KEVIN CAMERON

A quick introduction is in order. Remember those catchy Holiday Inn Express commercials from several years ago? The catch line went something like this, "I'm not a ____ (fill-in-the-blank, rocket scientist, doctor, lawyer), but I did stay at a Holiday Inn Express last night."

Well, I'm not an engineer or a really great writer, but Kevin Cameron is both. I checked with him, and he has stayed at a Holiday Inn, making him uniquely qualified to discuss lube oil and engines. Presenting, Mr. Kevin Cameron:

KEEPING ENGINE OIL FLOWING

by Kevin Cameron

The First Problem

During and immediately after WWII the cold-starting of large aircraft and heavy equipment engines was a difficult problem. Aircraft piston engines were lubricated with military grade 1100 or 1120 single viscosity oils equivalent to SAE 50 and 60, so when cold in winter weather they were immoveable. To prepare for starting, a complicated canvas hood was placed over the front of the engine and a sort of mobile oil furnace was connected to it by a large flex hose, to blow hot air over the engine and its cooling fins. Then everyone made coffee and waited for the temperature to rise. Up to 100 gallons of engine oil (the 4-engined 'Globemaster', aka "Old Shakey", carried that amount for each engine) also had to be heated to a temperature at which it could be pumped.

Bruce's Insulated Covers photo.

Lightplane with canvas engine hood.

On the heavy equipment side, Diesel tractors or generator engines were often provided with a 'donkey' spark-ignition starting engine, fueled with the military's "Jeep gas"—color coded red, of 80 Octane. The donkey was relatively easy to start and, once warmed up, was clutched through gearing to begin turning the Diesel, warming it by cylinder compression and by friction (shearing of oil films between pistons and cylinders, and in bearings). This process typically took 30 minutes or more and was labor-intensive as the oil had to be pre-heated as well. When the Diesel and its lube oil were finally at starting temperature, it might start.

Using a "Donkey" to start a cold DC-3 engine.

The Cold War brought the need for far-northern radar stations to provide early warning of possible Soviet bomber streams coming over the North Pole. All power on such stations had to be generated by constantly-running DIesel gen-sets, with stand-by units present to supply continuous power when maintenance was necessary. It would have been highly inconvenient to have to start a back-up unit in minus-40 weather, telling Washington over a scrambler, "Yes sir, we do understand sir. But it takes thirty minutes, sir, to start the back-up Diesel. Yes, sir, I have my best men on the problem now." It's not hard to imagine Strategic Air Command General LeMay swallowing his famous cigar at such a time.

Chemistry to the Rescue

Chemists provided a better answer. All engine oils consist of long hydrocarbon chains, each of which is in contact with many other such chains (I think of this every time I boil spaghetti). At operating temperature, the average energy of each molecule (consisting of vibrating and rotating) is great enough to overcome the normal molecule-to-molecule attraction that at low temperature causes the oil to become a solid. It is the balance between these two effects—the molecular energy of temperature and the attraction between molecules—that determines an oil's viscosity.

The result of graphing an oil's viscosity against its temperature produced a sloping line, which is called the viscosity index (VI). An arbitrary scale was devised—a high viscosity index for less steep slopes (desirable) a lower one for steeper lines (bad).

In the course of routine operations, the oil industry knew that not all oils have the same viscosity index. Oils refined from Pennsylvania crude displayed a usefully shallower slope (higher VI), meaning that they lost viscosity more slowly as they warmed up. Chemists understood this to mean that oil molecules probably change their shape somewhat as temperature varies. The forces that made one oil chain molecule stick to others might also make it stick to itself! As temperature fell, and the vibrations, rotations, and jump-rope whippings-about of the molecule grew less energetic, some molecules might gradually fold, stick to themselves, and take up a more compact shape. That more compact shape would correspond to a lower viscosity.

Hmm, what if we did a bit of research on this point, and specifically looked for molecular structures that have this shape-changing property in high degree? That might allow us to make an oil that would be thin enough to allow engine starting in below-zero temperatures, yet would lose viscosity so slowly as it warmed up that at operating temperature it would still retain enough viscosity to carry normal piston-ring and bearing loads.

The alternatives were unattractive. Military aircraft operators diluted their engine oil with gasoline before shut-down, enough that the engine could still be turned by the starter the following morning even without the use of pre-heater. The gasoline would then boil out of the oil and be lost out the breather. (Can you imagine the purple faces at EPA if such a practice existed today?) Or imagine keeping the stand-by engine full of oil thin enough for starting, then once warmed-up, switching it to a separate oil system containing the heavier oil required for hot operation. If that switch-over was not performed at the right temperature, the thin starting oil would thin to a watery viscosity that would lead straight to major engine damage—spun bearings, scored or seized pistons. Experienced crews, yes. Recruits, wishing they were anywhere else on earth but here on the tundra? Maybe.

Ground crew starting a WWII aircraft in frigid cold temperatures.

Multi-grade Oil Development

Presently, a special oil having an extremely high VI was developed specifically to allow rapid, safe cold-starting of Diesel engines in the far north. It was probably a military secret at the time. At cold-soak temperature, the oil remained fluid enough to flow to the oil pump (rather than cavitate—be pulled apart by pump suction, interrupting or stopping lubricant flow altogether). But as that oil warmed up, the rolled-up-in-a-ball shape of the cold molecules would gradually unroll, supplying added viscosity to partly cancel the normal loss of viscosity with rising temperature.

Beginning in the 1950s, multi-grade oils for major markets became available, using the same effect but provided mainly by an additive, rather than as an inherent property of the oil molecules themselves. The additives were called "VI-improvers' and they were long-chain molecules of polymers such as methyl methacrylate (aka 'Plexiglas') that could be dissolved in the base stock of the oil. When you see a multigrade rating such as 10W-30, what that means is that the oil at zero degrees F behaves as a 10 at that temperature, but at 210F behaves as a 30 grade. This doesn't mean that the oil gains viscosity as it warms up—merely that it loses viscosity less quickly than a single grade oil like the straight 30, long the standard in lawnmower engines. (Multi-grade not necessary, because who mows the lawn in winter?)

Yet when the very highest degree of VI was required, both effects might be necessary – the use of shape-changing oil molecules *and* a shape-changing additive.

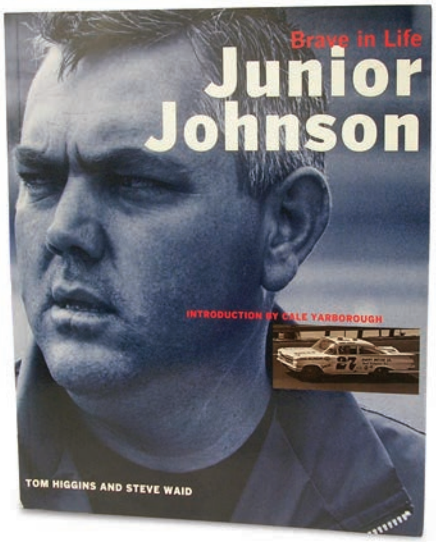
Creatures of Routine

This brings us to the special requirement spelled out in Cummins CGI 6.7-liter Owner's Manuals for a special *synthetic* 5W-40 oil for below-zero operation. We humans are creatures of routine, making it easy to overlook such callouts. Yeah, yeah, something about the oil. It'll be okay. Oil is oil.

No, potentially not okay. What if, in very cold weather, your engine's oil system is still filled with warm weather oil that was not originally developed to enable instant cold-starting of DEW-Line Diesel gen-sets? Physics trumps inattention. If the cold-thickened normal oil cavitates in the suction line to the oil pump, your engine may start and run with zero oil pressure – because the oil is too thick to flow to the pump.

The Second Problem

Many years ago famed stock-car racer and builder Junior Johnson decided there was too much oil flying around in his race engines, making life difficult for low-pressure oil scraper rings, and taking energy from the whirling crankshaft and turning it into excessive oil temperature. What if, he wondered, I could close up bearing clearances? Could I still support the loads with the thinner oil I'd have to use? Then there would be less oil flying about, causing troubles (and robbing horsepower).



This book about Junior Johnson give us insight about NASCASR racing before it became entertainment.

He consulted experts and found the problem had already been addressed for the very large piston aircraft engines produced by the hundred thousands during WW II. Their problem was the large volume of scarce aviation gasoline required to break such engines in. The industry switched to pre-lapped piston rings (adopted by Detroit in the late 1980s) and crankshaft journals that were not merely shiny (like a shoe polished by a fast-moving cloth) but truly cylindrical, lacking the usual waviness caused by small local variations in hardness. Research revealed the average height of crank journal surface irregularities (asperities), and also the normal minimum oil film thickness in the loaded zones of plain bearings. When the asperity height became equal to the minimum oil film thickness, surface contact (and possible failure) would begin. Johnson now needed to get his race crank journals made truly cylindrical by the wartime process known as "Chrysler Superfinish." Trouble was, no one in the US was doing it. The US auto industry was going great guns making "good enough" cars, so who cared about some obscure wartime weirdness?

Junior Johnson did, and he found a German firm that could supply his needs. Now he could tighten crank journal clearances and was able to greatly reduce the volume of "flying oil" in his engines.

The idea spread quickly once vehicle manufacturers felt the EPA's hot breath, urging them to reduce engine friction loss and fuel consumption. In the early '90s we began to hear of such oils as 5W-15 and even 0W-15.

Formula One, as usual, was ahead of everyone. What if, they reasoned, we want to run X (some tiny bearing clearance, suitable for the watery, low-loss oil we want to run in our 20,000-rpm V-10 race engines)? As the engine cools after operation, the aluminum cylinder block, having a much higher thermal coefficient of expansion (roughly three times as much), will contract more as it cools than does the steel crankshaft. Oh my goodness, my little calculator tells me that at room temperature, the bearing clearance will completely disappear. That means we can't start the engine without immediate oil starvation (can you pump oil into zero clearance?) and seizure.

But there is a way. Here comes a mechanic, pulling behind him a tower-like structure on little casters. He uncoils a couple of hoses and connects them to the race car's engine, then plugs the tower into the electrical main. With a slight hum, a circulator pump begins moving engine coolant through the heater in the tower. The row of techs at the team's "launch control" (the monitoring station for telemetered data from the car) will presently report that "we have temperature," and the flunky returns, removing the heater and its connections. The engine has been expanded by pre-heating just enough to have proper bearing clearances, and it can now be safely started. ***Editor's note: Sounds kinda like the WWII aircraft engines. Slightly different problem. Same solution, a pre-heater.***

Formula 1 racing engines are preheated before starting them.

Relevance to Your Engine?

What is the relevance to your 2019-2020 Cummins 6.7 CGI engine? In our era, finer and finer crank journal surface finishes ("low asperity height") have been introduced to allow cutting friction by use of lower-viscosity engine oils. The 15W-40 oil that *was* correct for engines manufactured in the past is no longer optimum for more recently built units with finer journal finishes. If you feed them 15W-40 rather than the new warm-weather call-out of 10W-30, you are paying for the extra fuel to overcome the higher viscosity oil's slightly greater bearing friction. If you leave the "summer" oil in, and not go with the recommended 5W-40 synthetic in the winter, you're asking for too much wear due to lack of circulation at start-up.

I've told this complicated back story in hope that you will find the reasons for different oil call-outs as interesting as I do, and will act on the information.

Kevin Cameron
TDR Writer

DIESEL SCR SERVICE/ REGENERATION

ISSUE 112 – TECHNICAL TOPICS

Introduction
by Robert Patton

For this article, let's take a trip back to your teenage years and the Chemistry 101 class you had to endure. (I'm still struggling with the three stages of matter: gas, liquid and solid. Okay, got it: steam, water, and ice. Now, back to the chemistry lesson.)

If you will think about an internal combustion engine as a big chemical reaction, perhaps you can better understand the use of the exhaust aftertreatment system and its components to clean up the fire from the ignition of the diesel fuel.

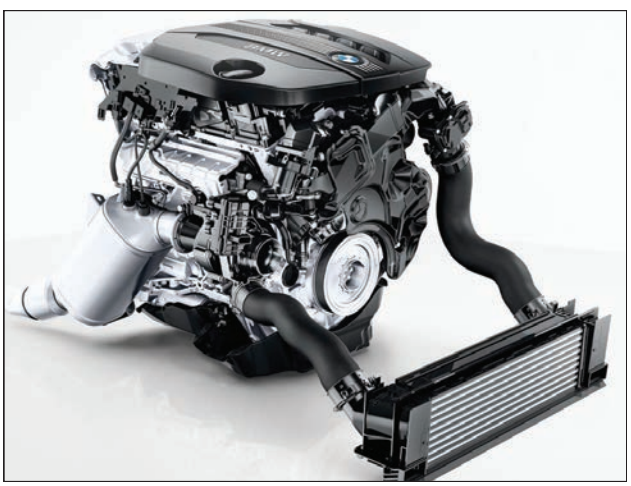
The chemist can list all of the elements, add the heat from combustion and relist the elements from the exhaust. However, as mentioned, Chemistry was a challenge and I was lost in the fancy chemical equations.

So, for me, some help in simplifying the terms used in diesel exhaust aftertreatment was needed.

To the rescue, Tracy Martin. Last year Tracy wrote an article on "Diesel SCR Service" for Motor Age magazine. I contacted him and asked if he could make a few tweaks and then it would be Ram/Cummins specific. I thought his easy-to-comprehend writing style would fit the TDR audience well. Here is his report.

DIESEL SCR SERVICE

by Tracy Martin



This 2010 BMW 5 Series 3.0L six-cylinder, twin-turbo diesel engine is required to have a selective catalytic reduction (SCR) system to control NO_x emissions. The 3.0L outputs 425 lb-ft. of torque and 265 hp plus returns EPA mileage of 19 mpg city and 26 highway thanks in part to SCR technology. Courtesy BMW of North America

Dirty Diesels

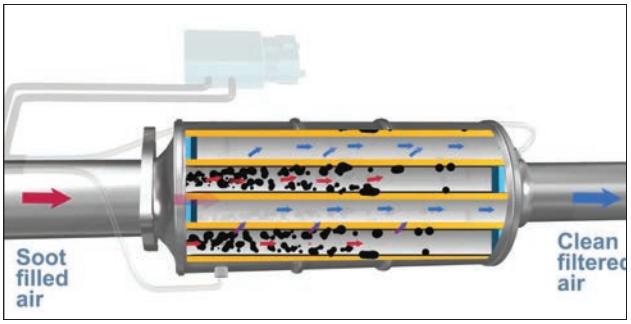
The use of diesel power for light trucks in the US is on the rise. As more Americans drive larger SUVs and pickup trucks the demand for diesel engines has increased due to their reliability, fuel efficiency and lower cost of operation. In 2018 sales reached an annual level of three percent of total vehicles, higher than hybrid and electrical automobiles. The largest group of vehicles that use diesel engines are pickup trucks like Ford's F150/F250; Chevy/GMC trucks and of course Dodge RAM 1500 series, with the 3.0L EcoDiesel and 2500/3500 series with the 6.7L Cummins Turbo Diesel engines. Over the last three years buyers of light trucks have checked the diesel engine option enough to grow diesel usage 35 percent. Even diesel sales for cars and SUVs have shown growth of 2.4% in 2018, increasing to 7.6% in 2020.

The Diesel is More Efficient

Diesel engines are more fuel-efficient than gasoline engines because diesel fuel contains about 10% to 15% more heat energy. This energy advantage translates to 20% to 30% more miles per gallon than a similar sized vehicle powered by gasoline. Unlike conventional gasoline engines, where power is controlled by the air/fuel mixture, diesel engine power is directly controlled by the fuel supply. This creates very lean mixtures of 25:1 or higher even at full power. The lean-burning nature of diesel engines comes at a price because lean mixtures produce high combustion temperatures that result in significant production of nitrogen oxides or NO_x. With no emission controls diesel engines produce 20 times more NO_x than a gasoline engine of the same size.

Similar to gasoline engines, diesel engines use exhaust gas recirculation (EGR) to reduce NO_x. EGR works by recirculating a portion of the exhaust gas into combustion chambers. This inert gas dilutes the oxygen in the incoming air stream and absorbs combustion heat, reducing peak temperatures. Lower combustion chamber temperatures facilitated by EGR reduce the amount of NO_x in the exhaust.

The downside of EGR diesel applications is that engine performance and fuel efficiency are decreased. In addition, EGR gases cause engine oil to become contaminated rapidly, resulting in more frequent oil changes. Because EGR reduces the amount of fuel burned during the power stroke, particulate matter (PM) or soot is increased. In fact, the very design of a diesel engine causes a conflict in chemical factors between PM and NO_x. When the engine is operating most efficiently for power, minimal PM is produced but NO_x levels are high. When exhaust gas is recirculated back into the intake manifold through the EGR system, NO_x is reduced but the PM levels are high.



Hot exhaust gases enter the DPF and are allowed to pass through the filter. The filter media collects the soot, or particulates and traps them. Periodically the filter has to be regenerated to burn off the soot and clean the filter media.

The Diesel Particulate Filter

Diesel exhaust soot is reduced by the use of a diesel particulate filter (DPF) that captures and intermittently burns off about 90% of PM. Because there is limited space to locate a DPF in a vehicle their physical size can only be so large, and depending on engine operating conditions, they can quickly accumulate a considerable volume of soot and restrict exhaust flow, drastically affecting engine performance.

DPF systems have to provide a way of removing the particulates from the filter to restore its capacity and lower exhaust backpressure. This process is known as filter regeneration, and depending on driving conditions can be either passive or active. Regeneration takes place continuously as the vehicle is driven. Typically, regeneration is triggered when the backpressure in the DPF reaches a predetermined level and the vehicle is operated for a time period long enough to burn off the particulates. Initiated by the vehicle's PCM, continuous regeneration should be "invisible" to the driver.

DPFs use thermal regeneration where the collected soot particulates are oxidized or burned. The DPF is heated and oxygen/nitrogen (air) is added causing the soot to burn transforming it to carbon dioxide or CO_2. The DPF must reach a high enough temperature (1100 degrees Fahrenheit) to oxidize the soot particles. This type of regeneration is passive and takes place continuously during normal operation of the engine where the soot oxidation temperature can be reached by using the engine's exhaust gas alone. Since the conditions that allow for passive regeneration don't always occur during everyday driving, the PCM initiates active regeneration to periodically burn off particulates that have accumulated in the filter. During active regeneration, commonly referred to as "reburn" or "regen", diesel fuel is introduced into the exhaust stream by an injection event occurring late in the power stroke and/or through the exhaust stroke.

NO_x Reduction via SCR

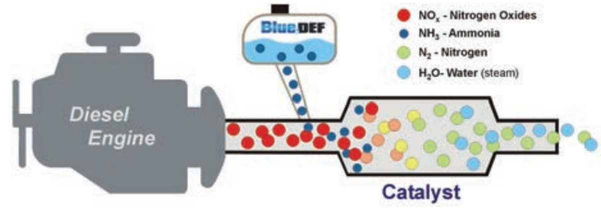


Figure 1. Diesel engines are fuel efficient because they operate on very lean mixtures that produce high levels of NO_x. This output is reduced when NO_x molecules in the exhaust are mixed with ammonia from the diesel emission fluid (DEF) tank and converted into nitrogen and water in the SCR catalyst.

Removal of NOx Using SCR

The very nature of the operating principals of a diesel engine make the removal of NO_x a challenge as EGR alone does not reduce it enough to meet 2010 and later emission standards. The only method to remove NO_x gases from diesel exhaust without affecting engine performance is to treat the exhaust. Selective catalytic reduction (SCR) is an exhaust system emissions control technology that converts NO_x into nitrogen, water and carbon dioxide—all components of the air we breathe (figure 1). SCR technology reduces NO_x by 90% through use of a catalytic where the NO_x is oxidized and converted into other elements. It is called "selective" because it reduces levels of NO_x using ammonia as a reductant within a catalyst system. The word "reductant" is a scientific term used to state that a compound (NO_x in this case) chemically changes into other compounds like nitrogen and water inside an SCR catalyst.

History of SCR

SCR technology has been used for decades in stationary diesel generator sets and in marine vessels like cargo ships, ferries and tugboats. SCR for NO_x reduction was used for coal-fired generation of electricity as early as 1975 in Japan and 1994 in the U.S. SCR has been applied to heavy-duty diesel engines in the United States and Europe since 2007. In 2010 the Environmental Protection Agency (EPA) required the reduction of NO_x in diesel-powered light trucks and automobiles to the extent that only vehicles equipped with SCR technology could pass the new emission standards.

All DEF containers should have this American Petroleum Institute (API) label that certifies the quality of the DEF fluid. DEF can be purchased at auto parts stores, Walmart, truck stops and some convenience stores. Courtesy American Petroleum Institute

SCR in Diesel Applications/DEF is Required

To reduce NO_x the SCR system injects ammonia into the engine's exhaust. Diesel exhaust fluid (DEF) provides ammonia used in the SCR process. DEF is made up of urea and deionized water. Urea is a waste product found in the urine of animals. Automotive grade urea is synthetically produced and has been in use as an inexpensive form of nitrogen fertilizer for many years. Deionized water has most minerals removed such as sodium, calcium, iron, copper and other elements. The ratio of urea to water in DEF is 32.5% urea and 67.5% deionized water. DEF is available at auto parts stores and truck stops and comes in a variety of containers including bulk, bottles or jugs. The American Petroleum Institute (API) rigorously tests DEF to ensure that it meets industry-wide quality standards and their certification label appears on all approved DEF containers.

In addition to reducing NO_x emissions, SCR simultaneously reduces HC and CO by 50 to 90 percent and PM emissions by 30 to 50 percent. In some applications where SCR and PM filters are combined, fuel efficiency has increased from three to five percent. While SCR has a positive effect on exhaust from diesel engines and increased fuel economy, it does have some downsides. SCR system components, including the DEF tank, tank heater, DEF injector, level sensor, temp sensors, NO_x sensors and the SCR catalyst all add cost to the vehicle. And like any other system, SCR components have to be maintained and/or repaired.

SCR in Action

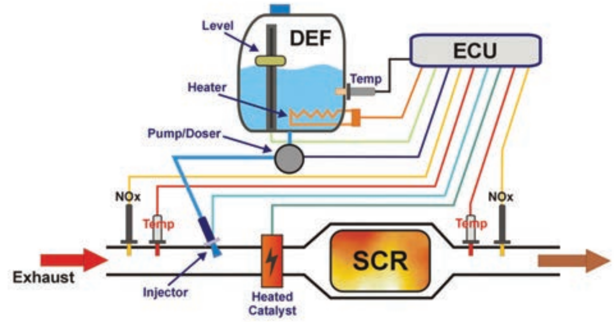


Figure 2. Upstream NOx sensor data is used by the ECU to determine how much DEF to inject into the exhaust. The downstream NOx sensor checks that NOx levels have been reduced after the SCR catalyst. The temp sensor in the DEF tank provides the ECU with information about DEF aging and when to turn on the tank heater.

Figure 2 shows a generic SCR system and how the ECU controls its operation. Not all the components in this graphic are found on all vehicles. Starting with the DEF tank, the fluid level sensor inside the tank provides information to the ECU, or dashboard DEF gauge (if equipped), regarding how much DEF is available.

The tank temperature sensor input signals the ECU to turn on the heater to keep DEF fluid from freezing. The heating element can be electrical or engine coolant based. Another function of the DEF tank temperature sensor is to help the ECU determine the service life of DEF. When in-tank temperatures are above 104° F, DEF ages/expires in only two months.

This Fluid-o-Tech gear pump provides a precise, high pressure source of urea for diesel SCR systems in passenger cars and light trucks. The Italian company is a major global OEM supplier for automotive emission control equipment. Courtesy Fluid-o-Tech

The pump, or doser valve, provides pressurized fluid to the DEF injector that sprays DEF into the exhaust. On some systems the injector is also heated electrically or with engine coolant (not shown in graphic). There are two NO_x sensors with the upstream sensor indicating the level of NO_x in the exhaust. This sensor input allows the ECU to determine how much DEF to inject. The downstream NO_x sensor measures the efficiency of the SCR catalyst. The upstream exhaust temperature sensor tells the ECU when the exhaust is hot enough for SCR operation and when to activate the heated catalyst (if equipped). The downstream temp sensor measures SCR catalyst efficiency.

BlueDEF Diesel Exhaust Fluid is formulated to meet the stringent requirements of the American Petroleum Institute (API). The company also offers reusable DEF dispensing systems for fleet, retail and commercial applications that provide significant savings over single-use containers. Courtesy PEAK BlueDEF

DEF and Vehicle Owners

Unlike other emission-related systems on diesel vehicles, SCR requires that the vehicle's owner do something to keep it operational—ensure that the DEF tank doesn't run dry. Dealerships and independent repair shops know all too well that it's a mixed bag when it comes down to drivers reading the section in their owners' manual about keeping the DEF tank from running low or out of fluid. On most vehicles, DEF range in miles corresponds with engine oil change intervals—usually around 7500 miles. The logic of this design is to have the DEF tank filled (5 gallons for a 2017 6.7L) when changing engine oil. However, this doesn't always work out and many owners overlook filling the DEF tank as part of an oil and filter service.

SCR systems don't kid around when it comes to low or no DEF fluid. A low level will result in messages sent to the driver via warning lights or text on the vehicle's digital display. There is no standard among OEMs regarding DEF warnings. On some vehicles, the digital display "Service Vehicle" menu may have a "DEF refill in XXX miles" function that informs owners when to add DEF. In addition, OEMs provide a variety of progressive warnings regarding decreasing DEF levels. A low DEF warning, and/or instrument panel light may display around 1500 miles. Other messages may include a text warning "No engine restarts possible soon. Fill DEF tank" and "Distance to NO ENGINE RESTART 100 miles." Once the "No Engine Starts Possible" warning is displayed the vehicle must to be driven to a location where DEF can be added to the tank before the engine is turned off.

If the engine is turned off, the ECU will prevent a restart. Owners that carry a 2.5-gallon jug of DEF may think that it is enough to get the engine restarted but, no—the fun is just beginning as many SCR systems require the DEF tank to be <u>completely full</u> before allowing engine starting .If the vehicle is driven until the DEF tank is dry, the ECU puts the engine into limp-in mode limiting vehicle speed. For example, 6.7-liter trucks may display a warning that states: "5 mph Max Speed in 100 mi, Service DEF System, See Dealer." Even if the distance to the nearest truck stop to buy DEF is only a few miles it will be a long trip. Limp-in mode and no engine restarts are mandated by the EPA and shows how serious they are about uncontrolled NO_x spewing from diesel exhaust.

Common SCR System Problems

The Bosch Automotive Service Solutions OTC 3095 tester simplifies DEF testing. By placing a drop of DEF on the tool's sensor the percent of urea is displayed. The tool can also measure the freeze point in degrees F of windshield washer fluid. The OTC 3095 retails for $579. Courtesy Bosch Automotive Service Solutions

An often overlooked component of SCR systems is DEF fluid. Automotive-grade urea like BlueDEF, AdBlue and other brands are API-certified to contain 32.5% urea and 67.5% deionized water. When faced with a "DEF Contaminated" code or scan tool message it's a good idea to find out what is in the DEF tank. Owners have been known to put other liquids into DEF tanks including: Dex Cool antifreeze, diesel fuel, distilled water, tap water, expired/old DEF and even human urine. Some SCR systems have a DEF quality sensor or use ECU software to indirectly determine DEF quality. For example, the ECU activates the DEF injector to spray fluid into the exhaust. The downstream NO_x sensor reports that NO_x levels are too high, the ECU injects more DEF into the exhaust but NO_x levels don't drop causing a DEF contamination code or "Exhaust Fluid Quality Poor" message to be displayed.

The Bosch Automotive Service Solutions OTC 5025 DEF tester is similar to refractometer tools used to test coolant. After placing a drop of DEF on the tool's prism, the user points the tool toward a bright light and looks through the eyepiece. By adjusting the focus ring, the reticle scale will indicate the percent of DEF to water. The OTC 5095 retails for around $100. Courtesy Bosch Automotive Service Solutions

DEF Testing

DEF testing should be done first when diagnosing DEF-related trouble codes. There are a number of DEF testers available including optical and electronic. A DEF refractometer is an optical tool that uses light to determine the percentage of urea contained in DEF fluid. These tools read the percentage of urea in 0.5% increments. Any reading other than 32.5% is a good indication that the DEF is contaminated, too old, or not present in the tank. It's a waste of a technician's time to chase down multiple SCR-related DTCs if DEF is contaminated. If it is, drain the tank, clean it, purge the lines and injector, then refill with fresh DEF.

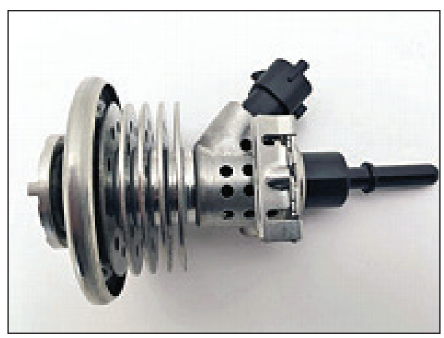
DEF fluid is unique among automotive products in that it has a shelf life. This is not the norm and technicians would not consider using a three, or more year-old container of engine oil, coolant, power steering fluid, brake fluid (unopened) or other automotive liquids as something to be concerned about. Every container of DEF has a date code, aka "Born-On-Date" or "Sell-by-Date." A typical code of "GA153590089" can be read where: GA is the plant that made the DEF; 15 is the year of manufacturing plus 1 year (this batch was made in 2014 + one year = 15); 359 is the day of the year (365 - 359 = 6 so this batch was made on the 6th day of the year, or January 6, 2014) and 0089 is the batch code. Confusing...you bet.

Repair shops need to consider the environment where they store DEF. When stored at temperatures above 95º F, DEF shelf life is shortened to six months and above 104º F to two months. Some customers want to be prepared in case they run low on DEF while on the road, so they keep a container in the trunk or inside the cab of their pickup truck. This is not a good idea as these locations can reach temperatures of over 140º F on a hot summer day. By the time they need the DEF it will be way past its shelf life due to the high storage temperatures. The BlueDEF spec sheet states that "The shelf life of DEF is directly related to the temperature at which it is stored. Storage temperature between 12º and 86º F are recommended to maintain optimal shelf life of up to two years. If BlueDEF freezes, its efficacy will not be affected upon thawing."

This Bosch Automotive Solutions NO_x sensor and controller are integrated as one part. Because NO_x sensors can't differentiate between NO_x readings and ammonia in DEF fluid, a malfunction in the SCR system could set a code for a faulty NO_x sensor. To read true NO_x sensor values, put the system into regen (cleans out any ammonia in CAT) so scan tool values for NO_x will be accurate. Symptoms of a bad NO_x sensor are increased fuel consumption and/or rough idle quality. Courtesy Bosch Automotive Service Solutions

DEF Trouble Codes

Most SCR systems don't require an undue amount of service but there are some common things that can go wrong. There are around 100 OBD-II SCR-related trouble codes and using a scan tool to diagnose SCR problems is to say the least, helpful. Not listed in any particular order are some basic, common SCR issues provided by the SCM Hotline, a company that for over 25 years has offered automotive diagnostic support to professional technicians. The most common issues are: DEF tank/injector heater failures, blocked or restricted DEF lines, DEF injector plugged and contaminated or expired DEF fluid.



Bosch Automotive Solutions DEF injectors are mounted on the exhaust inlet pipe just ahead of the SCR catalyst. Notice the heat fins that cool off the injector's electrical components. Courtesy Bosch Automotive Service Solutions

The following are some common SCR trouble codes:

DTC P20EF is defined as, "SCR NO_x Pre-Catalyst Efficiency Below Threshold." When the DEF tank is refilled, the SCR Catalyst Efficiency monitor is triggered. After the monitor is complete, and SCR function is normal, the monitor continues to calculate the cumulative efficiency of the SCR system. Each subsequent value for cumulative efficiency is included in two filtering routines, one for short term efficiency and the other for long term efficiency. If the difference between the two filtered efficiencies becomes greater than a pre-set threshold, the P20EF fault is set. Common problems that set a P20EF are DEF contamination, DEF injection failure, faulty NO_x sensor(s) and SCR catalyst failure.

Some other common codes are: DTCs P249D and/or P249E for "Poor DEF", incorrect DEF fluid, expired fluid and too sensitive recalibration; P208E for DEF heater electrical connectors; P20EE, P204F or P207F codes for wrong DEF fluid and incorrect urea amount; P204F, reductant filter, plugged DEF line or DEF injector and P208A, Redundant DEF Pump "A" Control Circuit Open.

DEF and Diesel Fuel Mix-ups

Despite the fact that the diesel fuel and DEF filler caps are different colors, sizes and are clearly marked "Diesel" and "Diesel Exhaust Fluid" owners can, and do mix up what goes into each tank. The wrong liquid in either the DEF or diesel fuel tank can cost thousands of dollars in repair bills.

One would think that putting fuel or DEF in the wrong tank would be difficult to do. The filler caps are clearly marked "Diesel" and "Diesel Exhaust Fluid" and are different colors and sizes. Still with these safeguards owners manage to add DEF to the Diesel fuel tank and vice versa. Either scenario results in huge problems and costly repairs.

What happens if diesel is put into the DEF tank? SCR systems have built in warnings to detect non-DEF substances. The ECU will signal the driver with a warning and/or code of impending SCR interruption if non-DEF is detected. If contaminated, the DEF tank should be drained and thoroughly cleaned with deionized water before refilling. Because diesel fuel is less dense than DEF it will float on top of the DEF but eventually make its way into the exhaust system. If diesel fuel enters the catalyst it may be damaged to the extent that replacement is the only option. SCR catalysts can cost upwards of $1000 plus labor.

Worse by far than diesel in the DEF tank is the opposite. The mistake of putting DEF into the fuel tank can cause rough idle, excessive exhaust smoke, low power, engine knocking, fuel rail pressure slow-to-build or no engine start. If these symptoms weren't bad enough, DEF in the fuel tank can cost hundreds to thousands of dollars to repair. Because DEF is corrosive it can cause steel lines to rust, fuel injectors to stick open and high-pressure injection pump failure. The DEF fluid crystallizes and can cause irreparable harm to components that use metals like carbon steel, brass, aluminum, copper, magnesium, nickel and zinc.

If the owner realizes that they added DEF to the fuel tank, and didn't start the engine, or turned the ignition key on, they could have their vehicle towed to a repair shop. In this case, the fuel tank needs to be drained and cleaned. If the key was turned on, the low-pressure side of the diesel fuel system will have to be cleaned as well. If the engine was started, DEF will be in the high-pressure side of the fuel system. The injectors may need to be removed and cleaned along with all fuel lines; fuel pump flushed and cleaned; fuel filters replaced and the fuel/water separator replaced. Worst case scenario is when the engine has been operated for some time with DEF present in the fuel tank. The corrosive DEF can damage beyond repair high-pressure fuel injection components. Depending on the vehicle's age and mileage, these types of expensive repairs could exceed its blue-book value.

If you work on your own truck, use of a scan tool to verify SCR system operation and/or to read fault codes is a good practice. Don't forget to perform a visual inspection of SCR system components looking for loose electrical connectors and blocked or leaking DEF lines. There is the possibility that the DEF fluid is expired so testing fluid quality will help to reduce issues on the road. Remember not to store DEF fluid in the cab of your truck and if you haven't already—read the section in your owner's manual about DEF fluid. This will provide you with information like what warning messages to expect when DEF fluid is low. If you know someone that is new to diesel engine ownership, help them out with some up-front advice about their SCR system and how to keep it operational and trouble-free.

Tracy Martin
TDR Writer

TDR RELATED ARTICLES

Editor's note: Here are some other articles about SCR/ DEF:

Issue 109, pages 106-109, "DEF and Your 2013-2020 Trucks": Stan Gozzi discusses trying to trick the system with distilled water. Robert Patton does an easy-to-follow pictorial on the simple task of removing and cleaning (hot water) the DEF injector.

Issue 108, pages 22-27, "Doug Leno Buys a New Turbo Diesel – Part II": Doug discusses the serious EVIC message, "Speed Limited to 5mph in 24 miles. Refill DEF." He refills the DEF tank.

Issue 102, pages 104-106, "2013-Current DEF Systems": Stan Gozzi gives the audience an overview of the system, discusses DEF "myths" and provides parts/warranty data that shows the system is not overwhelmed with parts being used in repairs. He suggests if you have a problem do this simple repair: remove the DEF injector, clean with hot water and replace the injector.

SIDEBAR – ARTICLES
by Robert Patton

INCORRECT DEF DETECTED

Often it is interesting how things come together.
In this case, I wish I did not have anything to report. However, as this magazine was coming together, the message "Incorrect DEF Detected, See Dealer" appeared on my 2014 EcoDiesel's electronic vehicle information center (EVIC) display.

From Tracy's overview and the millions of miles that TDR members have collectively travelled since its wide-spread use by Ram in 2013, the system has proven to be good.

However, the EVIC message "Incorrect DEF Detected, See Dealer" note accompanied by the "Truck will not restart in XXX miles message" will put the fear of a lighter wallet and "oops, I'm going to be stranded" into your psyche. Wow: expensive and stranded. Maybe we could start a new TV reality show?

Seriously, in my seven years/80,000 miles of ownership with the 2014 Ram 1500 EcoDiesel I have had this message happen twice. Both times the EVIC message was accompanied by a diagnostic trouble code "P20EE, SCR NOx Catalyst Efficiency Below Threshold."

The First Encounter

My first encounter with P20EE was in June 2016 when the truck was two-years old and the mileage was 32,000. The problem was corrected at no charge. Recall notice R69 and factory service bulletin 18-064-15 instructed the dealer to replace the following parts:

- 68263790AB NOx Converter Catalyst (now 68329871AA)
- Associated gaskets

This repair was performed at no charge. However, the catalyst has a price of $707 in the Mopar system.

The Second Encounter

I was travelling east on Interstate 40 and this flatlander encountered the western North Carolina mountains. With the change in terrain, the number of interstate super-service filling stations became fewer and farther between. The "Add DEF Fluid in XXX miles" continued to count down. Not by choice, I made it to this point inthe countdown. "Truck will not restart in 10 miles." Ouch!

I finally found a small convenience store that offered diesel fuel and DEF-in-the-box. Add fuel, add 2.5 gallons from the box: Everything should be good. Twenty miles down the road…now we come to the second encounter of "Incorrect DEF Detected, See Dealer." The "you dummy dinger" rang and the messages appeared on the EVIC.

Thoughts raced through my mind. Okay, maybe the repair would be covered under the EcoDiesel settlement's extended warranty or, perhaps, the extended warranty plan I had purchased from FCA. Either way, I was not in the mindset to find out.

Wait, perhaps it was my fault. Was the DEF-in-the-box of the type that had expired? I checked the date, it had been on the shelf for 90 days.

Then the EVIC added further anxiety to the situation: "Truck will not restart in 200 miles." Really. I had a stop to make that was 120 miles away and then a 200 mile trip to my home. I guessed that I was good-to-go. I could finish the trip with one shut off for an overnight stay at my daughter's house and then directly to my house. Or should I go directly to my local dealer? This was not fun.

The overnight stay gave me some time to do some research. Immediately I did a search on the message "Incorrect DEF Detected, See Dealer" message. Who would have guessed it would lead me to the TDR's website where I posted this same observation back in 2016. Back then, as I noted, the message was accompanied with the P20EE code. I used my EDGE monitor to retrieve the active DTCs. Yep, there it was again. P20EE. I cleared the code. I did more research. I tried to get a good night's sleep.

The next day the truck was started and the "you dummy dinger" initiated its countdown: no restart in 100 miles. I kept wondering, if the "incorrect DEF fluid was detected," what would it hurt to fill the DEF tank? The auto parts store was a convenient stop so I added two more boxes/five gallons, total fill was now 7.5. The capacity of the DEF tank on the EcoDiesel is 8 gallons. This trick didn't seem to work. Back out on the highway, "80 miles to no start."

Travelling on the interstate I had nothing better to do than to overthink the problem. Did running the truck so low on DEF cause a problem with the catalyst (you dummy)? Did running so low cause a clog in the injector (you dummy)? Did I have an initial 2.5 gallon bad batch of DEF (you dummy)? Would the new 5 gallons slosh/mix with the existing 2.5 gallons to make an "acceptable" concentration?

I had nothing to lose, I pulled over at an exit, downloaded the DTCs from the EDGE monitor (same ole P20EE) and cleared the code.

And the problem went away. Really.

The Rest of the Story

TechAuthority offers the dealer network so much data. We are fortunate at Geno's Garage to have access to some of the information. For code P20EE I took a look at the Theory of Operation; When Monitored and Set Conditions, Default Actions; Possible Causes; and Diagnostic Test.

To save a reprint of 8 pages, the Possible Causes troubleshooting tree told the story.

Possible Causes

- Other SCR, reductant, or NOx DTCs present
- Exhaust system leak
- DEF contamination or leak
- DEF supply line restriction
- SCR catalyst
- DEF injector
- DEF supply pump
- Damaged diesel particulate filter (DPF)
- NOx sensors

And what it didn't list as a possible cause: DEF too low to be injected (you dummy)/out of DEF.

In hindsight, I had a conversation with one of my service technician friends. We talked about the Issue 111 article "The Big Picture: EPA and CARB and we, again, reflected on the Cummins 6.7-liter engine that was introduced on 1/1/2007, three years prior to the emissions guidelines that were to be enacted on1/1/2010. Ram and Cummins met the emissions legislation without using the SCR/DEF technology. There was pressure from government regulators for the other OEMs to adopt the non-SCR/DEF aftertreatment. After all, how would "jurisdiction" over an empty DEF tank be controlled by the government?

Now you know. If you run out of fluid/use an incorrect fluid, "the truck will not restart in XXX miles."

Yet, when I added the first 2.5 gallons the gauge was no longer empty. So, back to the Troubleshooting Guide and this bit of commentary that is found later in the text:

Perform the SCR Healing Procedure

- Verify that the DEF tank is between 25% to 85% full.
- Turn key off
- Operate vehicle briefly
- Turn engine off, ignition on
- Using scan tool: "Perform DEF Tank Reset"

In hindsight, I somehow got the "reset" procedure done correctly. Again, the code has not reappeared (you dummy).

Conclusion

I was lucky, I did-not have to go to the dealership for the reset. Yes, I avoided that scheduling inconvenience and the "what's this going to cost" anxiety was eliminated. So, word to the wise (Cummins or EcoDiesel) don't run your DEF tank to the close-to-empty level.

EXHAUST SYSTEM REGENERATION – HOW OFTEN
by Robert Patton

Often it is interesting how things come together.

Two days after Tracy Martin had submitted his "Technical Topics" story, "Diesel SCR Service," I noticed an article on the internet titled "Here is My Ram HD Cummins Regen Schedule" written by Andre Smirnov at www.tfltruck.com (the fast lane). The story tracked regeneration of the diesel particulate filter (DPF) on a 2019 Ram/Cummins (power rated 370/850) and compared it to a 2020 Ford/Powerstroke (power rated 475/1050).

Regeneration Data on '13 - Current Trucks

Here are excerpts from Andre Smirnov's report:
"Here is a 'regen report' from Rod that documents his experience with a Ram/Cummins and the exhaust system (DPF) regeneration. Rod initially sent us his regen report for his newer Ford/Power Stroke.

"Before I get to the report, here is a little background about what the regeneration cycle is. The diesel particulate filter is a part of the exhaust system and it is designed to catch some of the unburned particulates in the exhaust stream. This filter accumulates these particulates and it must be cleaned to provide better exhaust flow and performance. The regeneration cycle takes care of this by injecting additional diesel fuel, heating up the exhaust system and the DPF to 1,000° or more, and burning the particulates out of the filter. (TDR Editor's note: Think self-cleaning oven.)

"The Ram report showed the truck was driven 14,475 miles while Rod was monitoring the exhaust regen cycles. The truck went through 14 regen cycles over that period. This is an average of once every 1033 miles. (Each cycle was an average of 17.5 miles.)

"The Ford would go into the exhaust regen mode once every 497.5 miles. Each regen lasted for about 16.25 miles."

TDR Editor's conclusion: The Ram went a little more than twice the distance between regeneration events. And, it looks like an "event" takes, say, 15-20 miles, just like the Ford.

Twice the Distance: An Observation

I have to wonder the reason that the Ram/Cummins truck has the big "twice the distance" advantage. So, I posed the question to one of my engineering buddies. For now, the explanation(s) for the Ram/Cummins edge in performance:

The Ford has a higher horsepower and torque rating. 475/1050 versus the Cummins at 370/850. Gee, with an approximately 25% power advantage, would you not expect a 25% greater need for regeneration? Counterpoint: Was that extra horsepower and torque "used" in the driving cycle comparisons?

The Ford engine simply makes more particulate matter and the DPF needs cleaning more often.

The Ford's DPF is smaller and, therefore, needs cleaning more often.

The answer is, likely, some combination of these three factors.

Been There, Done That – My Regeneration Data on the '07.5-'12 Trucks

Now, let's go one step further. I mentioned that it is interesting to see how things come together. Andre's look at regeneration events also coincided with my review of TDR Issue 72 that I would use to write my "10 Back" column. Therein was a feature article "6.7-Liter Engine Report for 2007.5-2011 Engines." A little later, Issue 78, we did a complete look back at the '07.5-'12 Cummins 6.7-liter engine with its nitrogen adsorber catalyst (NAC) hardware that was used to reduce NOx emissions.

The 2013-and-newer engines use the selective catalyst reduction (SCR)/diesel exhaust fluid (DEF) to control NOx, and that system was the basis for Tracy's article.

But, regardless of the technology used to address NOx (the '07.5-'12 NAC hardware and the use of diesel fuel to create a "rich" condition to chemically change the suspended NOx into more benign gasses) or the SCR/DEF "dosing" for a chemical reaction ('13-'18 and '19-current), all of these engines have the regeneration (self-cleaning oven) of the diesel particulate filter (DPF) by heating the exhaust system with an injection/squirt of diesel fuel after the combustion event.

So, clearly, the systems are a bit different in their use of diesel fuel. The '07.5-'12 system would create a rich condition for a "NAC reaction" as well as fuel for a DPF regeneration. I have found that exhaust gas temperatures fluctuated more often in my data from the Issue 72 article.

My (Crude) Test

In my test, I used an Edge Monitor to track higher-than-normal exhaust gas temperature. The data was easy to gather because the topography was flat interstate, speed at 75mph, and no trailer or load in the bed. I traveled two times for a total of 1700 miles. When the temperature rose beyond a 1000° threshold I would note the number of miles driven and I would reset the truck's "mpg" monitor. Then I would watch for the temperature to drop back to 800° or less. Afterward, I would wait for the next increase in temperature.

Crude, yes. But, back in the day the exaggerated "internet criers" were telling everyone that the exhaust aftertreatment system was detrimental to the tune of 5 miles-per-gallon. A crude test was better than no test.

The results: Unlike Andre's report with an average of one *DPF* regeneration every 1033 miles for about 15-20 miles, the '07.5-'12 system would put extra fuel into the exhaust every 200 miles for about a 20 mile period. The unknown in this scenario: Was the fuel used for the chemical reaction in the nitrogen adsorber catalyst (NAC) or was it a part of cleaning the DPF? Or both?

Now, a recap of the dollars-and-cents cost of the higher exhaust gas temperature "events" that I noted.

Off		On		
1560 miles	+	187 miles	=	1747 total miles
16.15 average mpg		13.2 average mpg		
96.6 gallons		14.16 gallons		110.76 total gallons

If the 1747 trip was made without any fuel for regeneration:
1747 ÷ 16.15mpg = 108.2 total gallons

Gallons used in "regeneration" fuel: 2.56

Cost of fuel at $3 (x 2.56 gallons) $7.68 per 1747 miles

2.56 fuel used in regeneration = 2.36% penalty
108.2 total gallons (ideal)

Crude, yes.

A 5mpg difference in mpg? Nope, that number was absurd.

A 5% difference in mpg? Nope, the number was 2.36%.

So, there you have it, a number ($7.68) that reflects the NAC reaction event and regeneration cost per 1747 miles.

COMPARISON '07.5-'12 NAC VERSUS '13-CURRENT SCR

Can we make a comparison?

If you will accept more unscientific data, I'll try a comparison:

In my '07.5-'12 scenario (using my 2010 Ram 2500 truck), the NAC cost of regeneration for 1700 miles was $7.68 in additional diesel fuel used to accomplish the regeneration events.

Andre's truck had one regeneration event (for 20 miles) every 1033 miles. For the sake of simplicity let's assume this would be 1.7 events in a 1700 mile journey, therefore 34 miles of driving at a lower miles-per-gallon. Unknown: How did the regen affect mpg. I could not tell from Andre's report.

Again, for simplicity, assume he was getting 17mpg "off" and, like the NAC data, a 3mpg penalty when "on": 14mpg. So, for the 34 mile cycle it would have used 2.43 gallons versus the ideal 2.0 gallons.

Diesel fuel penalty: .43 gallons @$3 = $1.29

And now, the estimated DEF that would be used in the 1700 mile trip (DEF use is calculated at 2% of diesel fuel used in 1700 miles / 17mpg = 100 x .02 = 2 gallons).

Penalty: 2 gallons @ $3* = $6

Total SCR system cost per 1700 miles: $7.29

*$3 is the price for DEF at most truck stop fuel islands. Obviously, it is twice that amount when purchased in the 2.5 gallon jugs as many TDR members choose to do.

Conclusion: It looks like the cost of fuel and DEF for the SCR system is approximately the same as the diesel fuel only that was used in the NAC system. The simplicity of the NAC system (no worries about the DEF fluid, its shelf-life, its miles-to-not-start) is to be envied.

However, and this is a big "however," the simplicity of the '07.5-'12 NAC system is not without a drawback. Please see the sidebar "Don't let the facts get in the way of a good story."

ANOTHER SIDEBAR

DON'T LET THE FACTS GET IN THE WAY OF A GOOD STORY – A NOTE TO '07.5-'12 OWNERS

Crude.

That was the word that I used to describe the regeneration observations of my 2010 Ram/Cummins. If you will recall, I observed higher-than-normal exhaust gas temperature readings for about 20 miles in a *200-mile* driving cycle during a collective 1700-mile trip. This is far different than the documented test of the 2020 Ram/Cummins with data showing a regeneration event that would last 15-20 miles and occur once in a *1033-mile* cycle.

An observation versus a documented event: Did my truck really go into a DPF regeneration every 200 miles?

Perhaps yes, perhaps no.

You have to remember how the nitrogen adsorber catalyst (NAC)functions within the '07.5-'12 exhaust system. Without going into the technical chemical reaction (again, chemistry, not the best subject in my younger years), let's see if we can give you a further understanding of the NAC's role in cleaning up the air.

The Fireside Chat

Remember from long ago our "fireside chat" and the teeter-totter relationships between the primary concerns of diesel exhaust, particulate matter (PM) and nitrogen oxide (NOx). With a startup fire (a rich condition), smoke/soot (PM) is high and heat (NOx) is low. With a raging hot fire (a lean condition), NOx is high and smoke/soot (PM) is minimized.

In the '07.5-'12 aftertreatment system the nitrogen adsorbers, which are incorporated into the catalyst washcoat, chemically bind nitrogen oxides during the engine's lean, high temperature operation. After the adsorber capacity is saturated, the system is regenerated during a period of rich engine operation, and the released NOx is catalytically reduced to nitrogen.

Got it. Hot fire = NOx is bound to the washcoat. Not so hot fire, a rich condition is created to release the NOx into benign gases.

The Bottom Line

And, now, the point of all this rambling: Those "rich" conditions are precipitated by fuel that is injected after the combustion event. In my zeal to do a cost of regeneration comparison between the two Cummins aftertreatment systems, the *crude* cost numbers (and *crude* observations) have no way to account for the "rich" fuel used to regenerate or clean the NAC's adsorber.

Anecdotally, I've had many '13-current owners tell me that, like-truck to like-truck, their newer Ram was/is better than the older Ram. How much? Maybe 3 to 5% better mpg.

As a further footnote to the '07-'12 system, we really have to take a trip back to its '07.5 introduction. The engine was three years early in meeting the EPA's upcoming 2010 standards, standards that would force the manufacturers to make a huge financial bet on how to control the NOx emission. Would they try to control the NOx by trying to lower in-cylinder temperatures with additional exhaust gas recirculation (Navistar)? Would the OEM adopt the NAC technology used by Ram/Cummins in their '07-'12 pickup trucks? Would the OEM add the SCR/DEF systems to the truck (pickups to big rigs) and hope the diesel exhaust fluid would find its way into the marketplace with some sort of packaging or an additional pump at the fuel island? Or, like Caterpillar, would they simply stop making big-rig truck engines?

Added to this situation was the ever changing pressure from government regulators. At first, they pushed the OEMs to adopt the non-SCR/DEF route. Then, overnight, it was okay to use SCR/DEF. This governmental flip-flop (and ultimately control) is seen every time the DEF tank gets low on your truck: "Fill tank in xxx miles or the engine will not restart."

No doubt Ram/Cummins earned a governmental feather-in-their-cap with the '07.5 engine's early introduction.

Oops, as election cycles go, give it four years and the government official that was appeased by the Ram/Cummins early adoption is no longer on the job.

Now, 14 years later, we can look back and say that the "feather" was not without its trials in the market. The '07.5-'12 trucks didn't require hardware changes, but, software reflashes...Back in the day it seemed that those were an every-other-month ordeal.

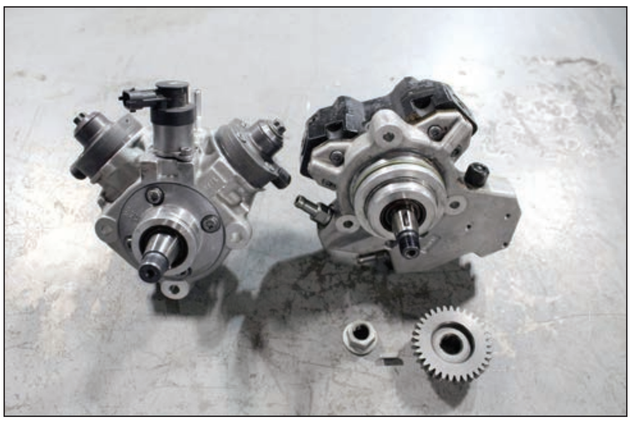
So, don't let these '07.5-'12 facts get in the way of a good story. Right?

Again, to accentuate the positive, those '07.5-'12 Turbo Diesel owners don't have to fill-up and/or worry about DEF.

BOSCH FUEL INJECTION PUMPS

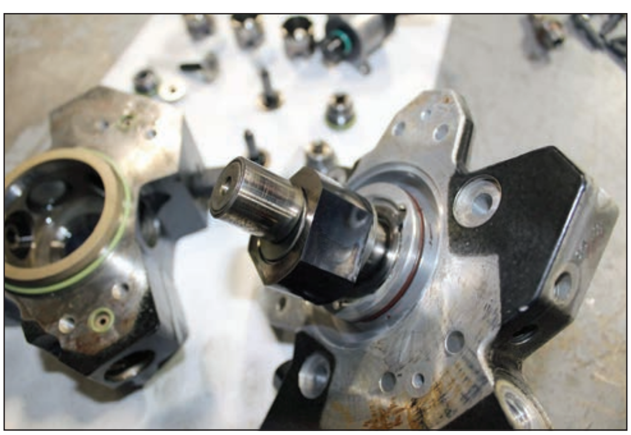
ISSUE 106 – THE REST OF THE STORY

Finally, let's take a look at the Bosch CP4-2 fuel pump that is on the new 2019 Ram 6.7 CGI engine. Even before the truck was released, some were saying they would never purchase one because it no longer had a Bosch CP3, and, to a lesser extent, because it now had a scissor gear driving the camshaft. We all know the CP3 fuel injection pump (models 2003-2018) has proven to be a reliable pump, and failures are rarely from some internal defect. Most CP3 pumps I know that have failed were taken out by some other concern, most notably fuel contamination. So, at this year's May Madness, I brought along a CP3 and CP4-2 and we disassembled them both for the TDR members to see for themselves if they thought there was any concern about a 2019 engine.



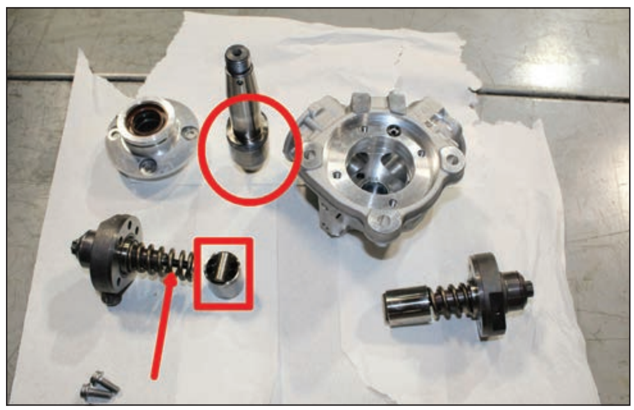
CP4-2 on the left, CP3 on the right. Notice the entire housing on the CP4-2 is aluminum, but the two cylinder heads and pumping pistons and cylinders are steel. The front cover of the CP3 is aluminum, while the rear housing, pumping cylinders, and pumping pistons are steel.

The most obvious difference between the two is the CP3 uses a triangular flat cam and piston to pressurize the fuel and the CP4-2 uses a round lobe cam and a roller piston similar to a roller cam in an engine.



Close-up of CP3 flat tappet camshaft.

CP3 follower pistons (arrow) and pumping piston (rectangle). Notice the small diameter of the pumping piston that creates high pressure but low volume of fuel.



CP4-2 cam lobes (circle), roller follower piston (square), and pumping piston with cylinder head (arrow). Looking inside the return spring you can see how small the actual pumping piston is compared to the roller follower piston. Also note the pumping piston and cylinder head are steel, same as the CP3.

The other major difference is that the pumping housing and cylinder in the CP3 is ferrous and the CP4-2 is aluminum. There is an obvious weight difference between the two, one of the reasons Cummins was able to shave 60 pounds off the weight of the new engine. When I looked late last year at the pricing between a 2018 CP3 and a 2017 CP4-2 used on the EcoDiesel, there was a significant price difference between the two. Now that I can see actual pricing on the 2019 6.7 CGI parts, the CP4-2 used on the 6.7 CGI engine is $6260, a long way from the $717 price for the 2017 EcoDiesel CP4-2 pump. The injectors are also considerably higher at $2465 each. All the more reason to keep the fuel filters changed on your new truck. It amazes me when you see someone post they found a deal online on some aftermarket filter instead of just purchasing an OEM filter from Geno's Garage, Mopar or Cummins.

When you see the two pumps apart they are amazingly simple. They perform the same task using similar theory of pistons, check valves, inlet controlled fuel pressure, but they do it in slightly different ways. Only time will tell what the reliability of the new pump will be, but based on what the Cummins engineers showed and told us at the CMEP tour, I would not be concerned.

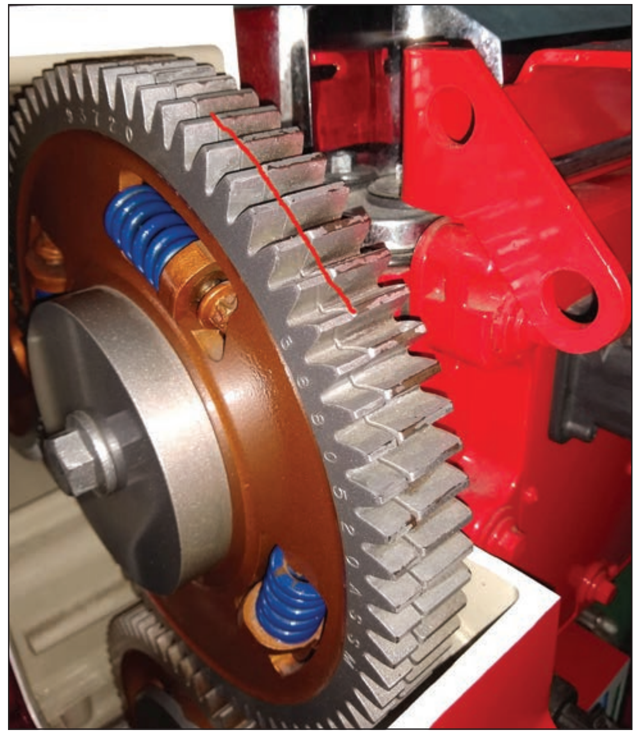
The photo captions point out the differences better than I can describe them. You don't have the same advantage as you do in person, but I think you are still able to draw some of your own conclusions that the design itself of the CP4-2 appears to be simple and effective. FCA is still on the hook for warranty coverage up to 100k miles, and they do not want to pay for repairs any more than a customer would. I would still caution that you maintain filters (and records) at least as often as the owner's manual indicates to minimize any concerns about failures.

Editor's note: On September 13, at the TDR's website, front page news, I posted an article from Diesel Army's Artie Maupin that discussed a lawsuit directed at General Motors for selling 6.6-liter Duramax engines (vintage 2011-2016) with "faulty fuel injection systems." This vintage engine uses a Bosch fuel pump known as the "CP4."

The lawsuit contends that the injection system was not designed for US specification diesel fuel (ultra low sulfur diesel, USLD). The lawsuit cites the USLD as having less lubricity and, thus, internal wear problems.

Perhaps now more is known. Yet, if you want insight to the GM problem and an intelligent discussion on the CP4, log onto our website and search backward to 9/13/19.

Okay, so what is there to discuss about the scissor cam drive gear, a gear that is similar to the one Duramax engines have used for years? That part is another concern some have had about the new 2019 6.7 CGI engine. As I mentioned, we were in Columbus on Saturday when Cummins was holding their employee open house. I was going through one of the tents of display engines when I spotted a 1997 Cummins Signature 600 engine. It is a 14.8-liter dual overhead cam, that was later renamed the ISX series. I hope these last two photos puts to rest the chatter about all that new technology.



Not sure why anyone would be concerned about a scissor gear. It is such a simple design. You can see the gear is actually a thicker gear with a thinner gear on the front side, spring loaded against each other to eliminate backlash. The larger gear half still takes the majority of the load. If you look at the red line, you can see where the gear is split.

Stan Gozzi
TDR Writer

STICK TO THE SUBJECT

ISSUE 112 – THE REST OF THE STORY

by Stan Gozzi

Attorneys

For this issue the editor asked us to stick with the subject: What we have done to our trucks lately? Similar to the last couple issues, I have not driven it much in the last year. Mostly because I have not worked many days doing the Lemon Law inspections because the courts were shut down for so long. It has started to open back up, but most of my inspections are scheduled and then cancelled at the last minute. One thing that has not seemed to slow down is the number of attorney billboards and other media advertising promising to get your money back for your lemon. The easy access of information from social media, forums, and watchdog groups has resulted in attorneys having a list of "defects" for every manufacturer that they advertise to get your business. If you have one or more of the problems listed, you're in luck, especially in California where that "luck" results in a payday for the law firm in the form of tens of thousands, to hundreds of thousands of dollars in fees (above and beyond the repurchase of the vehicle) that are paid by the manufacturer under California law. But, as we all know, those fees are promptly passed on to you and me when we purchase another product from that manufacturer. Just one of the reasons a new loaded Dually from any of the big three can be more than $100,000.

Lawsuits

Many of you are already aware of class action lawsuits against GM, Ford, and FCA for their use of the Bosch CP4 pumps in various models starting in 2011. The GM and Ford litigation was briefly discussed in Issue 107, page 57. The FCA suit is for the 3.0 EcoDiesel, not the 2019-2020 Cummins 6.7 CGI Cummins Turbo Diesel.

What is interesting is that in my many dealership visits I rarely see an EcoDiesel in for a high-pressure pump failure. Engine failures seem to be more frequent than fuel system failures, especially at high miles. To date I have run across very few 6.7 CGI Cummins Turbo Diesel failures. I did a little bit of research on the current lawsuits and found them strikingly similar, even though they were filed by different law firms. The underlying theme of all three is that the Bosch CP4 pumps were designed for European spec fuel and, because of the Ultra-Low Sulphur Diesel (USLD) fuel specification required in the US, the pumps fail from a lack of lubricity in the fuel. All three suits list evidence (remember, just because a suit alleges something, it is not true until a court finds the evidence to be true) that US fuel suppliers are not consistent in their fuel supply, and many times the fuel purchased by a consumer does not meet the minimum American Petroleum Institute (API) standard. In a previous TDR magazine the editor dude talked about API specifications and the inability of the diesel community (OEMs, fuel suppliers, fuel retailers, customer groups) to agree to a set of criteria for a "premium" diesel fuel offering. In the meantime, he noted that there is an existing API standard for lubricity. Unfortunately, the burden falls on the manufacturer, not the fuel supplier or the government regulators requiring a standard be met. None of these suits have been settled so we are not really sure if any of the allegations are true. But, what can the TDR audience do in the meantime to ensure a CP4 equipped truck does not experience a catastrophic failure we know can happen? Keep reading!

STICK TO THE SUBJECT: CUMMINS 2019-2020 ENGINES

There has been a lot of discussion about the 2019-2020 6.7 CGI Cummins Turbo Diesel trucks that were equipped with the Bosch CP4 fuel injection pump. A few people have "the sky is falling" attitude, while most others are not concerned at all about the new for Cummins pump choice. When we were in Columbus for the Cummins 100th anniversary celebration in 2019, we were told by the engineers that the reason for the change was to reach the higher fuel pressures required for stricter emissions. This sounded reasonable, but as I have told my students and many of you at technical sessions during May Madness events, manufactures generally make changes for one of three things: emissions, fuel economy, or cost. I have to think that Cummins and Ram engineers were looking at all three. If you look at TDR issue 111, pages 34-39 the editor dude did a nice job of relating the experiences of former Chrysler engineer Steve Albu from an article in Hagerty Drivers Club written by Editor-at-Large, Aaron Robinson reminding us the tightrope auto manufacturers must walk when it comes to emissions regulations. The laws are essentially forced on them, and it then falls on the manufacturer to make a technology work, or pay the price.

CP4 Preventive Maintenance

Back to the question for the TDR audience that own the 2019-2020 6.7CGI engine: What preventive measures/ best defense can you do?

1. DO NOT RUN THE TRUCK OUT OF FUEL! Yes, I'm yelling at you. Lack of fuel (no lubricity at all) can lead to certain disaster? Data is trending in that direction.

2. Keep the pump cool. Any engineer will tell you that as temperatures go up, lubrication is even more important to keep metal parts from scuffing. Try NOT to continually run the fuel tank near to empty before filling it. The more fuel in the tank, the cooler the fuel will be, and the cooler the CP4 fuel pump will run.

3. Lubricity. This is much talked about, and many of us just run clean #2 diesel. If you have a '19-'20 CGI 6.7 Turbo Diesel engine in your truck it can't hurt to add one of the commercially available lubricity additives to every tank. Just a little insurance to stack the odds in your favor.

4. Keep the fuel filters changed. Just like any other HPCR system, clean fuel is a must. Do your part and change the fuel filters at least every 15,000 miles. From my last filter change (Issue 111, page 107) you can see that the engine mounted fuel filter looked brand new at 15,000 miles. But I will continue to change the filters, regardless of what they look like, at the specified interval.

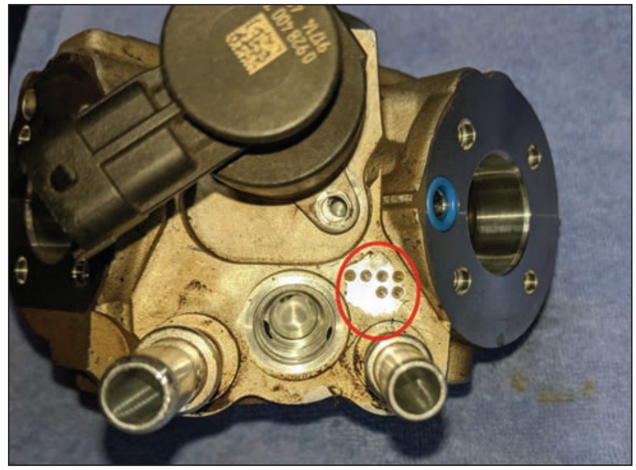
5. Keep the water out. Do yourself a favor and drain the filters once in a while. See the hoses I added (TDR Issue 111, page 107-108) to my truck to keep the mess down, and to easily capture a sample to check for water in the system.

As I pointed out in TDR Issue 106, page 111, only time will tell if the Bosch CP4 pump will prove reliable. It seems to have proven to be reliable in the EcoDiesel based on my unscientific dealer survey, but since Cummins has decided to switch back to the Bosch CP3 pump in late December 2020, it appears they believe it might be better for their customers to use the very reliable "old" pump.

All 2021 trucks are now shipping with a CP3 pump installed. A rumor floating around the internet is that a retrofit is coming for 2019-2020 trucks equipped with CP4 pumps, but I can find no credible evidence of that happening.

CP4 Examination

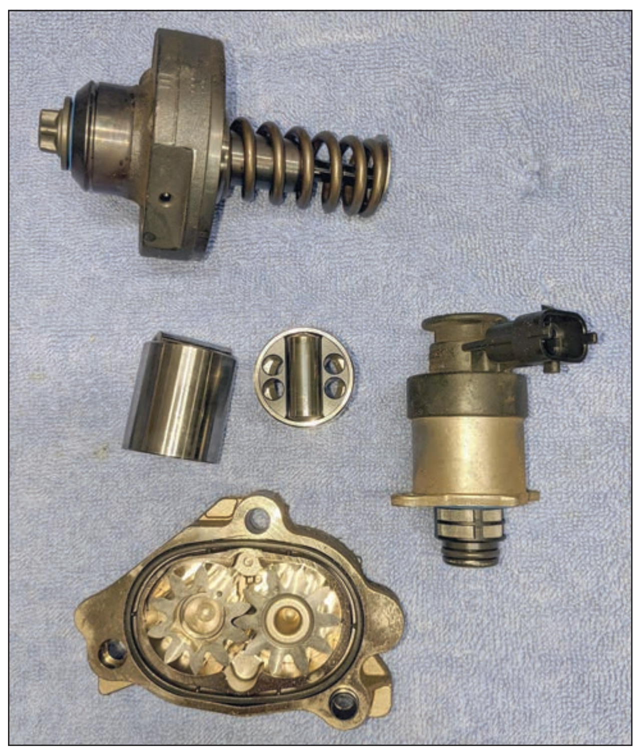
I was at a northern California dealer in December picking up some donation parts for the college when they asked me if I wanted a 6.7 CGI Cummins Turbo Diesel CP4 pump they had replaced. I figured this would be my chance to see for myself what kind of failure was happening, so of course I took it. When I got home, I promptly started taking it apart to check out the problem. The first thing I took notice of was it was one of the old style pumps as identified by the six drilled spots on the pump housing.



The multiple drilled dots indicate the original design pump. The revised design from TSB 18-060-20 REV. A will have a single drilled dot in this same location. The number of dots on the old style pump is not significant, just that any pump with more than a single dot is not the latest style.

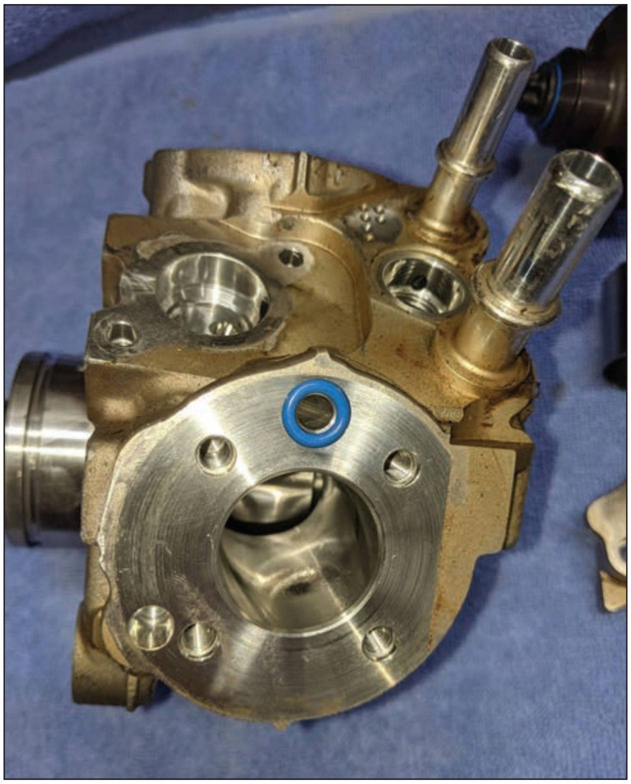
The Tear Down

As soon as I pulled the fuel control actuator, I noticed it was perfectly clean, but it smelled of gasoline. I kept a sample of the "fuel" from inside the pump, and tried another unscientific test. I put some on the bench and tried to light it. If you have ever tried to light diesel fuel, it is very difficult to do when not on a porous surface. The fuel from this pump caught fire quite easily. This appeared to confirm the pump was replaced because it was contaminated with gasoline.

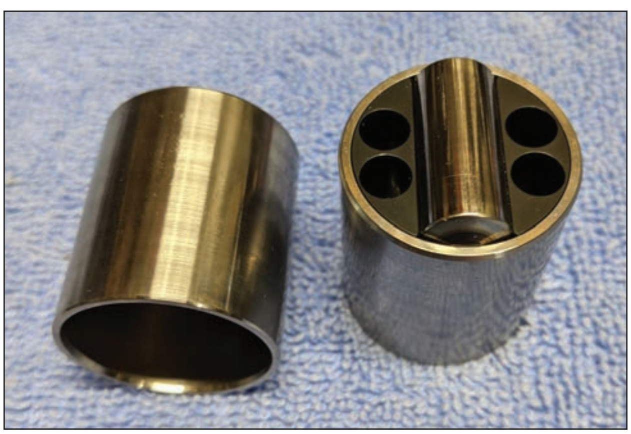


You can see that there is no metal debris present, especially on the screen on the fuel control actuator where you will first notice metal debris when the pump is coming apart.

I continued to disassemble it and as you can see from the photos it was in perfect condition. I do not know how long the truck ran with gasoline mixed with the fuel, or the concentration, but it did not seem to harm this pump, which is alleged to be so easily damaged from lack of lubricity. I will leave it to you to draw a conclusion about the design of the Bosch CP4 pump but, personally, if I had one, I would follow the suggestions above and just drive it.



The cylinders showed no abnormal wear or scoring.



The pistons and rollers show no abnormal wear from lack of lubrication.

The Rest of the Story:
I'm Sticking to the Subject, My Truck

I almost forgot a few changes I've made to my 2018 Turbo Diesel 3500 truck. I picked up a new set of tires for it at the end of the year. But, have yet to install them as I have a couple thousand miles of wear left on the OEM Firestone TRANSFORCE AT tires. I should be able to get about 35,000 miles out of them. The rears really wore on the 5,000-mile Columbus trip in 2019, so if I would have noticed the wear and rotated them during the trip, I probably could have got a few thousand more miles out of them. I have to say they were just an okay tire, as I was plagued with high-speed vibrations until the second wheel balance at my tire retailer, Road Force. And even that never completely solved the vibrations. The vibrations didn't occur until about 70-75 mph, so I was never bothered too much after the Road Force balance.

The new tires are a set of BF Goodrich All Terrain TA KO2s. If things pick up a little with the consulting, I may have them mounted and provide a report for Issue 113.

The truck is also sporting a new Coverking custom car cover from Costco.com. They were on sale again in December for $129 so I picked up a new one for the Dakota and the Ram, and finally one for the Neon. They really keep the vehicles clean, and tend to last about three years on average. Their customer service and warranty are excellent and even the regular $149 price can't be beat for a custom fit cover.

The new Coverking custom cover for Stan's 2018.

TECHNICAL SERVICE BULLETINS FOR 2020

ISSUE 110-113 – TDRESOURCE

Hello TDR Members:

Well, it is that time of year again, time to dust-off the credit card and go shopping at Chrysler's TechAuthority website to do the TDR's annual summary of technical service bulletins that have been released for our trucks during the past year.

"So, Mister Editor, how was your search for data this year?"

Good and not-so-good.

Good

Let me start my review with the positive.

- Service bulletins and recalls: the data is there and you can search on your VIN to find only the bulletins that are applicable to your truck—even if it is a 1993 truck!
- Service information: Hidden in this "file folder" is an electronic copy of the factory service manual (FSM). If you had the patience, a printer, and 1000+ pages of paper, you could print the entire book for your truck.
- Ditto specifications for the truck. I was *very* surprised to see that the 2014 EcoDiesel specifications call for the 5W40 synthetic engine oil that meets the CJ-4 specification (see page 47 for the discussion). My TechAuthority search was done on 8/15 and the TSB talking about the change (TSB 18-078-16) was dated 7/27/16. Talk about up to date!
- Wiring diagrams: I mentioned the FSM is buried in the "service information" folder. The truck's wiring diagrams are also found in a folder, "wiring diagrams."
- Owner's Manuals: Just as in the above discussion about service information, one could load the printer with paper and print the entire contents. As an aside, the EcoDiesel lube oil was also updated to the CJ-4 specification in the OM section of TechAuthority. Impressive.
- Parts books: Yes, you can pretend you are the counter person at your local dealership, you have complete access to the parts book for your truck.

Not-So-Good

If you've never used the TechAuthority web site, well, even the purchase of a subscription can be awkward. Again, my wife can tell you that I do a very good job of internet purchasing, but the hidden-in-the-corner "Log In" icon and the complicated check out process are sometimes frustrating.

Also, this year as in year's past I was armed with a handful of VINs and I used those vehicle numbers to access the bulletins that were released in 2016. Remind me next year, this is not the efficient way to search for data. The tried-and-true VIN search only uncovered about 14 TSBs. Wow, the truck is solid, not much to be updated or corrected at the dealer/owner level?

I don't know if this is a new feature, but on the front home page is a tab "What's New in Service Bulletins/Recalls." So, your do-it-the-hard-way editor clicked on this tab.

Oops, the Chrysler folks *have* been busy. The printed index was 36 pages in length and about 400+ in number. As I sifted through these I came across 55 that related to our trucks. So much for my thought of "not much to be updated."

Next Year

As you read, the above discussion about the tab "What's New in Service Bulletins/Recalls" changed the way in which I did my search for data. The "What's New" is so much more efficient.

This will prompt a change in the quarter of the year that our annual review takes place. I will move the review to early December rather than the early September date that we've used for the previous 20+ years. So, look for next year's summary to be in Issue 99.

Strange Billing

Again this year the credit card statement came and there was a strange entry: "SOI*SBS KENOSHA 888-371-8300 WI." I pull out Issue 90 and verified that this was the same third party billing as occurred last year. Perhaps next year the strange entry will not surprise me.

2019 AND 2020
TECHNICAL SERVICE BULLETINS (TSB) REVIEW

by Robert Patton

It has been a busy 18 months.

That's my story and I'm sticking to it.

Truthfully, our last look at factory-issued, technical service bulletins (TSBs) was 18 months ago in our Issue 103 magazine, pages 68-69. That summary covered the final quarter of 2018.

During that time we had a big open house event at Cummins; we celebrated Cummins' 100th anniversary; and we have had multiple articles on Cummins history. You'll note that our Ram/Dodge and Cummins history lesson continues in our "Take You Back" feature on pages 32-33. And, very coincidentally, the folks at Ram have vaulted to third place in the JD Power, Initial Quality Survey (see pages 70-71).

Therefore, lucky for me and you, the TSBs have been fewer in number.

So, what has been published? Time to get busy with the credit card to purchase access to the TSBs. The use of my hi-liter will help us summarize the information.

Seriously, the folks at Mopar's TechAuthority allow you to view their TSBs from the current calendar year to date. Using the prompt "What's New in Service Bulletins/ Recalls" gives me an opportunity to share these TSB and Recall updates with you. I signed up for a one-day visit ($25), logged on, printed bulletins, and did the following summary pages for you. This summary listing builds on the research presented in your previous TDR magazines. Issue 103 had information up to 1/1/19.

Throughout our summary pages, you'll see truck model codes listed for the various Ram trucks. The following is a chart of the model code meanings.

Series	'15	'16	'17	'18	'19	'20
1500 Pickup	DS	DS	DS	DS	DT	DT
2500 Pickup	DJ	DJ	DJ	DJ	DJ	DJ
3500 Pickup	D2	D2	D2	D2	D2	D2
3500 C/C	DD	DD	DD	DD	DD	DD
4500 C/C	DP	DP	DP	DP	DP	DP
5500 C/C	DP	DP	DP	DP	DP	DP

In an effort to organize the TSBs for the magazine, we're going to use the same index categories as those used by Chrysler. Below are the index categories:

2 Front Suspension	14 Fuel
3 Axle/Driveline	16 Propeller Shafts and U-Joints
5 Brakes	18 Vehicle Performance
6 Clutch	19 Steering
7 Cooling	21 Transmission
8 Electrical	22 Wheels and Tires
9 Engine	23 Body
11 Exhaust	24 Air Conditioning
13 Frame and Bumpers	25 Emissions Control
	26 Miscellaneous

A note concerning the TSBs and their use: The bulletins are intended to provide dealers with the latest repair information. Often the TSB is specific to the VIN. VIN data on the Chrysler service network helps the dealer in his service efforts. A TSB *is not* an implied warranty.

If you need a complete copy of the bulletin, you can contact your dealer with this magazine in hand. Or, armed with your truck's vehicle identification number (VIN) and a credit card, you can log onto www.techauthority.com and, for $25, you can view/print *all* of the TSBs that apply specifically to your vehicle. The $25 buys you one-day access. (Be ready with some time on your hands and a big stack of copy paper if you search your VIN. You do have to sift through a lot of data to hone in on your truck.)

HERE WE GO – PRESENTING THE 2020 TSBs

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Final note: Scattered throughout the bulletin summaries are some of my comments in bold text. Hey the TDR is supposed to enter-tain, right?

CATEGORY 3 DIFFERENTIAL AND DRIVELINE

TSB#	MODEL	SUBJECT/DESCRIPTION
03-001-20 5/9/20	'16-'18 DD/DJ/D2	*Rear Axle Vibration, Shudder or Chatter* This bulletin applies to vehicles equipped with an Anti-Spin Differential Rear Axle (Sales Code DSA). The customer may describe the following: A chatter, shudder, or vibration from the rear axle during turns. This may happen more as the vehicle ages, especially if the vehicle is used extensively for towing or hauling heavy loads. The cause of the concern may be due to degradation of the rear axle fluid. If you experience a vehicle with the above condition, please perform the proper maintenance procedures for the rear axle and replace the fluid first before replacing any hardware components. The repair involves changing the rear axle lube to address the chatter, shudder or vibratIon.

CATEGORY 8 ELECTRICAL

TSB#	MODEL	SUBJECT/DESCRIPTION
08-003-19 8/29/19	'19 DD/DP/DJ/D2	*Radio and Back-up Camera Enhancements* This bulletin applies to vehicles equipped with one of the following radios: • Uconnect 3 with 5" display • Uconnect 4 with 8.4" display • Uconnect 4 with 7" display Customers may experience one or more of the following problems: • Green horizontal lines on backup display, in reverse • Ghost touch, features, modes and app's changing without drivers input • Speaker pop noise when using Bluetooth device • When vehicle is first started, the radio will reset and the time display shows 12:00 • Audio distortion and volume fluctuation • Ring tone too loud • AM/FM volume fluctuates • While in CarPlay or Android Auto, Google maps showing wrong location • Phone disconnected after first call • Black screen or white screen with vertical lines • Audio static while in SXM/SAT modes • Echo heard during Bluetooth phone calls • The radio is locked up • The radio remains on after ignition has been turned off • The radio resets • The radio screen turns black • Intermittently requires an anti-theft code to be entered The repair procedure involves a flash drive update to the radio.
08-016-19 Rev. C 4/17/19	'18 DS/D2/DJ/ DD/DP	*UAS, UAQ, UCS and UCQ Radio Enhancements* This bulletin applies to all vehicles built before August 7, 2018 equipped with the following radios: • Uconnect 4C Nav with 8.4" display • Uconnect 4C with 8.4" display Customers may experience one or more of the following: • Audio Distortion (DS, D2, DP, DD, DF and DJ vehicle with UAS radio) • Menu bar at the bottom of the radio display is frozen • Cannot change the time on the clock • Anti-theft code request message • Backup camera screen is blank • Lines appear across screen • Radio control screen is blank or locked • Radio resets intermittently • Unable to adjust volume • Radio will not switch modes between AM, FM, SAT or Media The repair procedure involves updating the radio with the latest available software.

TSB#	MODEL	SUBJECT/DESCRIPTION
08-030-19 4/31/19	’15 DS/D2/DJ/ DP/DD	*Flash: Instrument Panel Cluster (IPC) Updates* This bulletin applies to vehicles equipped with one of the following: • (JA1) Instrument Cluster • (JA3) Instrument Cluster • (JA4) Instrument Cluster • JA6) Electroluminescent Instrument Cluster • (JAT) Instrument Cluster • (JAJ) Rebel Instrument Cluster • (JAX) Laramie Longhorn Instrument Cluster • (JAV) Laramie Limited Cluster Customers may also comment on one or more of the following problems: • Fuel tank will not fill past 24-27 gallons • Cruise set speed is different from actual vehicle speed • The IPC backlighting flickers at times • Engine hours will randomly reset. • Low fuel warning is triggered when Distance To Empty (DTE) is below or equal to 50 miles The repair procedure involves updating the instrument panel cluster with the latest available software.
08-034-19 5/3/19	’19 DJ/D2	*Flash: Active Noise Cancellation (ANC) Module Enhancements* This bulletin applies to vehicles built on or before April 12, 2019, equipped with Active Noise Control System (JLW) and 6 Speakers. The customer may describe the following: Hearing a booming, humming, muffled or pulsing noise inside the cabin. The issue can be reproduced while the vehicle is in motion by loading the rear seat with equipment/passengers, while coasting down and covering the rear speakers. Rolling the driver/passenger windows down should disable the ANC system, hence disabling the booming sound. Rolling the windows up will automatically enable the booming sound. The repair procedure involves an update to the ANC module to the latest software programming.
08-041-19 Rev. A 8/1/19	’19 DJ/D2	*Flash: Air Suspension Control Module (ASCM) Updates* Customers may experience a malfuntion indicator lamp(MIL) illumination. Upon further investigation the technician may find that one or more of the following trouble codes have been set: • C220C-48 – Active Suspension Module Internal-Supervision Software Failure • C211B-92 – Ignition Run/Start Input-Performance or Incorrect Operation • C156C-7A – Ride Height system Air Leak-Fluid Leak or Seal Failure The repair procedure involves an update flash to the ASCM to the latest software programming.
08-115-19 Rev. A 11/20,19	’19 DD/D2/DJ/DP	*Enable Tire Fill Alert* This bulletin applies to vehicles built on or after June 6, 2019, and on or before August 5, 2019, equipped with Tire Fill Alert (Sales Code LAW) and Selectable Tire Fill Alert (Sales Code LA5). The cusomer may notice that the tire fill alert or selectable tire fill alert does not work. The repair procedure involves a series of inflate/deflate operations to the tires and an update to the “Tire Fill Alert” feature.
08-121-19 12/6/19	’19 DD/DP	*Power Take Off (PTO) is Inoperable* This bulletin applies to vehicles built on or after May 23, 2018, and on or before August 5, 2019, equipped with Power Take Off Prep (Sales Code LBN) and Power Take Off (Sales Code LBV). The customer may describe that the PTO is inoperative. Upon futher investigation the technician may find that the following Diagnostic Trouble Code (DTC) may have been set: • P1123-00 – PTO System Performance The repair procedure involves adding a PTO Diode Jumper/Wiring Harness kit to the auxiliary power distribution center.

TSB# | **MODEL** | **SUBJECT/DESCRIPTION**

08-012-20
1/25/20
’19 DD/D2/DJ/DP

Flash: Driver Assistance System Module (DASM) Enhancements
This bulletin applies to DD, D2, DJ and DP vehicles built on or before September 11, 2019, equipped with Full Speed Fwd Collision Warn Plus (Sales Code LSU). The customer may describe one or more of the following:

- Brakes may intermittently apply unexpectedly together with Instrument Panel Cluster (IPC) warning
- IPC warnings for the Forward Collision Warning (FCW) informing the driver to apply the brakes

The repair procedure involves reprogramming the DASM with the latest software available.

08-020-20
2/8/20
’19-’20 DD/DJ/DP

Body Control Module (BCM) Reconfigure for Enabling the Auto-On Comfort Settings
This bulletin applies to the vehicles built on or before January 24, 2020, equipped with Ventilated Front Seats (Sales Code CAJ), Heated Steering Wheel (Sales Code NHS) or Heated Front Seats (Sales Code JPM) and without Remote Start System (Sales Code XBM). Customers may comment on one or more of the following:

- If below 40°F the heated seats or heated steering wheel turn on by themselves
- If below 80°F the vented seats turn on by themselves
- Cannot turn off the auto-on comfort feature

If the customer describes the symptom/condition listed above, the proper repair procedure is a flash to the truck’s body control module.

08-048-20
4/18/20
’19-’20 DT/DJ/D2/DD/DP

UAX, UCX, UAV AND UCV Radio Over the Air Software Version Updates
This bulletin applies to DT vehicles built on or after January 12, 2019, and before February 7, 2020. This bulletin applies to D2, DD, DJ or DP vehicles built on or after December 6, 2018, and before January 31, 2020. The bulletin is directed to vehicles equipped with one of the following radios:

- Uconnect 12.0 with Navigation radio (Sales Codes UAX or UCX)
- Uconnect 4C NAV with 8.4” display (Sales Codes UAV or UCV)

Customers may experience one or more of the following:

- Display screen is black with no backlighting
- GPS unable to load and find location
- Bluetooth device is slow to pair
- Loss of saved radio presets
- No audio output coming from the radio
- Can not control audio volume
- Radio “locks up” or freezes
- Rear view camera display will not turn off.

This bulletin provides information regarding the latest Flash Over The Air (FOTA) update and provides the service technician an overview of the steps a customer will need to take to complete the update. The radio software will be updated to 33.3.

08-061-20
6/3/20
’19-’20 D2/DD/DJ/DP

Flash: Anti-lock Brake System (ABS) Enhancements
This bulletin applies to vehicles built on or before February 10, 2020, equipped with Electronic Stability Control (Sales Code BNB). Customers may experience a Malfunction Indicator Lamp (MIL) illumination. Upon further investigation the technician may find the following Diagnostic Trouble Code (DTC) has been set:

- C006A-49 – Multi-Axis Acceleration Sensor – Internal Electronic Failure

The repair procedure involves reprogramming the ABS module with the latest software available.

CATEGORY 8 ENGINE

TSB#	MODEL	SUBJECT/DESCRIPTION
09-011-20 7/24/20	’13-’20 DJ/D2/ DD/DP	*6.7 Engine Oil Usage Information* This bulletin provides information regarding the correct oil grade to use on the 6.7-liter Cummins engine used in the 2019 and newer HD Trucks. The following information-only bulletin is intended to eliminate confusion. For all trucks, *regardless of model year,* located in areas where the ambient temperatures routinely fall **below** 0°F during the winter, it is required to use **5W-40 synthetic** engine oil that meets US Material Standard MS-10902, and API CJ-4. Oils that meet this requirement can be found through Mopar, as well as Shell in the Rotella and the Rimula families. Although this grade of oil is *required* in colder climate areas, it is also safe to use during the summer months, and in warmer climates as well. However, for vehicles normally located in areas that routinely stay **above** 0°F there are two grades of engine oil recommended depending on the model year of the vehicle: • **2018 model year and older** vehicles it is recommended to use **15W-40** engine oil such as the Mopar, Shell Rotella and Shell Rimula branded oils that meets US Material Standard MS-10902 and the API CJ-4 engine oil. • **2019 model year and newer** vehicles it is recommended to use **10W-30** engine oil such as Mopar, Shell Rotella and Shell Rimula that meets FCA Material Standard MS-10902, and the API CK-4 engine oil category is required. Products meeting Cummins CES 20081 may also be used. CAUTION! 15W-40 grade oil CANNOT be used in any 2019 model year or newer 6.7-liter equipped vehicles due to the new designed valve train of this engine. If this oil is used, it will cause deposits to form in the hydraulic valve lash adjusters leading to undesirable noise, and/or engine damage.

CATEGORY 14 FUEL SYSTEM

TSB#	MODEL	SUBJECT/DESCRIPTION
14-003-19 6/21/19	’19 DJ/D2/DD/DP	*Possible Fuel Lines(s) Leaking, Cummins 6.7-liter Engine* This bulletin applies to vehicles built on or after April 24, 2019, and on or before May 19, 2019. These vehicles may have one or more high pressure fuel lines that may have a leak. This bulletin involves replacing certain high pressure fuel lines. Vehicles in dealer inventory have been previously inspected at the dealer by Cummins, and the suspect fuel line/s identified. Dealers will be notified by representatives of FCA which lines need to be replaced.

TSB#	MODEL	SUBJECT/DESCRIPTION
18-052-19 Rev. A 10/22/19	’19 DJ/D2	*Flash: Powertrain Control Module (PCM) and Engine Control Module (ECM) Updates*

This bulletin applies to vehicles built on or before September 28, 2019, equipped with a Cummins Turbo Diesel Engine or Cummins HO Turbo Diesel Engine. Customers may experience a malfunction indicator lamp (MIL) illumination. Upon further investigation the technician may find that one or more of the following Diagnostic Trouble Codes have been set:

- P0421-00 – Catalyst 1 Efficiency Below Threshold Bank 1
- P1451-00 – Diesel Particulate Filter System Performance
- P24A5-00 – EGR Cooler Bypass Bank 1 Control Stuck
- P21C4-00 – Reductant Line Heater Relay Control Circuit High
- P1D73-00 – AGS Performance
- P2560-00 – Engine Coolant Level Low
- P2201-00 – Aftertreatment NOx Sensor Circuit Performance – Bank 1 Sensor 1
- P0604-00 – Internal Control Module Ram
- P0607-00 – ECU Internal Performance
- P0868-00 – Line Pressure Low (Module, Powertrain Control (PCM), 68RFE)
- P0740-00 – TCC Out of Range
- P0299-00 – Turbocharger Underboost
- P218F-00 – Reductant No Flow Detected
- P20EE – NOx Catalyst Efficiency Below Threshold
- P226C – Turbocharger Boost Control “A” Slow Response (in extreme cold ambient temperatures)
- P061A – Level 2 Torque Performance
- P061B – Internal Control Module Torque Calculation Performance
- P061E – Internal Control Module Brake Signal Performance
- P062C – Etc Level 2 Mph Performance
- P203F – (Diesel Exhaust Fluid) Reductant Level Too Low
- P20E8 – (Diesel Exhaust Fluid) Reductant Pressure Too Low
- P0420 – Catalyst System Efficiency Bank 1
- U02A3 – Lost of Communication with PM Sensor
- P1507 – Crankcase Filter Restriction
- P0116 – Engine Coolant Temperature Sensor Performance
- P0106 – Manifold Absolute Pressure Sensor Performance (in extreme cold ambient temperatures)
- U3017 – Control Module Timer/Clock Performance
- P0870 – Hydraulic Pressure Test
- U0101 – Lost Communication with TCM
- P2579 – Turbocharger Speed Sensor Circuit

The customer may also notice one or more of the following:

- Tachometer bouncing at idle with no change in RPM
- Speed Control/Adaptive Cruise Control icon remains on in cluster after function has been cancelled.
- Stumble on acceleration in higher altitudes (D2 High Output Only)
- Cruise Control Resume Function will not go to last set speed after cuise control was turned off
- Rough idle
- Oil life monitor resets after PCM flash
- Diesel exhaust fluid (DEF) level gauge inaccurate
- Excessive DEF consumption
- Poor idle quality at times when engaging cab heat feature

Continued on next page.

TSB#	MODEL	SUBJECT/DESCRIPTION
		In addition the following enhancements are included: • Enabling message in dash alerting operator when in “Exhaust Brake - Cab Warm Up” mode • System Improvement for “Exhaust Brake – Cab Warm Up” mode • Transmission upshift quality enhancements (68RFE Only) • wiTECH “Fuel Pressure Override” test improvement • wiTECH Mass Air Flow (MAF) data parameter improvement (displaying raw value instead of estimated) • wiTECH fuel system run-up test improvement • wiTECH fan actuation test improvement • Engine warm up protection system improvement. Max engine speed limit change from 1200rpm to 1,000rpm during initial startup in extreme cold ambient temperatures. • Improved shift quality and engine performance when in 4LO • Idle Shutdown Timer System improvement The repair procedure involves reprogramming the ECM and PCM with the latest software programming.
18-066-19 9/5/19	’18 DJ/D2	*Flash: Powertrain Diagnostic and System Improvements* This bulletin applies to vehicles equipped with a Cummins Turbo Diesel Engine (Sales Code ETK). Customers may experience a Malfunction Indicator Lamp (MIL) illumination. Upon further investigation the technician may find that one or more of the following DTCs have been set: • P229F – Aftertreatment NOx Sensor Circuit Performance – Bank 1 Sensor 2 • P207F – Reductant Quality Performance • P2509 – PCM/PCM Power Input Signal Intermittent • P0401 – EGR System Performance • P0870 – OD Hydraulic Pressure Test • P040B – Exhaust Gas Recirculation Temperature Sensor “A” Circuit Performance • P2201 – Aftertreatment NOx Sensor Circuit Performance – Bank 1 Sensor 1 • P1C54 – SCR NOx Catalyst Missing • P249E – Closed Loop SCR Reductant Injection Control at Limit – Flow too High • P0128 – Thermostat Rationality • P24C7 – Particulate Matter Sensor Temperature Circuit Performance Customers may experience one or more of the following conditions: • Engine misfire in cold ambient temperatures In addition, the following software enhancements are also available: • Scan Tool Fan Actuation Test fix • Enabling diagnostics for DTC P208B – Reductant Pump 1 Control Performance • unable to turn on the ability to set “MAX” road speed using wiTECH scan tool • Mass Air Flow (MAF) Sensor Out Of Range (OOR) low calibration • Improved 5-4 shift (reduce shift flare) after extended operation in 5th or 6th gear • Engine Manifold Pressure Misfire Monitor (EMP MFM) retune (68RFE Only) • Idle based misfire retune • Abort timer for Selective Catalytic Reduction (SCR) Out NOx Sensor missing change to 70 seconds • Map SCR missing DTC/Fault (P1C54) to tampering inducement • PM Sensor False Fault Improvement • CC inner loop used up faults • Ultrasonic Flow Meter (UFM) test results fix • Engine run state idle unstable software fix • Ability to write Engine Serial Number (ESN) through wiTECH • Add Diesel Exhaust Fluid (DEF)/Reagent type as a readable value in wiTECH • SCR missing tuning capability improvement • Smart tampering improvement • Transmission shift quality and performance improvements. The repair procedure involves reprogramming the ECM and PCM with the latest software programming.

CATEGORY 19 STEERING

TSB#	MODEL	SUBJECT/DESCRIPTION
19-001-19 6/20/19	’13-’18 D2 ’14-’18 DJ/DD	*Toe Adjustment with Welded Drag Link* This information only bulletin gives the dealer an updated procedure on how to adjust the toe on a vehicle after it has had (VO6) recall performed (welded drag link) in the event that the front toe needs adjustment at a later date. The bulletin advises the dealer to refer to the detailed service procedures available in Dealer Connect/Service Library under, Service Info: 02 – Front Suspension/Wheel Alignment/Standard procedure, Tie Rod Ball Stud Housing Misalignment Check.

CATEGORY 21 TRANSMISSION AND TRANSFER CASE

TSB#	MODEL	SUBJECT/DESCRIPTION
21-002-20 1/11/20	’19 DJ/DD/DP	*A Whine or Whistle Noise from Transfer Case While in 4WD HI* This bulletin applies to vehicles equipped with a Man Shift-On-The-Fly Transfer Case (Sales Code DK1) or an Elec Shift-On-The-Fly Transfer Case (Sales Code DK3). The customer may comment on the following: • A whine or whistle noise from the transfer case while in 4WD HI and above 35mph. If the customer describes the symptom/condition listed above, the repair procedure involves installing a damper onto the front output shaft dust shield.
21-004-20 1/15/20	’19 DD/DP	*Flash: Transmission Control Module (TCM) Updates* This bulletin applies to vehicles equipped with a Cummins Turbo Diesel Engine and an AISIN AS69RC HD Transmission. The customer may experience the following: • The 6-4 and 5-3 shift can have a bump • Some shifts may “flare” when cold (2-3, 3-4, 4-5) • Coastdown bump Also, the following software enhancements are available: • Stored faults can only be cleared by a diagnostic scan tool, this software will allow the TCM to self clear. The repair procedure involves reprogramming the TCM with the latest available software.

CATEGORY 23 BODY

TSB#	MODEL	SUBJECT/DESCRIPTION
23-013-19 Rev. A 11/26/19	’19 DT/DJ/D2	*Noise From A-Pillar or Floor Area During Turns or Body Movement* This bulletin applies to DT vehicles built on or after January 8, 2018, and on or before October 10, 2018. This bulletin applies to DJ and D2 vehicles built on or before February 18, 2019. The customer may describe popping or cracking noises heard around the front floor or A-Pillar area, while turning left or right (during a lateral movement). Verify the customer concern by test driving the vehicle while performing left and right turns, that will induce significant body roll and suspension articulation. The repair procedure involves replacement of several of the cab mounting bolts with a revised part.
23-015-19 5/10/19	’19 D2/DJ	*Tailgate Does Not Open Smoothly* This bulletin applies to vehicles built on or after January 8, 2019, and on or before March 8, 2019, equipped with Dampened Tailgate (Sales Code MWD). The customer may comment that the tailgate does not have a smooth operation when opening: just before the tailgate is fully opened, it has a sudden drop or makes popping noise. The repair procedure involves replacement of the strut damper with a revised part.

CATEGORY 23 BODY

TSB#	MODEL	SUBJECT/DESCRIPTION
23-010-20 3/18/20	'19 DS/DJ/D2	*Sunroof Water Leak* This bulletin applies to DS vehicles built on or after May 1, 2019, and before November 1, 2019. This bulletin applies to DJ and D2 vehicles built on or after May 1, 2019, and before November 3, 2019. This bulletin is written for vehicles equipped with Power Sunroof (Sales Code GWA). The customer may describe a water leak from A-pillar grab handle or headliner microphone. The bulletin outlines how to test the sunroof for leaks and how to replace the power sunroof glass, if necessary.
23-012-20 3/10/20	'19-'20 D2/DP	*Park Brake Pedal Doesn't Fully Return* This bulletin applies to DP and D2 vehicles built on or after July 31, 2019, and before February 1, 2020, equipped with Dual Rear Wheels. The customer may comment on one or more of the following: • The parking brake foot pedal does not fully return • The red "brake" light is illuminated in the Instrument Panel Claster (IPC) The bulletin outlines how to inspect, and, if necessary, replace the parking brake tensioner and then adjust the parking brake cable system.
23-016-20 6/3/20	'13-'20 D2 '14-'20 DJ	*Fifth-Wheel/Gooseneck Trailer Hitch Does Not Fit* This bulletin applies to vehicles equipped with Fifth-Wheel/Gooseneck Towing Prep Group or Mopar Fifth-Wheel Prep Kit. This information only bulletin reminds the dealer network and other installers that there is a one-shim/two-shim kit available for those applications where the legs of a fifth-wheel hitch are too narrow to fit the pucks in the bed of the truck.

RECALLS FROM Q4 2018 TO CURRENT

SAFETY RECALL Y76 – INJECTOR LINES

Date: July 2019

Models/Production:
'19 DJ Ram 2500 Pickup
'19 D2 Ram 3500 Pickup
'19 DD Ram 3500 Cab Chassis
'19 DP Ram 4500/5500 Cab Chassis

Subject: The diesel engine on about 560 of the above vehicles may have been manufactured with fuel lines with incorrectly formed end fittings that may not properly seal to other fuel system components.

Repair: Cummins will send a representative to inspect the fuel line date codes. If any of the fuel line date codes are found to be within the suspect build population, the suspect line(s) will be replaced.

SAFETY RECALL V98 – FRONT BRAKE CALIPERS

Date: December 2019

Models/Production:
'19 DJ Ram 2500 Pickup
'19 D2 Ram 3500 Pickup
'19 DD Ram 3500 Cab Chassis

Subject: The front brake calipers on about 5,490 of the above vehicles may have contamination of a caliper piston seal with incorrect assembly lube which may cause the caliper piston seal to swell, and may result in brake drag (failure or incomplete caliper disengagement) when the brake pedal is released.

Brake drag can cause overheating of the brake pads, brake rotor, and brake fluid, which may result in a reduction in front brake system performance.

Repair: Replace the front brake calipers, front rubber brake lines, and bleed the brakes on all affected vehicles.

EMISSIONS RECALL U95 – SELECTIVE CATALYTIC REDUCTION CATALYST

Date: December 2018

Models/Production:
’11-‘12 DP Ram 4500/5500 Cab Chassis

Subject: The subject of this recall is that some 2011 and 2012 model year Ram 4500/5500 Cab Chassis trucks may experience degradation of the selective catalyst reduction (SCR) system. Degradation of the SCR system can cause tailpipe emissions of oxides of nitrogen (NOx) to exceed emissions standard.

Repair: The repair involves replacing the existing SCR catalyst with a new SCR catalyst.

EQUIPMENT SAFETY RECALL U40 NHTSA 18E-028 – MOPAR GOOSENECK BALL KIT

Date: March 2019

Models/Production:
Mopar Aftermarket

Subject: Some Mopar Gooseneck Ball Kits may have retention balls that do not fully seat into the receiver plate and lock into position.

Repair: The repair involves exchanging the customer’s Gooseneck Ball for the new redesigned Gooseneck Ball, then rendering the recalled Gooseneck Ball unusable and discarding.

CUSTOMER SATISFACTION NOTIFICATION V36 – MEDIA HUB

Date: March 2019

Models/Production:
’18 DP Ram 4500/5500 Cab Chassis
’18 DD Ram 3500 Cab Chassis

Subject: The media hub on about 184 of the above vehicles may be the incorrect hub which was installed during the manufacturing process.

Repair: The repair involves replacing the media hub.

SAFETY RECALL W06/NHTSA 19V-021 – DRAG LINK

Date: April 2019

Models/Production:
’14-’18 DJ Ram 2500 Pickup
’14-’18 D2 Ram 3500 Pickup
’14-’18 DD Ram 3500 Cab Chassis

Subject: The drag link on the above vehicles may have a jam nut that could loosen, allowing, one end of the drag link to separate from the adjuster sleeve.

Repair: The repair procedure involves inspecting the jam nut for the proper torque valves. If thread engagement is acceptable, the link will be reassembled, the vehicle will be aligned, and the nuts will be welded to the adjuster sleeve.

EMISSIONS RECALL V11 – 3.0L DIESEL EMISSIONS

Date: May 2019

Models/Production:
’14-’16 DS Ram 1500 Pickup

Subject: Per FCA’s agreement with EPA and CARB, FCA agreed to recall approximately 100,000 EcoDiesel vehicles to update the emissions control system software with the approved emissions modification or “AEM.”

Repair: The repair involves reprogramming the truck’s engine control module.

SAFETY RECALL V44 – TAILGATE LATCH

Date: May 2019

Models/Production:
’15-’18 DS Ram 1500 Pickup
’15-’18 DJ Ram 2500 Pickup
’15-’18 D2 Ram 3500 Pickup

Subject: The tailgate latch on about 7,192 of the above vehicles may have been built with a tailgate actuator limiter tab (within the power lock actuator control assembly) that may fracture. This allows the lock rod control bracket to over-travel, which may pull the lock rod and release the tailgate latch.

Repair: The repair involves installing a tailgate actuator stop block that will limit the pivot arm from over traveling and pulling on the locking/unlocking rods.

CUSTOMER SATISFACTION VA2 – POWER TAKE-OFF

Date: December 2019

Models/Production:
’19 DD Ram 3500 Cab Chassis
’19 DP Ram 4500/5500 Cab Chassis

Subject: The Powertrain Control Module (PCM) on about 2,870 of the above vehicles may be damaged by a voltage spike when the aftermarket up-fit Power Take-Off (PTO) is disengaged. This can result in an illuminated Malfunction Indicator Lamp (MIL) and an inoperative PTO.

Repair: Install a jumper harness with a diode to protect the PCM from damage.

CUSTOMER SATISFACTION VB7 – TIRE FILL ALERT

Date: January 2020

Models/Production:
’19 DJ Ram 2500 Pickup
’19 D2 Ram 3500 Pickup
’19 DD Ram 3500 Cab Chassis
’19 DP Ram 4500/5500 Cab Chassis

Subject: On about 1070 of the above vehicles, the tire fill alert option may be present on the 5” radio screen, but it cannot be activated. With the 8.4” and 12” radio screens, the tire fill alert may be present, but cannot be activated or, once activated, the horn does not sound when the selected tire pressure is achieved.

Repair: Update the Body Control Module (BCM) configuration via a software reflash.

SAFETY RECALL W03 – TRANSMISSION VALVE BODY

Date: March 2020

Models/Production:
’19-’20 DJ Ram 2500 Pickup
’19-’20 D2 Ram 3500 Pickup

Subject: The transmission on about 85,000 of the above vehicles may experience a buildup of pressure and heat inside the 68RFE automatic transmission which may result in transmission fluid being expelled from the dipstick tube. Transmission fluid may come in contact with the turbocharger or other ignition sources within the engine compartment.

Repair: Replace the lower transmission valve body separater plate and reprogram the Powertrain Control Module (PCM).

EMISSIONS RECALL VB6 – DIESEL ENGINE RECALIBRATION

Date: March 2020

Models/Production:
’19 DJ Ram 2500 Pickup
’19 D2 Ram 3500 Pickup

Subject: The engine control software on about 91,000 of the above vehicles must be updated with an upgraded calibration as required by the US Environmental Protection Agency and California Air Resources Board for better emission performance.

Repair: The approved repair procedure involves the reflash of the engines electronic control module (ECM).

CUSTOMER SATISFACTION VF1 – SEAT HEATER SWITCH

Date: March 2020

Models/Production:
’19 DD Ram 3500 Cab Chassis
’19 DP Ram 4500/5500 Cab Chassis

Subject: The touch screen seat heater switches on about 40 of the above vehicles may be missing.

Repair: Replace the 5” radio with an 8.4” radio and associated trim, then update the BCM configuration.

SAFETY RECALL W32 – VP RADIO SOFTWARE

Date: May 2020

Models/Production:
’19-’20 DJ Ram 2500 Pickup
’19-’20 D2 Ram 3500 Pickup

Subject: The radio on about 19,855 of the above vehicles may be equipped with a radio that may allow for the rear view camera to be displayed longer than the time allowed.

Repair: The radio software will need to be inspected and, if required, updated on all of the above-mentioned vehicles.

SAFETY RECALL W24 – BED STEP

Date: July 2020

Models/Production:
’19-’20 DJ Ram 2500 Pickup

Subject: The bed step on about 15,600 of the above vehicles may fail in certain angular or side-load loading conditions. If a sufficient side-load is applied to the bed step, its mounting bracket may fracture and cause the bed step to suddenly and unexpectedly fail while in use, which can increase the risk of an injury to the user.

Repair: Replace the bed step support brace.

SAFETY RECALL W57 – POWERTRAIN SCONTROL MODULE SOFTWARE

Date: September 2020

Models/Production:
’19-’20 DD Ram 3500 Cab Chassis
’19-’20 DP Ram 4500/5500 Cab Chassis

Subject: The powertrain control module (PCM) on about 34,000 of the above vehicles may have engine calibration software that does not provide adequate engine warm up protection. Inadequate warmup protection can cause a lack of oil film on the rod bearings while the engine is reaching operating temperature, resulting in engine damage.

Repair: Reprogram the powertrain control module (PCM) with an updated calibration.

2020 RAM 2500 & 3500 HEAVY DUTY

Specifications

Specifications are based on the latest product information available at the time of publication.
All dimensions are in inches (millimeters) unless otherwise noted.
All dimensions measured at curb weight with standard tires and wheels.

GENERAL INFORMATION	
Vehicle Type	Regular Cab, Crew Cab and Mega Cab: 4x2, 4x4
Assembly Plant	Saltillo Truck Assembly Plant, Coahuila, Mexico
EPA Vehicle Class	Standard Pickup

BODY/CHASSIS		
Model	**4x2**	**4x4**
Layout	Longitudinal, front engine	Longitudinal, front engine, transfer case
Construction	Ladder-type frame, steel cab, Double-wall steel pickup box	Ladder-type frame, steel cab, Double-wall steel pickup box

ENGINE: 6.4-LITER HEMI® V-8	
Type And Description	90-degree gasoline V-8 with variable cam timing
Displacement	392 cu. in. (6,417 cu. cm)
Bore X Stroke	4.09 X 3.72 (103.9 X 94.6)
Valve System	Pushrod-operated overhead valves, 16 valves, eight deactivating and eight hydraulic lifters, all with roller followers
Fuel Injection	Sequential, multiport, electronic, returnless
Construction	Deep-skirt cast-iron block with cross-bolted main bearing caps, 356 aluminum cylinder heads with hemispherical combustion chambers
Compression Ratio	10.0:1
Power	410 hp (306 Kw) @ 5,600 RPM

Torque	429 lb.-ft. (582 N•M) at 4,000 RPM
Maximum Engine Speed	5,800 RPM limited
Fuel Requirement	Unleaded regular, 87 octane
Oil Capacity	7.0 quarts (6.6 liters)
Coolant Capacity	16.6 quarts (15.75 liters)
Emission Control	Three-way catalytic converters, heated oxygen sensors, cooled electronic exhaust-gas recirculation (EGR) and individual cylinder fuel control

ENGINE: 6.7-LITER CUMMINS TURBO DIESEL I-6 (2500/3500 STANDARD OUTPUT)	
Type and Description	Inline six cylinder, turbocharged, intercooled diesel
Displacement	408 cu. in. (6,690 cu. cm)
Bore X Stroke	4.21 X 4.88 (107 X 124)
Valve System	Pushrod-operated overhead valves, 24 valves, hydraulic lifters
Fuel Injection	Electronic high-pressure common rail
Construction	Compacted graphite iron (CGI) block cast-iron head
Compression Ratio	19.0:1
Power	370 hp (276 Kw) @ 2,800 RPM (68RFE automatic transmission)
Torque	850 lb.-ft. (1,084 N•M) @ 1,152 RPM
Maximum High-Idle Engine Speed	3,200 RPM
Fuel Requirement	Ultra-low sulfur diesel
Oil Capacity	12.0 quarts (11.3 liters) with filter
Coolant Capacity	23.8 quarts (22.50 liters)
Emission Controls	Selective catalytic reduction (SCR)

ENGINE: 6.7-LITER CUMMINS TURBO DIESEL I-6 (3500 HIGH OUTPUT)	
Type And Description	Inline six cylinder, turbocharged, intercooled diesel
Displacement	408 cu. in. (6,690 cu. cm)
Bore X Stroke	4.21 X 4.88 (107 X 124)
Valve System	Pushrod-operated overhead valves, 24 valves, hydraulic lifters
Fuel Injection	Electronic high-pressure common rail
Construction	Compacted graphite iron (CGI) block cast-iron head
Compression Ratio	16.2:1
Power	400 hp (276 Kw) @ 2,800 RPM (Aisin automatic transmission)
Torque	1,000 lb.-ft. (1,084 N•M) @ 1,356 RPM
Maximum High-Idle Engine Speed	3,200 RPM
Fuel Requirement	Ultra-low sulfur diesel
Oil Capacity	12.0 quarts (11.3 liters) with filter
Coolant Capacity	23.8 quarts (22.50 liters)
Emission Controls	Selective catalytic reduction (SCR)

TRANSMISSION: AISIN AS69RC — AUTOMATIC SIX-SPEED (3500 HIGH OUTPUT)	
Availability	6.7-liter diesel high output
Description	Three planetary gear sets, full electronic control, electronically controlled converter clutch
Gear Ratios	
1st	3.75
2nd	2.0
3rd	1.34
4th	1.0
5th	0.77

6th	0.63
Reverse	3.54
Axle Ratios	3.73 (SRW and DRW), 4.10 (DRW only)

TRANSMISSION: ZF 8HP75 — AUTOMATIC EIGHT-SPEED	
Availability	6.4-liter HEMI V-8
Description	Adaptive electronic control, automatic or Electronic Range Select (ERS) manual control. Five clutch-pack design with only two open clutches in any gear. Torque converter lock with turbine torsional damper for low lock-up speeds in 1st through 8th gear
Gear Ratios	
1st	4.71
2nd	3.14
3rd	2.10
4th	1.67
5th	1.29
6th	1.00
7th	0.84
8th	0.67
Reverse	3.30
Axle Gear Ratios	3.73, 4.10

TRANSMISSION: 68RFE — AUTOMATIC SIX-SPEED	
Availability	6.7-liter diesel (standard output 2500 and 3500)
Description	Three planetary gearsets, one overrunning clutch, full electronic control, and electronically controlled converter clutch
Gear Ratios	
1st	3.23
2nd	1.84

3rd	1.41
4th	1.0
5th	0.82
6th	0.63
Reverse	4.44
Axle Ratios	3.73 (SRW and DRW), 4.10 (DRW)

TRANSFER CASE: BW 44-46, BW 44-47	
Availability	Optional on 6.7-liter diesel and 6.4-liter HEMI V-8
Type	Part-time – BW 44-47 manual shift and BW 44-46 electric shift
Operating Modes	2WD; 4WD High; Neutral; 4WD Low
Low-Range Ratio	2.64
Center Differential	None

TRANSFER CASE: BW 44-48	
Availability	6.7-liter diesel high output
Type	44-48 part-time with electric shift, 44-49 part-time manual shift
Operating Modes	2WD; 4WD High; Neutral; 4WD Low
Low-Range Ratio	2.64
Center Differential	None

AXLES	
Front (4x4)	AAM 9.25-in. beam front axle with center disconnect (locking differentials on Power Wagon)
Rear	AAM 11.5-in. beam rear axle (2500 and 3500 limited-slip and locking differentials on Power Wagon)
	AAM 12.0-in. beam rear axle (3500 Max Tow)

ELECTRICAL SYSTEM	
Alternator	
Rating	180-amp included with 6.4-liter HEMI V-8 and 6.7-liter diesel
	220-amp included with 6.7-liter Laramie, Longhorn and Limited
Rating	Dual (220 and 160) optional on 6.4-liter HEMI V-8
Rating	Dual 220-amp optional on 6.7-liter diesel
Battery	
Description	Group 65, maintenance-free, 730 CCA on 6.4-liter HEMI V-8
	Dual Group 65, maintenance-free, 730 CCA on 6.7-liter diesel

SUSPENSION 2500		
Model	**4x2**	**4x4**
Front	Three-link with track bar, coil springs, stabilizer bar, solid axle	Three-link with track bar, coil springs, stabilizer bar, solid axle, disconnecting sway bar (Power Wagon only)
Rear	Five-link with track bar, coil springs, stabilizer bar, solid axle	Five-link with track bar, coil springs, stabilizer bar, solid axle (optional air bags)

SUSPENSION 3500		
Model	**4x2**	**4x4**
Front	Three-link with track bar, coil springs, stabilizer bar, solid axle	Three-link with track bar, coil springs, stabilizer bar, solid axle
Rear	Two-stage longitudinal leaf (optional supplemental air bags) solid axle	Two-stage longitudinal leaf (optional supplemental air bags) solid axle

BRAKES	
Front	
Size and Type	14.17 X 1.54 (359.9 X 39.1) disc with twin-piston pin-slider caliper and ABS

Rear	
Size and Type	14.09 X 1.34 (357.9 X 34.0) disc with twin-piston pin-slider caliper and ABS
Power-Assist Type	Dual-rate, Tandem Diaphragm Vacuum (2500 gas)
	Hydro-boost (2500 diesel and all 3500)

AIR BAGS	
Regular Cab	6
Crew Cab	6
Mega Cab	6

STEERING	
Power Assist	Hydraulic Assist

CARGO BOX

NOMINAL BOX SIZE	6-FT. 4-IN. (CREW OR MEGA)	8-FT. (REGULAR OR CREW)
SAE Volume, cu. ft. (cu. m)	57.5 (1.6)	74.7 (2.1)
Length at Floor, Tailgate Closed	76.3 (1,938.5)	98.3 (2,496.5)
Cargo Width	66.4 (1,686.9)	66.4 (1,686.9)
Distance Between Wheelhouses	51 (1,295.4)	51 (1,295.4)
Depth	20.1 (511.1)	20.2 (513.0)
Tailgate Opening Width	60.4 (1,535.3)	60.4 (1,535.3)

ELECTRICAL SYSTEM	
Alternator	
Rating	180-amp included with 6.4-liter HEMI V-8 and 6.7-liter diesel
	220-amp included with 6.7-liter Laramie, Longhorn and Limited
Rating	Dual (220 and 160) optional on 6.4-liter HEMI V-8
Rating	Dual 220-amp optional on 6.7-liter diesel
Battery	
Description	Group 65, maintenance-free, 730 CCA on 6.4-liter HEMI V-8
	Dual Group 65, maintenance-free, 730 CCA on 6.7-liter diesel

SUSPENSION 2500		
Model	**4x2**	**4x4**
Front	Three-link with track bar, coil springs, stabilizer bar, solid axle	Three-link with track bar, coil springs, stabilizer bar, solid axle, disconnecting sway bar (Power Wagon only)
Rear	Five-link with track bar, coil springs, stabilizer bar, solid axle	Five-link with track bar, coil springs, stabilizer bar, solid axle (optional air bags)

SUSPENSION 3500		
Model	**4x2**	**4x4**
Front	Three-link with track bar, coil springs, stabilizer bar, solid axle	Three-link with track bar, coil springs, stabilizer bar, solid axle
Rear	Two-stage longitudinal leaf (optional supplemental air bags) solid axle	Two-stage longitudinal leaf (optional supplemental air bags) solid axle

BRAKES	
Front	
Size and Type	14.17 X 1.54 (359.9 X 39.1) disc with twin-piston pin-slider caliper and ABS

Rear	
Size and Type	14.09 X 1.34 (357.9 X 34.0) disc with twin-piston pin-slider caliper and ABS
Power-Assist Type	Dual-rate, Tandem Diaphragm Vacuum (2500 gas)
	Hydro-boost (2500 diesel and all 3500)

AIR BAGS	
Regular Cab	6
Crew Cab	6
Mega Cab	6

STEERING	
Power Assist	Hydraulic Assist

CARGO BOX

NOMINAL BOX SIZE	6-FT. 4-IN. (CREW OR MEGA)	8-FT. (REGULAR OR CREW)
SAE Volume, cu. ft. (cu. m)	57.5 (1.6)	74.7 (2.1)
Length at Floor, Tailgate Closed	76.3 (1,938.5)	98.3 (2,496.5)
Cargo Width	66.4 (1,686.9)	66.4 (1,686.9)
Distance Between Wheelhouses	51 (1,295.4)	51 (1,295.4)
Depth	20.1 (511.1)	20.2 (513.0)
Tailgate Opening Width	60.4 (1,535.3)	60.4 (1,535.3)

EXTERIOR DIMENSIONS

REGULAR CAB 140.5-IN. WB, 8-FT. BOX (2500)	4x2	4x4
Wheelbase	140 (3,560)	140.2 (3,560)
Track Width – Front	68.7 (1,745)	68.7 (1,745)
Track Width – Rear	68.1 (1,729)	68.1 (1,729)
Overall Length	232 (5,892)	232 (5,892)
Overall Width @ SgRp Front	83.5 (2,120)	83.5 (2,120)
Overall Height	78 (1,981)	80.2 (2,037)

REGULAR CAB 140.5-IN. WB, 8-FT. BOX (2500) (CONTINUED)	4x2	4x4
Ground Clearance		
Suspension or Axle to Ground – Front	7.3 (184)	9.3 (237)
Suspension or Axle to Ground – Rear	8.4 (212)	8.5 (217)
Approach Angle (Degrees)	18.8	22.8
Ramp Breakover Angle (Degrees)	20.8	23.9
Departure Angle (Degrees)	22.9	29.9
Ground Clearance	13 (332)	13.1 (333)
Turning Diameter	45.4 (13.8)	45.5 (13.9)

CREW CAB 149.5-IN. WB, 6-FT. 4-IN. BOX (2500)	4x2	4x4
Wheelbase	149 (3,785)	149 (3,785)
Track Width – Front	68.7 (1,745)	68.7 (1,745)
Track Width – Rear	68.1 (1,729)	68.1 (1,729)
Overall Length	238.8 (6,066)	238.8 (6,067)
Overall Width @ SgRp Front	83.5 (2,120)	83.5 (2,120)
Overall Height	78.2 (1,987)	80.2 (2,037)
Suspension or Axle to Ground – Front	7.4 (188)	9.3 (236)
Suspension or Axle to Ground – Rear	8.5 (216)	8.5 (217)
Approach Angle (Degrees)	18.8	22.9
Ramp Breakover Angle (Degrees)	20.3	23.9
Departure Angle (Degrees)	23.6	25.8
Ground Clearance	11.1 (281)	13.1 (333)
Turning Diameter	14.6 (47.9)	14.6 (47.9)

CREW CAB 169.5-IN. WB, 8-FT. BOX (2500)	4x2	4x4
Wheelbase	169 (4,293)	169 (4,293)
Track Width – Front	68.7 (1,734.8)	68.7 (1,745)
Track Width – Rear	68.1 (1,729)	68.1 (1,729)
Overall Length	260.8 (6,626)	260.8 (6,626)
Overall Width @ SgRp Front	83.5 (2,120)	83.5 (2,120)
Overall Height	78.1 (1,983)	80.1 (2,035)
Suspension or Axle to Ground – Front	7.3 (185)	9.4 (237)
Suspension or Axle to Ground – Rear	9.9 (253)	8.6 (218)
Approach Angle (Degrees)	18.7	23.2
Ramp Breakover Angle (Degrees)	19.1	22.7
Departure Angle (Degrees)	22.5	24.7
Ground Clearance	11.1 (282)	13.1 (334)
Turning Diameter	16.3 (53.5)	16.3 (53.5)

POWER WAGON CREW CAB 149.3-IN. WB, 6-FT. 4-IN. BOX	4x2	4x4
Wheelbase	–	149.3 (3,792)
Track Width – Front	–	68.7 (1,745)
Track Width – Rear	–	68.1 (1,729)
Overall Length	–	238.8 (6,067)
Overall Width @ SgRp Front	–	83.4 (2,119)
Overall Height	–	80.9 (2,054)
Suspension or Axle to Ground – Front	–	8.3 (210)
Suspension or Axle to Ground – Rear	–	8.3 (210)
Approach Angle (Degrees)	–	29.4
Ramp Breakover Angle (Degrees)	–	22
Departure Angle (Degrees)	–	26
Ground Clearance	–	14.2 (360)
Turning Diameter	–	14.7 (48.2)

MEGA CAB 160.5-IN. WB, 6-FT. 4-IN. BOX (2500)	4x2	4x4
Wheelbase	–	160.4 (4,074)
Track Width – Front	–	68.7 (1,745)
Track Width – Rear	–	68.1 (1,729)
Overall Length	–	249.9 (6,348)
Overall Width @ SgRp Front	–	83.5 (2,120)
Overall Height	–	80.1 (2,036)
Suspension or Axle to Ground – Front	–	9.4 (238)
Suspension or Axle to Ground – Rear	–	8.5 (217)
Approach Angle (Degrees)	–	23.3
Ramp Breakover Angle (Degrees)	–	23.2
Departure Angle (Degrees)	–	25.7
Ground Clearance	–	13.1 (334)
Turning Diameter	–	15.6 (51.2)

REGULAR CAB 140.5-IN. WB, 8-FT. BOX (3500)	4x2	4x4
Wheelbase	140.2 (3,560)	140.2 (3,560)
Track Width – Front	67.7 (1,719)	67.7 (1,719)
	69.6 (1,769) DRW	69.6 (1,769) DRW
Track Width – Rear	67.1 (1,703)	67.1 (1,703)
	75.9 (1,927) DRW	75.9 (1,927) DRW
Overall Length	232 (5,892)	232 (5,892)
Overall Width @ SgRp Front	83.5 (2,120)	83.5 (2,120)
	96.5 (2,450) DRW	96.5 (2,450) DRW
Overall Height	77.8 (1,976)	79.5 (2,019)
Suspension or Axle to Ground – Front	7.4 (188)	9.3 (237)
	6.6 (168) DRW	8.5 (216) DRW
Suspension or Axle to Ground – Rear	7.9 (209)	8.5 (217)
	8.2 (208) DRW	8.4 (213) DRW
Approach Angle (Degrees)	18.2	23.2
	16.6 DRW	20.6 DRW
Ramp Breakover Angle (Degrees)	21.8	25.2
	19.7 DRW	23.2 DRW
Departure Angle (Degrees)	25.4	25.2
	23.6 DRW	24.4 DRW
Ground Clearance	11.2 (286)	13.3 (338)
	10.6 (269) DRW	12.4 (314) DRW
Turning Diameter	13.8 (45.4)	13.9 (45.5)

CREW CAB 169.5-IN. WB, 8-FT. BOX (3500)	4x2	4x4
Wheelbase	169.1 (4,294)	169 (4,300)
Track Width – Front	67.7 (1,719)	67.7 (1,719)
	69.6 (1,769) DRW	69.6 (1,769) DRW
Track Width – Rear	67.1 (1,703)	67.1 (1,703)
	75.9 (1,927) DRW	75.9 (1,927) DRW
Overall Length	260.8 (6,626)	260.8 (6,626)
Overall Width @ SgRp Front	83.5 (2,120)	83.5 (2,120)
	96.5 (2,450) DRW	96.5 (2,450) DRW
Overall Height	78.4 (1,990)	78.4 (1,990)
	77.1 (1,959) DRW	79.3 (2,015) DRW
Suspension or Axle to Ground – Front	7.3 (186)	7.3 (186)
	6.4 (162) DRW	8.4 (214) DRW
Suspension or Axle to Ground – Rear	9.0 (228)	9.0 (228)
	6.4 (162) DRW	9.3 (236) DRW
Approach Angle (Degrees)	18.3	23.3
	16.9 DRW	20.6 DRW
Ramp Breakover Angle (Degrees)	19.5	22.4
	17.3 DRW	21.3 DRW
Departure Angle (Degrees)	24.2	23.5
	21.2 DRW	24.2 DRW
Ground Clearance	11.2 (285)	11.5 (290)
	10.2 (260) DRW	12.3 (312) DRW
Turning Diameter	16.3 (53.6)	16.4 (53.7)

MEGA CAB 160.5-IN. WB, 6-FT. 4-IN. BOX (3500)	4x2	4x4
Wheelbase	–	160.4 (4,074)
Track Width – Front	–	67.7 (1,719)
		69.6 (1,769) DRW
Track Width – Rear	–	67.1 (1,704)
		75.9 (1,927) DRW
Overall Length	–	249.9 (6,348)
Overall Width @ SgRp Front	–	83.5 (1,994)
		96.5 (2,450) DRW
Overall Height	–	78.5 (2,036)
		78.9 (2,004) DRW
Suspension or Axle to Ground – Front	–	7.3 (187)
		8.4 (214) DRW
Suspension or Axle to Ground – Rear	–	8.3 (210)
		6.8 (174) DRW
Approach Angle (Degrees)	–	18.5
		21.7 DRW
Ramp Breakover Angle (Degrees)	–	20.3
		21.5 DRW
Departure Angle (Degrees)	–	25.7
		23.1 DRW

INTERIOR DIMENSIONS			
ACCOMMODATIONS			
MODEL			
Seating Capacity, F/R			
FRONT	**REGULAR CAB**	**CREW CAB**	**MEGA CAB**
Seating	3/0 or 2/0	3/3 or 2/3	3/3 or 2/3
Headroom	39.8 (1,011)	40.9 (1,038)	40.9 (1,038)
Legroom	40.9 (1,040)	40.9 (1,040)	40.9 (1,040)
Shoulder Room	65.9 (1,675)	65.9 (1,675)	65.9 (1,675)
Hip Room	62.9 (1,598)	62.9 (1,598)	62.9 (1,598)
REAR	**REGULAR CAB**	**CREW CAB**	**MEGA CAB**
Headroom	–	39.8 (1,010)	40.3 (1,023)
Legroom	–	40.2 (1,022)	43.1 (1,096)
Shoulder Room	–	65.6 (1,666)	65.6 (1,667)
Hip Room	–	62.7 (1,593)	62.8 (1,595)
INTERIOR VOLUME	**REGULAR CAB**	**CREW CAB**	**MEGA CAB**
Front – cu. ft. (cu. m)	62.5 (1.8)	63.9 (1.8)	63.9 (1.8)
Rear – cu. ft. (cu. m)	–	60.7 (1.7)	66 (1.9)

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Additional information and news from FCA US LLC is available at http://media.fcanorthamerica.com.

RAM

2020 FCA US LLC
Product Info

2020 RAM 2500 & 3500 HEAVY DUTY
Towing Chart

2020 RAM 2500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 2500 4X2 REGULAR CAB: TRADESMAN 8’ BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI®	A8 8HP75	3.73	10000	4010	5988.35	3400.83	2587.52	5,500	6,000	21,500	15,040
6.4L V-8 HEMI	A8 8HP75	4.10	10000	4010	5988.35	3400.83	2587.52	5,500	6,000	24,000	17,540
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	3160	843.89	4212.22	2631.67	5,500	6,000	27,000	19,680

RAM 2500 4X2 REGULAR CAB: TRADESMAN W/O BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	4480	5524.22	3465.83	2058.39	5,500	6,390	21,500	14,850
6.4L V-8 HEMI	A8 8HP75	4.10	10000	4480	5524.22	3465.83	2058.39	5,500	6,390	24,000	17,350

RAM 2500 4X2 REGULAR CAB: TRADESMAN 8’ BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3950	5952.83	3398.31	2554.52	5,500	6,000	21,500	15,080
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3950	5952.83	3398.31	2554.52	5,500	6,000	24,000	17,580
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	3060	6843.71	4213.56	2630.15	5,500	6,000	27,000	19,680

RAM 2500 4X2 REGULAR CAB: TRADESMAN W/O BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	4380	5524.22	3465.83	2058.39	5,500	6,390	21,500	14,850
6.4L V-8 HEMI	A8 8HP75	4.10	9900	4380	5524.22	3465.83	2058.39	5,500	6,390	24,000	17,350

2020 RAM 2500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 2500 4X2 CREW CAB: TRADESMAN 6'4" BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3660	6343.06	3559.52	2783.54	5,500	6,000	21,500	14,690
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3660	6343.06	3559.52	2783.54	5,500	6,000	24,000	17,190
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2770	7233.68	4398.37	2835.31	5,500	6,000	27,000	19,310

RAM 2500 4X2 CREW CAB: TRADESMAN W/ RAMBOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3540	6456.41	3553.91	2902.5	5,500	6,000	21,500	14,570
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3540	6456.41	3553.91	2902.5	5,500	6,000	24,000	17,070
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2660	7343.82	4369.44	2974.38	5,500	6,000	27,000	19,180

RAM 2500 4X2 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	4000	5998.61	3679.85	2318.76	5,500	6,390	21,500	14,460
6.4L V-8 HEMI	A8 8HP75	4.10	10000	4000	5998.61	3679.85	2318.76	5,500	6,390	24,000	16,960

RAM 2500 4X2 CREW CAB: TRADESMAN 6'4" BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3560	6343.06	3559.52	2783.54	5,500	6,000	21,500	14,690
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3560	6343.06	3559.52	2783.54	5,500	6,000	24,000	17,190
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	2680	7216.72	4379.79	2836.93	5,500	6,000	27,000	19,310

2020 RAM 2500 TRAILER TOWING CHART (CONTINUED)
SAE J2807 COMPLIANT

RAM 2500 4X2 CREW CAB: TRADESMAN RAMBOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3440	6456.41	3553.91	2902.5	5,500	6,000	21,500	14,570
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3440	6456.41	3553.91	2902.5	5,500	6,000	24,000	17,070
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	2610	7287.5	4255.84	3031.66	5,500	6,000	27,000	18,820

RAM 2500 4X2 CREW CAB: TRADESMAN W/O BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3900	5998.61	3679.85	2318.76	5,500	6,390	21,500	14,460
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3900	5998.61	3679.85	2318.76	5,500	6,390	24,000	16,960

2020 RAM 2500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 2500 4X2 CREW CAB: TRADESMAN 8' BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3520	6477.63	3688.49	2789.14	5,500	6,000	21,500	14,550
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3520	6477.63	3688.49	2789.14	5,500	6,000	24,000	17,050
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2630	7372.3	4531.7	2840.6	5,500	6,000	27,000	19,150

RAM 2500 4X2 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3990	6006.08	3744.37	2261.71	5,500	6,390	21,500	14,380
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3990	6006.08	3744.37	2261.71	5,500	6,390	24,000	16,880

RAM 2500 4X2 CREW CAB: TRADESMAN 8' BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3420	6477.63	3688.49	2789.14	5,500	6,000	21,500	14,550
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3420	6477.63	3688.49	2789.14	5,500	6,000	24,000	17,050
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	2530	7370.93	4527.32	2843.61	5,500	6,000	27,000	19,150

RAM 2500 4X2 CREW CAB: TRADESMAN W/O BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3890	6006.08	3744.37	2261.71	5,500	6,390	21,500	14,380
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3890	6006.08	3744.37	2261.71	5,500	6,390	24,000	16,880

2020 RAM 2500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 2500 4X4 MEGA CAB: BIG HORN/ 6'4" BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	2940	7061.36	4061.29	3000.07	5,500	6,390	21,500	13,970
6.4L V-8 HEMI	A8 8HP75	4.10	10000	2940	7061.36	4061.29	3000.07	5,500	6,390	24,000	16,460
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2040	7955.59	4894.97	3060.62	6,000	6,040	25,265	15,690

RAM 2500 4X4 MEGA CAB: BIG HORN/LONE STAR RAMBOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	2790	7205.22	4075.07	3130.15	5,500	6,390	21,500	13,820
6.4L V-8 HEMI	A8 8HP75	4.10	10000	2790	7205.22	4075.07	3130.15	5,500	6,390	24,000	16,320
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	1930	8070.42	4890.36	3180.06	6,000	6,040	25,265	14,550

RAM 2500 4X4 MEGA CAB: BIG HORN/ 6'4" BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	2840	7061.36	4061.29	3000.07	5,500	6,390	21,500	13,970
6.4L V-8 HEMI	A8 8HP75	4.10	9900	2840	7061.36	4061.29	3000.07	5,500	6,390	24,000	16,460
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	1940	7955.59	4894.97	3060.62	6,000	6,040	25,265	14,690

RAM 2500 4X4 MEGA CAB: BIG HORN RAMBOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	2690	7205.22	4075.07	3130.15	5,500	6,390	21,500	13,820
6.4L V-8 HEMI	A8 8HP75	4.10	9900	2690	7205.22	4075.07	3130.15	5,500	6,390	24,000	16,320
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	1830	8070.42	4890.36	3180.06	6,000	6,040	25,265	13,550

2020 RAM 2500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 2500 4X4 REGULAR CAB: TRADESMAN 8' BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3690	6309.89	3688.31	2621.58	5,500	6,000	21,500	14,720
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3690	6309.89	3688.31	2621.58	5,500	6,000	24,000	17,220
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2810	7194.15	4515.84	2678.31	5,750	6,000	27,000	19,330

RAM 2500 4X4 REGULAR CAB: TRADESMAN W/O BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	4160	5841.43	3746.61	2094.82	5,500	6,390	21,500	14,530
6.4L V-8 HEMI	A8 8HP75	4.10	10000	4160	5841.43	3746.61	2094.82	5,500	6,390	24,000	17,030

RAM 2500 4X4 REGULAR CAB: TRADESMAN 8' BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3580	6321.48	3695.8	2625.68	5,500	6,000	21,500	14,710
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3580	6321.48	3695.8	2625.68	5,500	6,000	24,000	17,210
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	2710	7194.15	4515.84	2678.31	5,750	6,000	27,000	19,330

RAM 2500 4X4 REGULAR CAB: TRADESMAN W/O BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	4060	5838.68	3672.45	2166.23	5,500	6,390	21,500	14,540
6.4L V-8 HEMI	A8 8HP75	4.10	9900	4060	5838.68	3672.45	2166.23	5,500	6,390	24,000	17,040

2020 RAM 2500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 2500 4X4 CREW CAB: TRADESMAN 6'4" BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3350	6648.79	3847.03	2801.76	5,500	6,000	21,500	14,380
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3350	6648.79	3847.03	2801.76	5,500	6,000	24,000	16,880
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2490	7508.33	4660.7	2847.63	5,750	6,000	27,000	19,020

RAM 2500 4X4 CREW CAB: TRADESMAN RAMBOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3220	6777.47	3849.02	2928.45	5,500	6,000	21,500	14,250
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3220	6777.47	3849.02	2928.45	5,500	6,000	24,000	16,750
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2350	7645.67	4673.16	2972.51	5,750	6,000	27,000	18,790

RAM 2500 4X4 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3730	6269.36	3947.93	2321.43	5,500	6,390	21,500	14,190
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3730	6269.36	3947.93	2321.43	5,500	6,390	24,000	16,690

RAM 2500 4X4 CREW CAB: TRADESMAN W/ POWER WAGON EQUIPMENT 6'4" BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	4.10	8565	1620	6943.87	4086.68	2857.19	4,750	6,200	18,000	10,580

RAM 2500 4X4 CREW CAB: TRADESMAN W/ POWER WAGON EQUIPMENT RAMBOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	4.10	8565	1500	7061.23	4090	2971.23	4,750	6,200	18,000	10,290

2020 RAM 2500 TRAILER TOWING CHART (CONTINUED)
SAE J2807 COMPLIANT

RAM 2500 4X4 CREW CAB: TRADESMAN 6'4" BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3240	6657.92	3856.99	2800.93	5,500	6,000	21,500	14,370
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3240	6657.92	3856.99	2800.93	5,500	6,000	24,000	16,870
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	2380	7516.38	4646.93	2869.45	5,750	6,000	27,000	19,010

RAM 2500 4X4 CREW CAB: TRADESMAN RAMBOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3150	6750.83	3831.03	2919.8	5,500	6,000	21,500	14,280
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3150	6750.83	3831.03	2919.8	5,500	6,000	24,000	16,780
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	2260	7636.48	4647.23	2989.25	5,750	6,000	27,000	17,890

RAM 2500 4X4 CREW CAB: TRADESMAN W/O BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3630	6269.36	3947.93	2321.43	5,500	6,390	21,500	14,190
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3630	6269.36	3947.93	2321.43	5,500	6,390	24,000	16,690

2020 RAM 2500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 2500 4X4 CREW CAB: TRADESMAN 8' BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3160	6837.54	4002.13	2835.41	5,500	6,000	21,500	14,190
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3160	6837.54	4002.13	2835.41	5,500	6,000	24,000	16,690
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	10000	2300	7702.93	4822.77	2880.16	5,750	6,000	25,525	17,350

RAM 2500 4X4 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	10000	3640	6357.58	4048.62	2308.96	5,500	6,390	21,500	14,030
6.4L V-8 HEMI	A8 8HP75	4.10	10000	3640	6357.58	4048.62	2308.96	5,500	6,390	24,000	16,530

RAM 2500 4X4 CREW CAB: TRADESMAN 8' BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3070	6827.1	3998.58	2828.52	5,500	6,000	21,500	14,200
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3070	6827.1	3998.58	2828.52	5,500	6,000	24,000	16,700
6.7L I-6 TURBO DIESEL	A6 68RFE	3.73	9900	2190	7708.42	4825.86	2882.56	5,750	6,000	25,525	17,170

RAM 2500 4X4 CREW CAB: TRADESMAN W/O BOX CANADA ONLY

Engine	Transmission	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
					Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	3.73	9900	3530	6374.63	4017.92	2356.71	5,500	6,390	21,500	14,020
6.4L V-8 HEMI	A8 8HP75	4.10	9900	3530	6374.63	4017.92	2356.71	5,500	6,390	24,000	16,510

2020 RAM 3500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 3500 4X2 REGULAR CAB: TRADESMAN 8' BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	DRW	3.73	14000	7680	6319.01	3396.24	2922.77	5,500	9,750	21,500	14,710
6.4L V-8 HEMI	A8 8HP75	DRW	4.10	14000	7680	6319.01	3396.24	2922.77	5,500	9,750	25,000	18,210
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	10700	4640	6056.26	3414.1	2642.16	5,500	7,000	21,500	14,970
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	10700	4640	6056.26	3414.1	2642.16	5,500	7,000	24,000	17,470
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	11500	4680	6822.09	4160.68	2661.41	5,500	7,000	28,300	21,010
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	3.73	14000	6840	7163.61	4218.74	2944.87	5,500	9,750	28,300	20,670
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	4.10	14000	6840	7163.61	4218.74	2944.87	5,500	9,750	30,300	22,670
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	11500	4500	7000.99	4281.03	2719.96	5,500	7,000	34,630	26,860
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	3.73	14000	6570	7428.36	4320.13	3108.23	5,500	9,750	41,600	33,700
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	4.10	14000	6570	7428.36	4320.13	3108.23	5,500	9,750	43,000	35,100

RAM 3500 4X2 REGULAR CAB: TRADESMAN W/O BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	10700	5170	5525.26	3448.14	2077.12	5,500	7,000	21,500	14,850
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	10700	5170	5525.26	3448.14	2077.12	5,500	7,000	24,000	17,350

2020 RAM 3500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 3500 4X2 CREW CAB: TRADESMAN 6'4" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	10700	4110	6588.71	3657.02	2931.69	5,500	7,000	21,500	14,440
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	10700	4110	6588.71	3657.02	2931.69	5,500	7,000	24,000	16,940
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	11500	4240	7261.53	4351.35	2910.18	5,500	7,000	28,300	20,570
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	11500	4100	7403.37	4460.92	2942.45	5,500	7,000	32,240	24,180

RAM 3500 4X2 CREW CAB: TRADESMAN W/ RAMBOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	10700	3970	6733.71	3655.08	3078.63	5,500	7,000	21,500	14,300
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	10700	3970	6733.71	3655.08	3078.63	5,500	7,000	24,000	16,800
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	11500	4090	7407.11	4373.78	3033.33	5,500	7,000	28,300	20,420
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	11500	3950	7548.91	4483.33	3065.58	5,500	7,000	32,240	23,210

RAM 3500 4X2 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	10700	4720	5984.15	3670.58	2313.57	5,500	7,000	21,500	14,480
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	10700	4720	5984.15	3670.58	2313.57	5,500	7,000	24,000	16,980

2020 RAM 3500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 3500 4X2 CREW CAB: TRADESMAN 8' BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11100	4520	6582.85	3746.58	2836.27	5,500	7,000	21,500	14,450
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11100	4520	6582.85	3746.58	2836.27	5,500	7,000	24,000	16,950
6.4L V-8 HEMI	A8 8HP75	DRW	3.73	14000	7050	6949.31	3763.09	3186.22	5,500	9,750	21,500	14,080
6.4L V-8 HEMI	A8 8HP75	DRW	4.10	14000	7050	6949.31	3763.09	3186.22	5,500	9,750	25,000	17,580
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	12000	4600	7402.86	4580.82	2822.04	5,500	7,000	28,300	20,430
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	3.73	14000	6180	7817.77	4536.74	3281.03	5,500	9,750	28,300	20,010
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	4.10	14000	6180	7817.77	4536.74	3281.03	5,500	9,750	30,300	22,010
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	12000	4450	7547.96	4607.03	2940.93	5,500	7,000	33,670	25,580
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	3.73	14000	5950	8054.19	4686.06	3368.13	5,500	9,750	41,600	33,080
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	4.10	14000	5950	8054.19	4686.06	3368.13	5,500	9,750	43,000	34,480

RAM 3500 4X2 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11100	5080	6019	3749	2270	5,500	7,000	21,500	14,370
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11100	5080	6019	3749	2270	5,500	7,000	24,000	16,870

2020 RAM 3500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 3500 4X4 MEGA CAB: BIG HORN/LONE STAR 6'4" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	DRW	3.73	14000	6630	7373.56	4032.87	3340.69	5,500	9,750	21,500	13,660
6.4L V-8 HEMI	A8 8HP75	DRW	4.10	14000	6630	7373.56	4032.87	3340.69	5,500	9,750	25,000	17,160
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11400	4340	7063.12	4049.35	3013.77	5,500	7,000	21,500	13,970
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11400	4340	7063.12	4049.35	3013.77	5,500	7,000	24,000	16,470
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	12300	4290	8007.91	4895.23	3112.68	6,000	7,000	28,300	19,820
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	3.73	14000	5670	8328.8	4869.58	3459.22	6,000	9,750	28,300	19,500
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	4.10	14000	5670	8328.8	4869.58	3459.22	6,000	9,750	30,300	21,500
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	12300	4150	8153.4	5004.11	3149.29	6,000	7,000	32,710	24,090
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	3.73	14000	5400	8598.01	4999.92	3598.09	6,000	9,750	41,600	32,530
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	4.10	14000	5400	8598.01	4999.92	3598.09	6,000	9,750	43,000	32,880

RAM 3500 4X4 MEGA CAB: BIG HORN/LONE STAR RAMBOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11400	4280	7123.03	4009.15	3113.88	5,500	7,000	21,500	13,910
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11400	4280	7123.03	4009.15	3113.88	5,500	7,000	24,000	16,410
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	12300	4120	8183.95	4946.4	3237.55	6,000	7,000	28,300	19,650
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	12300	3990	8314.74	5040.36	3274.38	6,000	7,000	32,710	23,320

2020 RAM 3500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 3500 4X4 REGULAR CAB: TRADESMAN 8' BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11000	4600	6404.46	3724.93	2679.53	5,500	7,000	21,500	14,630
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11000	4600	6404.46	3724.93	2679.53	5,500	7,000	24,000	17,130
6.4L V-8 HEMI	A8 8HP75	DRW	3.73	14000	7260	6742.08	3744.95	2997.13	5,500	9,750	21,500	14,290
6.4L V-8 HEMI	A8 8HP75	DRW	4.10	14000	7260	6742.08	3744.95	2997.13	5,500	9,750	25,000	17,790
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	3.73	14000	6400	7601.06	4516.66	3084.4	6,000	9,750	28,300	20,230
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	4.10	14000	6400	7601.06	4516.66	3084.4	6,000	9,750	30,300	22,230
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	11800	4550	7251.54	4521.21	2730.33	6,000	7,000	28,300	20,580
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	3.73	14000	6130	7867.45	4531.43	3336.02	6,000	9,750	41,600	33,260
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	4.10	14000	6130	7867.45	4531.43	3336.02	6,000	9,750	43,000	34,660
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	11800	4380	7422.75	4628.02	2794.73	6,000	7,000	34,540	26,050

RAM 3500 4X4 REGULAR CAB: TRADESMAN W/O BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11000	5120	5880.68	3754.13	2126.55	5,500	7,000	21,500	14,490
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11000	5120	5880.68	3754.13	2126.55	5,500	7,000	24,000	16,990

2020 RAM 3500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 3500 4X4 CREW CAB: TRADESMAN 6'4" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11000	4240	6757.65	3891.72	2865.93	5,500	7,000	21,500	14,270
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11000	4240	6757.65	3891.72	2865.93	5,500	7,000	24,000	16,770
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	11800	4190	7606.45	4693.88	2912.57	6,000	7,000	28,300	20,220
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	11800	4020	7781.56	4802.28	2979.28	6,000	7,000	32,580	23,660

RAM 3500 4X4 CREW CAB: TRADESMAN RAMBOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11000	4140	6862.82	3871.8	2991.02	5,500	7,000	21,500	14,170
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11000	4140	6862.82	3871.8	2991.02	5,500	7,000	24,000	16,670
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	11800	4050	7751.45	4691.94	3059.51	6,000	7,000	28,300	20,080
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	11800	3880	7917.59	4799.21	3118.38	6,000	7,000	32,580	23,000

RAM 3500 4X4 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11000	4720	6277.74	3927.12	2350.62	5,500	7,000	21,500	14,180
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11000	4720	6277.74	3927.12	2350.62	5,500	7,000	24,000	16,680

2020 RAM 3500 TRAILER TOWING CHART
SAE J2807 COMPLIANT

RAM 3500 4X4 CREW CAB: TRADESMAN 8' BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	DRW	3.73	14000	6700	7301.78	4065.23	3236.55	5,500	9,750	21,500	13,730
6.4L V-8 HEMI	A8 8HP75	DRW	4.10	14000	6700	7301.78	4065.23	3236.55	5,500	9,750	25,000	17,230
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11400	4440	6956.2	4054.34	2901.86	5,500	7,000	21,500	14,070
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11400	4440	6956.2	4054.34	2901.86	5,500	7,000	24,000	16,570
6.7L I-6 TURBO DIESEL	A6 68RFE	SRW	3.73	12300	4490	7808.91	4851.99	2956.92	6,000	7,000	28,300	20,020
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	3.73	14000	5850	8151.21	4841.93	3309.28	6,000	9,750	28,300	19,680
6.7L I-6 TURBO DIESEL	A6 68RFE	DRW	4.10	14000	5850	8151.21	4841.93	3309.28	6,000	9,750	30,300	21,680
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	SRW	3.73	12300	4320	7975.69	4961.86	3013.83	6,000	7,000	33,610	25,090
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	3.73	14000	5590	8414.17	4990.63	3423.54	6,000	9,750	41,600	32,720
6.7L I-6 HO TURBO DIESEL	A6 AS69RC	DRW	4.10	14000	5590	8414.17	4990.63	3423.54	6,000	9,750	43,000	34,110

RAM 3500 4X4 CREW CAB: TRADESMAN W/O BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear		
6.4L V-8 HEMI	A8 8HP75	SRW	3.73	11400	4970	6426.81	4078.91	2347.9	5,500	7,000	21,500	13,960
6.4L V-8 HEMI	A8 8HP75	SRW	4.10	11400	4970	6426.81	4078.91	2347.9	5,500	7,000	24,000	16,460

NOTES

1. **Payload and Max Trailer Weights are ESTIMATED values.**
2. **All values are shown in pounds unless otherwise stated.**
3. **Payload and Max Trailer Weight values are rounded to the nearest 10 lb.**
4. **Payload = GVWR – Base Weight.**
5. **Payload and Trailer Weight Rating are mutually exclusive.**
6. **GAWRs, GVWRs and GCWRs should never be exceeded.**
7. **Trailer Weight Rating and Tow Vehicle Trailering Weight are calculated as specified in SAE J2807.**
   Passenger Weight = 300 lb.
   Options Weight = 100 lb.
   Trailering Equipment Weight: 75 lb. for Conventional Hitch, 70 lb. for Gooseneck and 250 lb. for 5th Wheel.
   Tongue weight: 10 percent of the gross trailer weight for Conventional Hitch, 15 percent of the gross trailer weight for a 5th Wheel or Gooseneck hitch.
   Payload and GAWR should never be exceeded and must account for all of the above weights, including the appropriate trailering equipment and tongue weight.
   Box Off Body Completion Weight = 80 lb. per foot from end of cab to end of frame.
8. **A fifth-wheel hitch is required for trailers over 23,000 lbs.**
9. **A Gooseneck hitch is required for trailers over 30,000 lbs.**
10. **Maximum Capability**

WEIGHT TERM DEFINITIONS

33% option weight
Combined weight of all production installed options that have a projected sales volume of more than 33% and comply with EPA rules.

Axle Ratio
The ratio between the driveshaft rpm and axle shaft rpm. The axle ratio is critical in the operation of the transmission/driveshaft/axle system that transmits engine torque to the driving wheels.

Base Weight
The weight of a standard equipped sales unit (vehicle line, body style, GVWR, engine, transmission & electrification) with full quantities of fuel, lubricant & coolant.

Gross Axle Weight Rating (GAWR)
The maximum weight to be carried by a single axle (front or rear).

Gross Combined Weight Rating (GCWR)
The maximum allowable weight of the towing vehicle and the loaded trailer – including all cargo and passengers – that the vehicle can handle without risking damage.

Gross Vehicle Weight Rating (GVWR)
The maximum allowable weight of the fully loaded vehicle.

Payload
The combined maximum allowable weight of options, cargo and passengers that the truck is designed to carry.

Tongue Weight
The weight a conventional trailer puts on the back of a tow vehicle. 10 percent of the trailer weight recommended for a conventional hitch trailer and 15 percent recommended for a gooseneck or fifth wheel trailer.

Trailer Weight Rating (TWR)
The maximum allowable weight of a trailer plus cargo that a vehicle configuration can handle.

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2020 RAM 1500

Specifications

Specifications are based on the latest product information available at the time of publication.
All dimensions are in inches (millimeters) unless otherwise noted.
All dimensions measured at curb weight with standard tires and wheels.

GENERAL INFORMATION	
Vehicle Type	Quad Cab and Crew Cab: 4x2, 4x4
Assembly Plant	Sterling Heights Assembly Plant, Sterling Heights, Michigan
EPA Vehicle Class	Standard Pickup

BODY/CHASSIS	
Layout	4x2 — Longitudinal, front engine
	4x4 — Longitudinal, front engine, transfer case
Construction	4x2 — Ladder-type frame, steel cab, double-wall steel pickup box
	4x4 — Ladder-type frame, steel cab, double-wall steel pickup box

ENGINE: 3.6-LITER PENTASTAR V-6 WITH eTORQUE	
Type and Description	60-degree gasoline V-6 with variable valve timing, V-type, liquid-cooled
Hybrid Battery	48-volt, 12-cell lithium-ion, nickel manganese cobalt (NMC) graphite chemistry, .43 kWh
Belt-starter Generator	9kW power, 90 lb.-ft. launch torque
Displacement	220 cu. in. (3,604 cu. cm)
Bore x Stroke	3.78 x 3.27 (96.0 x 83.0)
Valve System	Chain-driven DOHC, 24 valves and hydraulic end-pivot roller rockers
Fuel Injection	Sequential, multiport, electronic, returnless
Construction	Aluminum deep-skirt block, aluminum alloy heads

Compression Ratio	11.3:1
Power	305 hp (224 kW) @ 6,400 rpm
Torque	269 lb.-ft. (364 N•m) @ 4,800 rpm
Max. Engine Speed	6,400 rpm (electronically limited)
Fuel Requirement	Unleaded regular, 87 octane
Oil Capacity	6.0 quarts (5.7 liters)
Coolant Capacity	14.0 quarts (13.25 liters)
Emission Controls	Dual three-way catalytic converters, heated oxygen sensors
EPA Fuel Economy mpg (city/hwy)	20/25

ENGINE: 3.0-LITER ECODIESEL V-6	
Type and Description	90-degree diesel V-6
Displacement	182 cu. in. (2,988 cu. cm)
Bore x Stroke	3.27 x 3.60 (83 x 92)
Valve System	Chain driven DOHC, 24 valves
Fuel Injection	Common rail, 29,000 psi (2000 bar), solenoid injectors
Construction	Cast-iron block, aluminum alloy heads
Compression Ratio	16.0:1
Power	260 hp (194 kW) @ 3,600 rpm
Torque	480 lb.-ft. (651 N•m) @ 1,600 rpm
Max. Engine Speed	5,800 rpm
Fuel Requirement	Ultra-low sulfur diesel
Oil Capacity	10.5 quarts (7.8 liters)
Coolant Capacity	12.0 quarts (11.4 liters)
Emission Controls	Cooled EGR, oxidation catalyst, diesel particulate filter, SCR with urea injection
EPA Fuel Economy mpg (city/hwy)	22/32

ENGINE: 5.7-LITER HEMI® V-8	
Type and Description	90-degree gasoline, V-8 with variable cam timing
Displacement	345 cu. in. (5,654 cu. cm)
Bore x Stroke	3.92 x 3.58 (99.5 x 90.9)
Valve System	Variable-cam timing, pushrod-operated overhead valves, 16 valves, hydraulic lifters with roller followers
Fuel Injection	Sequential, multiport, electronic, returnless
Construction	Deep-skirt cast-iron block with cross-bolted main bearing caps, aluminum alloy heads with hemispherical combustion chambers
Compression Ratio	10.5:1
Power	395 hp (291 kW) @ 5,600 rpm
Torque	410 lb.-ft. (556 N•m) @ 3,950 rpm
Max. Engine Speed	5,800 rpm
Fuel Requirement	Unleaded mid-grade, 89 octane — recommended
	Unleaded regular, 87 octane — acceptable
Oil Capacity	7.0 quarts (6.6 liters)
Coolant Capacity	14.0 quarts (13.33 liters)
Emission Controls	Three-way catalytic converters, heated oxygen sensors and internal engine features
EPA Fuel Economy mpg (city/hwy)	15/22

ENGINE: 5.7-LITER HEMI V-8 ETORQUE	
Type and Description	90-degree gasoline V-8 with variable cam timing
Hybrid Battery	48-volt, 12-cell lithium-ion, nickel manganese cobalt (NMC) graphite chemistry, .43 kWh
Belt-starter Generator	12kW power, 130 lb.-ft. launch torque
Displacement	345 cu. in. (5,654 cu. cm)
Bore x Stroke	3.92 x 3.58 (99.5 x 90.9)

Valve System	Variable-cam timing, pushrod-operated overhead valves, 16 valves, hydraulic lifters with roller followers
Fuel Injection	Sequential, multiport, electronic, returnless
Construction	Deep-skirt cast-iron block with cross-bolted main bearing caps, aluminum-alloy heads with hemispherical combustion chambers
Compression Ratio	10.5:1
Power	395 hp (291 kW) @ 5,600 rpm
Torque	410 lb.-ft. (556 N•m) @ 3,950 rpm
Max. Engine Speed	5,800 rpm
Fuel Requirement	Unleaded mid-grade, 89 octane — recommended
	Unleaded regular, 87 octane — acceptable
Oil Capacity	7.0 quarts (6.6 liters)
Coolant Capacity	14.0 quarts (13.33 liters)
Emission Controls	Three-way catalytic converters, heated oxygen sensors and internal engine features
EPA Fuel Economy mpg (city/hwy)	17/23

TRANSMISSION: TORQUEFLITE 845RE EIGHT-SPEED AUTOMATIC	
Availability	Standard with 3.6-liter Pentastar V-6
Description	Adaptive electronic control, automatic or Electronic Range Select (ERS) manual control. Five-clutch-pack design with only two open clutches in any gear. Torque converter lock with turbine torsional damper for low lock-up speeds in 1st through 8th gear
Gear Ratios	
1st	4.71
2nd	3.14
3rd	2.10
4th	1.67
5th	1.29

6th	1.00
7th	0.84
8th	0.67
Reverse	3.30
Axle Ratios	3.21, 3.55, 3.92 (Rebel only)

TRANSMISSION: TORQUEFLITE 8HP75 EIGHT-SPEED AUTOMATIC	
Availability	Standard with 3.0-liter EcoDiesel V-6, 5.7-liter HEMI V-8 and 5.7-liter V-8 with eTorque
Description	Adaptive electronic control, automatic or ERS manual control. Five-clutch-pack design with only two open clutches in any gear. Torque converter lock with turbine torsional damper for low lock-up speeds in 1st through 8th gear
Gear Ratios	
1st	4.71
2nd	3.14
3rd	2.10
4th	1.67
5th	1.29
6th	1.00
7th	0.84
8th	0.67
Reverse	3.30
Axle Ratios	3.21, 3.55 (excluding 5.7-liter HEMI V-8), 3.92

TRANSFER CASE: BW 48-12 PART-TIME	
Availability	3.6-liter Pentastar V-6 4x4 with eTorque, 3.0-liter EcoDiesel V-6, 5.7-liter HEMI V-8 4x4 and 5.7-liter HEMI V-8 with eTorque assist
Shift Mechanism	Electric

Available Speeds	Two-speed
Operating Modes	2WD High; 4WD High, Locked; Neutral; 4WD Low, Locked
Low-range Ratio	2.64
Center Differential Type	None

TRANSFER CASE: BW 48-11 ON-DEMAND	
Availability	3.0-liter EcoDiesel V-6, 5.7-liter HEMI V-8 4x4 and 5.7-liter HEMI V-8 with eTorque assist
Shift Mechanism	Electric
Available Speeds	Two-speed
Operating Modes	2WD High; 4WD Auto; 4WD High, Locked; Neutral; 4WD Low, Locked
Low-range Ratio	2.64
Center Differential Type	None

AXLES	
Front	215mm
Rear	235mm (standard) with available open, limited slip or electronic locking differential
	256mm (optional max tow with Dana Super 60 center section)
Available Ratios	3.21, 3.55, 3.92

ELECTRICAL SYSTEM	
Architecture	Powernet
Alternator	160-amp, 180-amp, 220-amp (Special Services Package)
Battery	Group 94R, low-maintenance H7 730 CCA

SUSPENSION	
Front	Upper and lower A-arms, coil springs, twin-tube shock absorbers and stabilizer bar. Optional air suspension replaces twin-tube shock absorbers and progressive rate coil springs
Rear	Five-link with track bar, progressive rate coil springs, stabilizer bar, twin-tube shock absorbers, solid axle. Optional air suspension replaces progressive rate coil springs

BRAKES	
Front	
Size and Type	14.9 x 1.2 (378 x 30) vented disc with 2.2 in. (57 mm) two-piston pin-slider caliper and anti-lock braking system (ABS)
Swept Area	493.6 sq.in. (3,184 sq.cm)
Rear	
Size and Type	14.8 x 0.87 (375 x 22) disc with 2.2 in. (57 mm) single-piston pin-slider caliper and ABS
Swept Area	367.6 sq.in. (2,371.9 sq.cm)
Power-assist	Dual-rate, tandem diaphragm vacuum

STEERING	
Power assist	Electric power steering

AIR BAGS	
Quad Cab	6
Crew Cab	6

CARGO BOX		
NOMINAL BOX SIZE	5FT., 7IN. (CREW)	6FT., 4IN. (REGULAR, QUAD OR CREW)
SAE volume, cu. ft. (cu m)	53.9 (1.5)	61.5 (1.7)
Length-at-Floor, Tailgate Closed	67.4 (1,711)	76.3 (1,937)
Cargo Width	66.4 (1,687)	66.4 (1,687)
Distance Between Wheelhouses	51.0 (1,295)	51.0 (1,295)
Depth	21.4 (543)	21.5 (545)
Tailgate Opening Width	60.0 (1,525)	60.0 (1,525)

EXTERIOR DIMENSIONS		
QUAD CAB PICKUP, 6FT., 4IN. BOX		
MODEL – TIRE SIZE	4X2 - 275/55R20	4X4 - 275/55R20
Wheelbase (nominal)	140.5 (3,569)	140.5 (3,569)
Track, Front	68.5 (1,741)	68.5 (1,741)
Track, Rear	68.1 (1,729)	68.1 (1,729)
Overall Length	228.9 (5,814)	228.9 (5,814)
Overall Width	82.1 (2,084)	82.1 (2,084)
Overall Height	77.6 (1,971)	77.7 (1,973)
GROUND CLEARANCE	4X2 - 275/55R20	4X4 - 275/55R20
Front Axle	7.8 (199)	8.2 (208)
Rear Axle	8.7 (221)	8.7 (221)
Open Tailgate to Ground	34.6 (979)	34.4 (875)
Pickup Body Height	21.4 (545)	21.4 (545)
Approach Angle, degrees	18.1	18.9

QUAD CAB PICKUP, 6FT., 4IN. BOX (CONTINUED)		
GROUND CLEARANCE	**4X2 - 275/55R20**	**4X4 - 275/55R20**
Departure Angle, degrees	25.2	25.0
Ramp Breakover Angle Without Skid Plate, degrees	19.5	19.9
Ramp Breakover Angle With Skid Plate, degrees	–	17.8
Ground Clearance Without Skid Plate	8.4 (213)	8.7 (221)
Ground Clearance With Skid Plate	–	8.2 (208)
Fuel Tank Capacity	23-gal. (87-liter) (standard) 26-gal. (98-liter) (standard) 33-gal. (125-liter) (optional)	23-gal. (87-liter) (standard) 26-gal. (98-liter) (standard) 33-gal. (125-liter) (optional)

EXTERIOR DIMENSIONS

QUAD CAB PICKUP, 6FT., 4IN. BOX – AIR SUSPENSION, 4X2 AND 4X4

TIRE SIZE: 275/55R20

SUSPENSION MODE	ENTRY / EXIT	NORMAL RIDE HEIGHT	OFF ROAD 1	OFF ROAD 2
Wheelbase (nominal)	140.5 (3,569)	140.5 (3569)	140.5 (3,569)	140.5 (3,569)
Track, Front	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)
Track, Rear	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)
Overall Length	228.9 (5,814)	228.9 (5,814)	228.9 (5,814)	228.9 (5,814)
Overall Width	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)
Overall Height	75.9 (1,927)	77.7 (1,973)	78.7 (1,998)	79.7 (2,025)

QUAD CAB PICKUP, 6FT., 4IN. BOX – AIR SUSPENSION, 4X2 AND 4X4 (CONTINUED)				
GROUND CLEARANCE	**ENTRY / EXIT**	**NORMAL RIDE HEIGHT**	**OFF ROAD 1**	**OFF ROAD 2**
Front Axle	8.2 (208)	8.2 (208)	8.2 (208)	8.2 (208)
Rear Axle	8.7 (221)	8.7 (221)	8.7 (221)	8.7 (221)
Open Tailgate to Ground	32.9 (836)	34.4 (875)	35.1 (893)	36.4 (925)
Pickup Body Height	21.4 (545)	21.4 (545)	21.4 (545)	21.4 (545)
Approach Angle, degrees	14.4	18.9	21.5	23.1
Departure Angle, degrees	22.5	25.0	25.9	27.3
Ramp Breakover Angle Without Skid Plate, degrees	16.5	19.9	21.8	23.5
Ramp Breakover Angle With Skid Plate, degrees	14.4	17.8	19.7	21.3
Ground Clearance Without Skid Plate	6.7 (169)	8.7 (221)	9.9 (251)	10.7 (273)
Ground Clearance With Skid Plate	6.1 (156)	8.2 (208)	9.4 (238)	10.2 (260)
Fuel Tank Capacity	23-gal. (87-liter) (standard) 26-gal. (98-liter) (standard) 33-gal. (125-liter) (optional)			

EXTERIOR DIMENSIONS				
CREW CAB PICKUP				
MODEL – TIRE SIZE	**4X2 – 275/55R20**		**4X4 – 275/55R20**	
BOX LENGTH	**5FT., 7IN.**	**6FT., 4IN.**	**5FT., 7IN.**	**6FT., 4IN.**
Wheelbase (nominal)	144.6 (3,672)	153.5 (3,898)	144.6 (3,672)	153.5 (3,898)
Track, Front	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)
Track, Rear	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)
Overall Length	232.9 (5,916)	241.8 (6,142)	232.9 (5,916)	241.8 (6,142)

CREW CAB PICKUP (CONTINUED)				
MODEL – TIRE SIZE	4X2 – 275/55R20		4X4 – 275/55R20	
BOX LENGTH	5FT., 7IN.	6FT., 4IN.	5FT., 7IN.	6FT., 4IN.
Overall Width	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)
Overall Height	77.5 (1,968)	77.4 (1,966)	77.6 (1,971	77.5 (1,968)

GROUND CLEARANCE	5FT., 7IN.	6FT., 4IN.	5FT., 7IN.	6FT., 4IN.
Front Axle	7.8 (199)	7.8 (199)	8.2 (209)	8.1 (207)
Rear Axle	8.6 (220)	8.7 (220)	8.7 (220)	8.6 (220)
Open Tailgate to Ground	34.5 (877)	34.4 (875)	34.3 (872)	34.3 (871)
Pickup Body Height	21.4 (543)	21.4 (545)	21.4 (543)	21.4 (545)
Approach Angle, degrees	18.0	18.1	19.0	18.9
Departure Angle, degrees	25.1	25.0	24.9	24.9
Ramp Breakover Angle Without Skid Plate, degrees	19.0	18.4	19.5	18.7
Ramp Breakover Angle With Skid Plate, degrees	–	–	17.5	16.7
Ground Clearance Without Skid Plate	8.3 (211)	8.3 (212)	8.7 (222)	8.6 (220)
Ground Clearance With Skid Plate	–	–	8.2 (209)	8.1 (207)
Fuel Tank Capacity	23-gal. (87-liter) (standard) 26-gal. (98-liter) (standard) 33-gal. (125-liter) (optional)			

EXTERIOR DIMENSIONS

CREW CAB, 5FT., 7IN. BOX – AIR SUSPENSION, 4X2 AND 4X4

TIRE SIZE: 275/55R20

SUSPENSION MODE	ENTRY / EXIT	NORMAL RIDE HEIGHT	OFF ROAD 1	OFF ROAD 2
Wheelbase (nominal)	144.6 (3,672)	144.6 (3,672)	144.6 (3,672)	144.6 (3,672)
Track, Front	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)
Track, Rear	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)
Overall Length	232.9 (5,916)	232.9 (5,916)	232.9 (5,916)	232.9 (5,916)
Overall Width	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)
Overall Height	75.8 (1,926)	77.6 (1,971)	78.6 (1,996)	79.6 (2,023)

GROUND CLEARANCE	ENTRY / EXIT	NORMAL RIDE HEIGHT	OFF ROAD 1	OFF ROAD 2
Front Axle	8.2 (209)	8.2 (209)	8.2 (209)	8.2 (209)
Rear Axle	8.7 (220)	8.7 (220)	8.7 (220)	8.7 (220)
Open Tailgate to Ground	32.8 (833)	34.3 (872)	35.0 (890)	36.3 (923)
Pickup Body Height	21.4 (543)	21.4 (543)	21.4 (543)	21.4 (543)
Approach Angle, degrees	14.6	19.0	21.7	23.3
Departure Angle, degrees	22.4	24.9	25.8	27.2
Ramp Breakover Angle Without Skid Plate, degrees	16.2	19.5	21.4	23.0
Ramp Breakover Angle With Skid Plate, degrees	14.2	17.5	19.3	21.0
Ground Clearance Without Skid Plate	6.7 (170)	8.7 (222)	9.9 (252)	10.8 (273)
Ground Clearance With Skid Plate	6.2 (157)	8.2 (209)	9.4 (239)	10.3 (261)
Fuel Tank Capacity	23-gal. (87-liter) (standard) 26-gal. (98-liter) (standard) 33-gal. (125-liter) (optional)			

EXTERIOR DIMENSIONS				
CREW CAB, 6FT., 4IN. BOX – AIR SUSPENSION, 4X2 AND 4X4				
TIRE SIZE: 275/55R20				
SUSPENSION MODE	**ENTRY / EXIT**	**NORMAL RIDE HEIGHT**	**OFF ROAD 1**	**OFF ROAD 2**
Wheelbase (nominal)	153.5 (3,898)	153.5 (3,898)	153.5 (3,898)	153.5 (3,898)
Track, Front	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)	68.5 (1,741)
Track, Rear	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)	68.1 (1,729)
Overall Length	241.8 (6,142)	241.8 (6,142)	241.8 (6,142)	241.8 (6,142)
Overall Width	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)	82.1 (2,084)
Overall Height	75.7 (1,922)	77.5 (1,968)	78.4 (1,993)	79.5 (2,019)
GROUND CLEARANCE	**ENTRY / EXIT**	**NORMAL RIDE HEIGHT**	**OFF ROAD 1**	**OFF ROAD 2**
Front Axle	8.1 (207)	8.1 (207)	8.1 (207)	8.1 (207)
Rear Axle	8.6 (220)	8.6 (220)	8.6 (220)	8.6 (220)
Open Tailgate to Ground	32.7 (832)	34.3 (871)	35.0 (889)	36.3 (922)
Pickup Body Height	21.4 (545)	21.4 (545)	21.4 (545)	21.4 (545)
Approach Angle, degrees	14.5	18.9	21.5	23.1
Departure Angle, degrees	22.7	24.9	25.8	27.1
Ramp Breakover Angle Without Skid Plate, degrees	15.5	18.7	20.6	22.1
Ramp Breakover Angle With Skid Plate, degrees	13.5	16.7	18.5	20.1
Ground Clearance Without Skid Plate	6.6 (168)	8.6 (220)	9.8 (250)	10.7 (271)
Ground Clearance With Skid Plate	6.1 (155)	8.1 (207)	9.3 (237)	10.2 (259)
Fuel Tank Capacity	23-gal. (87-liter) (standard) 26-gal. (98-liter) (standard) 33-gal. (125-liter) (optional)			

INTERIOR DIMENSIONS

ACCOMMODATIONS

MODEL	QUAD CAB	CREW CAB
Seating Capacity, F/R	3/3	3/3

FRONT	QUAD CAB	CREW CAB
Headroom	40.9 (1,038)	40.9 (1,038)
Legroom	40.9 (1,040)	40.9 (1,040)
Shoulder Room	66.0 (1,676)	66.0 (1,676)
Hip Room	63.4 (1,610)	63.4 (1,610)
Seat Travel	8.7 (220)	8.7 (220)
Recliner Range (degrees)	Total travel 71 degrees (from full forward) 18 degrees forward (from design) 53 degrees rearward (from design)	

REAR	QUAD CAB	CREW CAB
Headroom	39.2 (995)	39.8 (1,011)
Legroom	35.6 (903)	45.2 (1,147)
Shoulder Room	65.7 (1,668)	65.7 (1,670)
Hip Room	63.4 (1,610)	63.4 (1,611)

INTERIOR VOLUME	QUAD CAB	CREW CAB
Front – cu. ft. (cu m)	63.9 (1.8)	63.9 (1.8)
Rear – cu. ft. (cu m)	53.3 (1.5)	68.5 (1.9)

STEERING SPECIFICATIONS

QUAD CAB PICKUP

MEASUREMENT	2WD SHORT BED	2WD LONG BED	4WD SHORT BED	4WD LONG BED	4WD REBEL
Wheelbase (nominal; in/mm)	140.5 / 3,569	140.5 / 3,569	140.5 / 3,569	140.5 / 3,569	140.5 / 3,569
Overall Ratio	16.3:1	16.3:1	16.3:1	16.3:1	17.8:1
Steering Wheel Turns (lock-to-lock)	3.1	3.1	3.1	3.1	3.4
18-in. Tire Turning Diameter (ft. / M)*	46.2 / 14.1	46.2 / 14.1	46.2 / 14.1	46.2 / 14.1	46.2 / 14.1
20-in. Tire Turning Diameter (ft. / M)*	45.1 / 13.74	45.1 / 13.74	45.1 / 13.74	45.1 / 13.74	NA

CREW CAB PICKUP

MEASUREMENT	2WD SHORT BED	2WD LONG BED	4WD SHORT BED	4WD LONG BED	4WD REBEL
Wheelbase (nominal)	144.6 / 3,672	153.5 / 3,898	144.6 / 3,572	153.5 / 3,898	144.6 / 3,572
Overall Ratio	16.3:1	15.5:1	16.3:1	15.5:1	17.8:1
Steering Wheel Turns (lock-to-lock)	3.1	2.9	3.1	2.9	3.4
18-in. Tire Turning Diameter (ft. / M)*	46.2 / 14.08	48.7 / 14.84	46.2 / 14.08	48.7 / 14.84	46.2 / 14.1
20-in. Tire Turning Diameter (ft. / M)*	46.2 / 14.08	48.7 / 14.84	46.2 / 14.08	48.7 / 14.84	NA

*** = Curb-to-curb turning diameter is measured at the outside of the tires at curb height. Turning diameters and steering wheel turns, lock-to-lock may differ with optional tires and wheels.**

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2020 RAM 1500

Towing Chart

RAM 1500 4X2 QUAD CAB: HFE 6'4" BOX

Engine	Transmission	SRW/DRW	Axle Ratio	GVWR	Payload	Base Weight Total	Base Weight Front	Base Weight Rear	GAWR Front	GAWR Rear	GCW	GCWR	Max. Trailer Weight Rating
3.6L V-6	A8 845RE	SRW	3.21	6010	1200	4809.80	2732.37	2077.43	3,700	4,100	11,900	11,900	6,720

RAM 1500 4X2 QUAD CAB: TRADESMAN 6'4" BOX

Engine	Transmission	SRW/DRW	Axle Ratio	GVWR	Payload	Base Weight Total	Base Weight Front	Base Weight Rear	GAWR Front	GAWR Rear	GCW	GCWR	Max. Trailer Weight Rating
3.6L V-6	A8 845RE	SRW	3.55	7100	2300	4804.74	2737.13	2067.61	3,700	4,100	12,900	12,900	7,710
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.21	7200	2040	5160.07	3030.15	2129.92	3,700	4,100	13,900	13,900	8,370
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.92	7200	2040	5160.07	3030.15	2129.92	3,700	4,100	15,600	15,600	10,070
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.92	7200	2040	5160.07	3030.15	2129.92	3,700	4,100	18,092	18,200	12,560
5.7L V-8 HEMI®	A8 8HP75	SRW	3.21	6900	1900	4997.46	2921.07	2076.39	3,700	4,100	13,900	13,900	8,520
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1900	4997.46	2921.07	2076.39	3,700	4,100	13,900	13,900	8,520
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1900	4997.46	2921.07	2076.39	3,700	4,100	17,000	17,000	11,620
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1900	4997.46	2921.07	2076.39	3,700	4,100	17,000	17,000	11,620
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1820	5078.24	2978.74	2099.50	3,700	4,100	13,900	13,900	8,440

RAM 1500 4X2 QUAD CAB: TRADESMAN 6'4" BOX (CONTINUED)

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1820	5078.24	2978.74	2099.50	3,700	4,100	13,900	13,900	8,440
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1820	5078.24	2978.74	2099.50	3,700	4,100	17,000	17,000	11,540
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1820	5078.24	2978.74	2099.50	3,700	4,100	17,000	17,000	11,540
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1820	5078.24	2978.74	2099.50	3,700	4,100	18,208	18,350	12,750
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1820	5078.24	2978.74	2099.50	3,700	4,100	18,208	18,350	12,750

RAM 1500 4X2 CREW CAB: TRADESMAN 6'4" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
3.6L V-6	A8 845RE	SRW	3.21	6900	1960	4944.61	2823.08	2121.53	3,700	4,100	11,900	11,900	6,580
3.6L V-6	A8 845RE	SRW	3.55	6900	1960	4944.61	2823.08	2121.53	3,700	4,100	12,900	12,900	7,580
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.21	7000	1740	5264.61	3125.09	2139.52	3,700	4,100	13,900	13,900	8,250
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.92	7000	1740	5264.61	3125.09	2139.52	3,700	4,100	15,600	15,600	9,950
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1770	5131.07	3009.25	2121.82	3,700	4,100	13,900	13,900	8,390
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1770	5131.07	3009.25	2121.82	3,700	4,100	13,900	13,900	8,390
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1770	5131.07	3009.25	2121.82	3,700	4,100	17,000	17,000	11,490

RAM 1500 4X2 CREW CAB: TRADESMAN 6'4" BOX (CONTINUED)

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1770	5131.07	3009.25	2121.82	3,700	4,100	17,000	17,000	11,490
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1680	5216.96	3049.94	2167.02	3,700	4,100	13,900	13,900	8,300
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1680	5216.96	3049.94	2167.02	3,700	4,100	13,900	13,900	8,300
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1680	5216.96	3049.94	2167.02	3,700	4,100	17,000	17,000	11,400
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1680	5216.96	3049.94	2167.02	3,700	4,100	17,000	17,000	11,400

RAM 1500 4X2 CREW CAB: TRADESMAN 5'7" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
3.6L V-6	A8 845RE	SRW	3.21	6900	2000	4901.98	2760.90	2141.08	3,700	4,100	11,900	11,900	6,620
3.6L V-6	A8 845RE	SRW	3.55	6900	2000	4901.98	2760.90	2141.08	3,700	4,100	12,900	12,900	7,620
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.21	7000	1780	5220.33	3061.04	2159.29	3,700	4,100	13,900	13,900	8,210
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.92	7000	1780	5220.33	3061.04	2159.29	3,700	4,100	15,600	15,600	9,910
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1810	5086.79	2945.20	2141.59	3,700	4,100	13,900	13,900	8,440
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1810	5086.79	2945.20	2141.59	3,700	4,100	13,900	13,900	8,440
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1810	5086.79	2945.20	2141.59	3,700	4,100	17,000	17,000	11,540

RAM 1500 4X2 CREW CAB: TRADESMAN 5'7" BOX (CONTINUED)

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight Total	Base Weight Front	Base Weight Rear	GAWR Front	GAWR Rear	GCW	GCWR	Max. Trailer Weight Rating
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1810	5086.79	2945.20	2141.59	3,700	4,100	17,000	17,000	11,540
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1720	5176.82	3006.87	2169.95	3,700	4,100	13,900	13,900	8,300
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	6900	1720	5176.82	3006.87	2169.95	3,700	4,100	13,900	13,900	8,300
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1720	5176.82	3006.87	2169.95	3,700	4,100	17,000	17,000	11,400
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	6900	1720	5176.82	3006.87	2169.95	3,700	4,100	17,000	17,000	11,400

RAM 1500 4X4 QUAD CAB: TRADESMAN 6'4" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight Total	Base Weight Front	Base Weight Rear	GAWR Front	GAWR Rear	GCW	GCWR	Max. Trailer Weight Rating
3.6L V-6	A8 845RE	SRW	3.21	6800	1810	4993.77	2901.45	2092.32	3,900	4,100	11,900	11,900	6,460
3.6L V-6	A8 845RE	SRW	3.55	6800	1810	4993.77	2901.45	2092.32	3,900	4,100	12,900	12,900	7,460
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.21	7100	1750	5353.51	3189.06	2164.45	3,900	4,100	13,900	13,900	8,160
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.92	7100	1750	5353.51	3189.06	2164.45	3,900	4,100	15,600	15,600	9,860
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1910	5191.28	3086.40	2104.88	3,900	4,100	13,900	13,900	8,310
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1910	5191.28	3086.40	2104.88	3,900	4,100	13,900	13,900	8,310
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1910	5191.28	3086.40	2104.88	3,900	4,100	17,000	17,000	11,410

RAM 1500 4X4 QUAD CAB: TRADESMAN 6'4" BOX (CONTINUED)

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1910	5191.28	3086.40	2104.88	3,900	4,100	17,000	17,000	11,410
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1820	5278.23	3150.25	2127.98	3,900	4,100	13,900	13,900	8,220
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1820	5278.23	3150.25	2127.98	3,900	4,100	13,900	13,900	8,220
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1820	5278.23	3150.25	2127.98	3,900	4,100	17,000	17,000	11,320
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1820	5278.23	3150.25	2127.98	3,900	4,100	17,000	17,000	11,320

RAM 1500 4X4 CREW CAB: TRADESMAN 6'4" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
3.6L V-6	A8 845RE	SRW	3.21	6900	1770	5125.12	2993.75	2131.37	3,900	4,100	11,900	11,900	6,390
3.6L V-6	A8 845RE	SRW	3.55	6900	1770	5125.12	2993.75	2131.37	3,900	4,100	12,900	12,900	7,390
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.21	7200	1750	5448.39	3295.21	2153.18	3,900	4,100	13,900	13,900	7,850
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.92	7200	1750	5448.39	3295.21	2153.18	3,900	4,100	15,600	15,600	9,550
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1790	5314.85	3179.37	2135.48	3,900	4,100	13,900	13,900	8,200
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1790	5314.85	3179.37	2135.48	3,900	4,100	13,900	13,900	8,200
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1790	5314.85	3179.37	2135.48	3,900	4,100	17,000	17,000	11,300

RAM 1500 4X4 CREW CAB: TRADESMAN 6'4" BOX (CONTINUED)

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1790	5314.85	3179.37	2135.48	3,900	4,100	17,000	17,000	11,300
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1690	5413.14	3243.54	2169.60	3,900	4,100	13,900	13,900	7,990
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1690	5413.14	3243.54	2169.60	3,900	4,100	13,900	13,900	7,990
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1690	5413.14	3243.54	2169.60	3,900	4,100	17,000	17,000	11,090
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1690	5413.14	3243.54	2169.60	3,900	4,100	17,000	17,000	11,090

RAM 1500 4X4 CREW CAB: TRADESMAN 5'7" BOX

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
3.6L V-6	A8 845RE	SRW	3.21	6900	1810	5089.64	2916.73	2172.91	3,900	4,100	11,900	11,900	6,410
3.6L V-6	A8 845RE	SRW	3.55	6900	1810	5089.64	2916.73	2172.91	3,900	4,100	12,900	12,900	7,410
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.21	7200	1800	5398.16	3227.55	2170.61	3,900	4,100	13,900	13,900	8,010
3.0L V-6 ECODIESEL	A8 8HP75	SRW	3.92	7200	1800	5398.16	3227.55	2170.61	3,900	4,100	15,600	15,600	9,710
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1840	5264.62	3111.71	2152.91	3,900	4,100	13,900	13,900	8,190
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1840	5264.62	3111.71	2152.91	3,900	4,100	13,900	13,900	8,190
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1840	5264.62	3111.71	2152.91	3,900	4,100	17,000	17,000	11,290

RAM 1500 4X4 CREW CAB: TRADESMAN 5'7" BOX (CONTINUED)

Engine	Transmission	SRW/ DRW	Axle Ratio	GVWR	Payload	Base Weight			GAWR		GCW	GCWR	Max. Trailer Weight Rating
						Total	Front	Rear	Front	Rear			
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1840	5264.62	3111.71	2152.91	3,900	4,100	17,000	17,000	11,290
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1770	5334.44	3162.65	2171.79	3,900	4,100	13,900	13,900	8,120
5.7L V-8 HEMI	A8 8HP75	SRW	3.21	7100	1770	5334.44	3162.65	2171.79	3,900	4,100	13,900	13,900	8,120
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1770	5334.44	3162.65	2171.79	3,900	4,100	17,000	17,000	11,220
5.7L V-8 HEMI	A8 8HP75	SRW	3.92	7100	1770	5334.44	3162.65	2171.79	3,900	4,100	17,000	17,000	11,220

NOTES

1. **Payload and Max Trailer Weights are ESTIMATED values.**
2. **All weights are shown in pounds unless otherwise stated.**
3. **Payload and Max Trailer Weight values are rounded to the nearest 10 lb.**
4. **Payload = GVWR – Base Weight.**
5. **Trailer Weight Rating and Tow Vehicle Trailering Weight are calculated as specified in SAE J2807.**
   Passenger Weight = 300 lb.
   Options Weight is option content above 33 percent of sales volume.
   Trailer equipment weight = Class IV receiver hitch is 11.1 lb. (if not already included in options weight).
   Trailer Hitch is 10 lb. if TWR is less or equal to 5,000 lb. and 65 lb. if TWR is greater than 5,000 lb.
6. **Payload and Trailer Weight Rating are mutually exclusive.**
7. **GAWRs, GVWRs and GCWRs should never be exceeded.**
8. **The recommended tongue weight for a conventional hitch is 10 percent of the gross trailer weight.**
   The maximum tongue weight for Class IV receiver hitch is limited to 1100 lb.
9. **Weight Distributing Hitch is recommended for trailers over 5,000 lb.**

WEIGHT TERM DEFINITIONS

33% Option Weight
Combined weight of all production installed options that have a projected sales volume of more than 33% and comply with EPA rules.

Axle Ratio
The ratio between the driveshaft rpm and axle shaft rpm. The axle ratio is critical in the operation of the transmission/driveshaft/axle system that transmits engine torque to the driving wheels.

Base Weight
The weight of a standard equipped sales unit (vehicle line, body style, GVWR, engine, transmission & electrification) with full quantities of fuel, lubricant & coolant.

Gross Axle Weight Rating (GAWR)
The maximum weight to be carried by a single axle (front or rear).

Gross Combined Weight Rating (GCWR)
The maximum allowable weight of the towing vehicle and the loaded trailer – including all cargo and passengers – that the vehicle can handle without risking damage.

Gross Vehicle Weight Rating (GVWR)
The maximum allowable weight of the fully loaded vehicle.

Payload
The combined maximum allowable weight of options, cargo and passengers that the truck is designed to carry.

Tongue Weight
The weight a conventional trailer puts on the back of a tow vehicle. 10 percent of the trailer weight recommended for a conventional hitch trailer and 15 percent recommended for a gooseneck or fifth wheel trailer.

Trailer Weight Rating (TWR)
The maximum allowable weight of a trailer plus cargo that a vehicle configuration can handle.

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