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The Numbers Game

How Truck Makers Determine
Towing Capacity

by gary witzenburg



Towing Capacity

Thanks to youthful ignorance and inexperience, my early towing travails were less than terrific. Following my senior year in high school, I battled a treacherously unstable rental trailer packed full of my stuff for 600 miles, stopping to pick much of it up off the road each time the trailer whipsawed so violently its poorly secured doors flew open. Home at last, I discovered that the idiot who had hung the temporary hitch on my bumper had mounted it way off center.

A few years later, I was dragging my low-budget race car all over the Midwest on a low-budget trailer designed for a much lighter load. I soon learned to handle it, but that overloaded trailer was so unstable that no one else could keep it under control. More years passed before I could afford a proper trailer with decent trailer brakes, which made things much better.

I sometimes wonder if today's fledgling trailer-towers struggle through such learning curves. But it's a more sophisticated art these days, with much more capable vehicles and technology

and no shortage of help and advice from manufacturers and media.

For starters, nearly everything capable of towing or hauling, from full-size pickups to compact crossovers, carries factory ratings that tell you how much it can handle. Most of us understand these are not to be ignored if we want to avoid the frustrations of insufficient performance, cooling, braking, or handling and even tire, wheel, chassis, or structural failures.

But where do these capability ratings come from? How much can we trust them? Do they result from rigorous testing by experienced engineers—or from marketing mavens bent on one-upping each other? Are there government and/or Society of Automotive Engineers (SAE) procedures and standards that manufacturers must follow?

It's safe to say that dedicated teams of tireless truck engineers toil in laboratories and on proving grounds and public roads, in all extremes of weather, to ensure that their

Honda Ridgeline





Chevrolet Silverado HD



tow-capable vehicles measure up to their published ratings. It's also safe to say that marketing types typically set the targets based on customer research and competitive needs.

There have not been industry standards for establishing tow ratings—but there soon will be. A group of engineers from GM, Ford, Chrysler, Toyota, Nissan, and Honda has been formulating SAE “recommended practices” that will establish a consistent set of procedures and measures for determining Gross Combined Weight (GCW) and tow ratings. It is targeted for the 2011 model year, but the industry’s financial struggles may set it back a year.

CURRENT PRACTICE

How have these oh-so-important ratings been determined in the past? “First is market considerations,” says GM trailering engineer Robert Krouse,

who chairs the group putting together the SAE standards. “We hear from our customers—what they want to haul, what they want to trailer—and see what our competitors are doing.”

“The starting point is defining the customer’s intended usage or purpose for the vehicle,” echoes Eric Kuehn, chief engineer for Ford’s full-size trucks. “With specifics around our previous model and competitive sets, we define what those capabilities need to be. That sets up overall design metrics around the GCWRs, GAWRs [gross axle weight ratings], tongue weight, and payload, which set up design criteria for the architecture and specific components.”

“It all starts when we’re developing a platform,” adds Richard Miller, regional product manager for Nissan trucks. “We research the market and the customers, see what our competitors are doing, and decide where we want to position our vehicle. If we want to be the leader, we’ll check competitors’ ratings, project where we expect them to be by the time we launch our new platform, and set that as a target. That target is then cascaded to the different engineering and component groups, who test and develop their parts to meet it.”

Karl Forster, a member of the SAE trailer towing group who was vehicle

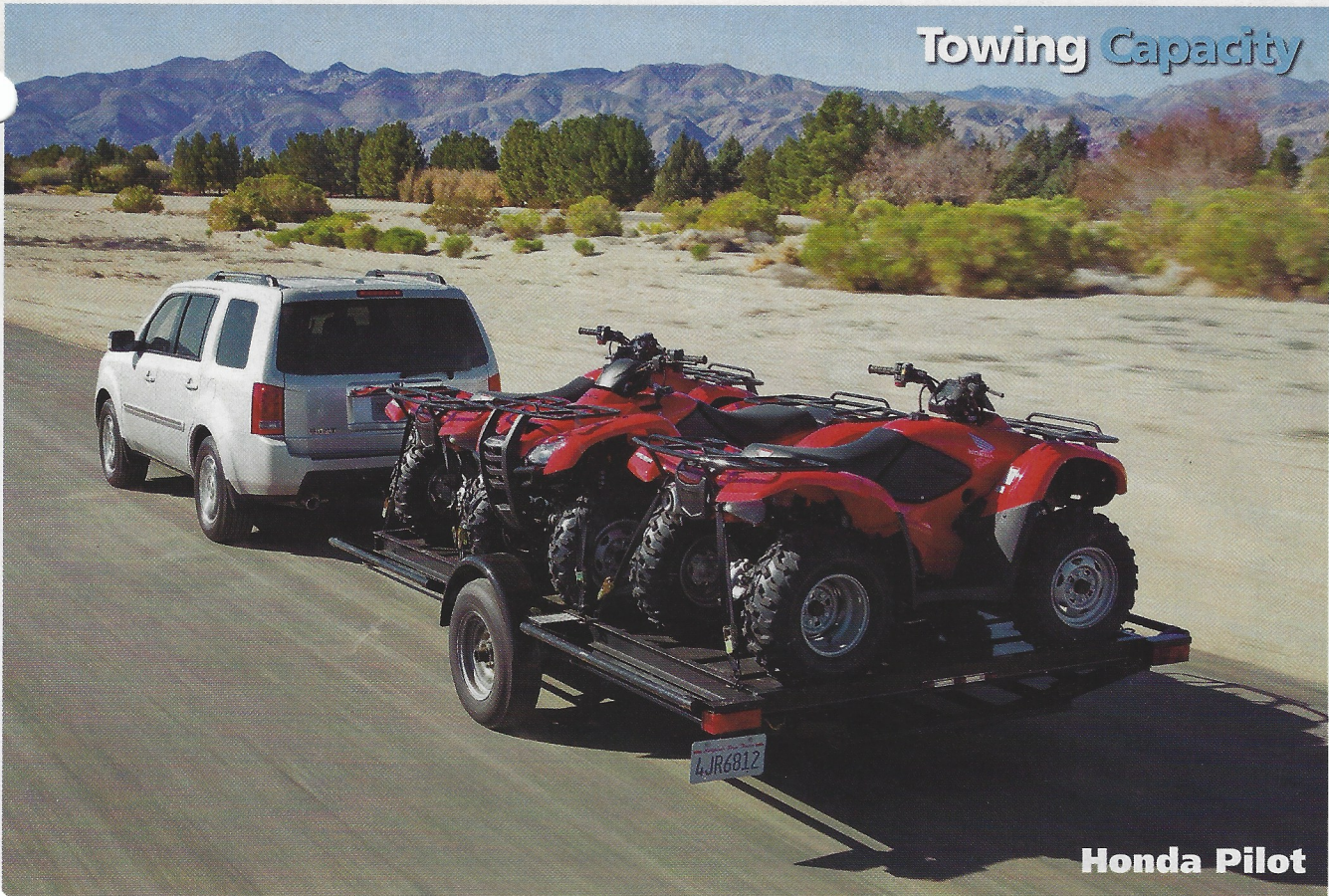
dynamics project leader on Honda’s unibody Ridgeline pickup and Pilot SUV, says Honda’s ratings come from actual customer usage. “We spent a fair amount of time observing and talking to light-truck customers to understand how they use and load their vehicles and how they tow trailers,” he says. “For the Ridgeline, our survey found out that 84 percent of truck buyers tow 5000 pounds or less.” Toyota says simply that it uses several measures to determine a vehicle’s tow rating, including vehicle dynamics and powertrain effectiveness.

THE RATINGS

Among key truck specifications, GVWR (gross vehicle weight rating) is the maximum a vehicle can weigh fully loaded, including occupants, cargo, and trailer tongue weight. Payload (GVWR minus curb weight) is the maximum it can carry, including occupants, in addition to its own weight. GCWR is the maximum a fully loaded tow vehicle and trailer combined can weigh.

For obvious reasons, truck makers have often aimed to leap-frog each others’ ratings when designing new market entries. “In the 1998 time frame,” GM’s Krouse points out, “half-ton tow ratings were maybe 7500 pounds, and a duallie’s was 10,000. Now, half-tons are about 11,000 and duallies 15,000.

Towing Capacity



Honda Pilot

Certainly improvements have been made to our vehicles and their capabilities—but 50 percent increases? The marketing people want higher numbers, but the industry has realized that we need to get a handle on it. We all realize something needs to be done to get something in place and stop this escalation.”

Both Ford and Chrysler launched new light-duty pickups for 2009, and while the F-150 boasts industry-leading tow ratings, Chrysler took the unusual step of holding its new Dodge Ram's capabilities where the outgoing models' were. “We did a lot of customer research,” explains Ram chief engineer Mike Cairns. “That data showed that well over 90 percent of light-duty truck customers were happy and satisfied with their current tow ratings, well over 80 percent tow less than a 6000-pound trailer, and an overwhelming majority were looking for improved fuel economy. We took that to heart. To improve tow ratings, you're going to add weight and cooling drag, both of which reduce fuel economy, so we didn't think that made sense.

“Based on all this research data and customer feedback, we set targets for tow and payload ratings to match our 2008 models. The customers were not asking for more, so that's where 2009 targets were set. Also, our new light-duty Ram has an all-new coil-sprung

rear suspension, and we achieved those targets with that rear suspension.”

Mike Raymond, Chrysler's senior manager for light-duty truck synthesis and vehicle development, points out that GVWRs, unlike tow ratings, are influenced by federal restrictions within each weight class: “Cargo without a trailer goes into the GVWR calculation, where you have to meet federal stopping requirements, for example. You have to pay attention to payload with a non-trailer vehicle and comply with brake and other standards.” He also suggests that customers who really need to tow large, heavy trailers should opt for the heavy-duty Ram.

CAPABILITY TESTING

When towing a trailer of any size, you need enough engine torque to get it launched from a stop, including uphill, and enough power to keep it moving at reasonable speeds up long, steep grades and to safely pass on two-lane roads. You need sufficient engine and driveline cooling to avoid overheating coolant or lubricants up long hills and in hot weather and sufficient brake capacity and cooling to safely descend long downhill grades. You don't want the trailer fishtailing or destabilizing your tow vehicle under any conditions, and you don't want to overload your tires,



wheels, suspension, frame, or body structure.

Not surprisingly, tow vehicle development and testing is extensive. It begins at the component level, in labs and on benches, continues through the subsystem level (chassis, brakes, powertrain) and culminates with complete vehicles from early prototypes through production. “We do a lot of hot-room and cold-room testing,” says Chrysler's Cairns. “We have goal temperatures for critical components, so we take thermal data from fully instrumented vehicles in test cells and match that against CFD [computational fluid dynamics].

“We also do a lot of work in the wind tunnel to assure that we're getting good cooling airflow while minimizing drag. Cooling drag is big drag, so you want to make sure you have enough but not



Dodge Durango



too much. [For that reason] for the first time, we have separated our light-duty from the heavy-duty truck in front-end styling, because we were able to optimize the light-duty for aerodynamics and the heavy-duty for capability."

Vehicle synthesis engineer Jason Briggs adds that Chrysler (like everyone) uses a variety of public-road test sites: "Davis Dam in Arizona, which is used in the coming SAE standards, Eisenhower Grade in Colorado, Baker Grade in California. We do climate-control testing in Death Valley and in the Southeast for heavy heat and humidity. We also do city traffic, with and without trailers, for cooling performance."

Miller points out that Nissan uses standard tests and procedures "to verify that whatever performances we've asked for are met. It's a two-step process: individual components, then the complete vehicle. We instrument

vehicle at concept time and drive it through the conditions at which we want to perform. GVWR testing is more handling, structure, and ride comfort. GCWR is where you get your powertrain and braking. We also do durability testing. Instead of driving one day's worth of traffic jams, we might do the traffic jam loop 10 times in one day to shorten our total test time."

NEW SAE STANDARDS

The upcoming SAE J2807 recommended practices will include five areas of testing: structure, propulsion, thermal, handling, and braking. The structure tests validate body, bumper, and frame strength and the hitch itself. The propulsion tests include: launching five times in five minutes, in forward and reverse, on a (very steep) 12-percent grade; zero to 30, zero-to-60, and 40-60-mph level-road acceleration tests; and minimum speed on the Davis Dam grade.

The thermal test, which is part of the long, grueling Davis Dam gradeability exercise, requires no loss of fluids and no warning alerts that would require customer action—and it must be done at 100 degrees F or hotter. The handling tests require sufficient trailer-sway damping and stability enhancing tow vehicle understeer with weight-carrying and weight-distributing hitch setups. The brake tests specify a maximum

stopping distance from 20 mph (from federal regulations) and both uphill and downhill park-brake performance on a 12-percent grade.

"SAE J2807 will say, 'Here are your performance requirements to set a GCWR—how fast you can get up a hill, how cool the truck is while doing it, how well the combination handles, etc.,'" says GM's Krouse. "Then the last section says, 'Now that you have validated to this GCWR, here's how to calculate your trailer weight rating from it.'

"And we're not going to let people use a stripped-down model to get their ratings for a whole group of models. We require the whole EPA content, the same weight we use for fuel economy and emissions certification, including two people. It will also take into account representative aftermarket trailering equipment—hitch inserts, weight-distributing bars if needed, and so on. We're trying to do it the way people really buy and use these vehicles, and anything that has a tow rating should follow these practices.

Even a Chevy Cobalt that wants to tow a 1000-pound trailer has to accelerate on grades, have cooling to get up those grades, and be able to handle and stop that trailer."

Ford's Kuehn adds that the trailer requirements will include frontal area: "For a trailer over 7700 pounds," he says,

Towing Capacity



Dodge Ram

a 60 square-foot frontal area is part of the test procedure. That obviously puts a lot of drag on the vehicle's powertrain and overall capabilities."

Ford full-size-truck engineering manager Jeff Lewis points out that these standard practices will get all tow vehicle makers aligned around how overall capabilities are defined "so that customers, as they go from vehicle to vehicle and competitor to competitor, will have a common means to assess its capabilities without having to go through each maker's own specific ways of rating them."

EVERYONE ON BOARD?

Once these SAE recommended practices take effect, will all automakers operating in North America comply? "It depends," says Nissan's Miller. "Right now it looks fair and straightforward, so I don't see why we wouldn't. But we want to see where it all comes out before we commit."

Honda's Forster says he's impressed by the professional approach of all the group's members: "They've recognized the opportunity to create a unified ratings practice," he says, "and everyone has worked well together to come to consensus." Toyota says it's aware that new SAE-proposed towing standards are coming and is reviewing them.

GM's Krouse believes the automakers

will comply. "They should end up with GCWRs similar to where they are today," he predicts, "but trailer weight ratings will drop at least a couple hundred pounds across the board because we're accounting for mass that we don't today. That will cause a little heartburn. Nobody's going to do this unilaterally."

What do these factory experts recommend looking for beyond the ratings themselves? "You can't bypass physics," says Chrysler's Cairns. "A stronger, more powerful engine is probably going to do the job better, whatever your trailer is, than a smaller, weaker one."

Vehicle weight is also important, since less vehicle weight gives you more trailer weight out of the GCWR." He also plugs the Ram's new link-coil rear suspension: "It has about twice the lateral stiffness of a leaf spring suspension, which translates to trailer control."

Rival Ford's experts, no surprise, offer somewhat different recommendations: "The first thing I would look at," Kuehn responds, "depending on what kind of towing you want to do, would be technologies available on the vehicle. Each manufacturer has a trailer-towing guide, so going through those in detail will help people understand the capabilities each has put into its vehicles."



The technology piece is what features are available that assist the customer in managing the truck and helping the truck manage the trailer—things like the tow/haul modes, trailer brake integrated controls, and trailer-sway mitigation."

Both also recommend third-party comparison tests and advice from credible media. Each potential tow vehicle will have its own competitive advantages and disadvantages: One may have higher ratings, while another offers more power and torque, another better fuel economy, another more quiet and comfortable ride, another more technology, still another its own exclusive features.

It's a major investment you'll live with for many years, so do your homework and test-drive everything on your candidate list before making your decision.

You'll be glad you did. **TT**