Defining Torque Converter Stall Speed

Part of an ongoing series from the
Torque Converter Rebuilder Association (TCRA)

Occasionally a customer may ask about the stall speed of a specific torque converter. Or he might ask, "I want a converter that stalls at 2100 RPM. What do you have?" At first glance these questions sound reasonable, and you might think they'd have simple, straightforward answers.

Unfortunately, the answers to these questions are neither straightforward nor simple. To answer these (and other similar) questions properly, you need to understand that *torque converter stall speed depends on the power output capabilities and characteristics of the engine it's mated to.* In other words, the power of the engine plays a big part in the stall speed of a converter.

In vehicles equipped with automatic transmissions, torque converter stall speed is defined as:

The maximum attainable engine RPM with (1) the engine running, (2) the transmission in gear, and (3) the transmission input shaft locked in place.

Another way to put it is: How fast can the engine spin the outer shell of the torque converter when the inner turbine is locked in a stationary position?

Given this definition, how can you determine the true stall speed of a specific converter? In most vehicles, you can't. First, the vehicle has to have an accurate tachometer to measure engine RPM, and second, there has to be a way to lock the transmission input shaft. Getting an accurate engine RPM reading is typically no problem, but locking the input shaft can be the tricky part. For sake of argument, let's say that locking the drive wheels is the same as locking the transmission input shaft. We'll assume that any friction or mechanical elements in the transmission will hold 100%; no slip at any of any bands, clutches or sprags that are applied in drive.

Hypothetically, if you have the engine running, the transmission in gear, and your foot on the brakes, what happens when you give the engine full throttle? If the brakes are strong enough to keep the drive wheels from spinning, you can rev the engine as high as it can go. The torque converter is putting a load on the engine, and the engine is only strong enough to reach a specific RPM.

For example, if you step on the gas pedal and get a maximum engine RPM of 1950 — and the wheels didn't spin — the stall speed rating of that converter… in that vehicle… with that engine… is 1950.

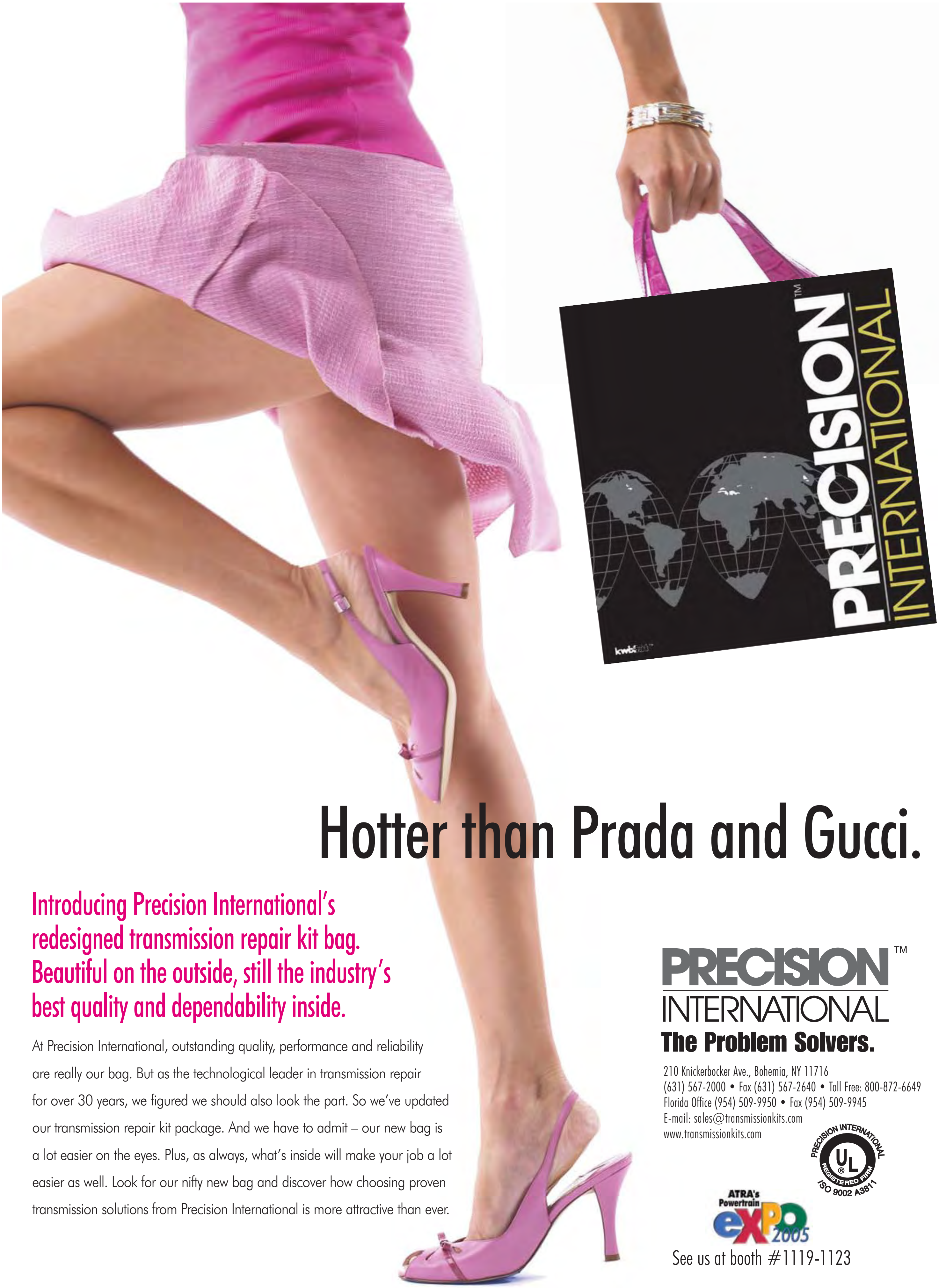
The more likely scenario is that, as you apply the throttle, the drive wheels will begin to spin before the engine reaches maximum RPM had the drive wheels stayed locked. Consequently, you won't get a correct stall speed reading. Because of this typical wheel spin, the exact stall speed rating of an individual torque converter in an individual vehicle isn't easy to measure in most instances.

CAUTION: Never attempt to check stall speed in the manner described. Aside from being an unsafe way to operate a vehicle, applying full throttle (with the brakes fully engaged), even for a short time, can generate high temperatures and material stresses within the torque converter and transmission, quickly damaging drivetrain and brake system components.

Then what's the point of knowing the converter stall speed if you can't easily determine the correct value, and you never really operate the vehicle with the converter fully stalled anyway? To answer that question, you have to realize that the torque converter is actually a tuning agent within the vehicle; it's a component that's calibrated against many aspects of the drivetrain.

As a hypothetical example, let's take a rear wheel drive pickup truck with an automatic transmission that's using an 11" diameter torque converter. Again, for arguments' sake, let's say this truck has an accurate tachometer, and a locking mechanical device in the differential that'll keep the drive wheels from spinning. As a scientific experiment of sorts, let's hypothetically swap a variety of different engines into this truck and see what happens. For this experiment, we'll only be changing the engine; the transmission, the 11" diameter torque converter and all other components will remain the same.

Example #1: We'll use a 1.5 liter inline 4 cylinder engine with a peak (maximum) torque of 90 ft-lbs at 4300 RPM. We start the truck, put it in gear, and give it full throttle. Remember,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since the differential is mechanically locked, the drive wheels can't spin. So, what happens? With this small engine, the maximum RPM is only 1300. So, in this case, our 11" diameter converter has a stall speed rating of 1300.

Example #2: Now we'll use a 2.8 liter V6. This V6 provides a maximum of 140 ft-lbs of torque at 3700 RPM. Again, we start the truck, put it in gear, and give it wide open throttle. This time the maximum RPM is 1600, which makes the stall speed of the same 11" converter 300 RPM higher than in example #1.

Example #3: This time we'll use a 4.7L small block V8. The 4.7L offers a maximum of 230 ft-lbs of torque at 3200 RPM. We start the truck and put it in gear. This time, at wide open throttle, we get the tach reading (stall speed) up to 2000 RPM. Same converter, but with the stronger engine the stall speed keeps going up.

Example #4: Now we'll try it with a 7.4L big block V8. This engine has a peak torque output of 330 ft-lbs at 2700 RPM. In this example, we can get the engine to spin our 11" torque converter up to 2500 RPM.

Example	Engine size	Maximum Torque Output of Engine	Stall Speed of 11" diameter Torque Converter
#1	1.5 Inline 4 cyl	90 ft-lbs @ 4300 RPM	1300
#2	2.8L V6	140 ft-lbs @ 3700	1600
#3	4.7L V8	230 ft-lbs @ 3200	2000
#4	7.4L V8	330 ft-lbs @ 2700	2500
#5	5.9L Inline 6 diesel	570 ft-lbs @ 1700	3100

Example #5: Last one: We'll use an inline 6 cylinder 5.9 liter diesel, such as a late model, high output Cummins engine from a Dodge Ram truck. Diesel engines can create a tremendous amount of power, but they typically peak out at a much lower RPM compared to gas engines of the same displacement. Let's say that this diesel reaches a maximum of 570 ft-lbs of torque at 1700 RPM. We start the engine, drop the transmission into drive, and apply full throttle; the maximum we can reach is 3100 RPM.

Looking at the chart above, you can quickly see what happens with our hypothetical 11" converter. Basically, the more power an engine can create, the higher the stall speed you'll get out of a torque converter. In addition, in our examples at least, the more powerful the engine, the lower the RPM at which the engine peaks out. This isn't a hard and fast rule when it comes to automotive engines, but it's generally true when dealing with stock OE applications.

Remember, we said that the torque converter is a tuning agent of the engine. Imagine if you actually got to drive our 5 different hypothetical vehicles. Example #1, with its 4 cylinder engine, doesn't reach peak output until 4100 RPM. But you have to drive it with a converter that stalls at 1300 RPM! In effect, you'd always be operating out of the engine's power band. From a complete stop, the truck would likely start moving at about 800 RPM, and would shift gears (at medium throttle) at about 2200 – 2500 RPM. You'd never get an efficient transfer of maximum engine power. This poor little old 4 cylinder would really have a tough time getting out of its own way. The result? Lack of power, poor drivability, and increased emissions.

At the other end of the spectrum is example #5. Putting this 11" converter behind a late model diesel, the drivability would be just as bad as in example #1 — maybe even more so. The converter stalls at 3100 RPM, but the engine develops all of its power way down at 1700 RPM! From a dead stop, the truck wouldn't even start to move until the engine had revved way past its peak power and efficiency. Just imagine towing a large load (as most diesel owners do) with this 11" converter! Once again, you get unsatisfactory results: lack of power, poor drivability, and decreased fuel mileage.

Torque converter stall speed depends on the power output capabilities and characteristics of the engine it's mated to. In other words, the power of the engine plays a big part in the stall speed of a converter.

So, in all of our examples, where does our 11" diameter converter fit best? Right in the middle, in example #3. The 4.7L V8 engine reaches its peak power at 3200 RPM, and the converter stalls 1200 RPM below that. That makes a nice driveable package: The vehicle would typically be operating right in the power band of the engine, resulting in good acceleration, efficient transfer of engine torque, good gas mileage, and optimal emissions characteristics.

What about customers who've modified their engine so it produces more power than when the vehicle was built? In today's world, vehicle owners have a wide variety of options available if they want (as Scotty on Star Trek would say) MORE POWER! Aftermarket engine product companies are everywhere, offering everything from intake and exhaust modifications, to reprogramming chips, to nitrous oxide injection, to bolt-on supercharger and turbo kits.

Let's look at example #3 again. But instead of the stock 4.7L V8 that the truck came with, the owner's modified the engine for more power. Instead of 230 ft-lbs of torque at 3200 RPM, the engine now develops 350 ft-lbs at 3200 RPM. The torque output has gone up 120 ft-lbs, but that peak rating is still at 3200 RPM. Naturally, the transmission is fried ("But I never even put my foot into it!" cries the customer), and now he's looking to you to solve his problems.

People sometimes refer to different types of torque converter stall speeds. As described in the accompanying article, the actual stall speed rating — sometimes referred to as the True Stall Speed of a torque converter — isn't easily determined in most vehicles. Because customers can't measure the true or actual stall speed, they may try to measure stall speed in a different manner. The two most popular alternative methods of measuring stall speed are known as Brake Stall or Flash Stall.

Brake Stall is the maximum engine RPM measured when the transmission is put in gear and the vehicle brakes are fully applied. As you press the accelerator and engine RPM rises, brake stall is where the drive wheels overcome the brake capacity and the tires start to spin. Because this method is relying on the capacity and integrity of the vehicle brakes, it can produce results that may be way off the mark from actual or true torque converter stall speed.

Flash Stall is measured when the vehicle is driven at a very low speed, and then the accelerator is fully depressed. At that point, if the wheels don't break loose, you can get a flash stall measurement by reading the engine RPM just at the point when you give it full throttle. Because the turbine in the converter is already spinning, this method of reading flash stall will also produce measurements that are significantly lower or different from actual or true stall.

Whenever talking about desired stall speeds with a customer, you should always try to communicate in terms of actual or true stall speed. Even though the customer won't likely be able to tell you the actual stall speed of what is currently in his vehicle, you can at least start at the same point and discuss things at the same level.

The customer tells you he wants to beef up the transmission and put in a higher stall torque converter, because someone told him that's what it needs. Oh boy, here we go. Now the customer is no longer just asking you just to fix his transmission. He may not realize it, but he's asking you to re-engineer a portion of his drivetrain. And if you agree, you're taking responsibility for that re-engineering. All of the engineering the OEM did to calibrate the converter to the powertrain and the rest of the vehicle went out the window as soon as the customer started making engine changes.

Now what? The customer has said he needs a higher stall converter. Does he really know what that means? In actuality, he needs a lower stall converter. Let's look at the facts: His OE converter (pre-engine modifications) stalled at 2000 RPM. But with the new engine modifications, the stock converter (because the engine is now substantially more powerful) now stalls at 2250 RPM. To put in a converter that stalls higher than 2250 (remember, that's what the customer asked for!) will mean that you'll be getting up into the 2400 – 2500 range.

A 2500 RPM stall speed with a peak torque rating at 3200 RPM isn't going to be very efficient. Remember, his modified truck is more powerful, but the maximum power is still produced at 3200 RPM. Mating a lower stall speed converter with the more powerful engine will allow the engine to operate in its power band. Putting a higher stall converter in this modified truck will only result in poor power transfer to the rear wheels.

Customer complaints and repeat failures can be avoided by understanding how a converter reacts in relation to the engine power curve. What this customer really needs is a converter with a slightly lower stall, and just as importantly, a converter with some durability characteristics built into it.

So, to answer the question: "What's the stall speed?" of a converter sitting on a shelf is a complete guessing game if you don't know the power characteristics of the specific engine it'll be mated to.

When an engine's been modified to produce more power, you should consider whether the OE converter components are up to the task and have the ability to survive behind a modified motor. On certain models, converter rebuilders often increase bearing sizes, add billet front covers, or install bearings in place of plastic or fiber thrust washers. Many converter builders will also braze components for added strength and efficiency. Modifications like these can be very beneficial, and can help the converter (and transmission) survive in modified applications.

It's readily apparent that the stall speed of a torque converter depends on the engine it's installed behind. Although hypothetical, our sample 11" diameter converter has 5 different stall speed ratings that range from 1300 RPM to 3100 RPM: an 1800 RPM difference, all from the same exact converter!

So, to answer the question: "What's the stall speed?" of a converter sitting on a shelf is a complete guessing game if you don't know the power characteristics of the specific engine it'll be mated to. Without knowing how much power an engine develops — and when it develops it — your answer to the question of specific converter stall speed can only be based upon very broad assumptions.

Before you answer the question: "What's the stall speed of my converter?" be sure you have all the necessary data, so you can give a meaningful response. Without all the facts, your answer will only be a guess, and that guess could be way off base.

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