TECHNICALLY *Speaking*

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TCC APPLY THE GROOVED FRICTION MATERIAL DEBATES

The debate about whether to use a grooved or smooth friction lining to rebuild a converter originally equipped with a grooved lining, has been going on since the day grooved linings first arrived at torque converter shops. Those advocating a grooved replacement lining always seemed to have the upper hand because they used the very strong argument that "it is the same as O.E." This argument has been losing ground lately because some of the clutches in O.E. remanufactured converters, that originally had a grooved lining, are now being remanufactured with a smooth lining. Torque converter rebuilders even debate the reason why the O.E. manufacturers started using the grooved lining in the first place. Some say the grooved lining was used for shift feel and others say it was used to reduce heat. These are probably the same people that inspired the light beer commercial about whether people drink light beer because it was "less filling" or "tastes great."

Raybestos Powertrain did some direct comparison testing using clutches bonded with the same material. One grooved and one smooth (un-grooved) version of the same friction material were tested under the same conditions.

Figure 1

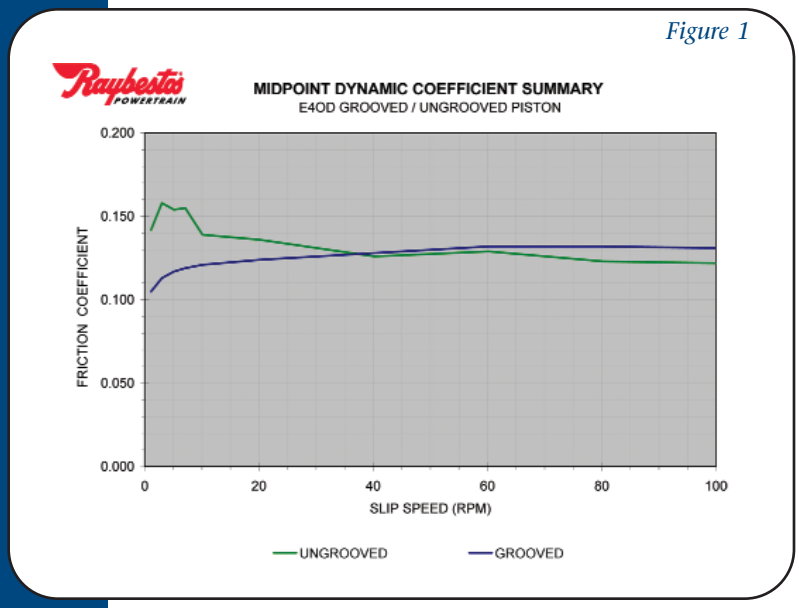

Figure 1 is a simplified version of the results of the tests done using an E4OD Clutch with the tan friction material. Note that the smooth lining shows slightly more erratic coefficient of friction at lower slip speeds (below 40 rpm). At slip speeds above 40 rpm, the grooved and smooth linings reacted the same. A higher coefficient of friction equates to an increased ability to hold or a reduced ability to slip. The high and erratic score of the smooth tan material at low RPM indicates an increased potential to grab, stick or shudder. A smooth tan friction material should NEVER be used to replace what was originally a grooved tan material. A smooth friction material that contains carbon (Power Torque or high carbon) will yield test results similar to the grooved tan material, at slip speeds under 40 rpm.

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When choosing a friction material for a replacement lining, a significant consideration should be the clutch apply strategy that the transmission uses. If the clutch apply strategy is EC3, either a carbon weave or high carbon lining is the wisest choice. For any modulated apply strategy except EC3,high carbon is the safest choice.

In addition to the apply feel issues discussed above, temperature is an equally important consideration. When a smooth lining is used, the increased interface temperature created during lock-up apply will not be removed because there is no flow across the reaction surface. A smooth friction material that contains carbon is needed to handle the higher temperatures. In a non lock-up torque converter, a large volume of oil continually enters and exits the converter during operation. In a lock-up converter the TCC piston acts like a one-way valve and stops the oil from exiting the converter when the TCC is applied. This prevents the heat from being removed from the converter by

Figure 2

fluid circulation. Of course, there would not be any heat generated in the converter with an on/off clutch apply strategy, if the clutch is holding.

Figure 3

When the demand for better fuel economy increased, it became necessary to bring the clutch on earlier and to have the clutch on for longer periods of time. These demands also made it necessary to increase the slip rates of clutches for better drivability. The increase of slip-rates also meant that heat was again being generated within the converter, even in the lock-up mode. Some manufacturers dealt with the heat issue by developing friction materials that were more heat resistant (carbon based). Some added controlled orifices to allow a portion of the oil to carry heat from the converter. These orifices allowed the oil to bypass the clutch and exit through the TCC release oil passage. Some manufacturers even did both by changing the friction material and adding an orifice in the piston itself. One import manufacturer added an orifice in the piston of its rear wheel drive vehicles and did not add the orifice to the same clutch used in its front wheel drive vehicles. The .028" orifice found in several of the TCC pistons will flow .19 gallons per minute (GPM) at 80 PSI at 150 degrees F ***(Figure 2)***.

Note: The .028" orifice is being phased out of most pistons because not enough heat was being removed from the converter to offset the loss of clamping force.

Now consider that each of the eight radial grooves of the front wheel drive clutch in ***Figure 3*** will also pass that same amount of fluid. This means that more than 1½ GPM of oil will leak past the clutch. When the vehicle is new, supplying the volume of oil necessary to offset a 1½ GPM leak should not be a problem. But, as mileage on the vehicle increases, the vehicle's ability to deliver this high volume of oil decreases. Wear in the pump and valve body bores will simply not allow the transmission to keep up with this type of leak. The O.E. has the advantage that as the transmission ages, the friction material also wears. The grooves become thinner, and therefore, pass less oil. When the after market torque converter rebuilder puts a new grooved clutch lining into his converter, he is restoring the 1½ GPM leak, with a lower volume capacity transmission. This is probably why the O.E. is replacing some of their grooved friction material with smooth linings in some remanufactured units.

Special thanks:

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Ed Lee *is a Sonnax Technical Specialist who writes on issues of interest to torque converter rebuilders. Sonnax supports the Torque Converter Rebuilders Association. Learn more about the group at www.tcraonline.com.*