

# A Slippery Slope The What (and Why) of **Woven Carbon**

Continuous clutch slippage? Whose idea was that! For years, any clutch that was continuously slipping was the mortal enemy of automatic transmission and torque converter rebuilders. A slipping clutch in one of your builds meant heat, and slippage combined with high heat meant clutch lining failure and warranty claims. Depending on how hard your customer pushed a slipping clutch in one of your units, the damage ranged from minor repairs to lube passages plugged with clutch material, causing gear train meltdown.

But an automatic transmission that is deliberately supposed to slip? Why would anyone ever intentionally design a transmission to have a continuously slipping clutch? That would be crazy!

In 1996, GM did just that by engineering what was previously considered unthinkable: a torque converter lockup clutch that slips continuously. GM introduced their EC3 system (also known as EC cubed or ECCC) to control the converter clutch in many of their transmission applications. EC3 stands for Electronically Controlled Clutch Capacity, and the system is a combination of software and hardware that allows the torque converter clutch (TCC) to slip constantly within a predetermined RPM window.

Prior to the introduction of EC3 (a few viscous clutches in various drivetrain applications notwithstanding), transmission and torque converter rebuilders alike had never serviced a transmission clutch that was intentionally designed to slip. Previously, a slipping clutch meant doing a root cause analysis and — at minimum — repairs to specific hydraulic circuits and clutch components.

*Continued on page 2...*

*Exclusively from Sonnax*  
**Woven Carbon Friction Rings**

- **Genuine OE Material**
- **Affordable & Durable**
- **Easy to Bond**

...Continued from page 1.

**The weave of carbon fiber facilitates cooling and calibrates slip rates by allowing an optimum amount of oil flow through the friction material.**



Upon the introduction of EC3, rebuilders suddenly found themselves in a new and strange position: instead of building units to keep slip at an absolute minimum, they now had to understand, diagnose and build units that would continuously slip — on purpose!

A key component in the EC3 system is the clutch material used inside the torque converter. To stand up to the demands of constant slip, GM developed a completely new clutch material. Instead of a traditional paper-based clutch lining, GM introduced a fabric that was woven from strands of carbon fiber. They found that carbon fiber was the best material to withstand the heat, and the weave that GM developed was calibrated to have a specific amount of oil that would flow through the material to facilitate cooling and calibrate slip rates.

Over the years, GM has employed woven carbon fiber converter clutches in many transmission platforms. The GM 4T60, 4T65, 4L30, 4L60, 5L40, 6T40, 6T70, 6L45 and 6L80 all use woven carbon converter clutches in some or all of the unit applications. This same material also is used in the Ford front-wheel drive 6-speeds (6F35 and 6F50) that were co-developed with GM.

## The “Catch 22” of Carbon Fiber Clutches

To the detriment of the aftermarket, GM kept this carbon fiber material proprietary. Torque converter rebuilders couldn't get access to the OE woven carbon material, and traditional clutch materials that were available to rebuilders could not hold up to the stress of a constant slip environment. If you were rebuilding transmissions or torque converters back in the late 1990's, you probably remember the struggles that the industry experienced as everyone searched for viable solutions.

To get around the problem, some transmission builders made hydraulic modifications in an attempt to eliminate the constant slip

feature altogether. Depending on the unit, these modifications had significant unintended consequences that ranged from drivability concerns to over-pressurizing converters. Torque converter parts suppliers such as Sonnax scrambled to provide suitable friction materials that gave builders a fighting chance in making units survive the punishing constant slip conditions.

Fast forward through the years since the introduction of EC3, and it's clear that some replacement friction materials have proven to be more successful than others at tackling the problem. No matter how good a builder may feel about their chosen material, however, they still have been forced to find a substitute for the OE woven carbon fabric...until now.

Sonnax is proud to announce the aftermarket now has a reliable source of woven carbon friction rings. This is the genuine OE material from the OE supplier, and it's offered exclusively by Sonnax!

## Protect Your Warranty with Woven Carbon Friction Rings from Sonnax

You now have the ability to deliver OE performance and durability in units designed for OE woven carbon material. Exclusively from Sonnax and surprisingly affordable, these rings are available in all the sizes used by GM and Ford.

### Genuine OE Material

Build your continuous slip converters with the confidence and peace of mind that comes with the original OE clutch material. Your customers will love it!

### Easy to Bond

Featuring a pre-applied adhesive, these woven carbon friction rings bond within the same time, temperature and pressure parameters as other rings offered by Sonnax.

### Engineered to Match OE Performance

Just like the OE friction material, Sonnax woven carbon products are made up of five segments assembled into rings. While the use of segments maximizes material utilization, there is a compelling technical reason why GM relies on this style of ring. The directional weave patterns of the carbon fiber must be properly oriented for optimal and consistent oil flow through the material, and segmentation allows this to occur. If Sonnax were to offer woven carbon in non-segmented, solid rings, the oil flow and slip rates would differ from the OE product. The cost of the rings also would be significantly higher due to material waste during manufacturing.

### Ideal for 4-Speed & 6-Speed Slip Converters

Transmission rebuilders are reporting that — while some of the GM 4-speed applications have a larger “window of allowable slip” and can initially get by with alternative aftermarket TCC materials — the newer 6-speed applications are much more sensitive to the amount of slip allowed by the transmission control unit. In-vehicle testing recently completed by Sonnax confirms the tight window of allowable slippage and sensitive calibration found in later-model units. To hit this tight window, it is vital to use the friction material that was specifically engineered for this purpose: woven carbon.

Contact your Sonnax sales representative today for more information about woven carbon friction rings. They are here to answer any questions you may have and help you continue building the best converters on the road.

## Woven Carbon Friction Rings

**Exclusively from Sonnax!**

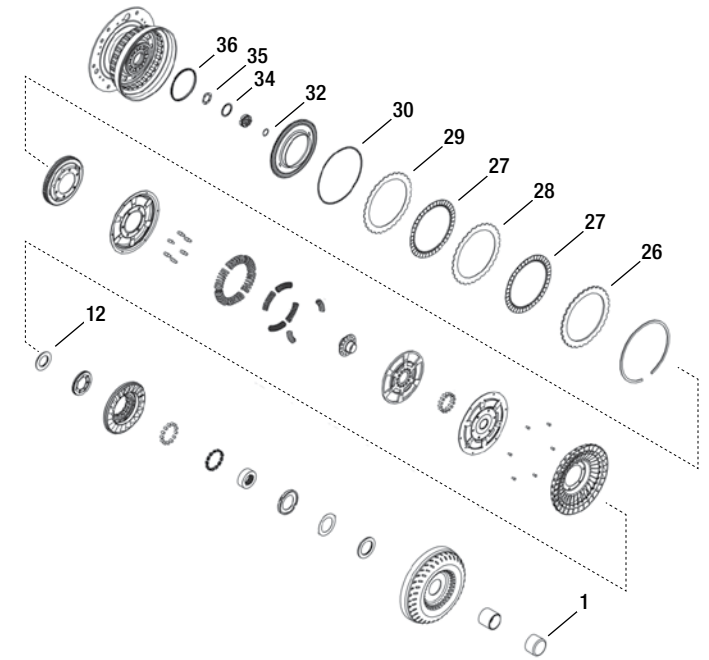
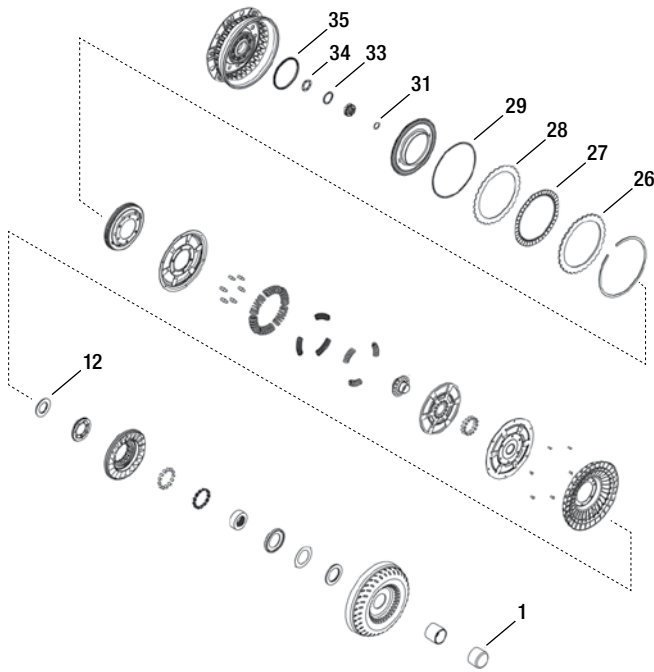
O.D. x I.D.	Part No.
9.000" x 7.750"	S20320WC
9.500" x 8.250"	S20300WC
9.813" x 8.562"	S20680WC
10.170" x 9.055"	S20960WC
10.200" x 9.200"	S20930WC
11.120" x 9.840"	S20750WC
11.125" x 10.000"	S20250WC

Genuine OE woven carbon material helps you build outstanding performance and durability into the following GM and Ford applications:

- 4L30-E
- 4T60
- 4T65-E
- 4L60/65/70-E
- 5L40/50-E
- 6T40/45/50-E
- 6F35
- 6T70/75-E
- 6F50/55
- 6L45/50-E
- 6L80/90-E

### Read More Great Tech Articles at [www.sonnax.com](http://www.sonnax.com)

- *Rebuilding the New GM Captive Clutch Without Fear*
- *Rebuilders Rally to Crack the Code: Converter Identification*
- *Carbon Woven Wear Characteristics*
- *Identifying Those GM 300mm Dampers*



## ZF8HP45

ID No.	Part No.	Part Name
1	MI-HC-R	Hub Cover
12	FS-N-4	Thrust Bearing
26	ZF-CP-11P	Clutch Plate
27	ZF-CP-8F	Friction Plate
28	ZF-CP-10S	Clutch Plate
29	ZF-0-3V	Seal
31	ZF-0-5V	O-Ring
33	ZF-0-2	Seal
34	ZF-WP-1	Thrust Washer
35	ZF-0-4V	Seal

## ZF8HP55

ID No.	Part No.	Part Name
1	MI-HC-R	Hub Cover
12	FS-N-4	Thrust Bearing
26	ZF-CP-11P	Clutch Plate
27	ZF-CP-8F	Friction Plate
28	ZF-CP-9S	Clutch Plate
29	ZF-CP-10S	Clutch Plate
30	ZF-0-3V	Seal
32	ZF-0-5V	O-Ring
34	ZF-0-2	Seal
35	ZF-WP-1	Thrust Washer
36	ZF-0-4V	Seal

Part No.	Part Name	Description
MI-HC-R	Hub Cover	2" Dia., Black, Plastic
FS-N-4	Thrust Bearing	Turbine side, Enclosed, 2.440" O.D., 1.496" I.D., .181" Thick, Hardened steel
ZF-CP-11P	Clutch Plate	8.151" O.D., 6.499" I.D., .169" Thick, 30 External teeth, Steel
ZF-CP-8F	Friction Plate	7.768" O.D., 6.120" I.D., .096" Thick, 80 Internal teeth
ZF-CP-9S	Clutch Plate	Fits ZFHP55 only, 8.151" O.D., 6.499" I.D., .071" Thick, 30 External teeth, Steel
ZF-CP-10S	Clutch Plate	8.151" O.D., 6.499" I.D., .109" Thick, 30 External teeth, Steel
ZF-0-3V	Seal	7.700" O.D., .176"H, .072"W, Solid, Black, Fluorocarbon
ZF-0-5V	O-Ring	.083" Cross section, .703" I.D., Black, Fluorocarbon
ZF-0-2	Seal	1.722" O.D., .094"W, Compound finger joint, Torlon®
ZF-WP-1	Thrust Washer	1.516" O.D., .984" I.D., .079" Thick, Vespel®
ZF-0-4V	Seal	4.349" O.D., .174"H, .194"W, Solid, four-lobed, Black, Fluorocarbon

**Note:** Except for clutch plate ZF-CP-9S, the parts shown here fit both units. The arrangement of clutch plates is one of the significant differences between the ZF8HP45 and ZF8HP55 converters.



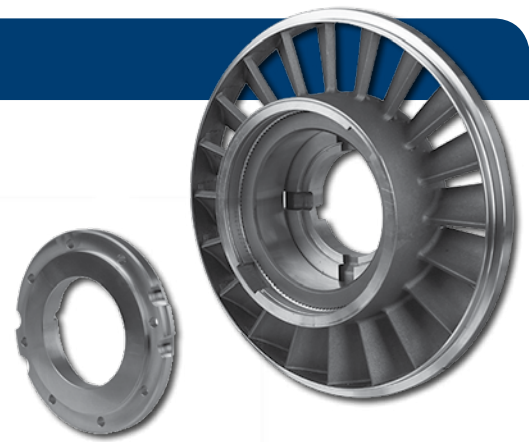
## Enhanced Stator Assembly for Allison® Multi-Plate Clutch Kits

- Robust holding power for diesel engines
- No machining required
- Ideal for failed converters & new rebuilds

Dodge Duramax® diesel engines produce far more torque than the stock 2006–2010 Allison 1000/2000/2400 converter is designed to handle. Rebuilders can easily eliminate the critical weakness of this converter with the new stator and outer stator race kit AL-ST-2K designed for use with Sonnax multi-plate clutch kit AL-RK-2A. A similarly enhanced stator kit, AL-ST-1K, is available for general use in Allison converters.

Sonnax highly recommends replacing OE assemblies that have not yet failed, especially in upgraded diesel performance units. The shallow serrations on the OE stator that engage the race often do not hold, causing the stator to break free, spinning and damaging the transmission with aluminum debris. The custom stator and outer stator race from Sonnax feature longer and deeper, precision-machined splines to hold many times more torque than the OE assembly.

Learn more about converters at risk for stator failure in “Defending the Duramax Diesel Against Allison 1000 Stator Weakness,” a tech article published in the July 2015 newsletter and also available in the tech resources area at [www.sonnax.com](http://www.sonnax.com).



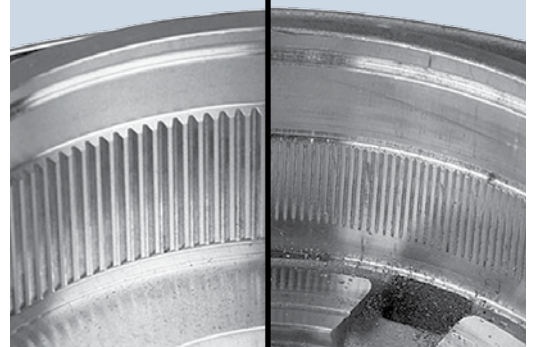
### Stator & Outer Stator Race Kit AL-ST-2K

Kit includes the aluminum stator, outer stator race already pressed in place and the stator cap. Complete assembly requires Sonnax sprag AL-SP-1, inner race AL-HR-2, OE snap ring and stator spacer.

The Sonnax assembly features longer, deeper splines for superior holding power.

#### Sonnax Race

#### OE Race



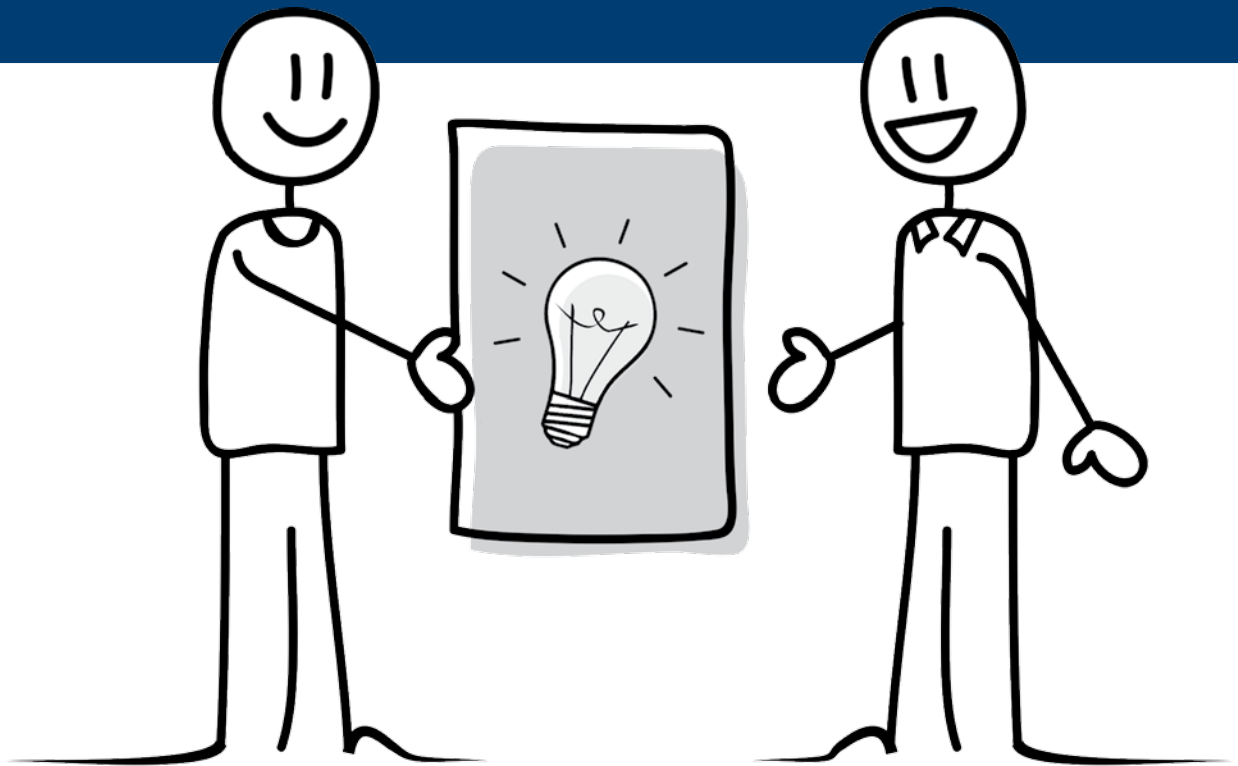
## 48RE Converted Valve Body

### Sonnax Innovation Ending Chronic Core Shortages

The 48RE converted valve body, a revolutionary new Sonnax transmission product that debuted this fall, is already opening the doors to new business for thousands of shops. Sonnax's patent-pending process for converting early-model RE cores to full-function 48REs means the aftermarket now has a plentiful source of these once-scarce valve bodies.

On the converter side, Sonnax is working to solve a similar problem with the high demand/low supply BorgWarner 310mm. A new dampered multi-plate kit is in development that converts the Ford 5R110W low-stall core for use in A618, 47RH/RE and 48RE trucks. Look for this product later this year and ask your sales representative for details.

Make/Unit	Part No.	Part Name	Description
GM	6T70/6T75, Ford 6F50/6F55	<b>GMFD-WP-2T</b>	Thrust Washer Vespel® material & thicker than OE, .154" Thick, 1.484" O.D., 1.010" I.D.
	6T40/6T45, 236mm	<b>GM-WA-49</b>	Stator Cap Fits spring & roller clutch units, Aluminum, 3.424" O.D., 1.460" I.D., .337" Thick, Notches
		<b>GM-WA-50</b>	Stator Cap Fits sprag clutch units, Aluminum, 3.424" O.D., 1.460" I.D., .348" Thick, Notches
	Allison® 1000/2000/2400, 2006-Later, Multi-Plate	<b>AL-ST-2K</b>	Stator & Outer Stator Race Kit Includes outer stator race pressed into stator & a special stator cap
Ford	6R80, 260 & 280mm (Late)	<b>FD-90-68G</b>	Impeller Hub Butt-Mount, Flats, 1.770" Journal dia., 2.270" Assembled height
	6R80, 260mm (Late)	<b>FD-CP-18</b>	Clutch Plate With frictions, 10.775" O.D., 8.700" I.D., .159" Thick, 40 Bent external tabs
	6R80, 280mm (Late)	<b>FD-CP-19</b>	Clutch Plate With frictions, 11.340" O.D., 9.145" I.D., .159" Thick, 40 Bent external tabs
	6F50/6F55, GM 6T70/6T75	<b>GMFD-WP-2T</b>	Thrust Washer Vespel® material & thicker than OE, .154" Thick, 1.484" O.D., 1.010" I.D.
Chrysler 45RFE, 545RFE			
Aisin AW	TR-80SD (OC8)	<b>VW-90-6G</b>	Impeller Hub Flanged, 1.724" Journal dia.
	TF-80SC, TF-81SC (Ford AF21)	<b>GMFD-WP-2T</b>	Thrust Washer Vespel® material & thicker than OE, .154" Thick, 1.484" O.D., 1.010" I.D.
Aisin Seiki A465, AS68RC	<b>AS-HB-1</b>	Front Cover Hub 3.860" O.D., .788" I.D., .900" Assembled height, .985" Bearing pocket I.D.	
Honda/Acura	B7TA, B7VA, B7YA	<b>HO-RS-1K</b>	Spring Retainer Kit All spring retainer components required replace all "B" stamped assemblies on one piston
		<b>HO-WS-2</b>	Spring Guide .016" Thick, Hardened steel
	MT4A, MDX	<b>HO-CP-1</b>	Clutch Plate OE-Style segmented friction plate, 8.183" O.D., .076" Thick, 40 Internal tabs
		<b>HO-CP-2</b>	Steel Clutch Plate 8.630" O.D., 7.173" I.D., .047" Thick, 36 External tabs
Hyundai/Kia A4CF1, A4CF2	<b>HK-O-1V</b>	Radial Lip Seal .985" Housing bore, .663" Shaft dia.	
Hyundai/Kia A5HF1, A6F24, A6MF1, A6MF2	<b>GMFD-WP-2T</b>	Thrust Washer Vespel® material & thicker than OE, .154" Thick, 1.484" O.D., 1.010" I.D.	
Jatco/Nissan	RE7R01A (JR710E)	<b>JA-O-13V</b>	Inner Piston Seal 2.075" O.D., .083"W, .133"H, D-Shaped
		<b>JA-O-14V</b>	Outer Piston Seal 6.504" O.D., .081"W, .152"H, D-Shaped
	REOF09A (JF010E)	<b>NI-90-7G</b>	Impeller Hub Flanged
Mercedes	722.9 (Late)	<b>MB-N-4</b>	Thrust Bearing Enclosed, Front cover, 2.270" O.D., 1.580" I.D., .180" Thick
		<b>MB-N-5</b>	Thrust Bearing Enclosed, Turbine-side, 2.820" O.D., 1.900" I.D., .195" Thick
		<b>MB-CP-8</b>	Clutch Plate With frictions, 7.717" O.D., 6.105" I.D., .108" Thick, 40 Flat external tabs
Toyota/Lexus	AB60E/F	<b>TO-90-24G</b>	Flanged Impeller Hub Slots, 1.771" Journal dia., 2.170"H, 1.884" Assembled height
	U660E	<b>TO-HT-22HS</b>	Turbine Hub
	U760E (TM-60LS)	<b>TO-HT-23HS</b>	Turbine Hub
	U660E, U760E (TM-60LS)	<b>TO-RV-4</b>	Turbine Hub Rivet Solid, Flat head, .352" Length, .203" Shank dia., .340" Head dia.
VW/Audi TR-80SD (OC8)	<b>VW-90-6G</b>	Flanged Impeller Hub Slots, 1.724" Journal dia., 1.730" Height, 1.663" Assembled height	
ZF	ZF5HP19 (Captive Clutch)	<b>FS-CP-2TKR</b>	Clutch Plate Thicker than OE, 10.216" O.D., 8.153" I.D., .138" Thick, 24 Flat external tabs
	ZF4HP16	<b>ZF-90-1G</b>	Flanged Impeller Hub Slots, 1.575" Journal dia., 2.008"H, 1.801" Assembled height
Friction Rings	Chrysler 66RFE	<b>B45066HTE</b>	Friction Ring 11.250" x 9.850" x .045", HTE
		<b>B66066HTE</b>	Friction Ring 11.250" x 9.850" x .066", HTE
		<b>B45066HTS</b>	Friction Ring 11.250" x 9.850" x .045", HTS
		<b>B66066HTS</b>	Friction Ring 11.250" x 9.850" x .066", HTS
	GM 6T40/6T45, 236mm	<b>B45680HTE</b>	Friction Ring 9.813" x 8.562" x .045", HTE
		<b>B66680HTE</b>	Friction Ring 9.813" x 8.562" x .066", HTE
	GM 6L90 (Captive Clutch)	<b>B45960HTE</b>	Friction Ring 10.170" x 9.055" x .045", HTE
		<b>B45960HTS</b>	Friction Ring 10.170" x 9.055" x .045", HTS
	GM/Ford 4-Speeds & 6-Speeds		Woven Carbon Friction Rings See page 3 for details
	Toyota/Lexus U760E (TM-60LS)	<b>B45970HTE</b>	Friction Ring 8.900" x 7.635" x .045", HTE
<b>B66970HTE</b>		Friction Ring 8.900" x 7.635" x .066", HTE	
Multi-Application	GM 258mm LU (4T65-E), 265mm LU (4T60-E, 4T80-E); Ford 4R100, AODE, 4R70W, AOD (FIOD), E40D	<b>GMFD-HR-1</b>	Inner Stator Race 2.156" O.D., .875"H, 22-Tooth internal spline
	Renault/Peugeot DPO & AL4, Early	<b>RE-O-1A</b>	Piston Seal 2.140" O.D., .074"W, .080"H, Scarf cut



## Got New Part Ideas? The Sonnax Team is All Ears



**Jeff**



**Joan**



**Bill**

Hundreds of new converter parts are released each year thanks to the insight rebuilders share with the great group of folks on the Sonnax sales team.

Is there a late-model component gap you'd like to see filled? A critical OE design flaw an improved part can address? Talk about what you're seeing in the field with your sales representative. They'll make sure that information gets into the idea pipeline right away.

If you've made a request, but haven't seen the part for sale, don't be afraid to ask again! Knowing there's demand for a part helps Sonnax bring it to market that much faster.



**Keith**



**Pat**



# **sonnax**<sup>®</sup>

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### **Featured in this Issue**

**Woven Carbon Friction Rings**

**ZF8HP45, ZF8HP55 Components**

**Allison<sup>®</sup> Multi-Plate Stator Assembly**

**48RE Conversion Parts Tackling**

**Chronic Core Shortages**

Sonnax designs, manufactures, tests and distributes a wide variety of products used to remanufacture torque converters, rebuild automatic transmissions, upgrade driveshafts and protect the driveline from over-torque damage.

**Sonnax is a 100% Employee-Owned Company**



***Exclusively  
from Sonnax!***

# **Woven Carbon Friction Rings**

*See Page 3*

- **Genuine OE Material**
- **Affordable & Durable**
- **Easy to Bond**

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### ***The wait is over for woven carbon!***

Sonnax now offers authentic, OE woven carbon friction material that delivers the very best in torque converter performance.

Choose from seven friction ring sizes designed to fit popular GM and Ford continuous slip applications.

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