TECHNICAL DISCUSSION

EC³ and PWM CONVERTER CLUTCH SOLUTIONS

The need to apply torque converter clutches throughout a broader range of conditions has resulted in the development of materials that can be slipped more frequently and for longer durations. These materials generally have a low coefficient of friction and an ability to dissipate heat away from the clutch surface. Carbon has the ability to dissipate heat efficiently and has become the basis for the materials developed by General Motors and others for converters with both the Pulse Width Modulated (PWM) controls and Electronically Controlled Capacity Clutch (EC³) controls.

Sonnax has developed a new High Carbon Composite (HCC) material that demonstrates performance characteristics that are similar to the GM woven carbon and carbon composite materials found in torque converters with EC³ and PWM controls. These HCC replacement friction rings are now available to torque converter rebuilders worldwide! The Sonnax material is extremely durable and has a consistent coefficient of friction over a wide range of operating temperatures and pressures. It has high thermal conductivity to efficiently remove heat from the clutch surface and dissipate it to the surrounding converter fluid. The non-woven design of the Sonnax HCC material functionally replaces the GM woven material without violating GM's patented design.

Testing of the Sonnax HCC material has confirmed that the shift timing, feel and performance are comparable to that of the GM woven carbon material throughout the clutch application schedules in these controlled slip converters. Without applying any special weaves, groove patterns, or complex and costly manufacturing processes, Sonnax offers this cost effective solution that meets the demands of this severe converter environment. In the absence of other transmission and converter problems, the Sonnax HCC linings provide "life-of-the-vehicle durability" in EC³ and PWM converters. The HCC material does not require any significant break-in time, making driveability consistant right from the start.

Sonnax's HCC material properties are achieved through a combination of materials and process control, resulting in a stronger and more durable friction material. The Sonnax HCC friction rings use the same adhesive and familiar bonding procedures as other Sonnax friction rings and are available in both .040" and .070" thickness'. Sonnax has also added three small flat sections to the I.D. of all HCC frition rings as a visual feature which allows anyone to recognize the Sonnax material and differentiate it from other "look-alikes."

HCC materials are not necessarily appropriate for use in all standard torque converter clutches. Likewise, neither Red nor Kevlar® friction materials are recommended for the continuous and modulated slip applications. Insist on Sonnax High Carbon Composite friction materials for your EC³ and PWM torque converter units.

Sonnax High Carbon Composite Friction Material

Direct Replacement Product for EC³ and Modulated Slip

APPLICATIONS	.040" THICKNESS	.070 THICKNESS
GM 298/300mm	GM-F-1HC	GM-F-2HC
GM 245mm	GM-F-4HC	GM-F-5HC
GM 258mm	FS-F-1HC	FS-F-2HC
GM 265mm	GM-F-9HC	GM-F-11HC

For a superior bond over a broader range of bonding conditions, Sonnax recommends the use of SonnaPrep®, a bond-enhancing agent, for any friction material bonding application.

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GM, OEM Friction Material Applications

Transmission	Year	Converter	Control	OEM Friction Material	Converter Tag, 3rd digit*
4L30-E	up to '98	245mm	PWM	Composition Carbon	9,H
	'99 - up	245mm	EC³	Woven Carbon	3406
5L40-E	'99 - up	245mm	EC³	Woven Carbon	(all)
	'99 - up	258mm	EC³	Woven Carbon	2977
4L60	'82 - '89	298mm	on-off	Paper	
	'90 - '92	298mm	on-off	Paper w/Low Carbon	
4L60-E	'93 - '94	298mm	on-off	Paper w/Carbon	
	'95 - '96	298mm	PWM	Composition Carbon	G,H,L
	'97 3.4L (car)	298mm	EC³	Woven Carbon	N,P
	'97 298mm (truck)	298mm	PWM	Composition Carbon	G,H,L
	'98 - up	298mm	EC³ *	Woven Carbon	N,P
	'5/97 - '02	300mm	non-EC³	Composition Carbon	A
	'98 - up	300mm	EC³	Woven Carbon	B-1, C-1*
	'01 - up	245mm	EC³	Woven Carbon	F,Q,H
4T40-E	'95	245mm	EC³	Compositon Carbon	G,L
4T40/45E	'00	245mm	EC³	Composition or Woven	H,F,K,Q
4T60	'86 - '89	245mm	on-off	Paper	
	'90	245mm	on-off	Paper w/Carbon	
4T60-E	'91 - '95	245mm	PWM	Paper w/Carbon	
	'96 3.4L DOHC	245mm	EC³	Woven Carbon	F,P,H
	'96 & others	245mm	PWM	Composition Carbon	Q
	'96 - '98 4 cyl	245mm	EC³	Composition Carbon	Q
	'97 3.8L	245mm	EC³	Woven Carbon	F,P,H
	'97 & others	245mm	EC³	Composition Carbon	Q
	'98 - up	245mm	EC³	Woven Carbon	(all)
4T65-E	'96 3.4L DOHC	245mm	EC³	Composition Carbon	G,Q,H
	'97 - up	245mm	EC³	Woven Carbon	H,Q,K,T,V
	'97 - up	258mm	EC³	Woven Carbon	F
4L80-E	'99 - up	310mm	PWM	Composition Carbon	(all)

***Notes:**

Alpha converter tag may not be specific to friction material. For example, the 3rd digit for friction material, with F,K,Q code, could use a paper, composition or the woven lining, depending on application. The 4 digit alpha code is replaced by a numerical stamp or ink number on many '99 and later converters. The numerical examples above, are the last 4 digits of the part number. Under the 3rd digit column, some applications have so many TCC piston codes, the "all" designates use of same lining but different damper assembly.

There are EC³ controls which do not slip TCC, in 258, 298, and 300mm from 5/'97 - '04, using woven linings. The 298mm converter in the Y/Vette and F/ Camaro is non-EC³. B-1, 380 lb. ft. damper torque. C-1, 280 lb.ft. damper torque

4 Digit Alpha Converter Tag

1st Digit:
S = 3L30, 4L30, 4L40-E, 5L40-E, 245mm
F = 3T40, 4T40-E, 4T45-E, 4T60-E, 4T65-E, 245mm
H = 4L60-E, 245mm
J = 4T65-E, 258mm
V = 4L60-E, 280mm
D = 4L60-E, 298mm
T = 4L60-E, 300mm

2nd Digit: Identifies the stall K factor and Stall Torque Ratio (STR)

3rd Digit: Identifies the friction material (see chart above)

4th Digit: Identifies cover bolt pattern for transmission