
Raybestos
POWERTRAIN

Overview

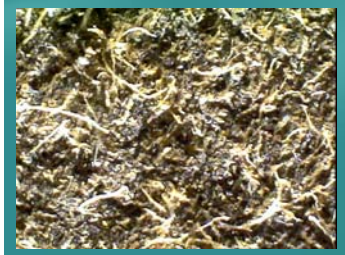
- Raybestos Friction Materials.
  - TAN
  - HIGH ENERGY (KEVLAR®)
  - SW CARBON™
  - POWERTORQUE™
- Applications Chart
- Adhesive Coating
- Surface Prep
- Bond Validation
- Clutch Packs in Converters

Overview

- Closing
  - Contact Information
  - Questions or Comments

Raybestos Torque Converter Friction Materials

- **OE Tan**
  - Used by OE Manufacturers
  - Commonly used for ON/OFF Lock up strategies
  - Proprietary blend of cellulose fibers and resin
  - High friction



- **High-Energy Kevlar®**
  - Tolerates elevated temperatures and added stresses associated with electronica controlled transmissions without glazing or burning.
  - Great for modulated lock up systems

- **SW Carbon™**
  - Developed specifically for Continuously Slipping EC³ applications
  - No slip codes
  - Extreme temperature resistance
  - Low compression-set after installation
  - High porosity for optimum oil flow
  - Low Wear

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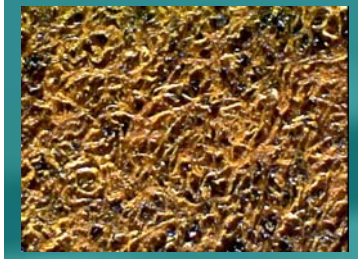
Raybestos Torque Converter Friction Materials



- **PowerTorque™**
  - Developed Specifically for Heavy Duty/Diesel and High Performance Applications.
  - 25% higher torque capacity and greater durability than Kevlar or Carbon based friction materials.
  - Higher density and higher temperature capacity than conventional tan torque converter linings.
  - Eliminates premature wear.
  - Higher friction levels for greater holding capacity and slip resistance behind high torque diesels and high powered performance vehicles.

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Application Cheat Sheet

Raybestos POWERTRAIN	EC³	PWM	ON/OFF	Heavy Duty	High Performance	**Temperature Resistance** *1=Highest 5=Lowest*	**Torque Capacity** *1=Highest 5=Lowest*
(T) Tan Organic Paper			●			5	2
(K) High Energy Kevlar®		●				3	3
(HC) Carbon Paper		●				2	4
(SW Carbon™) Carbon Fiber	●					1	5
(PT) PowerTorque™				●	●	4	1

Adhesive Coating

- **Plasti-Lock® 700**
  - **Black in Color**
  - **Heat Curing**
  - **Nitrile/Phenolic Base**
  - **Applied via Curtain Coat Process**
  - **Does not require a “pre-tack” activator**
  - **Possesses a high shear strength due to the lattice structure formed with the friction material.**
  - **OEM proven**
  - **Shear Strength @ 75°F = 2000 psi**
  - **Shear Strength @ 400°F = 500 psi**

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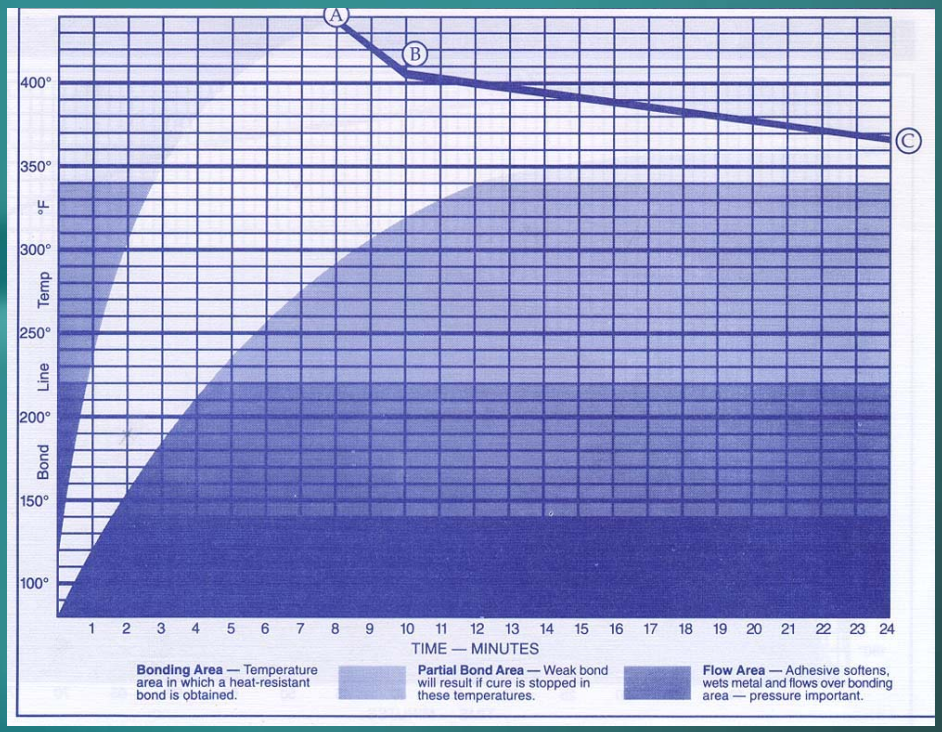
Adhesive Coating



- **Shelf Life**
  - **6 months at temperatures below 95°F and controlled humidity.**
  - **Can qualify with MEK Test**
- **Recommended bond cycle “window” as specified by SIA**

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Bond Pressure

- **Optimum pressure on Friction Material during bond cycle = 200 psi Face pressure.**
- **Acceptable range = 100-200 psi net facing pressure ON THE SURFACE OF THE FRICTION MATERIAL.**

	Hydraulic/Pneumatic Ram DIA (Inches):	D_R
$3.1416x(D_R/2)^2$	Area of Ram (inches squared):	A_R
	Line Pressure in (psi):	P_i
	Friction Ring OD (Inches):	Fr_{OD}
$3.1416x(Fr_{OD}/2)^2$	Area of friction ring OD (Inches squared):	A_{OD}
	Friction Ring ID (Inches):	Fr_{ID}
$3.1416x(Fr_{ID}/2)^2$	Area of friction ring ID (Inches squared):	A_{ID}
$A_{OD}-A_{ID}$	Area of Friction Material (Inches squared)	A_{Fr}
$A_R(P_I)$	Force of Ram (lbs.)	F_R
F_R/A_{Fr}	Pressure at friction (psi)	P_{Fr}

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Surface Prep

- **Material Removal**
  - Lathe (Machining)
  - Caustic Solution (Piston face is not disturbed)
- **Surface Preparation and Finish**
  - Recommended surface finish range of 80-150 Ra
  - Media blast bond surface ONLY w/80grit Aluminum Oxide for optimum bond
  - Remove ALL oils from the bond surface with solvents such as MEK or Acetone.
- **Reaction Surface**
  - Recommended surface finish range of 25 Ra MAX

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Surface Prep

- Although the analogy of a “record finish” is loosely used in the industry, the typical surface of a record is very course.

Bond Validation

Standard Bend Test

- The purpose of this evaluation is to measure the mechanical integrity of the bond between the friction material and the mating surface under the most extreme moisture and temperature conditions.
- The degree of cure, percent of bond area, and quality of adhesion are determined.
- The equipment must be capable of uniformly bending the bonded section over the specified radius, after being subjected to specific controlled temperature and moisture conditions

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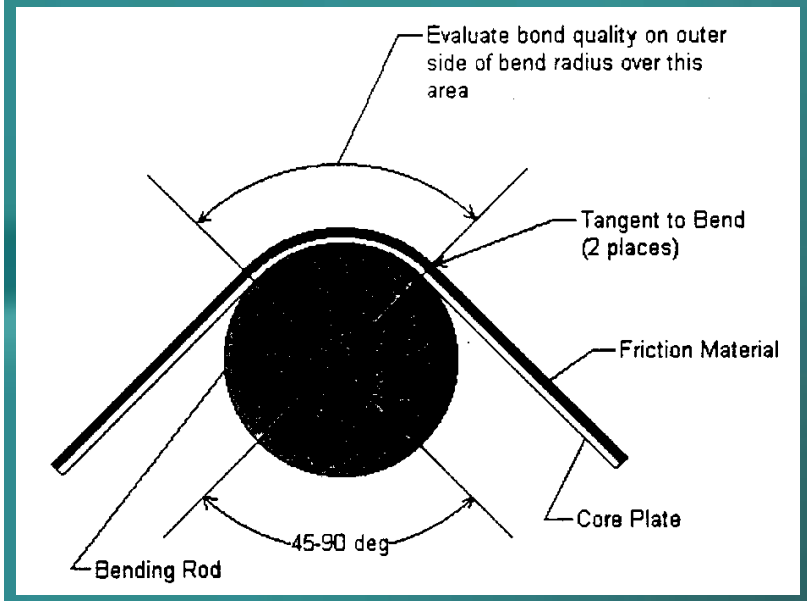
Bond Validation



Excellent Bond

Marginal Bond

- The bonded samples are soaked in ATF
- Parts are then placed in boiling water for 10 minutes.
- Parts are removed from water and allowed to sit for 10 minutes with the friction side facing up.
- A 12mm rod is anchored in place
- Within 15 minutes of removing the test piece from the water, pressure is exerted on the plate until the bend reaches a 90° angle.
- The test piece is placed on the rod over the diameter of the sample piece.
- The delaminated material is carefully removed from the bend area.
- The bond is considered satisfactory if a minimum of 50% of the friction material remains in the bend radius

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Alternative Bond Validation Methods

- Chisel Test
- Air Test

– In both cases, the same 50% material rule applies.

Clutch Packs in Torque Converters

- Evolution
- Applications
- Benefits
- Components
- The Clutch Pack
- Friction Plate FYI
- Reaction Plate Requirements
- Clearance

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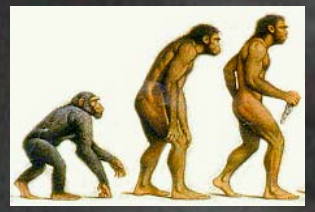
Clutch Packs in Torque Converters – Evolution



- Single Piston/Dampener to Cover Engagement.
- Multi-Plate Piston/Dampener to Cover Engagement.
- Multi-Plate “Clutch Pack” Engagement.

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Clutch Packs in Torque Converters – Applications

- **Examples of Applications where you will find a clutch pack instead of a single piston lockup dampener:**
  - **Nissan RE5R05A**
  - **Mercedes 722.6, 722.7, 722.9**

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Clutch Packs in Torque Converters – Benefits

- The “clutch pack” system grounds the inner hub to the front cover during an engagement.

- Packaging/Converter size is reduced:
  - Reduces rotating inertia
  - Overall Mass
  - Increases response to the engine performance.

Clutch Packs in Torque Converters – Benefits

- One of the greatest benefits of the “clutch pack” design is that it is a lubricated system.
- Oil is continuously carrying heat away from the pack, allowing for slippage, without catastrophic failure.

Clutch Packs in Torque Converters - Components

- The clutch pack system in a converter is made up of the same general components, you would find in a transmission drum or housing.

- Housing/Outer Hub
- Apply Piston
- Inner and outer piston seals

- Inner hub (Part of Dampener Assembly)

- Clutch Pack

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Clutch Packs in Torque Converters

- The clutch pack consists of:
  - Steel Reaction Plates
  - Friction Plates
  - Backing/Pressure Plate
  - Backing/Pressure Plate Snap Ring

- Stackup begins with a steel reaction plate splined to the outer hub, then stacked in an alternating pattern.

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Clutch Packs in Torque Converters

- Friction
- Steel Reaction
- Friction
- Backing/Pressure Plate
- Snap Ring

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Clutch Packs in Torque Converters – Friction Plates

- Friction plates are made with a thin steel core with friction material typically bonded to both sides.
- Cores are blanked, heat flattened, and etched to remove oils or surface contaminants, then coated with adhesive.
- Friction wafers are bonded to both sides under a specific time/temp/pressure cycle that will achieve a satisfactory bond & meet the target spec for material compression.

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Clutch Packs in Torque Converters – Friction Plates

- Critical points to keep in mind if you are going to take the time to re-line a friction plate:
  - Plates need to be caustically stripped and thoroughly cleaned.
  - Since some cores are as little as 0.032” thick, any removal of material (steel) will weaken the steel and upset the flatness.
  - When assembling, too much compression can fracture the material matrix.
  - Too little compression can result in material delamination.

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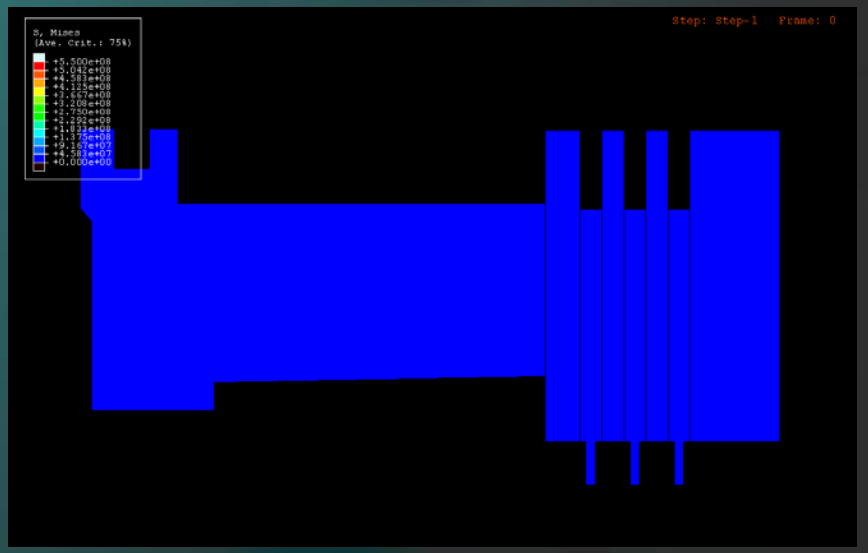
Clutch Packs in Torque Converters – Friction Plates

- **Assembly flatness is also critical.**
  - **As the clutch pack piston applies, the pack compresses.**
  - **If either the friction or steel plates are not flat, the highest point on either will make initial contact during engagement and receive the highest temperature and stress concentration.**



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Clutch Packs in Torque Converters – Friction Plates

- Friction material grooving is more vital on a small diameter friction plate than a typical piston/dampener assembly.
- The grooves serve several purposes:
  - Channel oil away from the friction material as it is being compressed.
  - Depending on groove geometry, grooving can be used to calibrate engagement time and control shudder.
  - Cool the interface.

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Clutch Packs in Torque Converters – Reaction Plates

- **Steel Reaction Plates aren't just stamped and packaged.**
  - **Steel thickness is a critical consideration in pack design.**
  - **Like friction cores, steel plates require a flattening process.**
  - **Finally, the surface finish is polished to spec.**

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Clutch Packs in Torque Converters – Reaction Plates

- Surface finish is critical. Think of a steel plate like the front cover of a converter.
- Average Surface roughness should not exceed 25 microinches.
- Warped or “Potato-Chipped” steels should not be re-used.

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Clutch Packs in Torque Converters – Reaction Plates

- Steel plates with Hot Spots or Smeared material should not be reused or reworked.

- Scotch Briting hot spots will only make the appearance disappear. The steel structure is permanently damaged.

Clutch Packs in Torque Converters – Clearance

- Aside from pre-soaking the friction plates, the most critical part of the clutch pack stackup is clearance.
- Clearance allows the pack to separate and relax when unapplied, preventing unwanted parasitic drag.
- Clearance can also be used to assist lockup modulation by controlling the amount of slip between the inner and outer hubs.

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Clutch Packs in Torque Converters – Clearance

- **Setting Clearance**

– **Refer to manufacturer's recommended spec. for clearance range.**

– **Assemble the clutch pack "dry"**

– **The optimum method is to dial indicate off the piston, then apply the piston with air via the feed orifice in the housing, and measure piston travel.**

– **Although not as accurate, feeler gauges can be placed in between the backing plate and snap ring or backing plate and first friction plate to confirm clearance.**

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Clutch Packs in Torque Converters – Recap

- If friction material is contaminated, burnt, or flaking, replace it rather than spending production time trying to reline it.
- If you choose to re-use the friction plates, do so at your own risk.
- Inspect steel reaction plates for flatness and surface imperfections.
- If the reaction plate is hot spotted, scratched, or out-of-flat – discard it.
- It is okay to re-use steels that have been polished. DO NOT REWORK! Wash and re-use.

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Questions/Comments?

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