ALTO PRODUCTS

FRICTION TECHNICAL DATA

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SAS® FRICTION

FRICTION TECHNICAL DATA

DESCRIPTION

SAS® is a (non-asbestos) organic based friction material. SAS was mainly developed to eliminate: noice, vibration, and shutter/harshness. The low endpoint to midpoint ratio, coupled with Alto's grooving techniques and proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

APPLICATIONS

The SAS® material has been successfully used in mid to high energy clutch applications:

- Automotive

>Automatic Transmission

>>Dynamic Shifting (Low, Moderate, High)

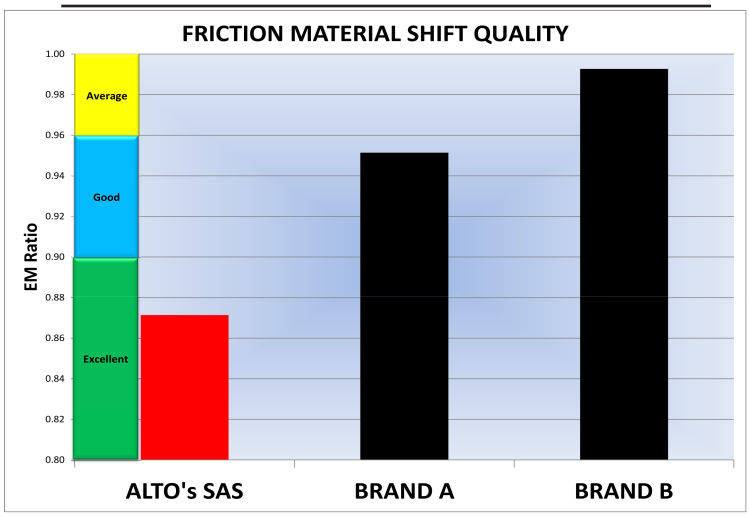
- Industrial Equipment

>Brakes

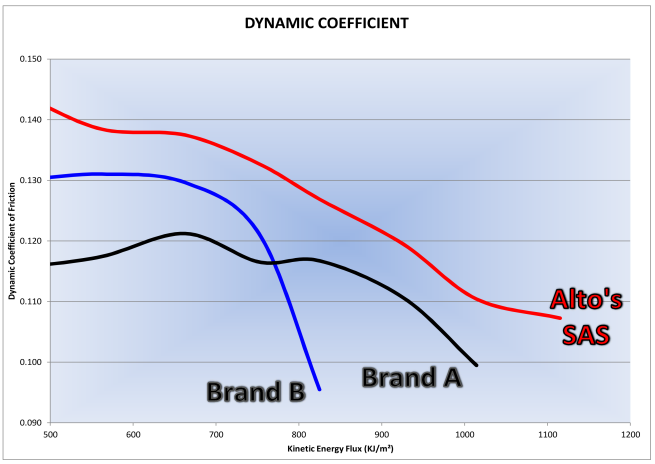
FRICTION RATING:

RATING: MID/HIGH ENERGY MATERIAL

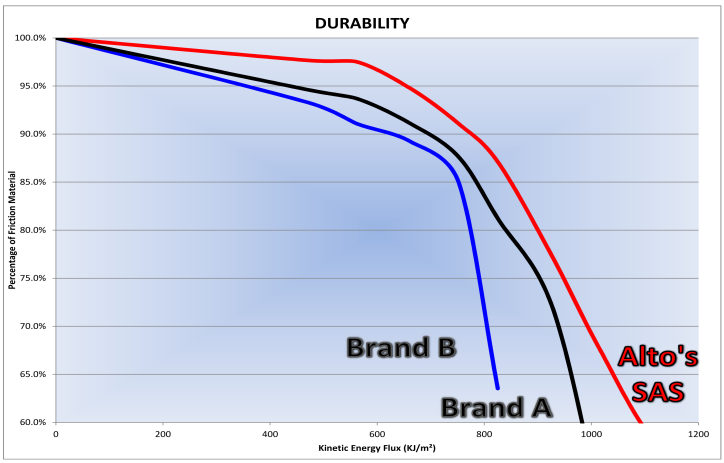
DIMENSIONS: Available in THICKNESS varying 0.018" to 0.045". Custom THICKNESS also available.



Alto's SAS material has an 8% improvement over Brand A and 12% improvement over Brand B.



Alto's SAS material generates 5% more torque than Brand A and 14% more than Brand B.



Alto's SAS material exhibits 9 % energy capacity advantage over the Brand A and 20% over Brand B at 10 % friction material loss.

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G3® FRICTION

FRICTION TECHNICAL DATA

DESCRIPTION

G3® is a (non-asbestos) organic based friction material with impregnated carbon graphitic particles. Carbon adds lubricity and high thermal stability to the friction material. Through Alto's grooving techniques and proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

APPLICATIONS

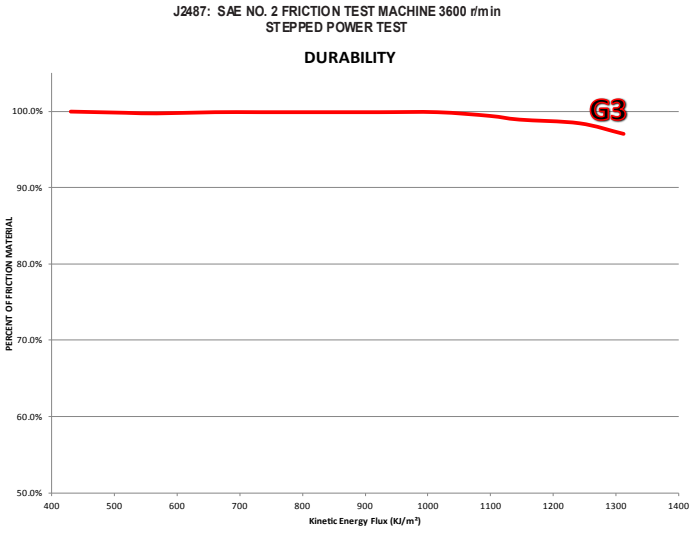
The G3® material has been successfully used in most clutch applications:

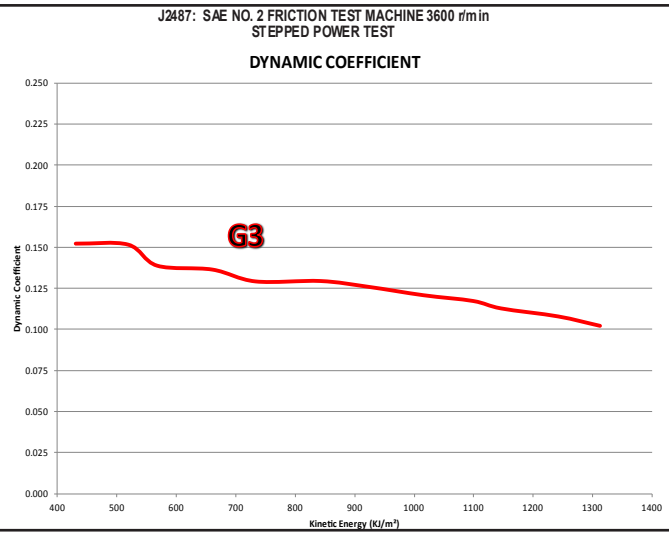
- Automotive
>Automatic Transmission
>>Dynamic Shifting (Low, Moderate, High)
>Slip Differential
>Torque Converter
>Hi- Performance Racing
- Heavy Duty On/Off Road
>Automatic Transmission
>Brakes
>Slip Differential
- Industrial Equipment
>Brakes
- Motorcycle
>Transmission
>Hi-Performance Racing

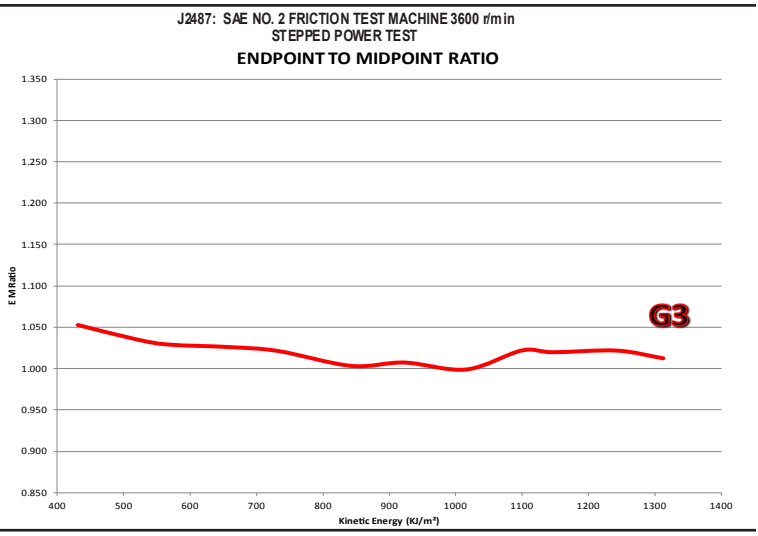
FRICTION RATING

RATING: HIGH ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.020" to 0.072". Custom THICKNESS also available.







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K1® FRICTION

FRICTION TECHNICAL DATA

DESCRIPTION

K1® is a (non-asbestos) organic based friction material. Kevlar particles add high thermal stability and boost the static and dynamic coefficient. Through Alto's grooving techniques and proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

FRICTION RATING:

RATING: MID/HIGH ENERGY MATERIAL

APPLICATIONS

The K1® material has been successfully used in mid to high energy clutch applications:

- Automotive

>Automatic Transmission

>>Dynamic Shifting (Low, Moderate, High)

>Slip Differential

>Torque Converter

>High Performance Racing

- Industrial Equipment

>Brakes

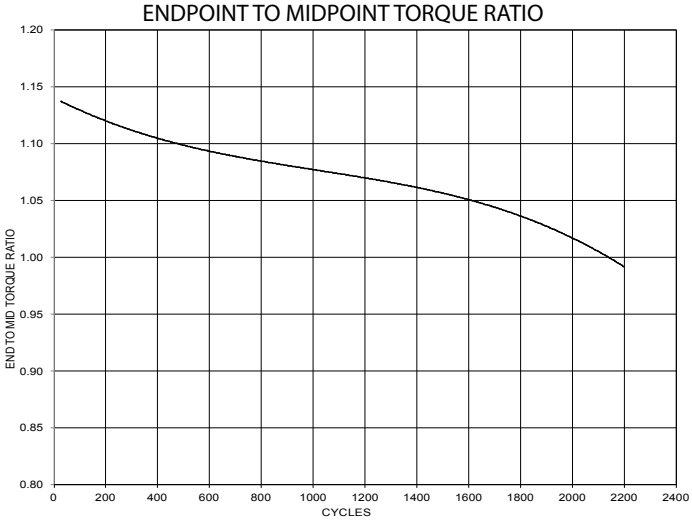
- Motorcycle

>Transmission

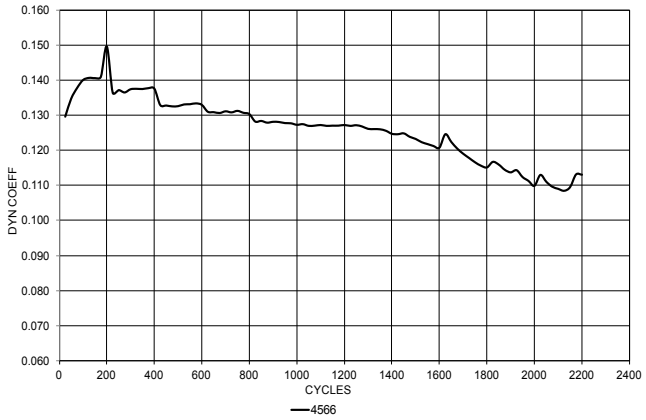
>High Performance Racing

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.058". Custom THICKNESS also available.

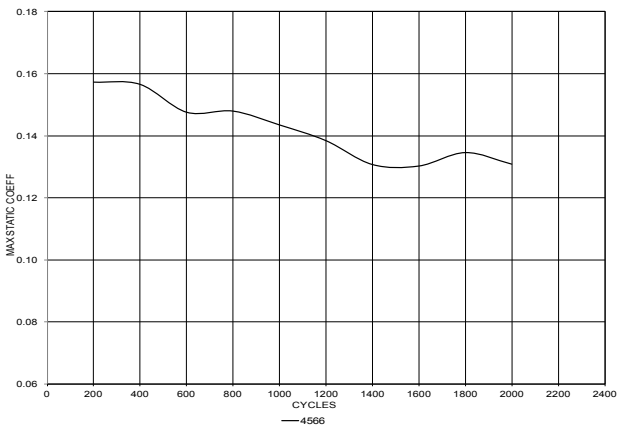
J2487: SAE NO. 2 FRICTION TEST MACHINE 3600 r/min
STEPPED POWER TEST
ENDPOINT TO MIDPOINT TORQUE RATIO



J2487: SAE NO. 2 FRICTION TEST MACHINE 3600 r/min
STEPPED POWER TEST
DYNAMIC COEFFICIENT



J2487: SAE NO. 2 FRICTION TEST MACHINE 3600 r/min
STEPPED POWER TEST
MAX STATIC COEFFICIENT



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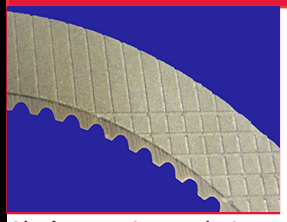
K2® FRICTION

FRICTION TECHNICAL DATA



DESCRIPTION

K2® is a (non-asbestos) organic based friction material with impregnated carbon graphitic particles. Carbon adds lubricity and high thermal stability to the friction material. Through Alto's grooving techniques and proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

APPLICATIONS

The K2® material has been successfully used in most clutch applications:

- Automotive
>Automatic Transmission
>>Dynamic Shifting (Low, Moderate, High)
>>Static Hold
>Slip Differential
>Torque Converter
- Heavy Duty On/Off Road
>Automatic Transmission
>Brakes
>Slip Differential
- Industrial Equipment
>Brakes
>Power Take Off Units (PTOs)
- Motorcycle
>Transmission

FRICTION RATING:

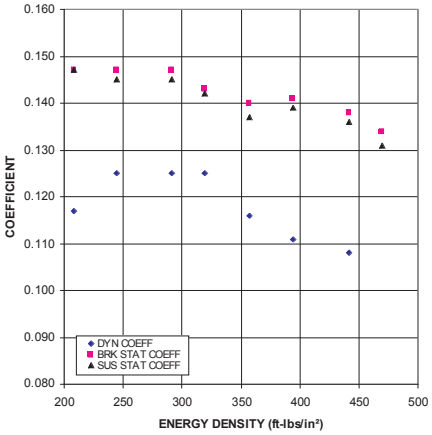
RATING: HIGH ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.034". Custom THICKNESS also available.

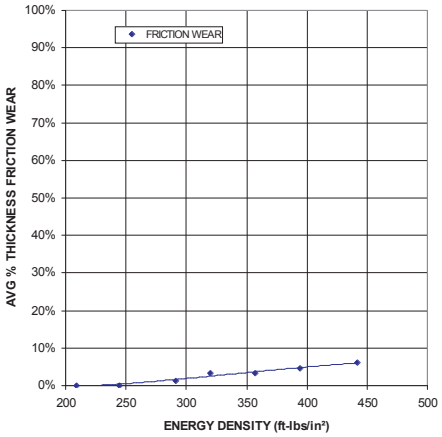
FRICTION PROPERTIES:

Using a modified SAE μPVT Test in Dexron III ATF, the following data was generated showing the effects of velocity, pressure, and temperature on the dynamic and static coefficients:

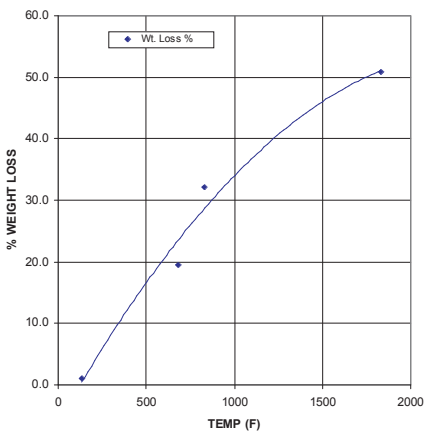
	VELOCITY/PRESSURE		TEMPERATURE	
	(17-34 ft/s)/(12-24 psi)	(62-80 ft/s)/(36-54 psi)	122°F	230°F
	(5-11 m/s)/(83-166 kpa)	(19-25 m/s)/(248-373 kpa)	50°C	110°C
μd	0.119 - 0.130	0.116 - 0.125	0.117 - 0.124	0.116 - 0.130
μsb	0.151 - 0.165	0.117 - 0.152	0.117 - 0.165	0.132 - 0.156
μss	0.147 - 0.157	0.115 - 0.146	0.115 - 0.157	0.128 - 0.152



Coefficient Data: Dynamic, Static Breakaway, & Sustained Static. Based on data complied from a modified SAE Test at 3600 RPM.



Avg Wear per plate after running 200 cycles at the designated energies. The max energy for the K2® is 394 ft-lbs/in^2.



Significant thermal limits of the components contained within the friction material.

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RED EAGLE® FRICTION

FRICTION TECHNICAL DATA

DESCRIPTION

Red Eagle® is a (non-asbestos) organic based friction material with impregnated special high temperature ingredients. The special ingredients provide high thermal stability to the friction material.Through Alto's grooving techniques and proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

APPLICATIONS

The Red Eagle® material has been successfully used in many clutch applications:

- Automotive

>Automatic Transmission

>>Dynamic Shifting (Low, Moderate, High)

>Torque Converter

>Hi- Performance Racing

- Motorcycle

>Transmission

>Hi- Performance Racing

FRICTION RATING:

RATING: MID/HIGH ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.058". Custom THICKNESS also available.

FRICTION PROPERTIES:

Durability results in Dexron II ATF

μd	0.124 - 0.136
μss	0.124 - 0.140

Average Wear per Plate After Running 10,000 Cycles

Energy Density: 350 ft·lbs/in²

Loss: 5.0%

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STC1 FRICTION

FRICTION TECHNICAL DATA

DESCRIPTION

STC1 is a (non-asbestos) organic based friction material. STC1 is a basic friction material whose advantages include low cost and midrange coefficients of friction. Through Alto's grooving techniques and proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

APPLICATIONS

The STC1 material has been successfully used in mild clutch applications:

. Automotive
>Automatic Transmission
>>Dynamic Shifting (Low, Moderate, High)
>Torque Converter
. Industrial Equipment
>Power Take Off Units (PTOs)

FRICTION RATING:

RATING: LOW/MID ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.058". Custom THICKNESS also available.

FRICTION PROPERTIES:

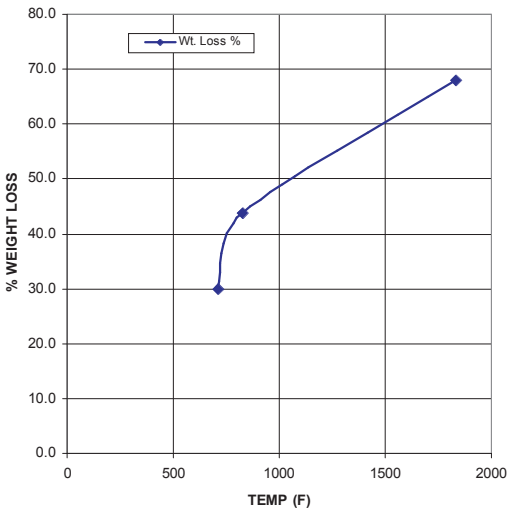
Durability results in Dexron II ATF

μd	0.125 - 0.133
μss	0.124 - 0.153

Average Wear per Plate After Running 10,000 Cycles

Energy Density: 350 ft·lbs/in²

Loss: 6.5%



Thermal Gravimetric Analysis (TGA)
The graph and the table below show the significant thermal limits of the components contained within the friction material.

TEMPERATURE	WEIGHT LOSS
° F	%
710	30.0
824	43.8
1832	67.9

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CF® FRICTION

FRICTION TECHNICAL DATA

DESCRIPTION

CF® is a (non-asbestos) organic based friction material with impregnated carbon graphitic particles. Carbon adds lubricity and high thermal stability to the friction material. Through Alto's proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

APPLICATIONS

The CF® material has been successfully used in most clutch applications:

- Automotive
>Automatic Transmission
>>Static Hold
>Slip Differential
>Torque Converter
- Heavy Duty On/Off Road
>Automatic Transmission
>Brakes
>Slip Differential
- Industrial Equipment
>Brakes
>Power Take Off Units (PTOs)
- Motorcycle
>Transmission

FRICTION RATING:

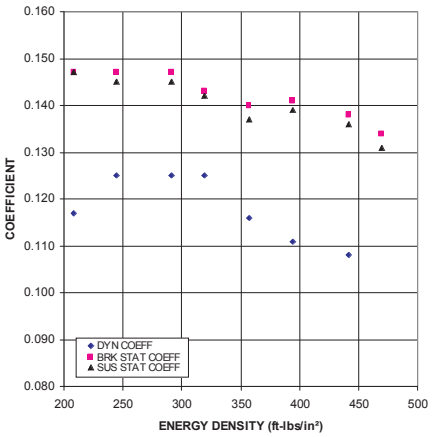
RATING: HIGH ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.074". Custom THICKNESS also available.

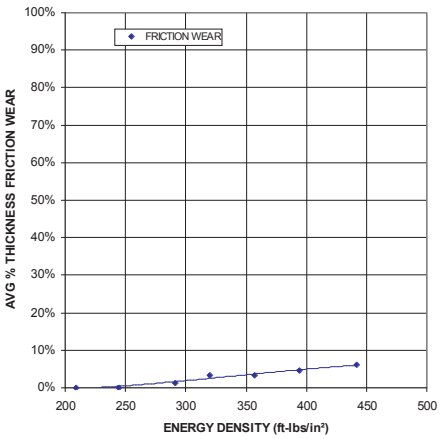
FRICTION PROPERTIES:

Using a modified SAE μPVT Test in Dexron III ATF, the following data was generated showing the effects of velocity, pressure, and temperature on the dynamic and static coefficients:

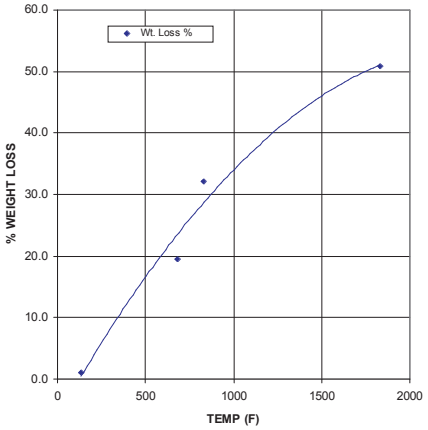
	VELOCITY/PRESSURE		TEMPERATURE	
	(17-34 ft/s)/(12-24 psi)	(62-80 ft/s)/(36-54 psi)	122°F	230°F
	(5-11 m/s)/(83-166 kpa)	(19-25 m/s)/(248-373 kpa)	50°C	110°C
μd	0.119 - 0.130	0.116 - 0.125	0.117 - 0.124	0.116 - 0.130
μsb	0.151 - 0.165	0.117 - 0.152	0.117 - 0.165	0.132 - 0.156
μss	0.147 - 0.157	0.115 - 0.146	0.115 - 0.157	0.128 - 0.152



Coefficient Data: Dynamic, Static Breakaway, & Sustained Static. Based on data complied from a modified SAE Test at 3600 RPM.



Avg Wear per plate after running 200 cycles at the designated energies. The max energy for the CF® is 394 ft-lbs/in^2.



Significant thermal limits of the components contained within the friction material.

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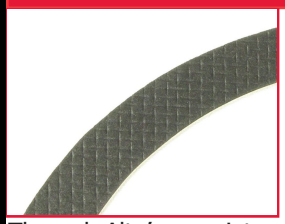
CFM® FRICTION

FRICTION TECHNICAL DATA



DESCRIPTION

CFM® is a (non-asbestos) organic based friction material with impregnated carbon graphitic particles. Carbon adds lubricity and high thermal stability to the friction material. Through Alto's proprietary processing, the friction material can be tailored within a specific friction performance range found within the natural limits described in the friction properties section.

APPLICATIONS

The CFM® material has been successfully used in most clutch applications:

- Automotive
  - >Automatic Transmission
  - >>Static Hold
  - >Slip Differential
  - >Torque Converter
- Heavy Duty On/Off Road
  - >Automatic Transmission
  - >Brakes
  - >Slip Differential
- Industrial Equipment
  - >Brakes
  - >Power Take Off Units (PTOs)
- Motorcycle
  - >Transmission

FRICTION RATING:

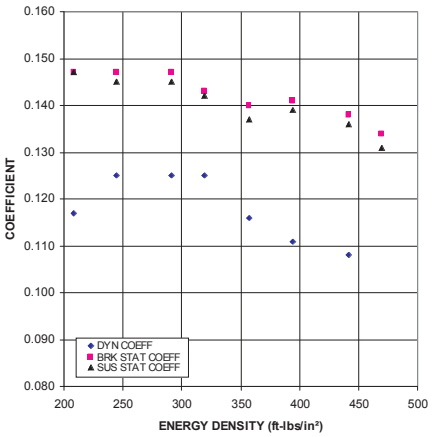
RATING: HIGH ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.074". Custom THICKNESS also available.

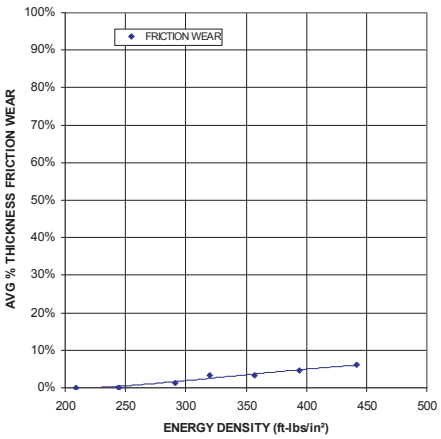
FRICTION PROPERTIES:

Using a modified SAE μPVT Test in Dexron III ATF, the following data was generated showing the effects of velocity, pressure, and temperature on the dynamic and static coefficients:

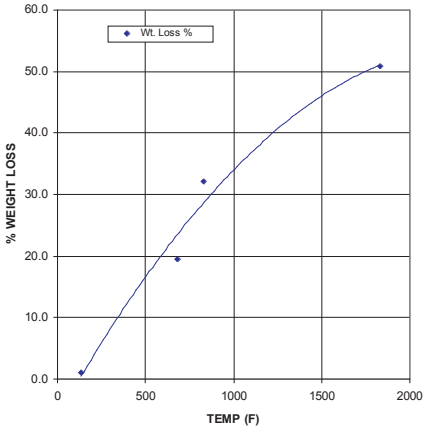
	VELOCITY/PRESSURE		TEMPERATURE	
	(17-34 ft/s)/(12-24 psi)	(62-80 ft/s)/(36-54 psi)	122°F	230°F
	(5-11 m/s)/(83-166 kpa)	(19-25 m/s)/(248-373 kpa)	50°C	110°C
μd	0.144 - 0.160	0.131 - 0.141	0.131 - 0.160	0.134 - 0.152
μsb	0.163 - 0.176	0.126 - 0.177	0.153 - 0.177	0.127 - 0.171
μss	0.163 - 0.179	0.123 - 0.179	0.152 - 0.179	0.123 - 0.172



Coefficient Data: Dynamic, Static Breakaway, & Sustained Static. Based on data complied from a modified SAE Test at 3600 RPM.



Avg Wear per plate after running 200 cycles at the designated energies. The max energy for the CFM® is 394 ft-lbs/in^2.



Significant thermal limits of the components contained within the friction material.

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STB1 FRICTION

FRICTION TECHNICAL DATA

DESCRIPTION

STB1 is a (non-asbestos) sintered bronze based friction material. STB1 is an all purpose material with medium energy capacity.

APPLICATIONS

The STB1 material has been successfully used in many clutch applications:

. Automotive
>Automatic Transmission
. Heavy Duty On/Off Road
>Automatic Transmission
>Slip Differential
>Brakes
. Industrial Equipment
>Brakes

FRICTION RATING:

RATING: MID ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.100". Custom THICKNESS also available.

FRICTION PROPERTIES:

Friction Performance in Mercon V ATF @ 3600 RPM

	43,000 ft·lbs Energy	76,000 ft·lbs Energy
μd	0.087	0.122
μss	0.138	0.144

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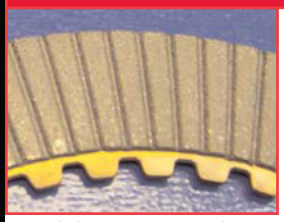
STB2 FRICTION

FRICTION TECHNICAL DATA



DESCRIPTION

STB2 is a (non-asbestos) sintered graphitic based friction material. The sintered graphitic material exhibits a smooth operation with a high energy absorption capability in most oils.

APPLICATIONS

The STB2 material has been successfully used in many clutch applications:

. Automotive
>Automatic Transmission
. Marine
>Automatic Transmission
. Heavy Duty On/Off Road
>Automatic Transmission
>Slip Differential
>Brakes
. Industrial Equipment
>Brakes

FRICTION RATING:

RATING: HIGH ENERGY MATERIAL

DIMENSIONS: Available in THICKNESS varying 0.018" to 0.100". Custom THICKNESS also available.

FRICTION PROPERTIES:

Friction Performance in Mercon V ATF @ 3600 RPM

	43,000 ft·lbs Energy	76,000 ft·lbs Energy
μd	0.099	0.141
μss	0.120	0.142

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