



TABLE OF CONTENTS

K2[®] FRICTION MATERIAL
RED EAGLE[®] FRICTION MATERIAL
G3[®] FRICTION MATERIAL
G4[®] FRICTION MATERIAL
SAS[®] FRICTION MATERIAL
CARBONITE FRICTION MATERIAL
STC1[®] FRICTION MATERIAL

K2 MATERIAL SPECIFICATION



1. Description

Asbestos free, organic friction lining with high carbon and aramid content exhibiting high thermal stability. High quality organic friction lining characteristic of sound porosity and resiliency allowing an efficient oil flow within the materials to improve heat dissipation favorable for high performance applications.

2. Applications

Friction lining in oil immersed applications, especially for differentials, clutches with high unit loads, and/or high energy/power demands. The lining can be specified for automatic clutch applications as well as torque converter applications.

For all applications, they can be made with hardened or unhardened reaction surfaces made from steel, cast iron, steel alloys, and aluminum having a surface roughness between the range of Ra 0.1 to 1.1 μm .

3. Physical Characteristics

▪ Color:	Gray
▪ E-modulus (@ 100 °C in Dexron VI ATF):	29 – 66 N/mm ²
▪ Thermal Decomposition:	325 °C (DSC inert gas)
▪ Thermal Conductivity:	0.185 – 0.186 W/mK

4. Conditions

▪ Friction value (Ref. Dexron VI ATF)	
Dynamic:	0.13 – 0.16
Static	0.10 – 0.14
▪ Recommended surface pressure:	0.3 – 4.8 N/mm ²
Max. surface pressure (dynamic):	5.5 N/mm ²
Max. surface pressure (static):	5.5 N/mm ²
▪ Oil cooling	
Recommended oil temperature:	80°C
Max. oil sump temperature:	150°C
Quantity (circulation):	0.5 L/min

5. Storage / Fitting / Application

The linings will fully perform when following the given instructions, e.g. stable friction values, low setting and reliable performance.

- The storage of discs in max. 65% moisture content should not exceed 6 months due to corrosion. The discs or clutch packs should be stored in a closed and dry place.
- During assembly it has to be ascertained that the linings are fully provided with oil before loading. It is recommended to dip the plates into application oil for 15 minutes at room temperature or 5



minutes at 50 – 70°C. Should this not be possible, Alto Products can supply oil impregnated parts. Discs that are not sufficiently oiled will wear faster and usually lead to noise problems.

- Full loading of the friction discs should only be done after the break-in in period (~500 cycles) to avoid higher wear.
- Depending on the application a reduction of the pack length or an expansion of the clearance could be possible due to the permanent set of the friction surfaces due to unit loading and the reaction surfaces.
- The oil has to be free from contamination and particles. Water content should not be higher than 1% in order to avoid corrosion or lining detaching.

6. Important note

The information and results shown in this material specification were generated according to the Society of Automotive Engineers test standards J2490 μ PVT and J2487 3,600 RPM Step Level on Alto's SAE #2 Friction Test Machine. This information cannot be used as a basis for choosing a material for a specific application, because the friction characteristic is dependent on the actual conditions and oil used.

Alto Products engineers are readily available to advise on technical applications.

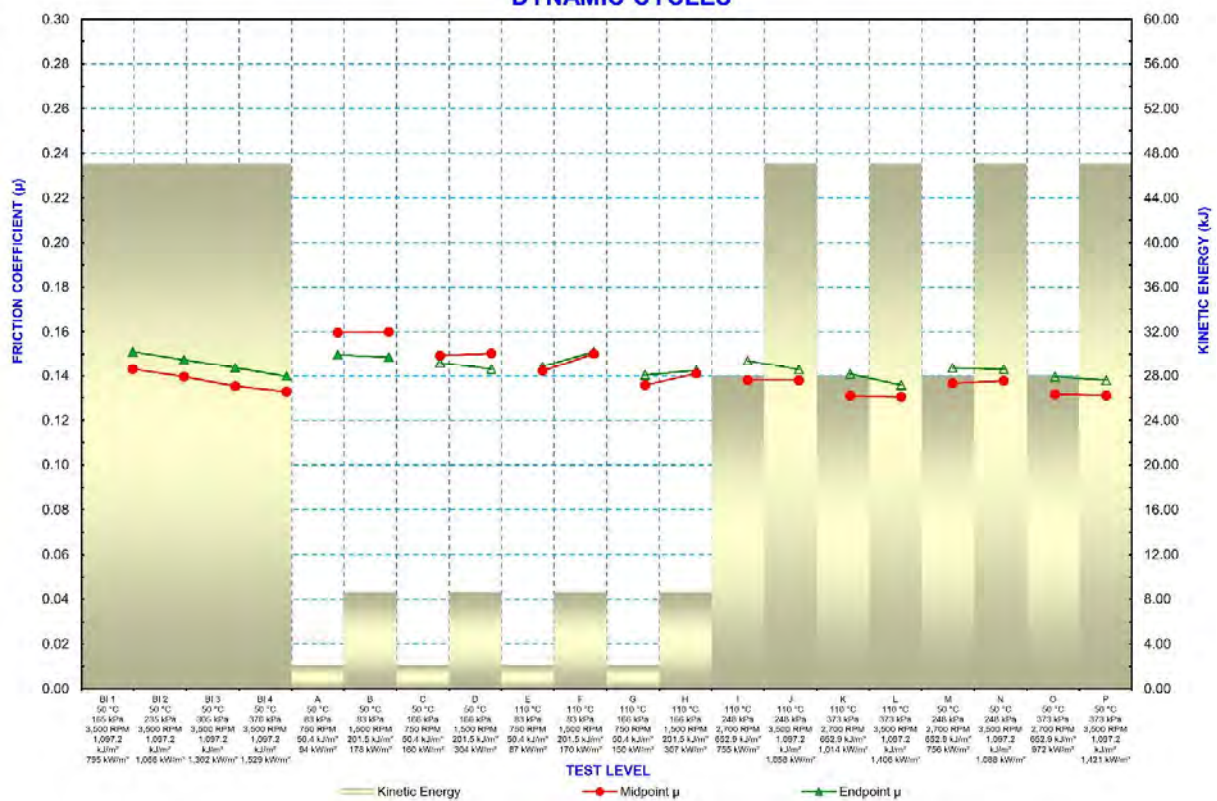
Every use of Alto Products friction lining has to be approved.



7. Diagrams

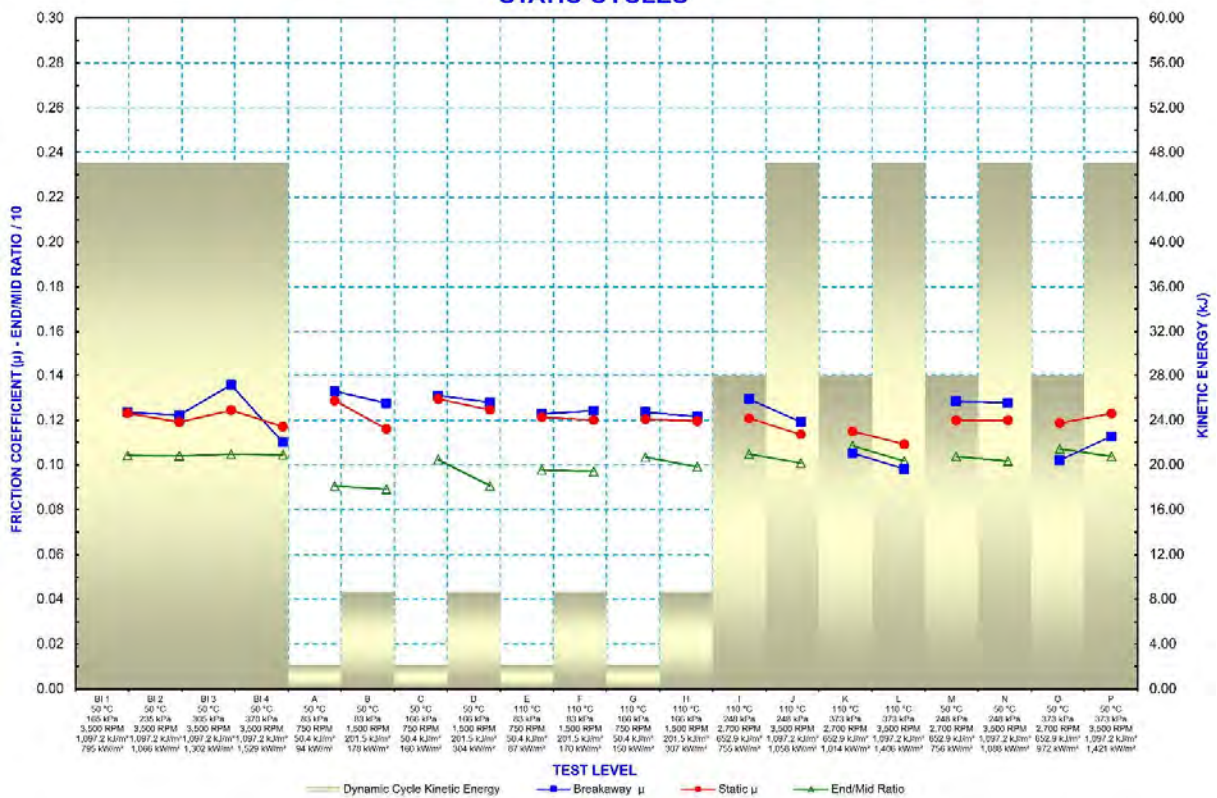
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST

DYNAMIC CYCLES





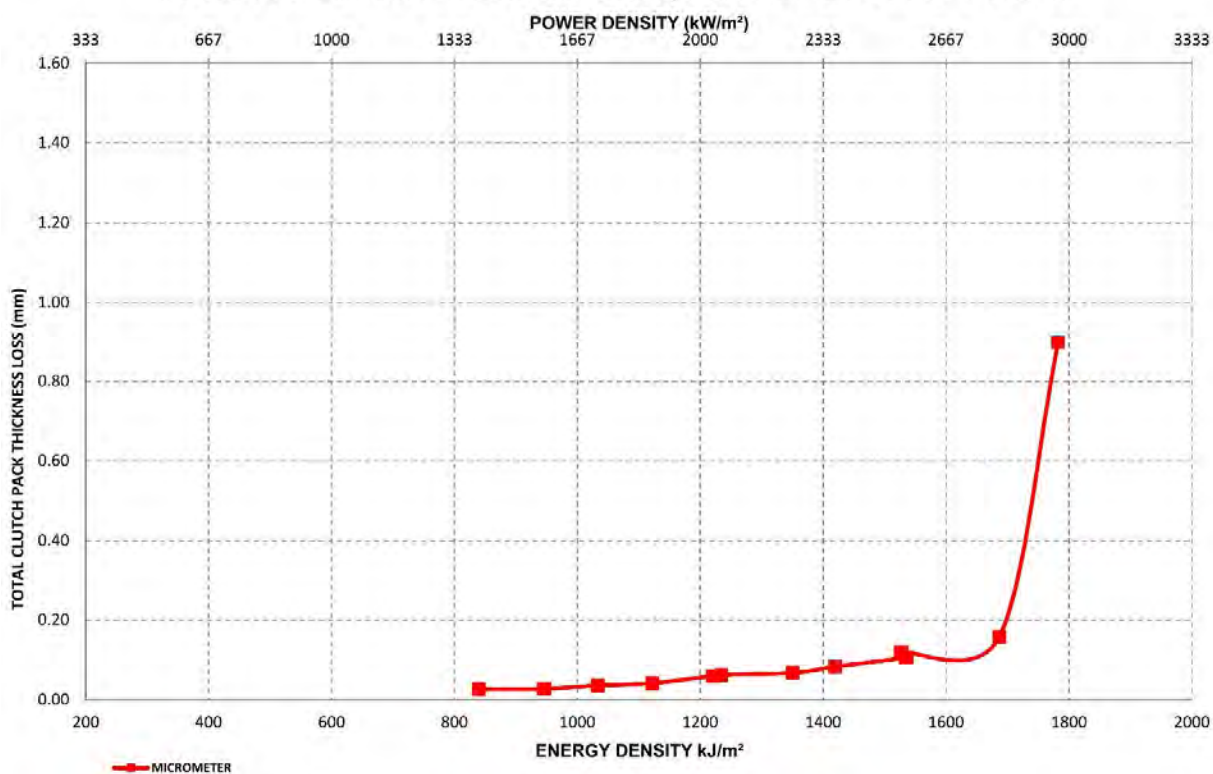
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST STATIC CYCLES





SAE J2488: SAE NO. 2 FRICTION TEST MACHINE
6000 RPM STEPPED POWER TEST

TOTAL CLUTCH PACK THICKNESS LOSS v/s ENERGY & POWER DENSITY



RED EAGLE® MATERIAL SPECIFICATION



1. 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.

2. Applications

Friction lining in oil immersed applications, especially for differentials and/or high energy/power demands. The lining is specified for automatic clutch, high performance, racing, original equipment replacement and upgrading applications.

For all applications, they can be made with hardened or unhardened reaction surfaces made from steel, cast iron, steel alloys, and aluminum having a surface roughness between the range of Ra 0.1 to 1.1 µm.

3. Physical Characteristics

▪ Color:	Red
▪ E-modulus (@ 100 °C in Dexron VI ATF):	27 – 63 N/mm ²
▪ Thermal Decomposition:	325 °C (DSC inert gas)
▪ Thermal Conductivity:	0.126 – 0.132 W/mK

4. Conditions

▪ Friction value (Ref. Dexron VI ATF)	
Dynamic:	0.13 – 0.15
Static	0.09 – 0.14
▪ Recommended surface pressure:	0.3 – 5.5 N/mm ²
Max. surface pressure (dynamic):	6.2 N/mm ²
Max. surface pressure (static):	6.2 N/mm ²
▪ Oil cooling	
Recommended oil temperature:	80°C
Max. oil sump temperature:	150°C
Quantity (circulation):	0.5 L/min

5. Storage / Fitting / Application

The linings will fully perform when following the given instructions, e.g. stable friction values, low setting and reliable performance.

- The storage of discs in max. 65% moisture content should not exceed 6 months due to corrosion. The discs or clutch packs should be stored in a closed and dry place.
- During assembly it has to be ascertained that the linings are fully provided with oil before loading. It is recommended to dip the plates into application oil for 15 minutes at room temperature or 5



minutes at 50 – 70°C. Should this not be possible, Alto Products can supply oil impregnated parts. Discs that are not sufficiently oiled will wear faster and usually lead to noise problems.

- Full loading of the friction discs should only be done after the break-in in period (~500 cycles) to avoid higher wear.
- Depending on the application a reduction of the pack length or an expansion of the clearance could be possible due to the permanent set of the friction surfaces due to unit loading and the reaction surfaces.
- The oil has to be free from contamination and particles. Water content should not be higher than 1% in order to avoid corrosion or lining detaching.

6. Important note

The information and results shown in this material specification were generated according to the Society of Automotive Engineers test standards J2490 μ PVT and J2488 6,000 RPM Step Level on Alto's SAE #2 Friction Test Machine. This information cannot be used as a basis for choosing a material for a specific application, because the friction characteristic is dependent on the actual conditions and oil used.

Alto Products engineers are readily available to advise on technical applications.

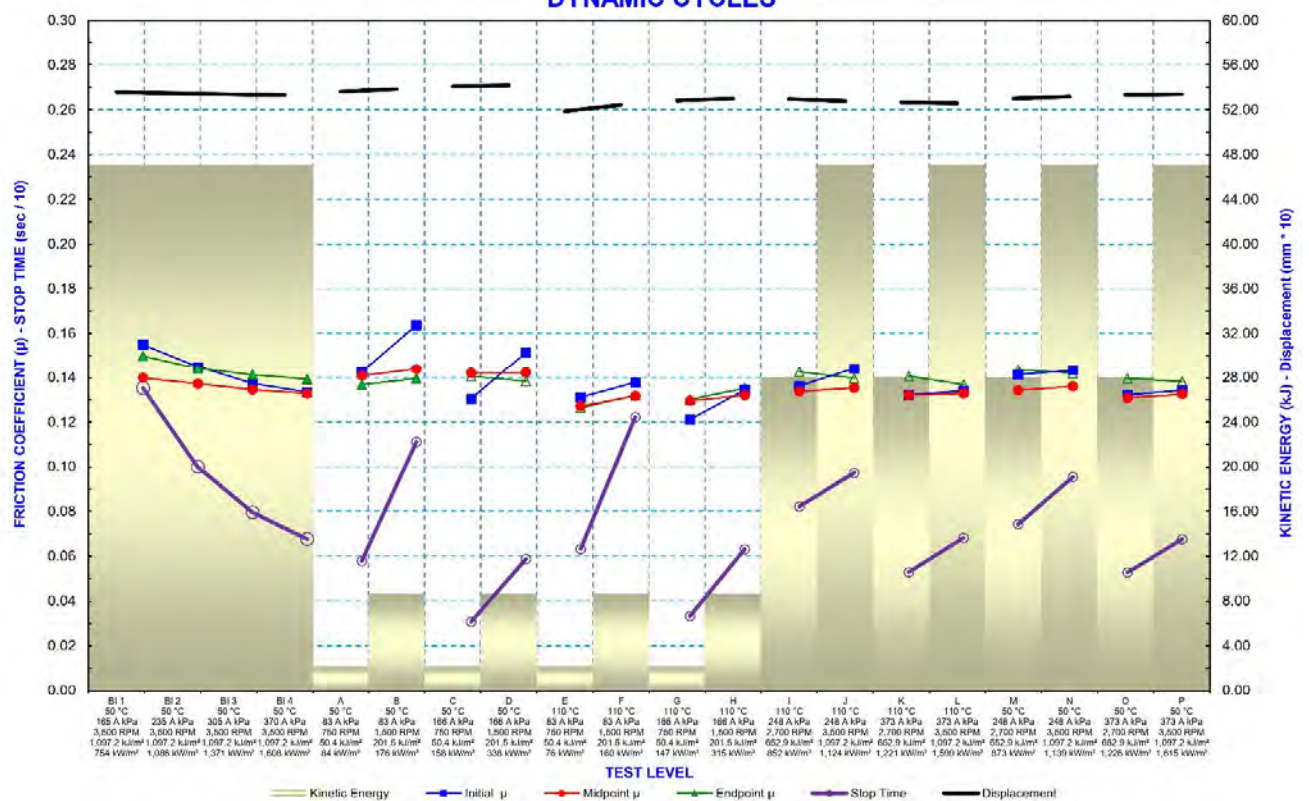
Every use of Alto Products friction lining has to be approved.



7. Diagrams

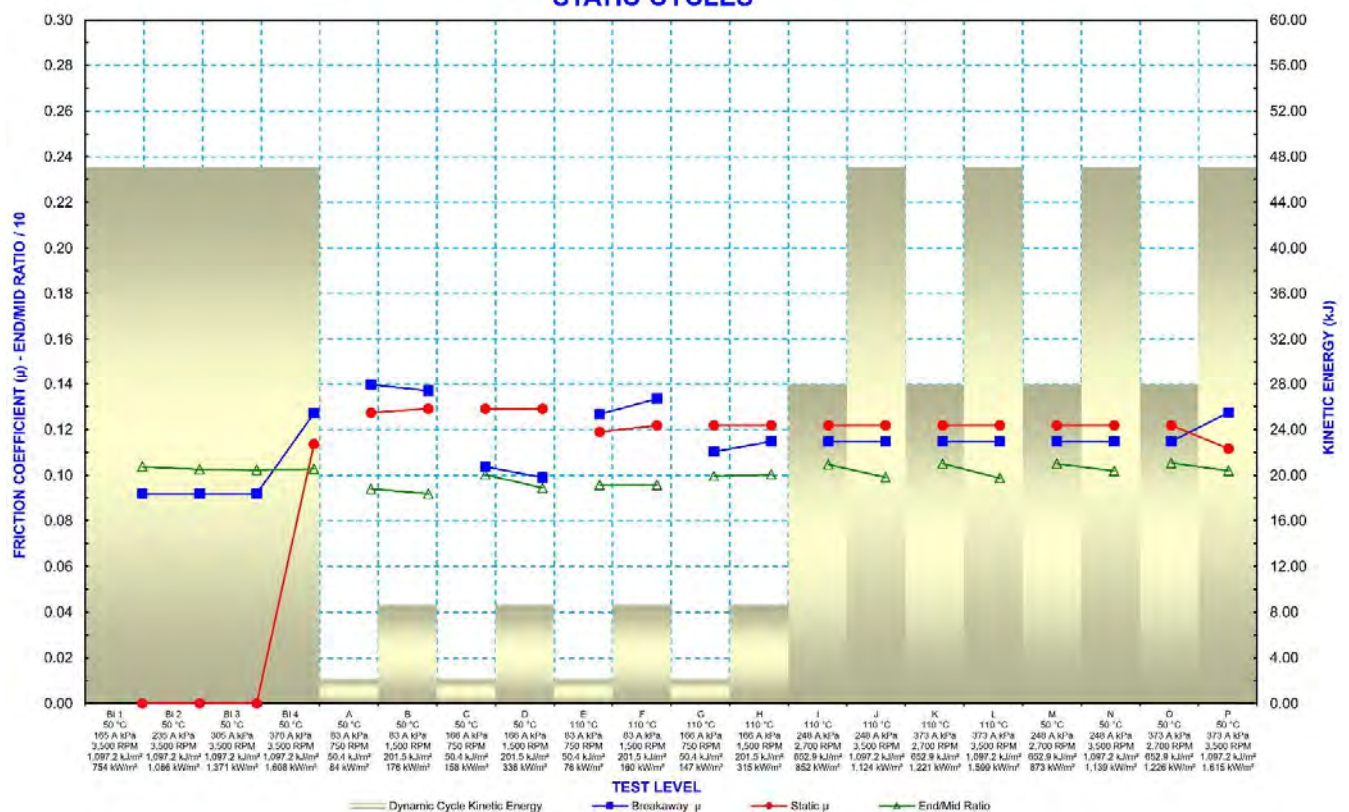
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST

DYNAMIC CYCLES





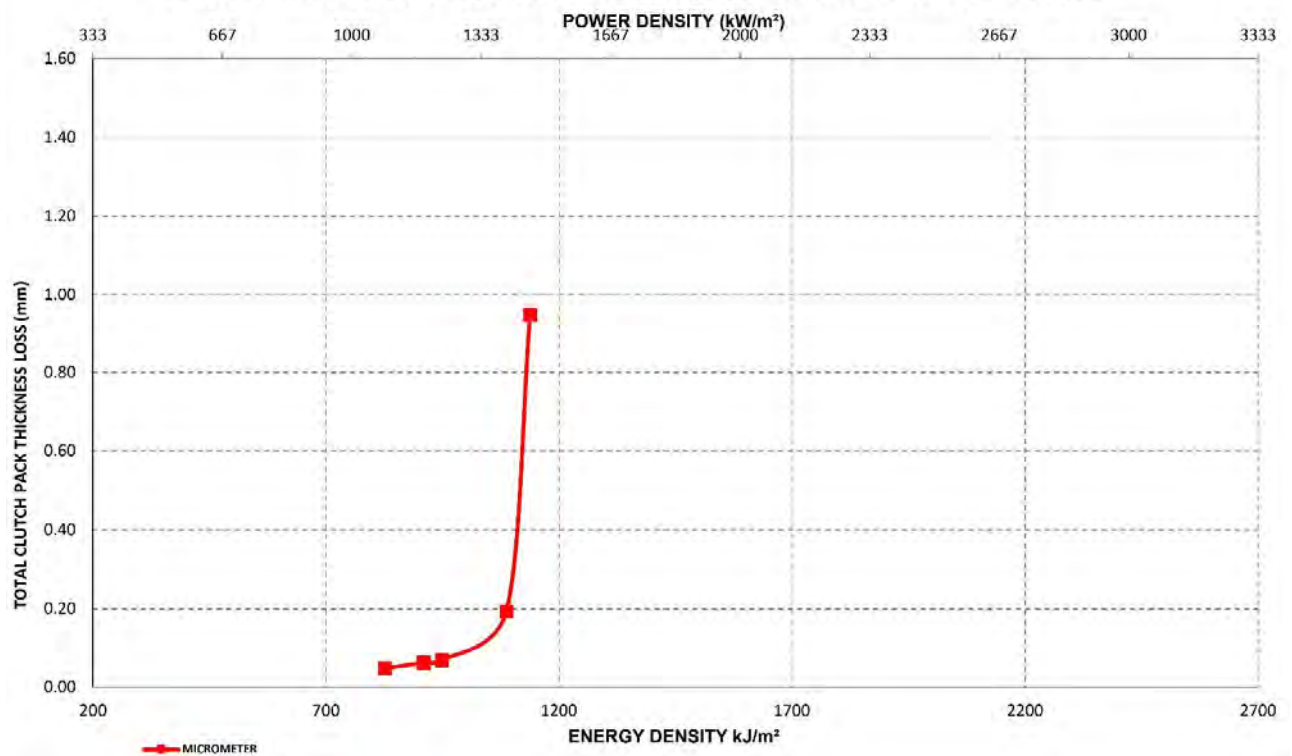
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST STATIC CYCLES





SAE J2488: SAE NO. 2 FRICTION TEST MACHINE
6000 RPM STEPPED POWER TEST

TOTAL CLUTCH PACK THICKNESS LOSS v/s ENERGY & POWER DENSITY



G3 MATERIAL SPECIFICATION



1. Description

Asbestos free, organic friction lining with high carbon and aramid content exhibiting high thermal stability. High quality organic friction lining characteristic of sound porosity and resiliency allowing an efficient oil flow within the materials to improve heat dissipation favorable for high performance applications.

2. Applications

Friction lining in oil immersed applications, especially for differentials, clutches with high unit loads, and/or high energy/power demands. The lining can be specified for automatic clutch applications as well as torque converter applications.

For all applications, they can be made with hardened or unhardened reaction surfaces made from steel, cast iron, steel alloys, and aluminum having a surface roughness between the range of Ra 0.1 to 1.1 μm .

3. Physical Characteristics

▪ Color:	Brown or Black
▪ E-modulus (@ 100 °C in Dexron VI ATF):	22 – 46 N/mm ²
▪ Thermal decomposition:	325 °C (DSC inert gas)
▪ Thermal Conductivity:	0.105 – 0.111 W/mK

4. Conditions

▪ Friction value (Ref. Dexron VI ATF)	
Dynamic:	0.14 – 0.20
Static	0.14 – 0.20
▪ Recommended surface pressure:	0.3 – 6.9 N/mm ²
Max. surface pressure (dynamic):	8.3 N/mm ²
Max. surface pressure (static):	8.3 N/mm ²
▪ Oil cooling	
Recommended oil temperature:	80°C
Max. oil sump temperature:	150°C
Quantity (circulation):	0.5 L/min

5. Storage / Fitting / Application

The linings will fully perform when following the given instructions, e.g. stable friction values, low setting and reliable performance.

- The storage of discs in max. 65% moisture content should not exceed 6 months due to corrosion. The discs or clutch packs should be stored in a closed and dry place.



- During assembly it has to be ascertained that the linings are fully provided with oil before loading. It is recommended to dip the plates into application oil for 15 minutes at room temperature or 5 minutes at 50 – 70°C. Should this not be possible, Alto Products can supply oil impregnated parts. Discs that are not sufficiently oiled will wear faster and usually lead to noise problems.
- Full loading of the friction discs should only be done after the break-in in period (~500 cycles) to avoid higher wear.
- Depending on the application a reduction of the pack length or an expansion of the clearance could be possible due to the permanent set of the friction surfaces due to unit loading and the reaction surfaces.
- The oil has to be free from contamination and particles. Water content should not be higher than 1% in order to avoid corrosion or lining detaching.

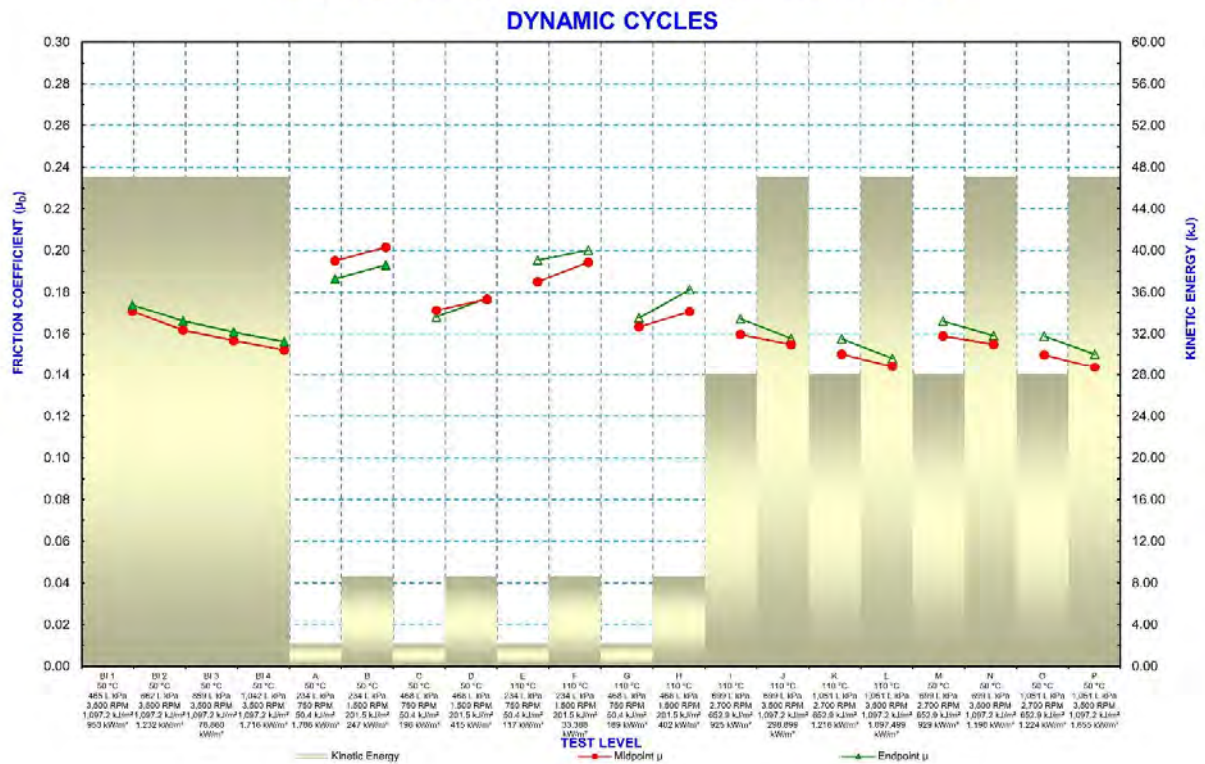
6. Important note

The information and results shown in this material specification were generated according to the Society of Automotive Engineers test standards J2490 μ PVT and J2487 3,600 RPM Step Level on Alto's SAE #2 Friction Test Machine. This information cannot be used as a basis for choosing a material for a specific application, because the friction characteristic is dependent on the actual conditions and oil used. Alto Products engineers are readily available to advise on technical applications. Every use of Alto Products friction lining has to be approved.



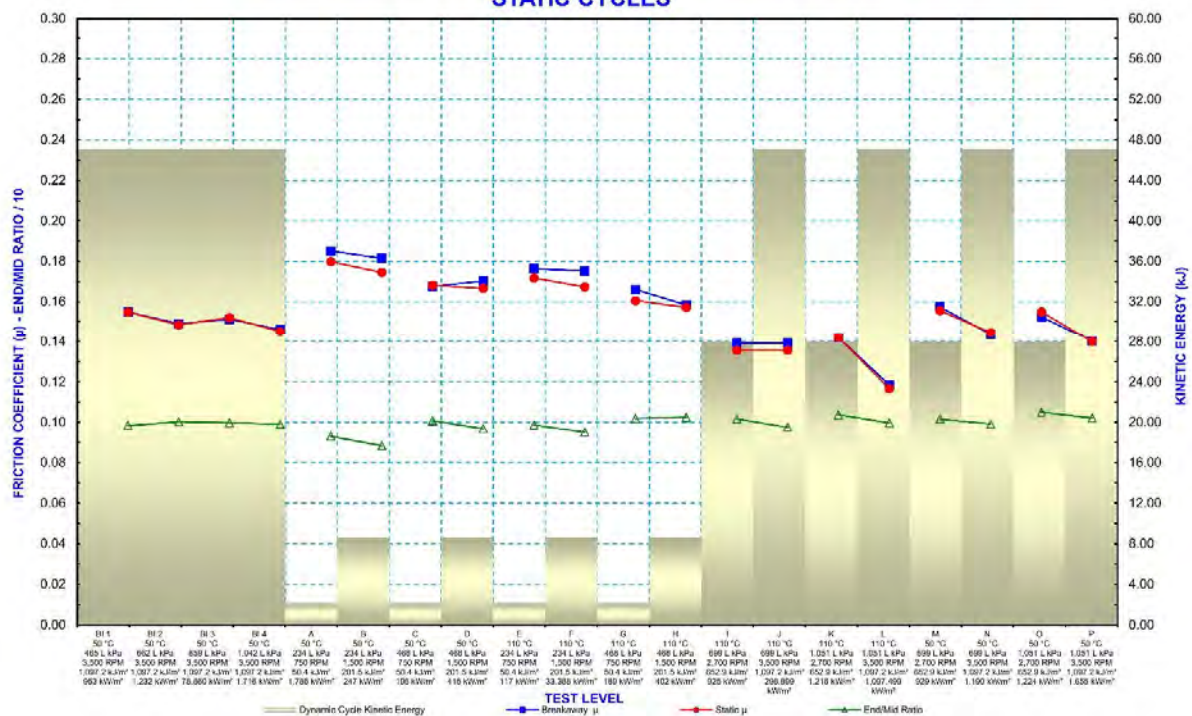
7. Diagrams

SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST





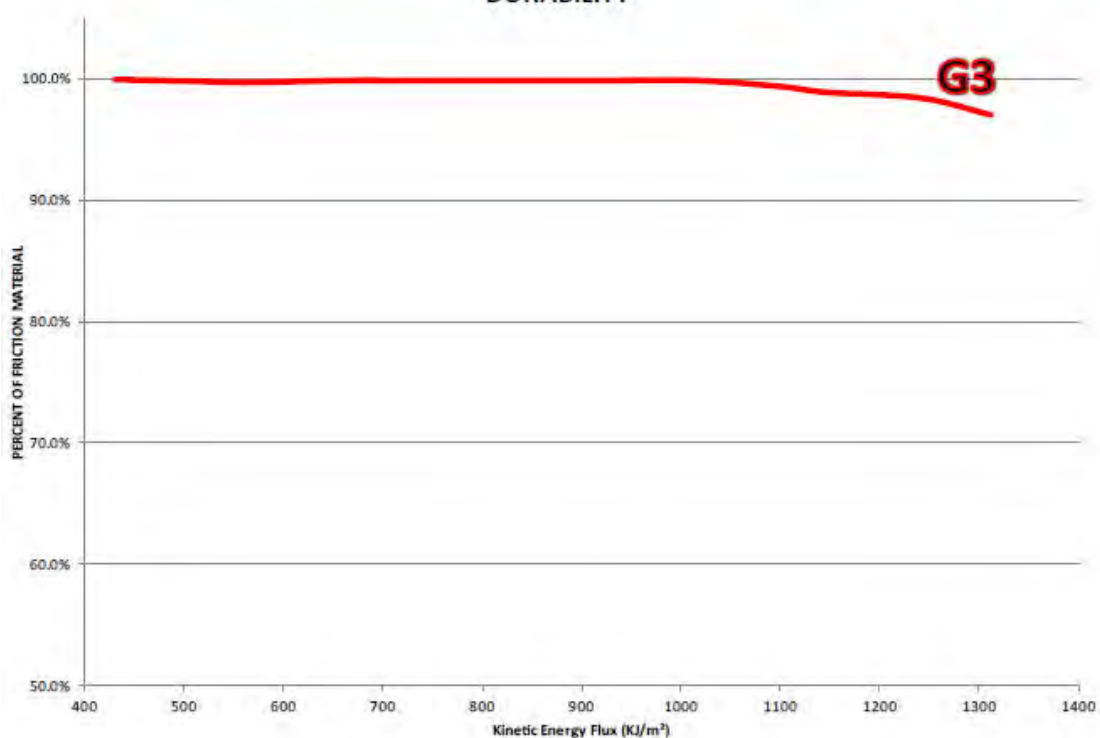
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST STATIC CYCLES





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

DURABILITY





Material Specification ALTO PRODUCTS CORP G4

1. Description

Asbestos free, organic friction lining with high carbon and aramid content exhibiting high thermal stability. High quality organic friction lining characteristic of sound porosity and resiliency allowing an efficient oil flow within the materials to improve heat dissipation favorable for high performance applications.

2. Applications

Friction lining in oil immersed applications, especially for differentials, clutches with high unit loads, and/or high energy/power demands. The lining can be specified for automatic clutch applications as well as torque converter applications.

For all applications, they can be made with hardened or unhardened reaction surfaces made from steel, cast iron, steel alloys, and aluminum having a surface roughness between the range of Ra 0.1 to 1.1 μm .

3. Physical Characteristics

- Color: Black
- Thermal decomposition: 375 °C (DSC inert gas)
- Thermal Conductivity: 0.145 – 0.250 W/mK

4. Conditions

- **Friction value (Ref. Dexron VI ATF)**
 - Dynamic: 0.12 – 0.17
 - Static: 0.13 – 0.17
- **Recommended surface pressure:**
 - 0.3 – 6.9 N/mm²
 - Max. surface pressure (dynamic): 8.3 N/mm²
 - Max. surface pressure (static): 8.3 N/mm²
- **Oil cooling**
 - Recommended oil temperature: 80°C
 - Max. oil sump temperature: 150°C
 - Quantity (circulation): 0.5 L/min

5. Storage / Fitting / Application

The linings will fully perform when following the given instructions, e.g. stable friction values, low setting and reliable performance.

- The storage of discs in max. 65% moisture content should not exceed 6 months due to corrosion. The discs or clutch packs should be stored in a closed and dry place.
- During assembly it has to be ascertained that the linings are fully provided with oil before loading. It is recommended to dip the plates into application oil for 15 minutes at room temperature or 5 minutes at 50 – 70°C. Should this not be possible, Alto Products can supply oil impregnated parts. Discs that are not sufficiently oiled will wear faster and usually lead to noise problems.
- Full loading of the friction discs should only be done after the break-in in period (~100 cycles) to avoid higher wear.
- Depending on the application a reduction of the pack length or an expansion of the clearance could be possible due to the permanent set of the friction surfaces due to unit loading and the reaction surfaces.
- The oil has to be free from contamination and particles. Water content should not be higher than 1% in order to avoid corrosion or lining detaching.

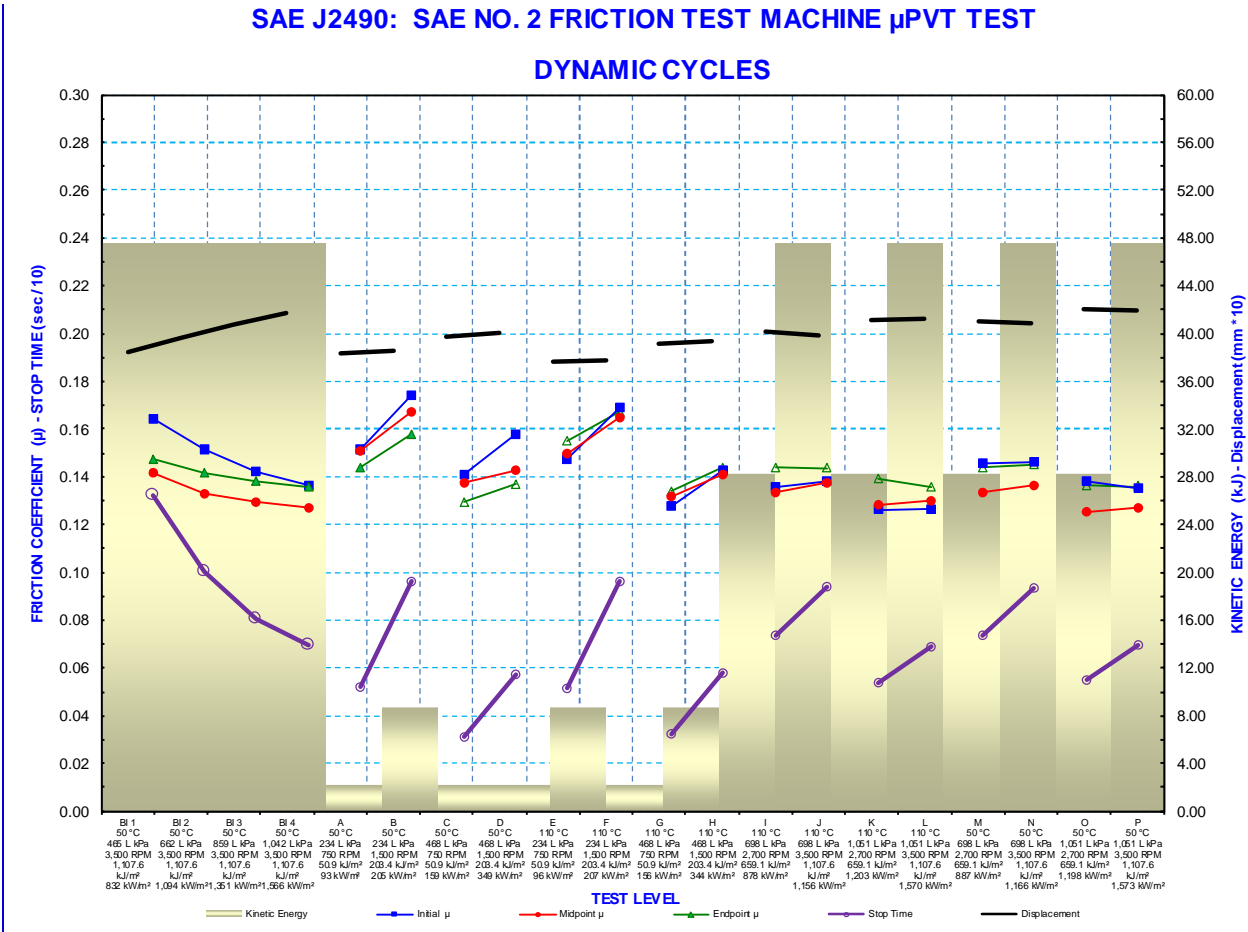
6. Important note

The information and results shown in this material specification were generated according to the Society of Automotive Engineers test standards J2490 μ PVT and J2488 6,000 RPM Step Level on Alto's SAE #2 Friction Test Machine. This information cannot be used as a basis for choosing a material for a specific application, because the friction characteristic is dependent on the actual conditions and oil used.

Alto Products engineers are readily available to advise on technical applications.

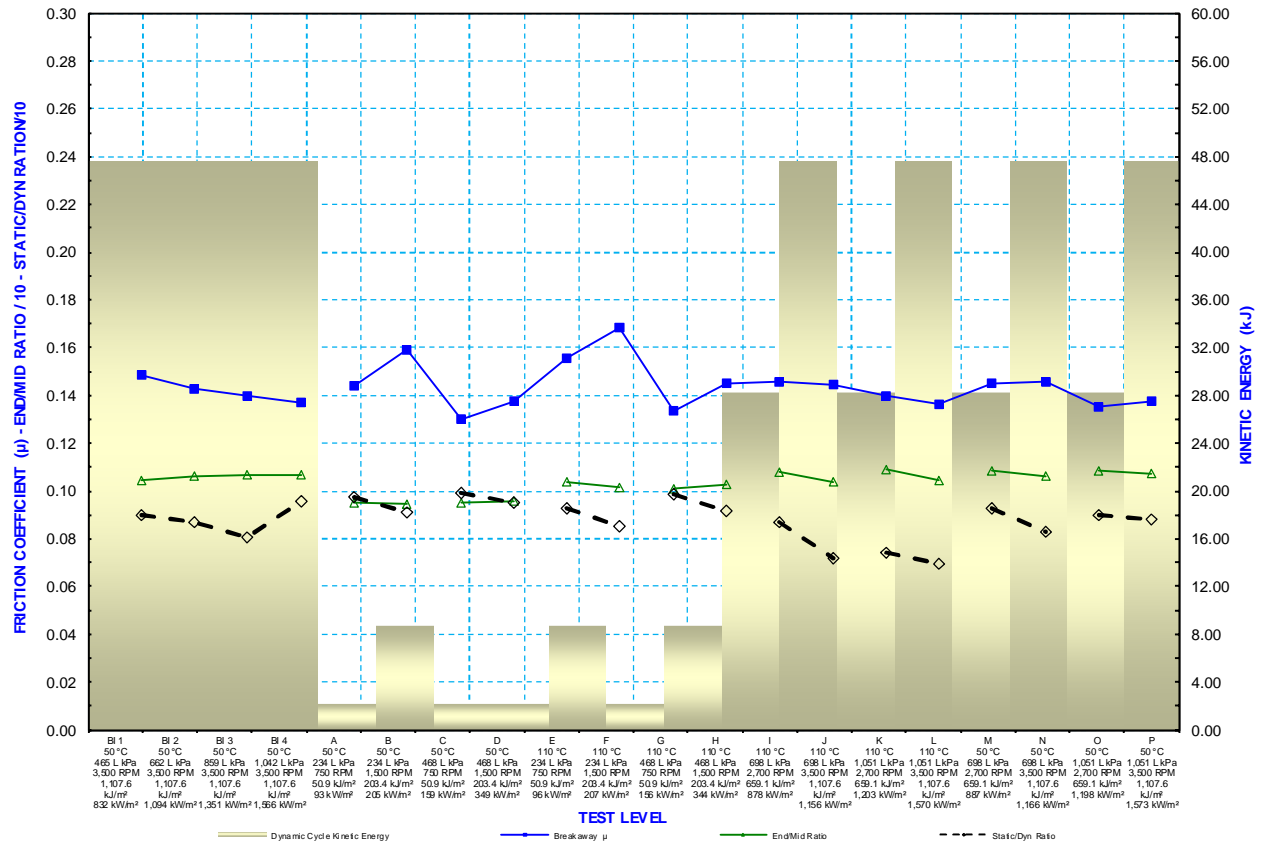
Every use of Alto Products friction lining has to be approved.

7. Diagrams

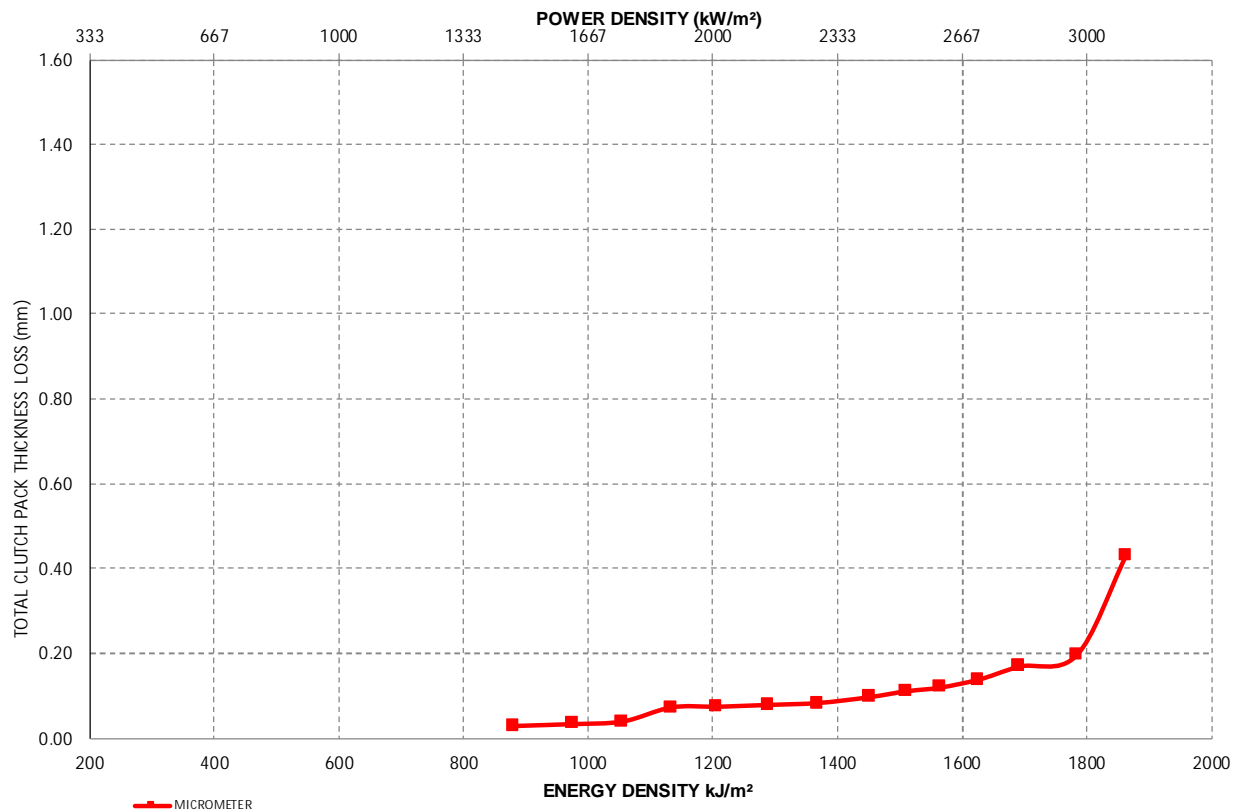


SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST

STATIC CYCLES



TOTAL CLUTCH PACK THICKNESS LOSS v/s ENERGY & POWER DENSITY



SAS MATERIAL SPECIFICATION



1. Description

Asbestos free, organic friction lining with aramid content supplying smooth shift feel eliminating noise, vibration, and hardness of shift phenomena. High quality organic friction lining characteristic of sound porosity and resiliency allowing an efficient oil flow within the materials to improve heat dissipation favorable for high performance applications.

2. Applications

Friction lining in oil immersed applications, especially for limited slip and dynamic shifting clutches at relatively low speeds. The lining can be specified for automatic clutch applications. For all applications, they can be made with hardened or unhardened reaction surfaces made from steel, cast iron, steel alloys, and aluminum having a surface roughness between the range of Ra 0.1 to 1.1 μm .

3. Physical Characteristics

- | | |
|--|------------------------|
| ▪ Color: | Brown |
| ▪ E-modulus (@ 100 °C in Dexron VI ATF): | 32.5 N/mm ² |
| ▪ Thermal decomposition: | 325 °C (DSC inert gas) |
| ▪ Thermal Conductivity: | 0.139 – 0.145 W/mK |

4. Conditions

- | | |
|--|-----------------------------|
| ▪ Friction value (Ref. Dexron VI ATF) | |
| Dynamic: | 0.135 – 0.165 |
| Static | 0.125 – 0.145 |
| ▪ Recommended surface pressure: | 0.3 – 4.8 N/mm ² |
| Max. surface pressure (dynamic): | 5.5 N/mm ² |
| Max. surface pressure (static): | 5.5 N/mm ² |
| ▪ Oil cooling | |
| Recommended oil temperature: | 80°C |
| Max. oil sump temperature: | 150°C |
| Quantity (circulation): | 0.5 L/min |

5. Storage / Fitting / Application

The linings will fully perform when following the given instructions, e.g. stable friction values, low setting and reliable performance.

- The storage of discs in max. 65% moisture content should not exceed 6 months due to corrosion. The discs or clutch packs should be stored in a closed and dry place.
- During assembly it has to be ascertained that the linings are fully provided with oil before loading. It is recommended to dip the plates into application oil for 15 minutes at room temperature or 5



minutes at 50 – 70°C. Should this not be possible, Alto Products can supply oil impregnated parts. Discs that are not sufficiently oiled will wear faster and usually lead to noise problems.

- Full loading of the friction discs should only be done after the break-in in period (~500 cycles) to avoid higher wear.
- Depending on the application a reduction of the pack length or an expansion of the clearance could be possible due to the permanent set of the friction surfaces due to unit loading and the reaction surfaces.
- The oil has to be free from contamination and particles. Water content should not be higher than 1% in order to avoid corrosion or lining detaching.

6. Important note

The information and results shown in this material specification were generated according to the Society of Automotive Engineers test standards J2490 μ PVT and J2488 6,000 RPM Step Level on Alto's SAE #2 Friction Test Machine. This information cannot be used as a basis for choosing a material for a specific application, because the friction characteristic is dependent on the actual conditions and oil used.

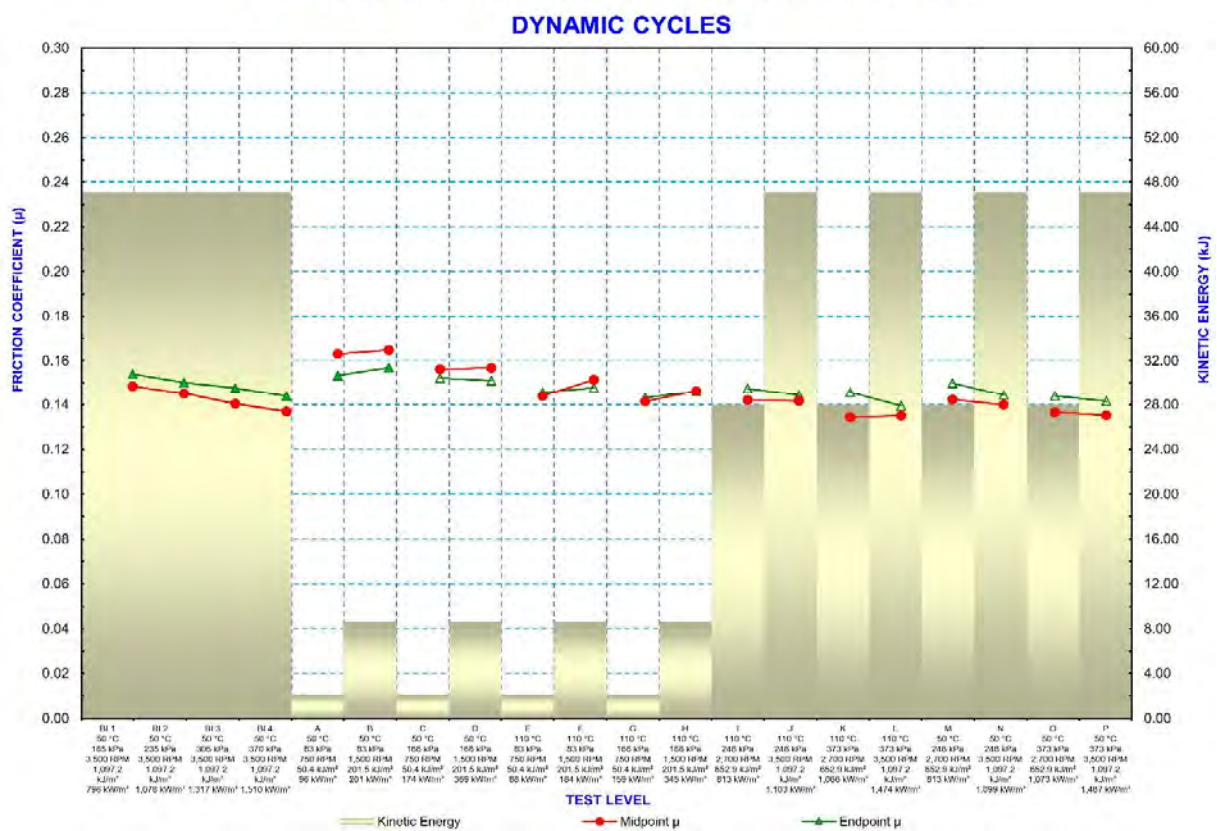
Alto Products engineers are readily available to advise on technical applications.

Every use of Alto Products friction lining has to be approved.



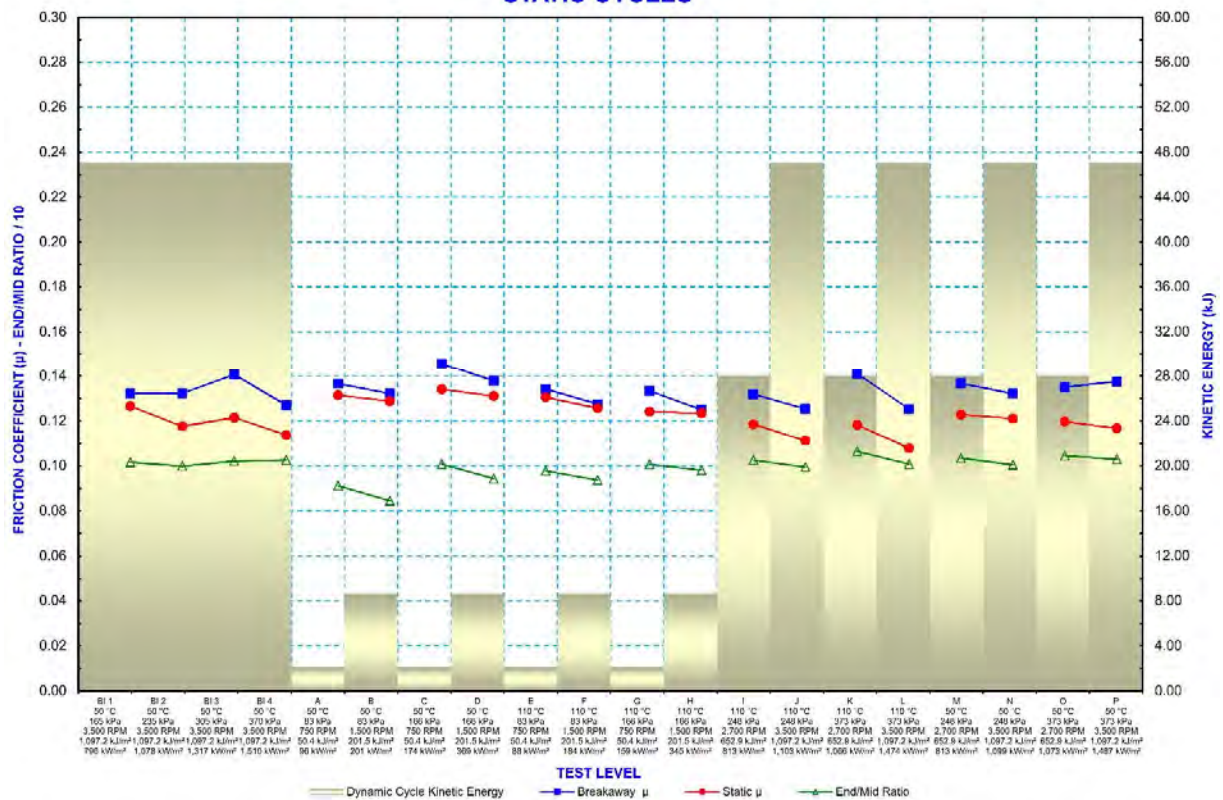
7. Diagrams

SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST





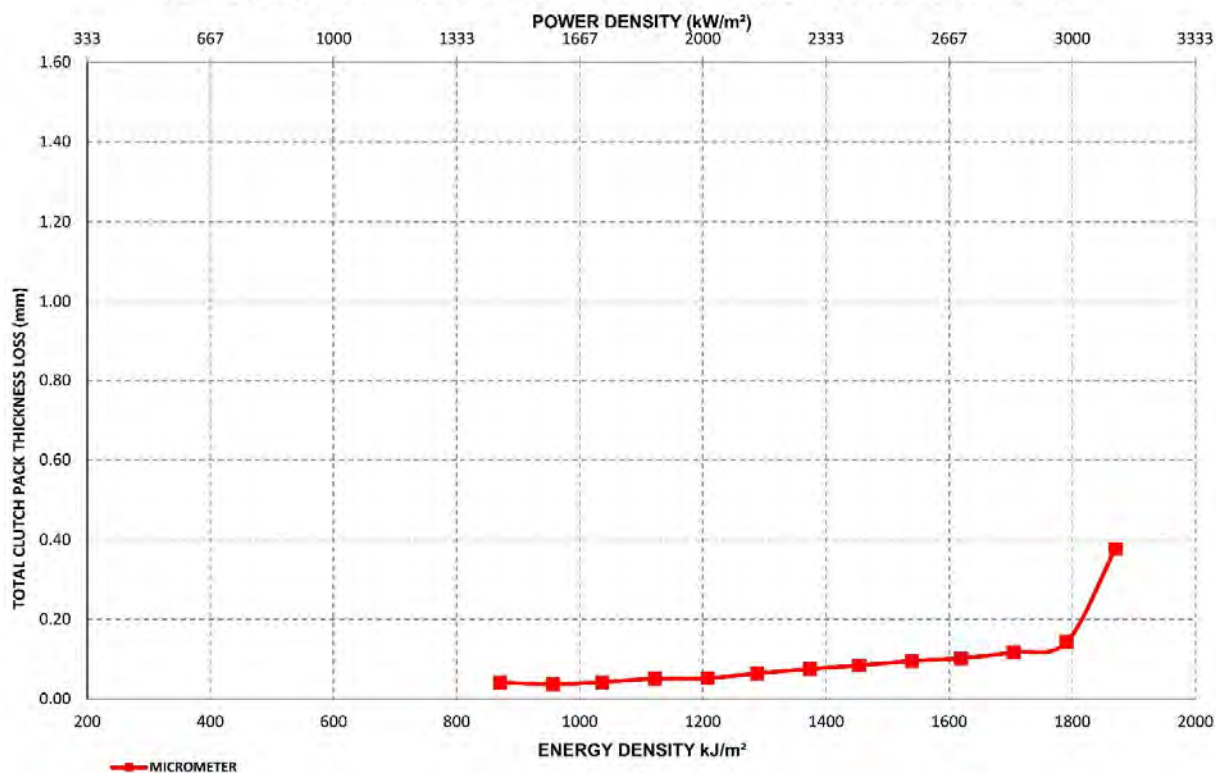
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST
STATIC CYCLES





SAE J2488: SAE NO. 2 FRICTION TEST MACHINE
6000 RPM STEPPED POWER TEST

TOTAL CLUTCH PACK THICKNESS LOSS v/s ENERGY & POWER DENSITY



CARBONITE MATERIAL SPECIFICATION



1. Description

Asbestos free, organic friction lining fortified with high content of carbon particles exhibiting high thermal stability and conductivity, lubricity, and smooth shifting. Friction lining characteristic of sound porosity and resiliency allowing an efficient oil flow within the materials to improve heat dissipation favorable for high performance applications.

2. Applications

Friction lining in oil immersed applications, used in dynamic shifting clutches, bands, torque converters, motorcycles, differentials where high energy/power demands exist.

For all applications, they can be made with hardened or unhardened reaction surfaces made from steel, cast iron, steel alloys, and aluminum having a surface roughness between the range of Ra 0.1 to 1.1 μm .

3. Physical Characteristics

- | | |
|--|---------------------------|
| ▪ Color: | Black |
| ▪ E-modulus (@ 100 °C in Dexron VI ATF): | 24 – 32 N/mm ² |
| ▪ Thermal decomposition: | 350 °C (DSC inert gas) |
| ▪ Thermal Conductivity: | 0.262 – 0.271 W/mK |

4. Conditions

- | | |
|--|-----------------------------|
| ▪ Friction value (Ref. Dexron VI ATF) | |
| Dynamic: | 0.135 – 0.165 |
| Static | 0.120 – 0.150 |
| ▪ Recommended surface pressure: | 0.3 – 4.8 N/mm ² |
| Max. surface pressure (dynamic): | 5.5 N/mm ² |
| Max. surface pressure (static): | 5.5 N/mm ² |
| ▪ Oil cooling | |
| Recommended oil temperature: | 80°C |
| Max. oil sump temperature: | 150°C |
| Quantity (circulation): | 0.5 L/min |

5. Storage / Fitting / Application

The linings will fully perform when following the given instructions, e.g. stable friction values, low setting and reliable performance.

- The storage of discs in max. 65% moisture content should not exceed 6 months due to corrosion. The discs or clutch packs should be stored in a closed and dry place.
- During assembly it has to be ascertained that the linings are fully provided with oil before loading. It is recommended to dip the plates into application oil for 15 minutes at room temperature or 5



minutes at 50 – 70 °C. Should this not be possible, Alto Products can supply oil impregnated parts. Discs that are not sufficiently oiled will wear faster and usually lead to noise problems.

- Full loading of the friction discs should only be done after the break-in in period (~500 cycles) to avoid higher wear.
- Depending on the application a reduction of the pack length or an expansion of the clearance could be possible due to the permanent set of the friction surfaces due to unit loading and the reaction surfaces.
- The oil has to be free from contamination and particles. Water content should not be higher than 1% in order to avoid corrosion or lining detaching.

6. Important note

The information and results shown in this material specification were generated according to the Society of Automotive Engineers test standards J2490 μ PVT and J2488 6,000 RPM Step Level on Alto's SAE #2 Friction Test Machine. This information cannot be used as a basis for choosing a material for a specific application, because the friction characteristic is dependent on the actual conditions and oil used.

Alto Products engineers are readily available to advise on technical applications.

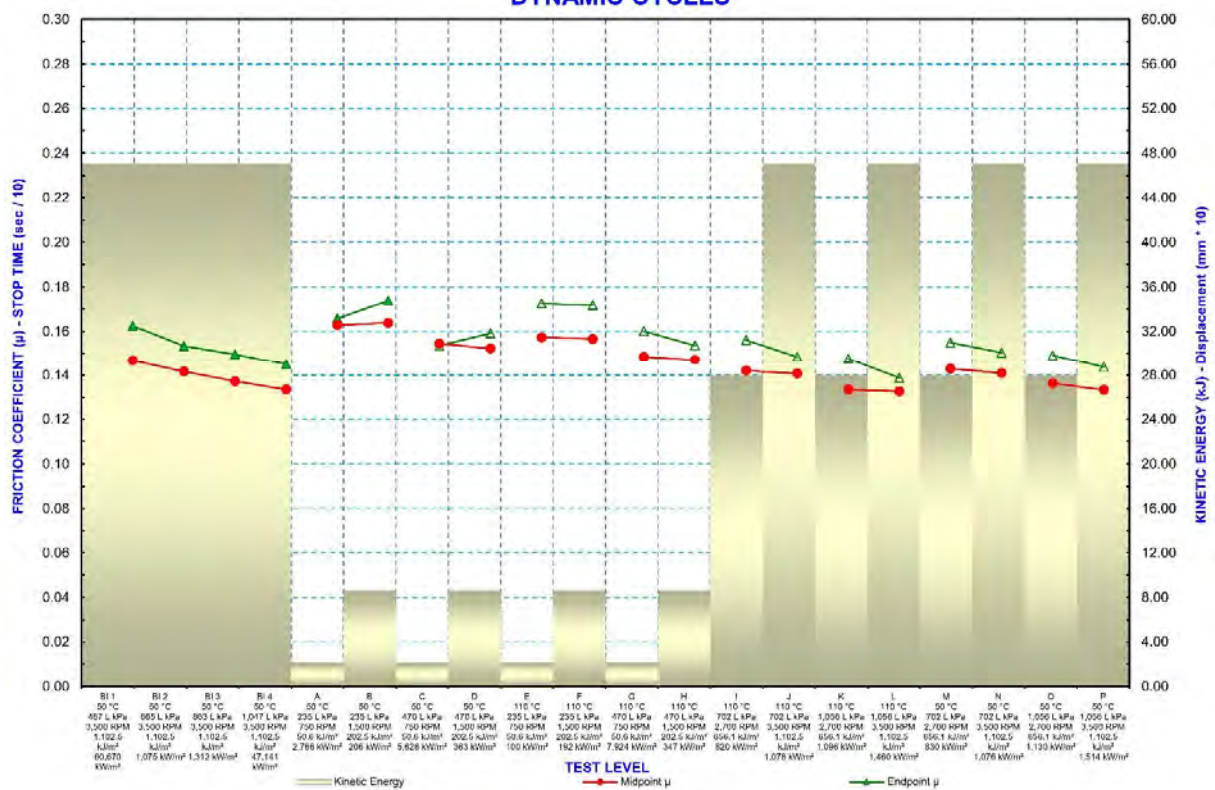
Every use of Alto Products friction lining has to be approved.



7. Diagrams

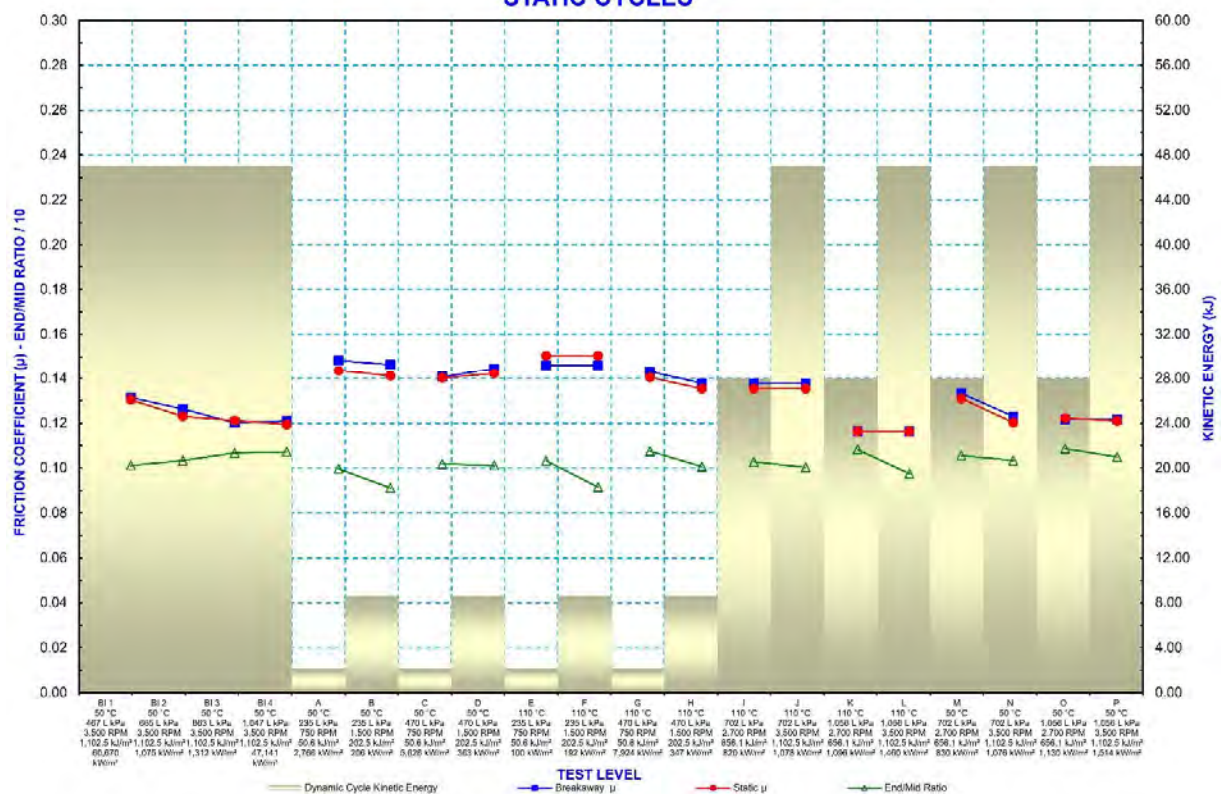
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST

DYNAMIC CYCLES





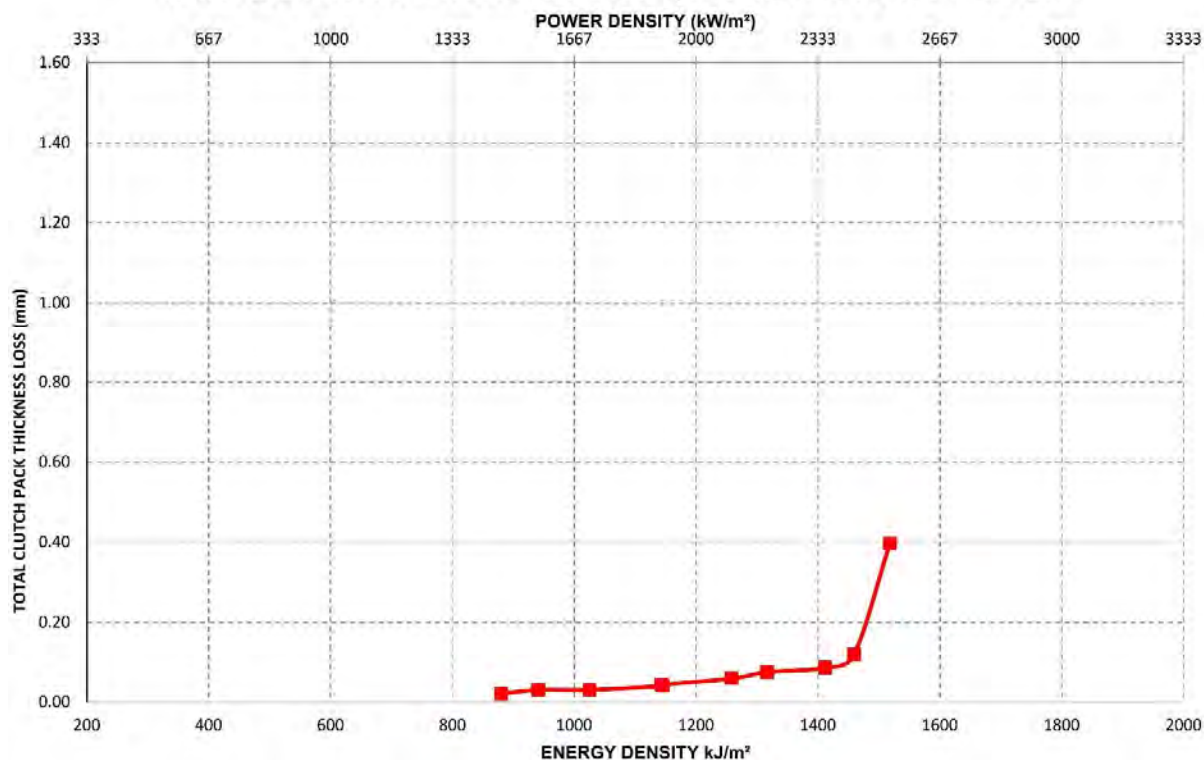
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST STATIC CYCLES





**SAE J2488: SAE NO. 2 FRICTION TEST MACHINE
6000 RPM STEPPED POWER TEST**

TOTAL CLUTCH PACK THICKNESS LOSS v/s ENERGY & POWER DENSITY



STC1 MATERIAL SPECIFICATION



1. Description

Asbestos free, organic based friction material. 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.

2. Applications

Friction lining in oil immersed applications, especially for automatic clutches with low to medium energy and power requirements. The lining can be used in power take offs as well as torque converter applications.

For all applications, they can be made with hardened or unhardened reaction surfaces made from steel, cast iron, steel alloys, and aluminum having a surface roughness between the range of Ra 0.1 to 1.1 μm .

3. Physical Characteristics

- | | |
|--|---------------------------|
| ▪ Color: | Tan |
| ▪ E-modulus (@ 100 °C in Dexron VI ATF): | 28 – 45 N/mm ² |
| ▪ Thermal Decomposition: | 325 °C (DSC inert gas) |
| ▪ Thermal Conductivity: | 0.107 – 0.129 W/mK |

4. Conditions

- | | |
|--|-----------------------------|
| ▪ Friction value (Ref. Dexron VI ATF) | |
| Dynamic: | 0.14 – 0.18 |
| Static | 0.12 – 0.17 |
| ▪ Recommended surface pressure: | 0.3 – 4.8 N/mm ² |
| Max. surface pressure (dynamic): | 4.8 N/mm ² |
| Max. surface pressure (static): | 4.8 N/mm ² |
| ▪ Oil cooling | |
| Recommended oil temperature: | 80°C |
| Max. oil sump temperature: | 150°C |
| Quantity (circulation): | 0.5 L/min |

5. Storage / Fitting / Application

The linings will fully perform when following the given instructions, e.g. stable friction values, low setting and reliable performance.

- The storage of discs in max. 65% moisture content should not exceed 6 months due to corrosion. The discs or clutch packs should be stored in a closed and dry place.
- During assembly it has to be ascertained that the linings are fully provided with oil before loading. It is recommended to dip the plates into application oil for 15 minutes at room temperature or 5



minutes at 50 – 70°C. Should this not be possible, Alto Products can supply oil impregnated parts. Discs that are not sufficiently oiled will wear faster and usually lead to noise problems.

- Full loading of the friction discs should only be done after the break-in in period (~500 cycles) to avoid higher wear.
- Depending on the application a reduction of the pack length or an expansion of the clearance could be possible due to the permanent set of the friction surfaces due to unit loading and the reaction surfaces.
- The oil has to be free from contamination and particles. Water content should not be higher than 1% in order to avoid corrosion or lining detaching.

6. Important note

The information and results shown in this material specification were generated according to the Society of Automotive Engineers test standards J2490 μ PVT and J2488 6,000 RPM Step Level on Alto's SAE #2 Friction Test Machine. This information cannot be used as a basis for choosing a material for a specific application, because the friction characteristic is dependent on the actual conditions and oil used.

Alto Products engineers are readily available to advise on technical applications.

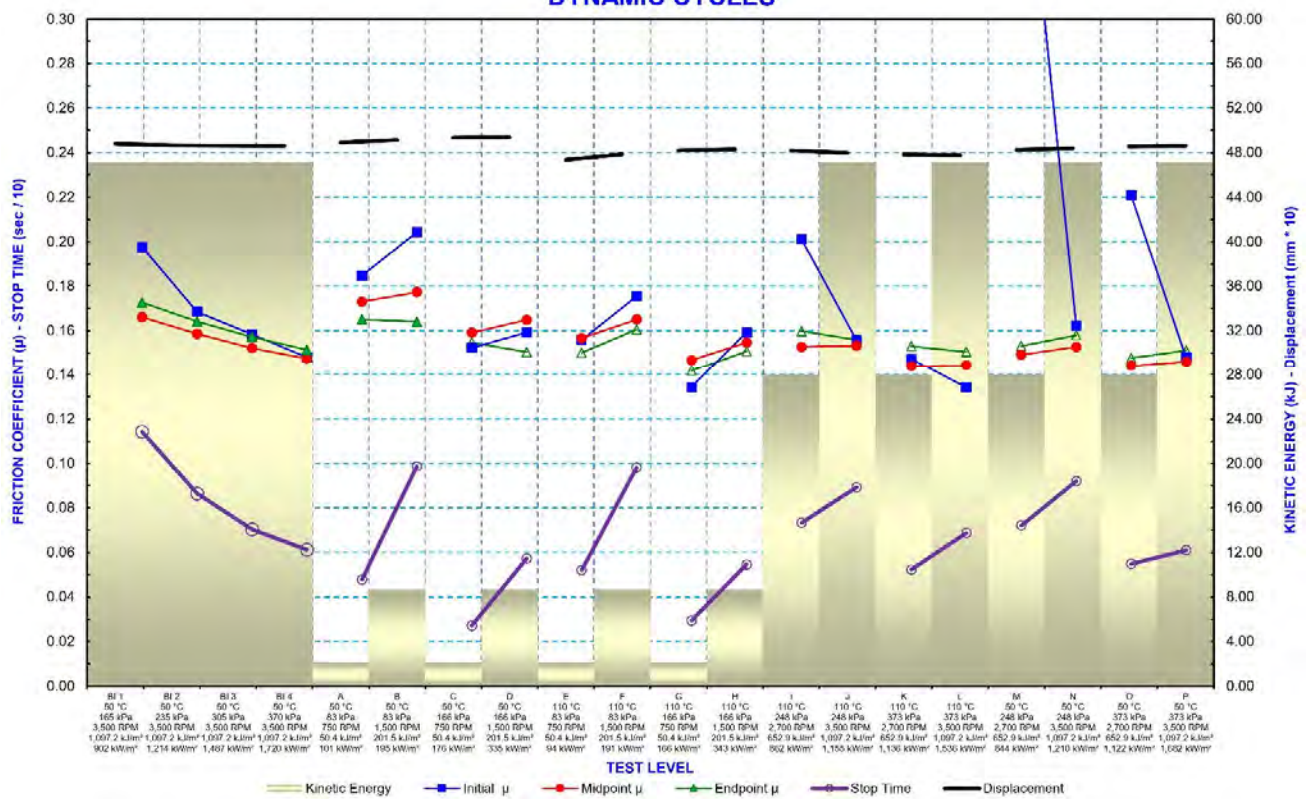
Every use of Alto Products friction lining has to be approved.



7. Diagrams

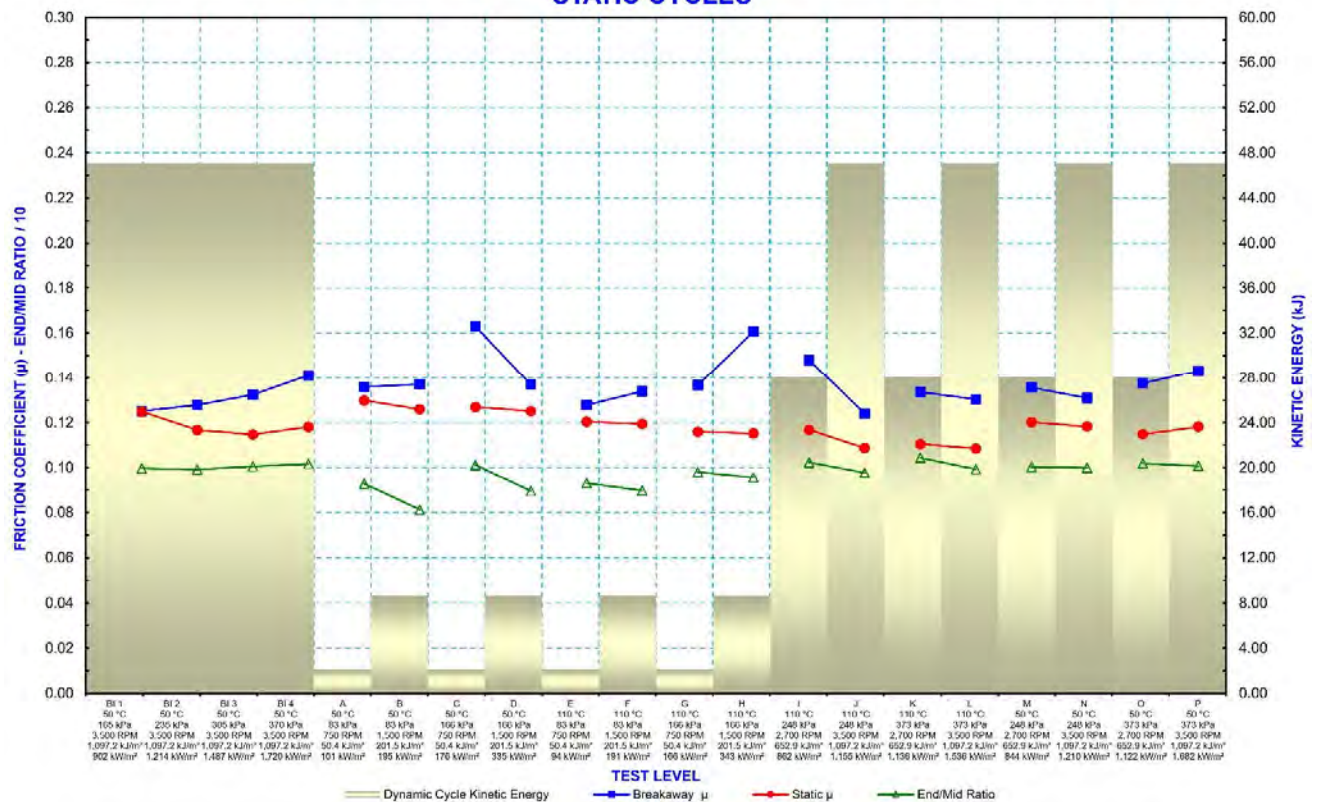
SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST

DYNAMIC CYCLES





SAE J2490: SAE NO. 2 FRICTION TEST MACHINE μ PVT TEST
STATIC CYCLES





**SAE J2488: SAE NO. 2 FRICTION TEST MACHINE
6000 RPM STEPPED POWER TEST**

TOTAL CLUTCH PACK THICKNESS LOSS v/s ENERGY & POWER DENSITY

