Centric/Stoptech Friction Development Lab

Overview:
Centric and Stoptech recently opened a Friction Development Lab that focuses on in-house research and development of friction materials. Past friction development cycles required long lead times from outside manufacturers, and limited control of the actual friction mixtures and associated components. The Friction Development Lab, coupled with our in-house friction expert Dr. Poh Wah Lee, allows Centric/Stoptech to rapidly produce custom friction blends and immediately test them on our Link Chase Machine or three Link Brake Dynamometers, thereby reducing the friction development cycle time substantially.

A main component of the Friction Development Lab is the Model 600 Link Chase Machine. The Chase Machine has been designed and engineered to rapidly evaluate friction material characteristics using the SAE J661 test protocol. The Chase Machine can be used to evaluate prototype or development materials, and also perform in-process quality control checks on production samples to ensure conformance. A one inch square of friction material is used as the test sample, and the sample is held at a specific normal force on a rotating brake drum. Throughout the SAE J661 test protocol, test sections with various speeds, temperatures, and normal forces are employed to produce an assessment of the friction material’s properties. Typical test durations range from 3 to 4 hours.

The rotating speed of the Chase drum is controlled by a variable speed drive that can spin to 1000 rpm. The normal force application is controlled by a closed-loop servo system that can apply up to a 600 pound force on the Chase drum. The drum also has two resistance heating coils that can heat the drum up to 540°C (1000°F), as well as a forced-air cooling system to facilitate cooling from elevated temperatures.

Stoptech/Centric Friction Lab and Link Chase Machine:
Link Model 600 Chase Machine Technical Specifications:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model 600 Chase Machine Range:</th>
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<tbody>
<tr>
<td>Normal Force Control</td>
<td>0 – 600 lbs</td>
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<tr>
<td>Friction Force</td>
<td>0 – 300 lbs</td>
</tr>
<tr>
<td>Rotating Speed</td>
<td>0 – 1000 rpm</td>
</tr>
<tr>
<td>Temperature</td>
<td>0 – 1000°F</td>
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<tr>
<td>Sample Size</td>
<td>1” x 1” x 0.25”</td>
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Note: The above parameters (excluding Sample Size) are calibrated by Link on a yearly basis. The last calibration was performed in July 2015, and the next calibration is scheduled for July 2016.

Additional Friction Lab Photos:

Chase Machine:
An electronic locking cage guards the test drum during operation. The cage can be opened once testing has completed for easy service of the test sample and drum.

Chase Machine:
A close-up view of the test drum and normal force applicator.
Chase Machine:
A close-up view of a test sample after completing the SAE J661 test. The friction sample is inverted 180 degrees to show the contact surface (the top surface shown is in contact with the test drum during testing).

Chase Machine:
A control screen is shown on the Chase Machine control computer. Various test parameters can be monitored or changed from this screen.

Friction Lab:
Various pad shape molds for creation of small-batch brake pads. These molds are filled with a backing plate and friction materials then compressed and heated to form the brake pad.
Friction Lab:
Close-up view of the D1611 brake pad mold. The backing plate is placed in the bottom of the mold, followed by the friction material mixture, then the mold insert (part on top of mold). The assembly is then placed into a hydraulic hot press at a specific temperature and pressure to form the brake pad.

Friction Lab:
Various components can be seen at the friction material mixing station.

From left to right:
- Isotemp Muffle Furnace
- Hydraulic Hot Press
- Mixer
- Scale

A ventilation hood can be seen on the back wall, and provides ventilation when working with various chemicals.

Friction Lab:
Two separate grinders are used for Chase sample preparations. Each grinder is installed inside a hood to prevent friction material particles from entering into the atmosphere during grinding operations.
Friction Lab:
Vertical grinder used for shaping Chase samples prior to testing.

Friction Lab:
Rotary grinder used for shaping Chase samples prior to testing.

Friction Lab:
A 3-in-1 grinder is used to grind slots, pad surfaces, and chamfer pad edges for variations on standard pad shapes. These variations can then be evaluated on Centric/Stoptech’s Brake Dynamometers for overall effectiveness.
Current Friction Testing Initiatives:
The chart below illustrates current Friction Testing Initiatives that the Friction Development Lab is currently undertaking.

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Test Purpose:</th>
<th>Data Output:</th>
<th>Test Requirements:</th>
</tr>
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<tbody>
<tr>
<td>Low Copper Testing</td>
<td>Identify new formulas with low to no copper that outperform current industry standards and product lines.</td>
<td>New friction formulations designed to be more environmentally friendly and compliant with industry regulations.</td>
<td>Per Senate Bill 346, all brake pads sold in California by 2021 must contain no more than 5% copper. Friction alternatives must be less hazardous to public health and the environment.</td>
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<td>Chase Testing</td>
<td>Pre-screen friction materials on the Chase machine prior to dyno testing in order to identify potential formulas. In-process test production friction formulas for quality control and baselining.</td>
<td>SAE J661 test report illustrating the friction performance in various conditions like Green, Post-Burnish, Fade, and Recovery.</td>
<td>Requirements defined by SAE J661. Friction samples cut from brake pads or shoes, and are ground down to a 1” x 1” x 0.25” thick test sample.</td>
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