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FOR IMMEDIATE RELEASE From the Bendix Tech Tips Series

THERE'S MORE TO YOUR FRICTION THAN A TEMPERATURE RATING

When Choosing Friction, Know the Facts behind Heat Transfer in Braking

ELYRIA, Ohio – April 27, 2016 – Heat is the enemy of braking performance: It's the cardinal rule when it comes to brakes, well-known to fleet technicians, drivers, and owner-operators.

As part of its Bendix Tech Tips series, Bendix Commercial Vehicle Systems LLC offers a dive into the science behind heat transfer in braking, a look at temperature ratings in friction, and a discussion of additional factors that should be considered when choosing friction. Use this information to better understand the connection between temperature and friction, ask the right questions about temperature ratings, and make the best friction selection for your operation.

Bringing the Heat

"In commercial vehicle drum brake applications, temperature's critical role begins at the engagement point between the lining and the drum," explained Earl Brown, product manager, Reman Brake Shoes, Bendix. "The bulk drum temperature generally ranges between 600° and 650°F, although for brief times during engagement – and during Federal Motor Vehicle Safety Standards (FMVSS) testing – it is not uncommon for this temperature to exceed 1,000°F. These two measurement points – engagement and bulk drum temperature – represent the full temperature range experienced by all friction materials in drum brake applications."

Specifics like these, Brown noted, are the keys to understanding the temperature ratings of friction materials for severe-duty applications.

"When discussing friction temperature, it's critical to establish a point of reference," Brown said. "Since the brake system has a wide variety of components – each with unique thermal properties – it's impossible to identify one temperature as most critical to the system as a whole."

In a drum brake, the system's temperature begins at the engagement point, where temperatures can go above 1,000°F. This heat dissipates as it is transferred into the heat sink – in this case, the drum. Without that heat dissipation, the cast-iron drum would be red hot, creating an extreme environment difficult for any type of friction material to withstand.

With repeated stops and this heat transfer into the drum, the overall temperature of both the drum and lining will slowly rise as they become heat soaked. In the case of normal commercial vehicle use with adequate cooling air, average temperatures may reach around 200° to 300°F on the lining and 300° to 500°F on the drum. These temperatures are within the acceptable range for their components' respective materials, such as cast iron and phenolic resins – the key binding agents used in non-asbestos organic (NAO) friction materials.

Chemistry, Physics, and Fade

Under some conditions, such as severe-duty use, applications requiring more frequent or harder stops, or situations in which cooling air to the brake is restricted, braking temperatures can increase.

"Phenolic resins begin to degrade at temperatures ranging from 248° to 482°F," Brown said. "In severe-duty applications, higher grade resins are used to better withstand this heat, but regardless of the brand of friction, bulk friction temperatures should never exceed 300° to 400°F. Basic chemistry and physics mean that even the best resins only survive to 600°F."

Because heat-induced degradation of the phenolic resins will increase lining wear, it can lead to the loss of stopping power in drum brakes known as brake fade. For this reason, the goal of brake and friction design is to maintain the lowest braking temperature possible.

It's important to remember, though, that the elevated temperatures at the engagement point of the friction and drum dissipate almost immediately. Although it may be acceptable to measure 1,000°F on the drum surface during engagement, prolonged exposure at this temperature will lead to the failure of *any* NAO friction.

Digging into Ratings and Testing

The importance of keeping brake temperatures low, however, can lead to a misplaced reliance on brake lining temperature ratings, particularly those that claim ratings of 950° to 1,000°F.

The most important and accepted industry tests in the OE and aftermarket friction certification process are the FMVSS 121 and Society of Automotive Engineers (SAE) J2115 tests, used by Bendix and other leading brake and friction suppliers. These two tests, which all commercial vehicle drum brake friction materials must adhere to, establish the following bulk drum temperature guidelines:

- FMVSS 121 Dynamometer Test Brake Power or Fade Section: 150° to 450°F
- SAE J2115 (Section 7 Wear and Effectiveness at Temperature) Measured at 250°, 350°, 450°, 550°, and 650°F

The crucial point to note is that neither of these tests references or makes a recommendation on "temperature ratings" for brake friction. Similarly, friction material certification guidelines from major truck manufacturers also do not include temperature ratings. This is because without specific information on what temperature is being measured – bulk drum or engagement – and where the readings are being taken, friction temperature ratings are merely numbers without context. Actual friction life and performance will be dictated by resin quality and performance in the SAE temperature wear section.

Asking the Right Questions

When considering friction for severe-duty applications, request the results of both the FMVSS 121 and SAE J2115 tests from any potential supplier – even if they have provided "temperature ratings" far exceeding normal system operating temperatures. Regarding specific temperature claims, ask whether they're measuring bulk drum or engagement heat, and where it's being measured.

Regarding measuring your own brake operating temperatures, the only reading that can be easily obtained without equipment such as thermocouples is the bulk drum temperature. And to put it bluntly, if the bulk drum temperature is anywhere near 1,000°F after brake operation, something is very wrong with the brake, and it may lead to a fire. Only brief in-stop drum brake temperatures should ever exceed 600°F.

"Selecting the proper friction – particularly in severe-duty applications – is vital for maintaining the performance, service life, and safe operation of drum brakes," Brown said. "Being familiar with the science and reasons behind friction design and recommendations, as well as proven industry standards, will go a long way toward making the right choices to meet your needs and keep your vehicles on the road and operating safely."

Information in the Bendix Tech Tips series, along with instructional videos and interactive training on foundation drum brakes and friction, can be found at the Bendix On-Line Brake School, www.brake-school.com. For more information on matching friction selection to application, contact the Bendix Tech Team at 1-800-AIR-BRAKE.

About the Bendix Tech Tips Series

Bendix, the North American leader in the development and manufacture of leading-edge active safety and braking system technologies, is committed to helping keep commercial vehicles on the road and in good working condition. The Bendix Tech Tips series addresses common commercial vehicle maintenance questions and issues concerning the total range of components found within foundation and air brake systems, as well as advanced safety systems.

About Bendix Commercial Vehicle Systems LLC

Bendix Commercial Vehicle Systems, a member of the Knorr-Bremse Group, develops and supplies leading-edge active safety technologies, energy management solutions, and air brake charging and control systems and components under the Bendix[®] brand name for medium- and heavy-duty trucks, tractors, trailers, buses, and other commercial vehicles throughout North America. An industry pioneer, employing more than 3,000 people, Bendix is driven to deliver solutions for improved vehicle safety, performance, and overall operating cost. Bendix is headquartered in Elyria, Ohio, with manufacturing plants in Bowling Green, Kentucky; Huntington, Indiana; North Aurora, Illinois; and Acuña, Mexico. For more information, call 1-800-AIR-BRAKE (1-800-247-2725) or visit www.bendix.com. To learn more about career opportunities at Bendix, visit www.bendix.com/careers. Follow Bendix on Twitter at http://twitter.com/Bendix_CVS. Log on and learn from the Bendix experts at www.brake-school.com.

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