Friction Focus
HXI 2020-1 FF
Haldex

Brakes – "The Job"

The principals of braking on any vehicle are simple. It is the job of the brakes to *transform energy from one type to another*. In this case, we are changing kinetic energy into heat energy. The brake is the conduit to achieve this.

Kinetic energy is energy in motion. The amount of energy in motion (ie, the vehicle) is dependent upon speed and weight. So the heavier a vehicle gets or the faster it goes, the higher the amount of kinetic energy that must be transformed into heat energy to stop the vehicle. The friction material (brake lining) is the pivot point for this energy transformation. To stop the vehicle, friction material must create heat energy sufficient enough to overcome the kinetic energy of the vehicle. This heat energy is created through the friction between the brake lining and the brake drum. This effort is assisted by other components such as brake adjusters and brake chambers, which provide mechanical torque to the stopping equation.

As heat is created through this "friction" (the lining's coefficient of friction – which is massively dependent upon temperature), it is transferred from the lining and dissipated into the atmosphere through the brake drum (thus the drum acts as a heat sink). A linings ability to maintain its "friction" at various temperatures is a major determinate of braking performance relative to the vehicle and its stopping characteristics.

Take Away –

- You can't stop a vehicle unless you create enough heat energy to overcome the energy in motion (kinetic energy).
- A linings ability to create heat, maintain its friction properties through a variety of temperature environments, and hold together (low wear & low fade) in a variety of braking environments define the linings performance.

Application Example

Compare 2 straight trucks. One, a single drive axle (4 total brakes) and the other a tandem drive (6 total brakes). Both weigh 15,000 lbs and are traveling at 55 mph and have to make the same stop. These two vehicles are fundamentally the same when you consider the basics of kinetic energy. The brake's job on each vehicle is to create enough heat energy to overcome the forces of kinetic energy (equal in this case).

What will be the difference between these two vehicles where brake temperatures are concerned?

The single drive, only having 4 brakes, will have to create the same heat energy as the vehicle with 6 brakes. Without fail, the four braked vehicle's braking temperatures will be hotter than its counterpart to make this stop. In fact, it's likely that the temperatures will be at least 33% higher since there are fewer brakes to do the same amount of work.

Good Heat vs Bad Heat

Good heat is simply the heat necessary to stop the vehicle based on its kinetic energy. It is unavoidable and desired, otherwise, no stop.

Bad heat is *unnecessary* heat. Bad heat is a derivative of "other stuff" going on at the wheel end that adds to brake temperatures, often substantial enough to render low performance braking. Regardless of what kind of heat is generated at the brake, the lining must be able to take the good with the bad while maintaining its coefficient of friction (or "grip"). If the good and bad heat go beyond the temperature range of the brake lining – there you have it – low performance braking (fade or no brakes) and excessive wear.

The "Other Stuff" – Bad Heat

Here are some examples of bad heat. Unfortunately, all of these are too common on vehicles running down the road today.

- Brakes not working on a wheel end (out of adjustment)- As shown earlier, if one brake (or more) on the vehicle isn't doing its fair share of work, the remaining brakes must still compensate and produce enough energy to stop the vehicle. If a vehicle has an out of adjustment brake (thus, lower or no brake torque), the other brakes will, without a doubt, no questions asked, run hotter. How much hotter will depend on the total number of brakes working and the kinetic energy involved, but it is entirely possible to raise brake temperatures over 100° due to a single out of adjustment brake on a vehicle (what about 2 or 3?).
- Poor maintenance – Poor maintenance practices can lead to generated braking temperatures up to 200° higher than are needed. It could be a bad brake return spring or a worn cam bushing. Reusing brake drums that are too thin or cracked achieve the same result (they can't dissipate heat fast enough, the heat stays in the lining).
- Aggressive drivers – compared to "normal" drivers, brakes controlled by the aggressive type can push temperatures higher by 150°.

When you consider the stacked effect of good heat combined with the possible bad heat, it is fairly easy to exceed the viable operating temperatures of many brake linings on the market today. Just bad heat alone can elevate temperatures at a wheel end by up to 450°. The problem here is that many low performance, low cost linings can't even handle this temperature level, let alone combining the good heat necessary to stop the vehicle (the stacked effect could reach over 650° for what would be considered a normal stop on flat roads at reasonable speeds).

Take Away-

- Not only do brake linings play a pivotal role in what we think of as a "typical stop", they must also compensate for everything else "bad" on the vehicle relative to braking.
- When choosing a brake lining, you should not only consider the application, but honestly assess maintenance practices and the habits of the driver pool involved.
- Choosing brake linings that can take higher temperatures will help compensate for the "bad" and still deliver better braking and less wear.

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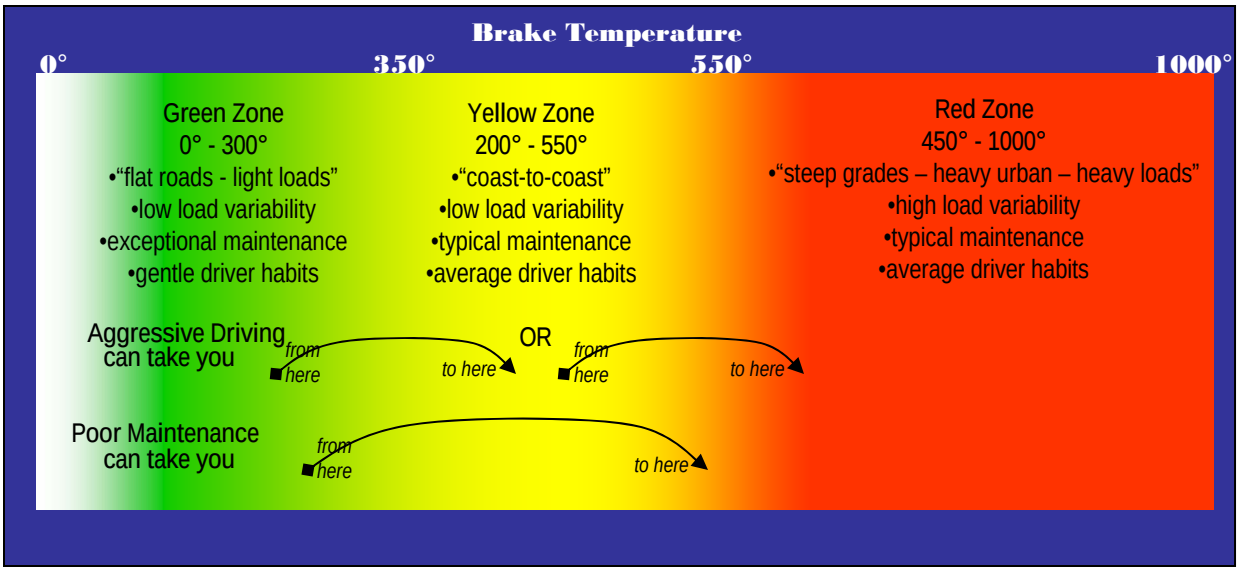
Issues To Consider When Choosing a Brake Lining



Don't Get Friction Fooled!

Fact or Fooled – *All brake linings are the same, it doesn't matter which one I buy as I am getting basically the same thing anyway!*

You've been fooled.

Brake linings all have their own performance characteristics and every single one of them react to different temperatures in different ways (some fade away, some get stronger). A fundamental truth relative to brake linings is that you inherently get what you pay for. If you are paying less, you are paying for a product who's capabilities exist in the "green zone". Pay a little more, and you move into high performance in the "yellow" or "red" zone.

Haldex Brake Lining Options

Haldex Brake Lining	Type	Axle Rating	AL Factor	FMVSS 121 Approved	Temperature Range
HV76/HV77	*Organic*	*20,000 lbs*	*165*	*YES*	*To 550°*
GN 2017	*Organic*	*20,000 lbs*	*165*	*YES*	*625°*
GF 2008	*Organic*	*20,000 lbs*	*165*	*YES*	*750°*
GR 2015	*Organic*	*20,000 lbs*	*165*	*YES*	*775°*
HV88	*Organic*	*23,000 lbs*	*165*	*YES*	*650°*
GD 2016	*Organic*	*23,000 lbs*	*165*	*YES*	*750°*
GH 2023	*Organic*	*23,000 lbs*	*165*	*YES*	*850°*
GG 2020	*Organic*	*23,000 lbs*	*165*	*YES*	*975°*
GZ 2035	*Semi-Met*	*23,000 lbs*	*165*	*YES*	*1000°*
GM 2040	*Semi-Met*	*25,000 lbs*	*165*	*YES*	*1000°*
GC Combo (2020/2035)	*Combo*	*23,000 lbs*	*165*	*YES*	*1000°*