	TECHNICAL BULLETIN	Series	Mustang Challenge Mustang Cup
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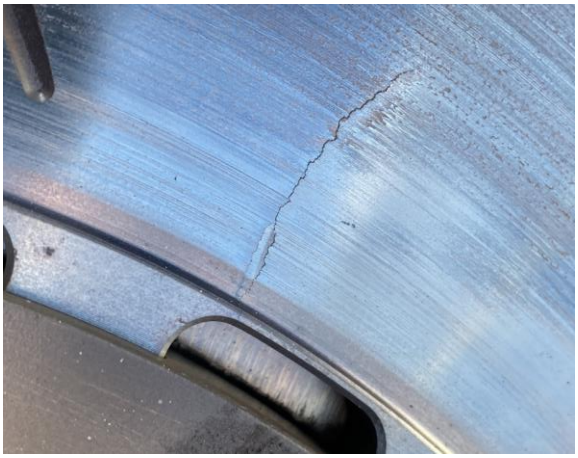
		Date	5/28/2025

Subject: Brake Rotor -Thermal Shock

Introduction: The objective of this bulletin is to educate and inform our customers about the phenomenon known as "thermal shock."

Thermal Shock: Occurs when a new rotor is brought up to temperature too quickly and then cooled rapidly. When this happens, it causes the rotor to distort which produces a crack (or multiple cracks) by the rotor fixing. This normally occurs on the out lap or the first "flying lap" when running a brand-new set of rotors. Running a properly pre-bedded set of rotors can help reduce the likelihood of thermal shock.

Thermal shock can be confused with the characteristics of running the rotor too hot which cause "stress cracks". A rotor that has had thermal shock will have cracks close to the fixing. (picture 1, below left)

1. 

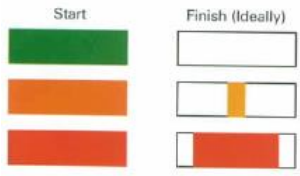
2. 

A rotor that has been used and / or run at a higher temperature range will exhibit "stress cracks" on the rotor outboard and inboard surfaces only (picture 2, above right). Continued use will cause these "cracks" to grow in length, which is considered normal. If the cracks propagate around the OD or the ID of the rotor then it is considered no longer usable and must be changed.

Rotor paint can serve as a useful tool during a race / test event and we always encourage our teams to paint their new/bedded rotors prior to use. Another item which can help identify thermal shock is analyzing the rotor paint. The green paint should be predominantly white with some of the orange showing signs of white as well, which is pictured

below. During the rotor warm up, if the rotor paint still shows all or most of the green paint, then it has not been exposed to the right amount of temperature. Further caution should be taken before performing “flying laps”. Adding tape or blockers to the brake ducts can help increase the operating temperature of the brakes during rotor warm-up and should be adjusted accordingly after its been completed.

Please review the rotor paint information.



Brake Disc Thermal Paint

Operation Instructions - The three different paints Green, Orange and Red are applied to the outside edge of the brake disc and will give a good indication of the maximum temperatures the disc has reached during use.

Three different paints are used:

- Green paint: Turns to White at 806 F (430°C)
- Orange paint: Turns to Yellow/Orange at 1040 F (560°C)
- Red paint: Turns to White at 1130 F (610°C)

At the above listed temperatures the corresponding paint colors will turn to the colors mentioned only after being exposed to these temperatures for a period of 30 seconds or longer. The optimum disc temperature for the discs, as shown through the temperature paint, is shown below;

Start Finish (Ideally)

The above shows the proper width of the “stripe” of paint required on the disc outer diameter surface (across the vanes of the discs). Basically the width of the applicator brushes will suffice. It also shows the ideal distribution of surface temperature for the disc (“Finish” appearance).

Thermal shock (cracking) of the disc is often confused with the disc running to “hot”. In fact, the majority of the time it is a result of the discs not operating at the proper temperature (to cold). In this case, cracking can occur when the disc sees “flashes” of high temperature and then is cooled too rapidly, which creates the distortion in the disc. By maintaining the optimum average operating temperature (between 800 & 900 degrees), it will not allow the disc to cool too rapidly and distort. The disc will see the same “flashes” of temperature (1000 to 1100 degrees) under braking applications while maintaining the required average operating temperature parameters. The desired increase or decrease in temperature can be managed through the brake cooling ducts.

This example more applies to a true “race” application.

The street or showroom stock application will differ somewhat from the above. By simply adjusting the parameters mentioned above down by 100 degrees will accommodate this application. The street or high performance disc applications do not incorporate the metallurgy as true race discs so it is not necessary for the average operating temperature to be as high.

Le Mans Notes:

For the teams running their Mustangs at Le Mans, it is important to have a clear understanding of how to avoid thermal shock at this track.

With the long straights, the brakes will have an ample amount of cooling time before the next brake zone. It's also important to consider that there are several high energy brake zones (red arrows) and the combination of ample cooling and high energy brake zones can induce thermal shock.

If you are running a brand new (pre-bedded) set of rotors, its recommended to take 1 lap to warm the rotor properly. You can do this by adding extra brake zones (taking caution of course) in the middle of the straights (green circles). Never drag the brake pedal to try and increase operating temperature.

A step further would be to run a small strip of tape over the brake duct (covering roughly 25%) for the first session to help maintain the temperature in the rotor. Considering the track layout of Le Mans, and the high temperature range the brakes endure on the regular Mustang Challenge/Cup schedule, some tape on the duct should not overheat the brake system.

If you have any questions or concerns about this topic, please contact Brandon Miller, bmiller@brembo.com.