Brake Cooling Kit

Informative Packet

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Document Revisions

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1	05/11/2016	E. Hazen	Issued for Release
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1. Purpose:
   This document contains information and notes regarding the construction, features, and testing of the full brake kit designed and produced by Velox Motorsports for the FR-S, BRZ, and GT86

2. Design:
   Starting from a clean slate with a solid idea in place, we wanted to design an OEM like installed cooling kit that maximizes cooling with as short of routing as possible. We also wanted to ensure it fit both big brake rotors and stock rotors alike. Doing our best to keep cost a forefront thought, we set into designing the kit you see tested below.

3. Video Data:
   Using tuft testing we were able to visualize the flow and effectiveness of the inlet into the brake duct kit as well as the backing plate and carbon duct through the internal rotor vanes.

Figure 3.1: Test Setup for Tuft Testing

Video is available for viewing here: https://www.youtube.com/watch?v=z8y6lf_AXag

4. Thermal Imaging:
   Using thermal imaging, we were able to test four conditions with the brake cooling kit. ***To keep the tests consistent, the passenger side had the full brake kit installed while the driver's side was left OEM***.

What is thermal imaging and how does it work?

Objects emit infrared energy based on a function of their temperature, also known as heat. This energy is referred to the objects heat signature. Generally, the hotter an object is, the more energy the object emits. A thermal imager (camera) is a heat sensor that is capable of detecting these differences in infrared energy or heat. These units collect the radiation from the viewing area and create electronic images based off this information and temperature differences. The unit we are using has a 330 degree C max temperature reading with an accuracy of +/- 1 degree C.

Testing Strategy:

Two control tests were mapped out that we believe accurately depicts the abilities of the duct kit in two severe cases and two cool down cases. Two speeds were tested, a 40 MPH low speed test, and a 75 MPH high speed test. This was to map out two different airflow rates, higher vehicle speeds translates to more airflow into the brake rotor via our kit. At each speed we tested two cases, a severe braking case and a cool down case. The severe braking case involved power braking with an engine load of 1.0 (constant load between the two tests) for 1 mile straight. The cool down case involved driving the same road the opposite direction with using as little brake as possible. At the end of each case, we would quickly gather thermal images of the brake rotor. In between the 40 MPH low speed test and the 75 MPH high speed test, we ensure the brake rotors equalized in temperature.

Please note time and date stamp added from the thermal image camera, pictures were taken within 30 seconds of one another.

5. Data:

40 MPH Speed Test			
	Velox Cooling Kit	**OEM**	**% Difference**
Hot Reading (Deg. C)	123	136	9.56%
Cold Reading (Deg, C)	87	103	15.53%
% Difference	29.27%	24.26%	
75 MPH Speed Test			
	Velox Cooling Kit	**OEM**	**% Difference**
Hot Reading (Deg. C)	136	199	31.66%
Cold Reading (Deg, C)	82	104	21.15%
% Difference	39.71%	47.74%	

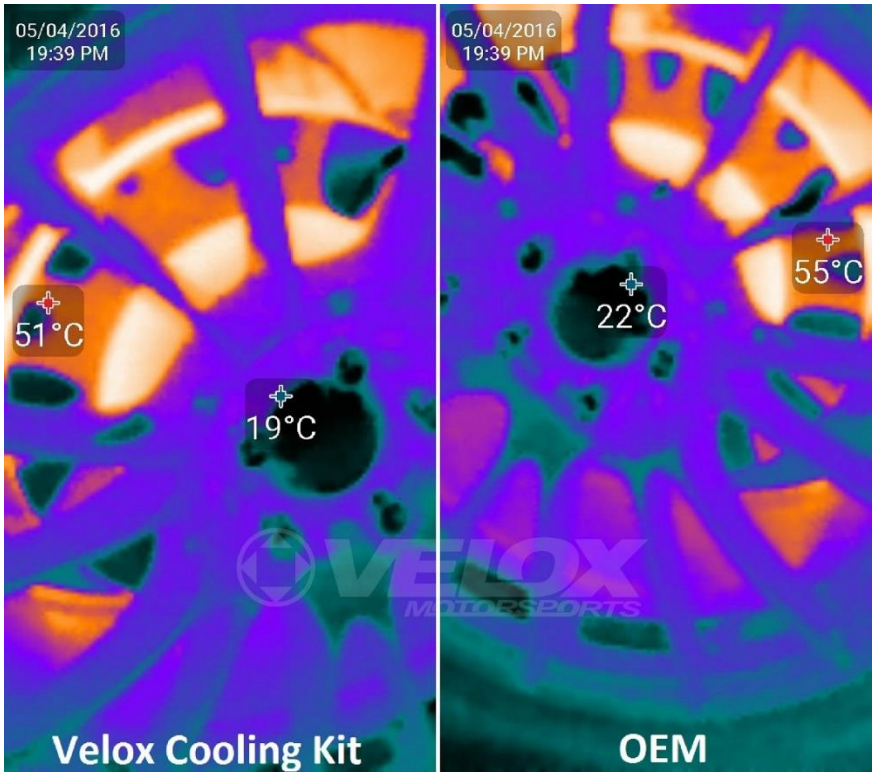

Figure 5.1: Control before initial 40 MPH test, rotors are within 4 degrees C of one another.

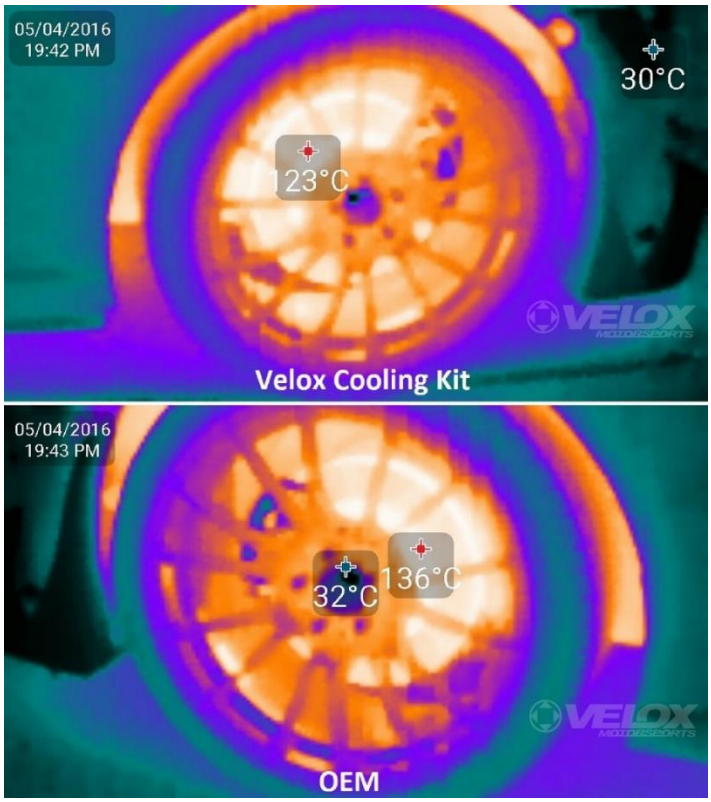

Figure 5.2: Hot readings directly after power braking for a mile

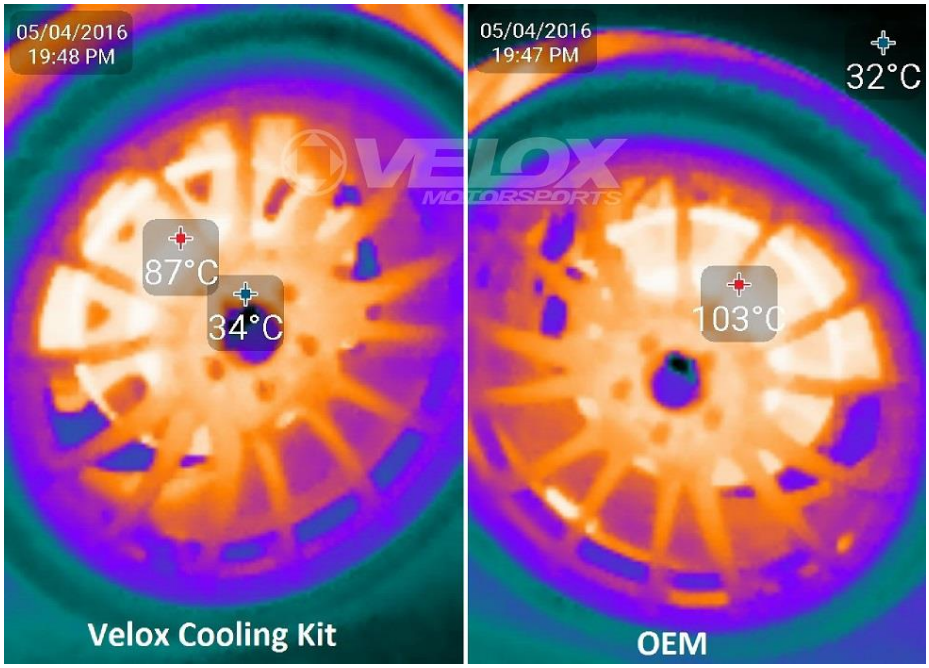

Figure 5.3: Cold readings directly after driving one mile at 40MPH with minimal brake use

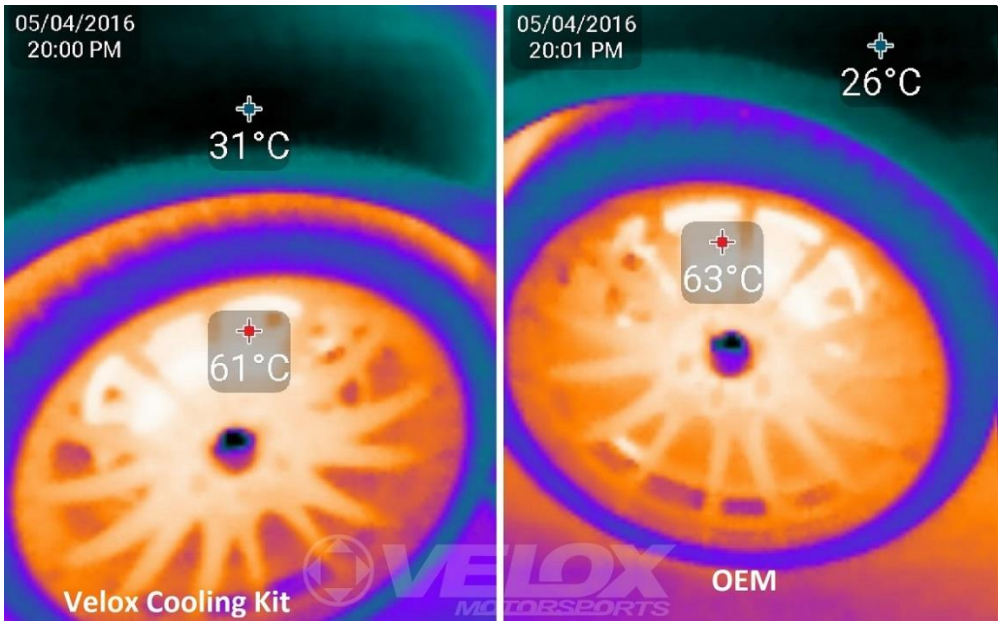

Figure 5.4: Control 2 showing rotors have leveled out in temperature after 12 minutes

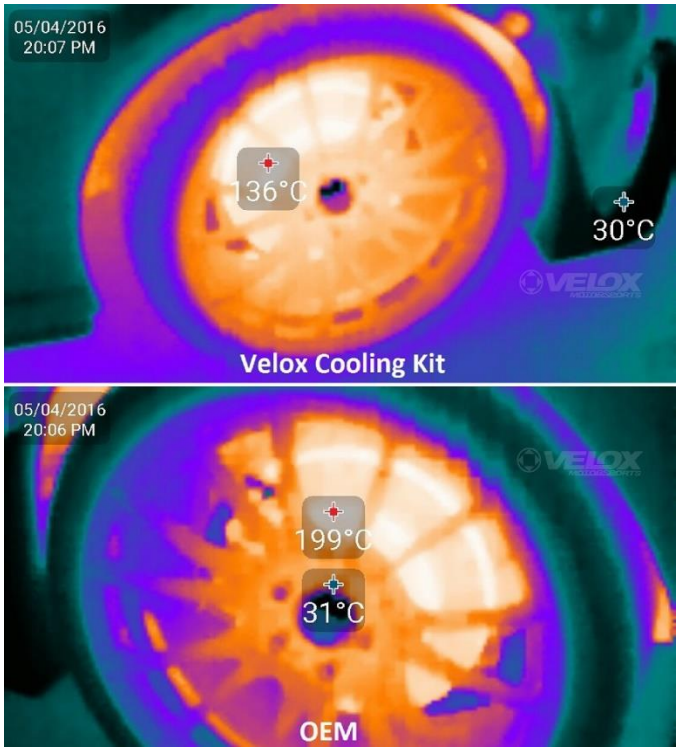

Figure 5.5: Hot readings directly after power braking at 75 MPH for 1 mile

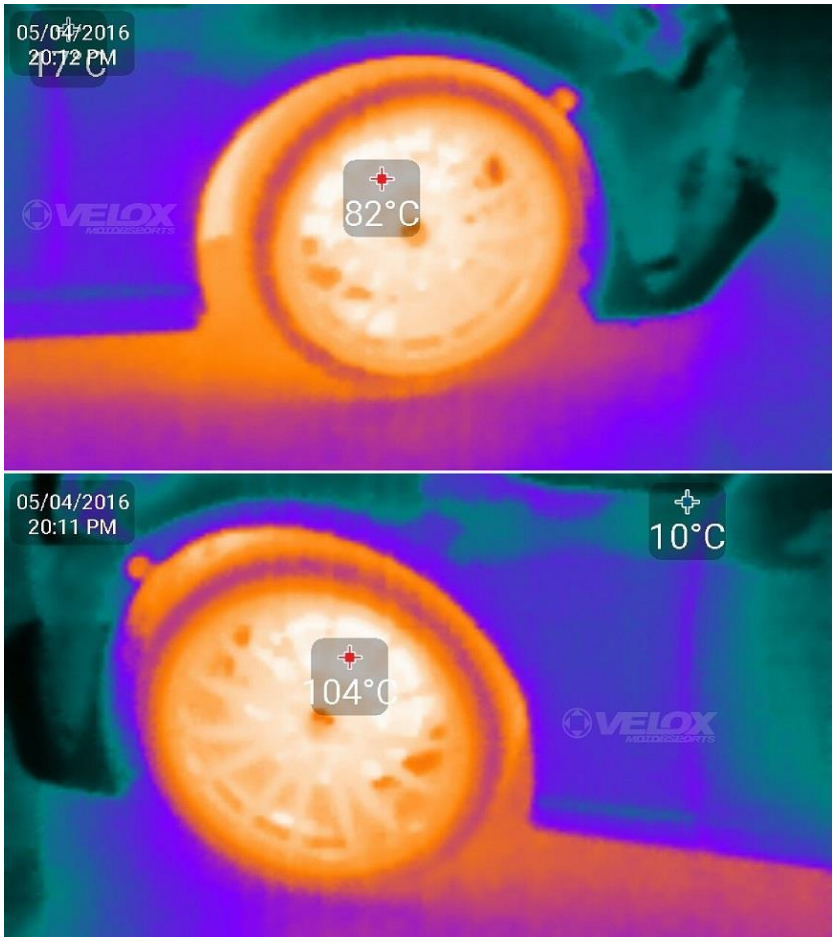

Figure 5.6: Temperature taken after 2.0 miles driving at 75 MPH with minimal brake use

6. Conclusion:

   Via tuft testing and thermal image testing it's quite clear that the brake cooling kit is highly effective even when used with the OEM rotors which have quite small vanes when compared to those of big brake kits. Smaller vanes will hurt flow and cooling due to the reduced size.

   With the brake cooling kit, the rotors remained much cooler directly after applying the brakes as well as after a short drive without using the brakes. It is also apparent that at high rates of speed, the brake cooling kit does significantly more than at lower speeds. This makes a lot of sense as the kit works by using frontal ambient air and funneling it into the center of the rotor. At higher speeds, pressure and flow rates are greater than at low speeds.

   We have heard reports back from customers tracking their cars having reduced brake fade, reduced rotor cracking, improved pad wear, and reduced brake fluid boiling. As a result,

this is a great kit to help keep brake components at an appropriate temperature during competition and/or track days.