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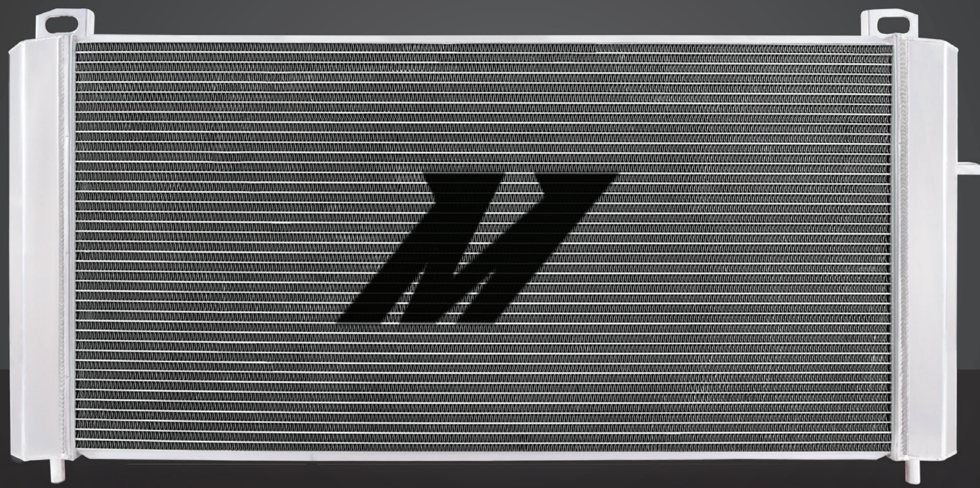

ENGINEERING REPORT

1999—2014 Chevy Silverado V8 Performance Aluminum Radiator | SKU: MMRAD-GMT-99

By Daniel Tafe, *Mishimoto Engineer*

REPORT AT A GLANCE

- Mishimoto designed a performance all-aluminum radiator that is a direct fit for the 1999-2014 Chevrolet Silverado V8. The Mishimoto Performance Radiator is 92% thicker than the stock radiator, which gives it a 72.4% increase in coolant capacity. It also boasts a 69% increase in air surface area (radiator fins) over the stock radiator. While towing a 4500 lb enclosed trailer, the Mishimoto Performance Radiator maintained a 20°F (11.1°C) reduction in radiator inlet temperatures and a 46°F (25.5°C) reduction in radiator outlet temperatures. Along with cooler radiator temperatures, the Mishimoto Performance Radiator also reduced the transmission fluid temperature by 25°F (13.9°C).
- **Objective:** To make a performance all-aluminum radiator that outperforms the stock radiator.
- **Test Vehicle:** Stock 2000 Chevrolet Tahoe with 5.3L V8 engine.
- **Testing Conditions:** Testing took place on a warm day with temperatures ranging from 77°F to 79°F (25°C to 26.1°C).

CONTENTS

TECH BRIEF

What is a radiator and what is its main purpose?

A radiator is a type of heat exchanger (known as a liquid-to-air heat exchanger) used to cool a vehicle's engine. Engine coolant (typically a 50/50 mix of distilled water and an antifreeze solution) is pumped through various components such as the engine block, cylinder head, transmission, and in some cases emissions equipment. The temperature to which the radiator cools the coolant is moderated by the vehicle's thermostat. Generally speaking, the stock radiator in a vehicle is okay for normal driving conditions, but when a vehicle is driven under more harsh conditions, such as aggressively on a track, the stock radiator may not be able to keep up with excessive heat generated by the stressed engine.

What are the basics of heat transfer?

Heat transfer is the transfer of energy in the form of heat and is explained most simply as "heat given up by hot fluid = heat gained by cold fluid." In a vehicle's heat exchanger, heat from the hot fluid flowing through the tubes is transferred to the cooler ambient air flowing through the fins. Heat is removed from the hot fluid and transferred to the ambient air, which then exits the heat exchanger at a hotter temperature. This is called convection and is one of the three types of heat transfer. See Figure 1 for the formula for convection.

Along with convection, another type of heat transfer is conduction. This is the contact heat transfer that occurs between the tubes that are heated by the hot fluid flowing through the heat exchanger and its fins. See Figure 2 for the formula for conduction.

The third type of heat transfer is called radiation, and typically accounts for only a small portion of the heat transfer that occurs with a heat exchanger. Radiation typically takes place at the end tanks or sides of the exchanger, which are usually located in areas with very low air circulation. See Figure 3 for the formula for radiation.

FORMULA FOR CONVECTION

$$Q_{convection} = h \times A \times (T_{hot} - T_{cold})$$

h = convection coefficient

A = surface area exposed to flow

FIGURE 1: *Convection is the form of heat transfer that occurs between the air passing through a heat exchanger and the tubes and fins.*

FORMULA FOR CONDUCTION

$$Q_{conduction} = \frac{k \times A}{l} \times (T_{hot} - T_{cold})$$

k = thermal conductivity

A = cross sectional area of conduction

l = conduction length through media

FIGURE 2: *Conduction is the form of heat transfer that occurs in the tubes and fins of a heat exchanger.*

FORMULA FOR RADIATION

$$Q_{radiation} = A_1 \times F_{1-2} \times \sigma \times (T_1^4 - T_2^4)$$

A_1 = surface area of body 1

F_{1-2} = factor to account for body 1 and 2 surface emittance and geometrical view of 1 to 2

σ = Stefan-Boltzmann constant

FIGURE 3: *Radiation is the form of heat transfer that occurs mostly in the end tanks of a heat exchanger and is generally ignored because of its small contribution to the overall heat exchanging process.*

APPARATUS

Fluid temperatures were taken with AEM fluid temperature sensors installed in the radiator hoses at the inlet and outlet of both the stock performance radiator and the Mishimoto radiator. OBD II transmission fluid temperatures were recorded using an HP tuner's VCM scanner.

BACKGROUND AND EXPERIMENTS

Core Information

Compared to the stock radiator, the Mishimoto Performance Radiator has several changes that improve its thermal conductance. Improvements include a decrease in fin height, which allows for more coolant tubes, and an increase in overall core thickness. Figures 5, 6, and 7 below represent these improvements. Overall capacity for the stock radiator in terms of volume is 1.12 gallons. The Mishimoto radiator has a capacity of 1.94 gallons, which is a 72.4% increase over the stock radiator capacity.

FIGURE 4: *AEM AQ-1 Data Logging System .*

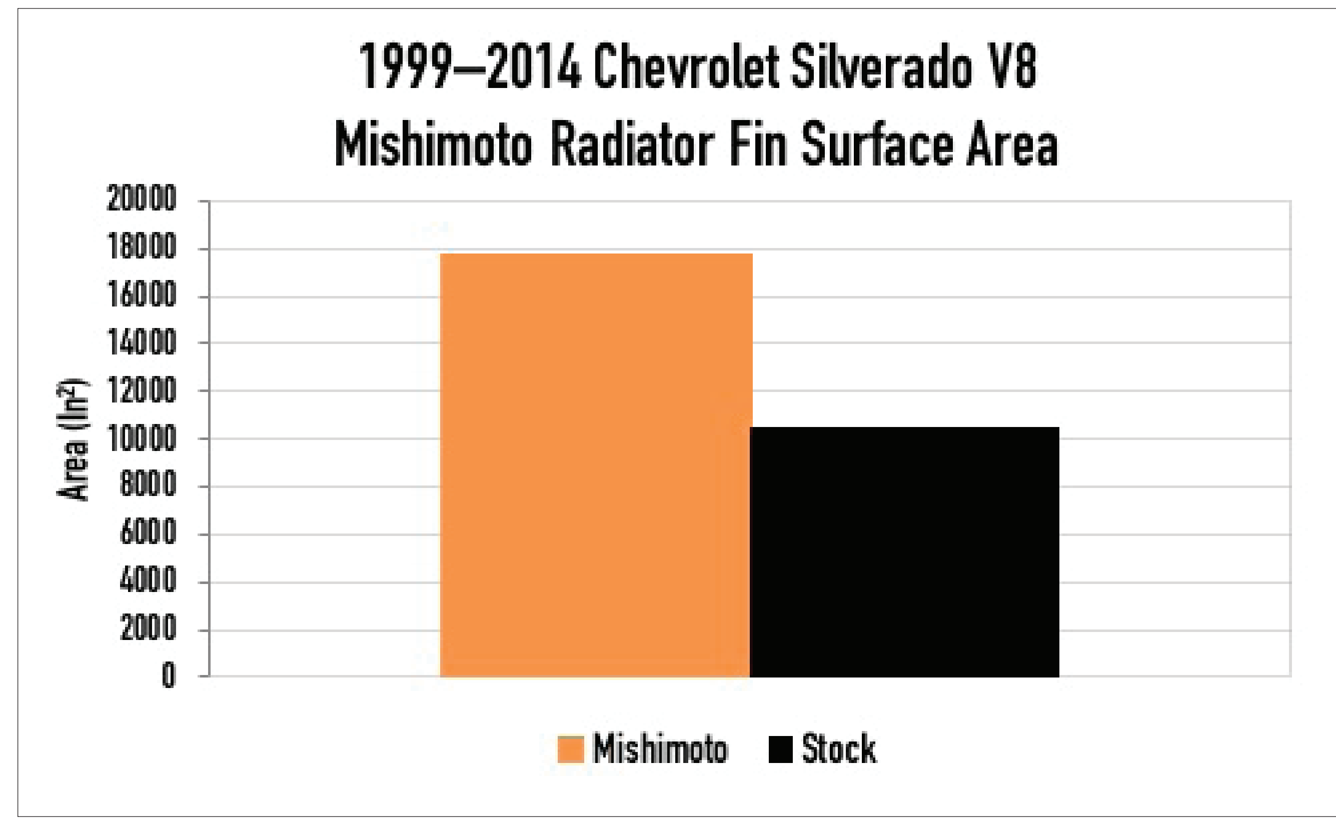

FIGURE 5: *Air surface area (fins) of the Mishimoto radiator increased by 69% over the stock radiator.*

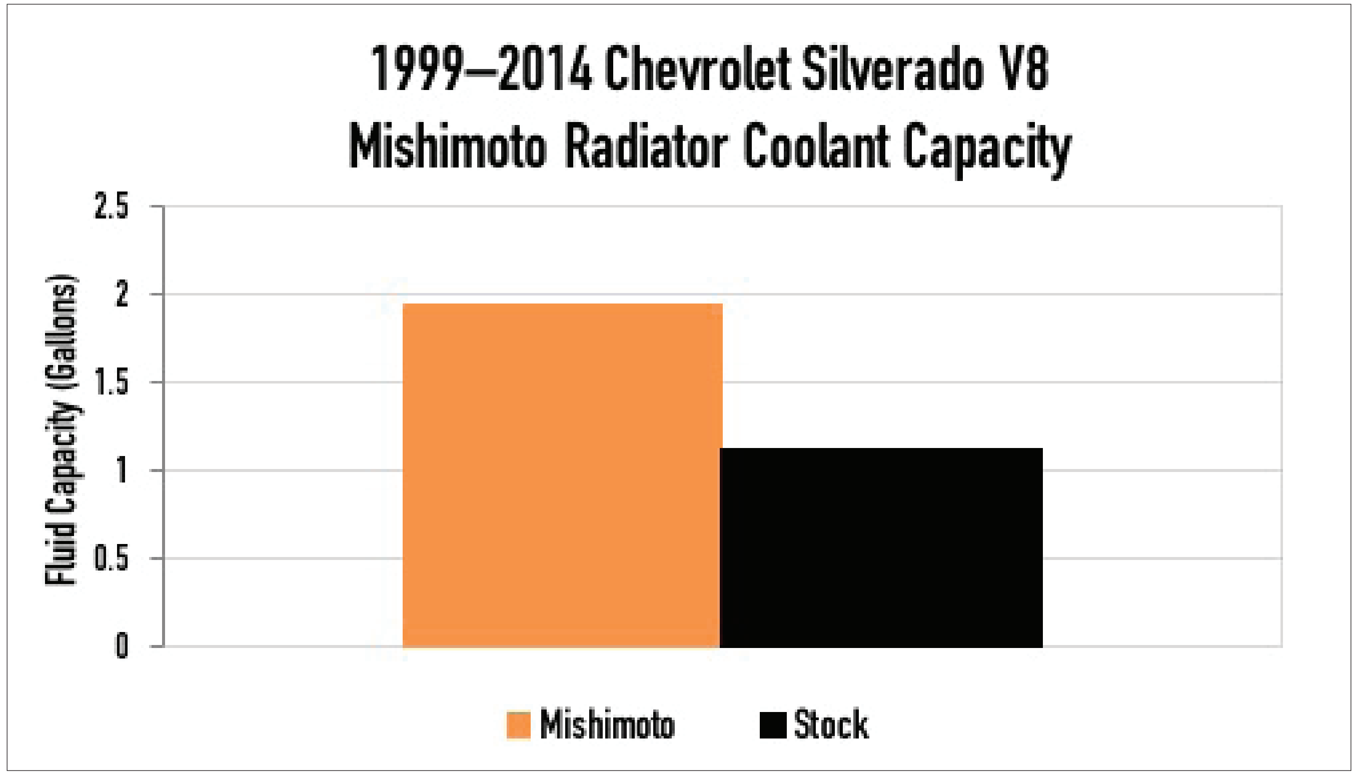

FIGURE 6: *Coolant capacity of the Mishimoto radiator increased by 72.4% over the stock radiator.*

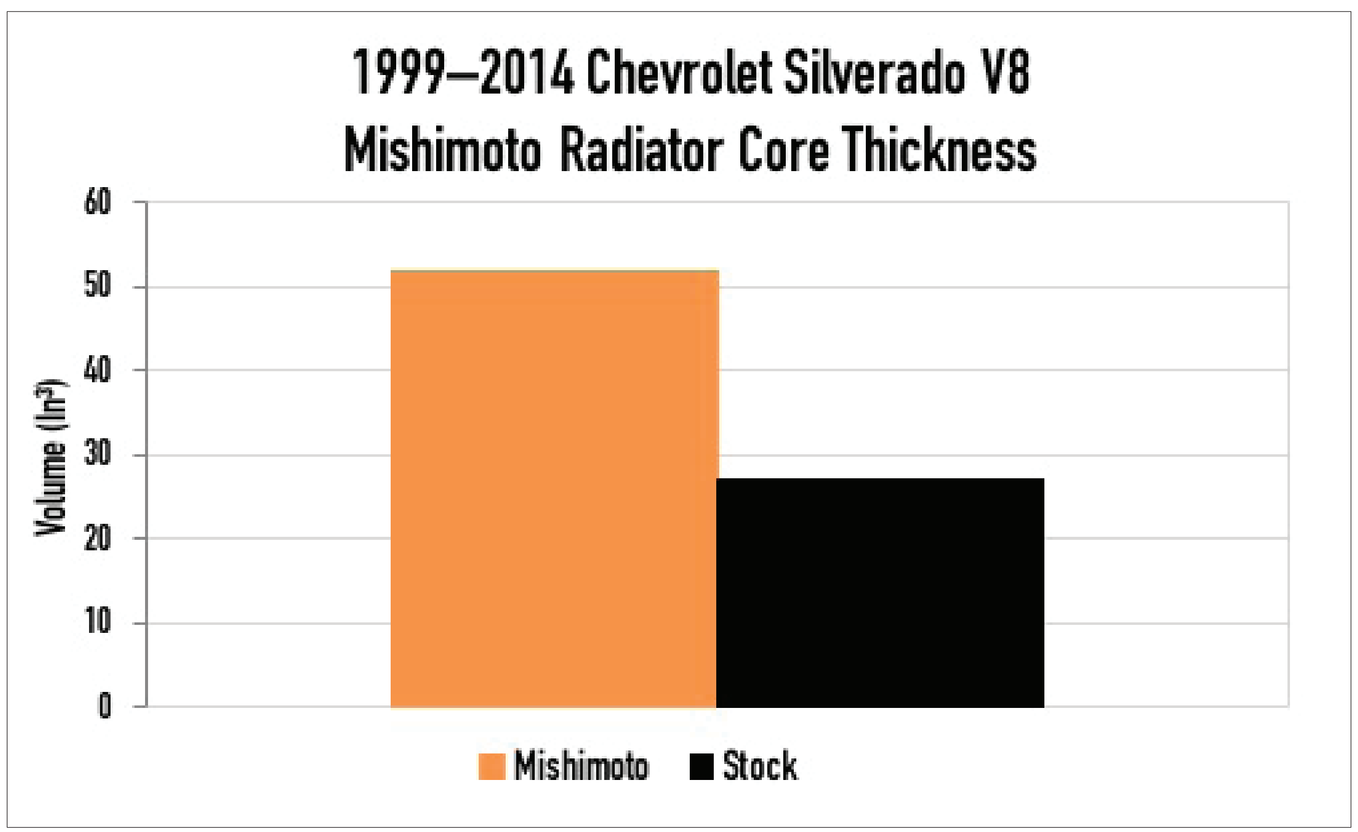

FIGURE 7: *Core thickness of the Mishimoto radiator increased by 92% over the stock radiator.*

TOW TESTING

The test took place on a back road with different grades including uphill, downhill, and flat stretches of road. The Chevrolet Tahoe's speed was set at exactly 55 mph using cruise control.

Special attention was given to the space between the Chevrolet Tahoe and the vehicle in front of it to ensure that an unobstructed wall of air entered the radiator. The results of both tests are shown below in Figures 8 through 11.

FIGURE 8: *Pressure and temperature sensors were installed in the hot-side intercooler pipe.*

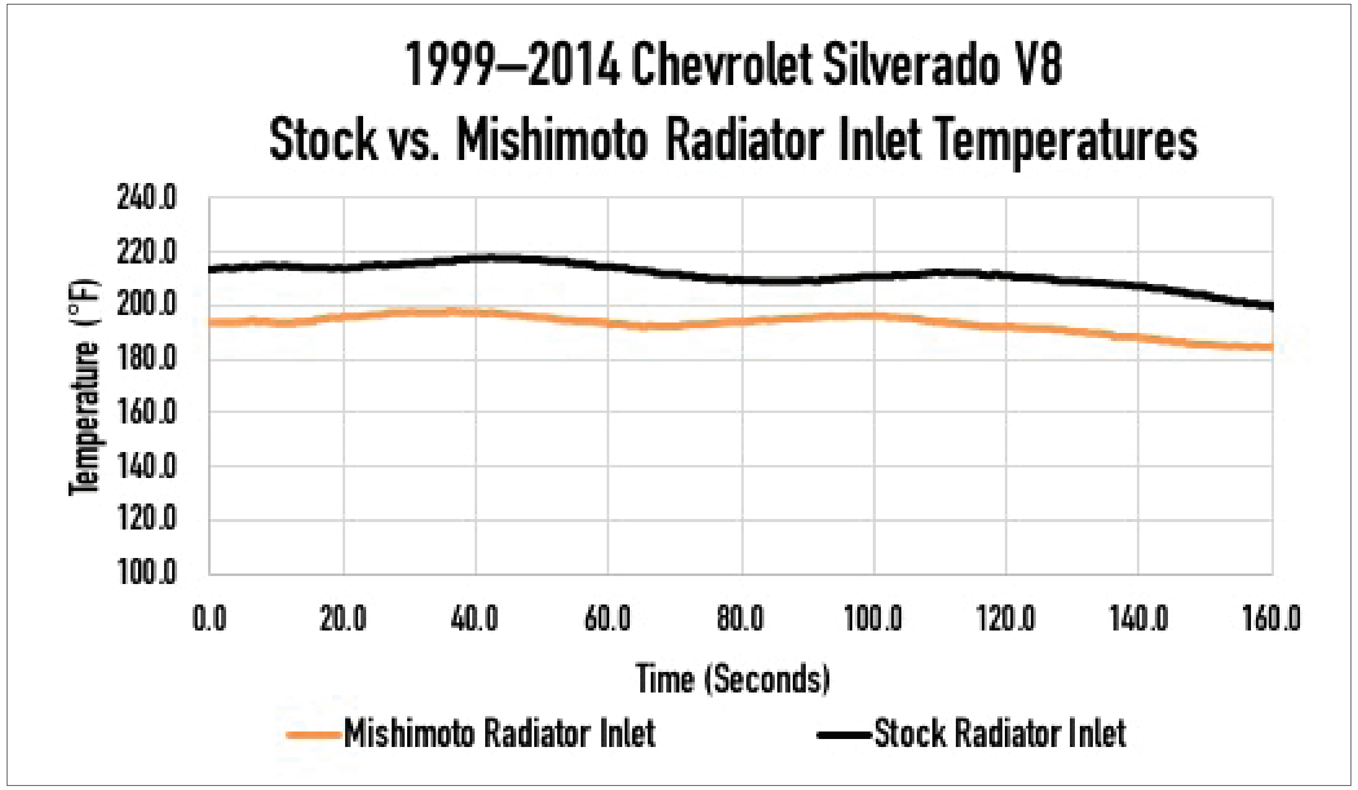

FIGURE 9: *Radiator temperature data comparing the inlet temperatures of both the stock and Mishimoto radiators. Notice the consistent reduction of approximately 20˚F (11.1˚C) throughout the entire length of the test.*

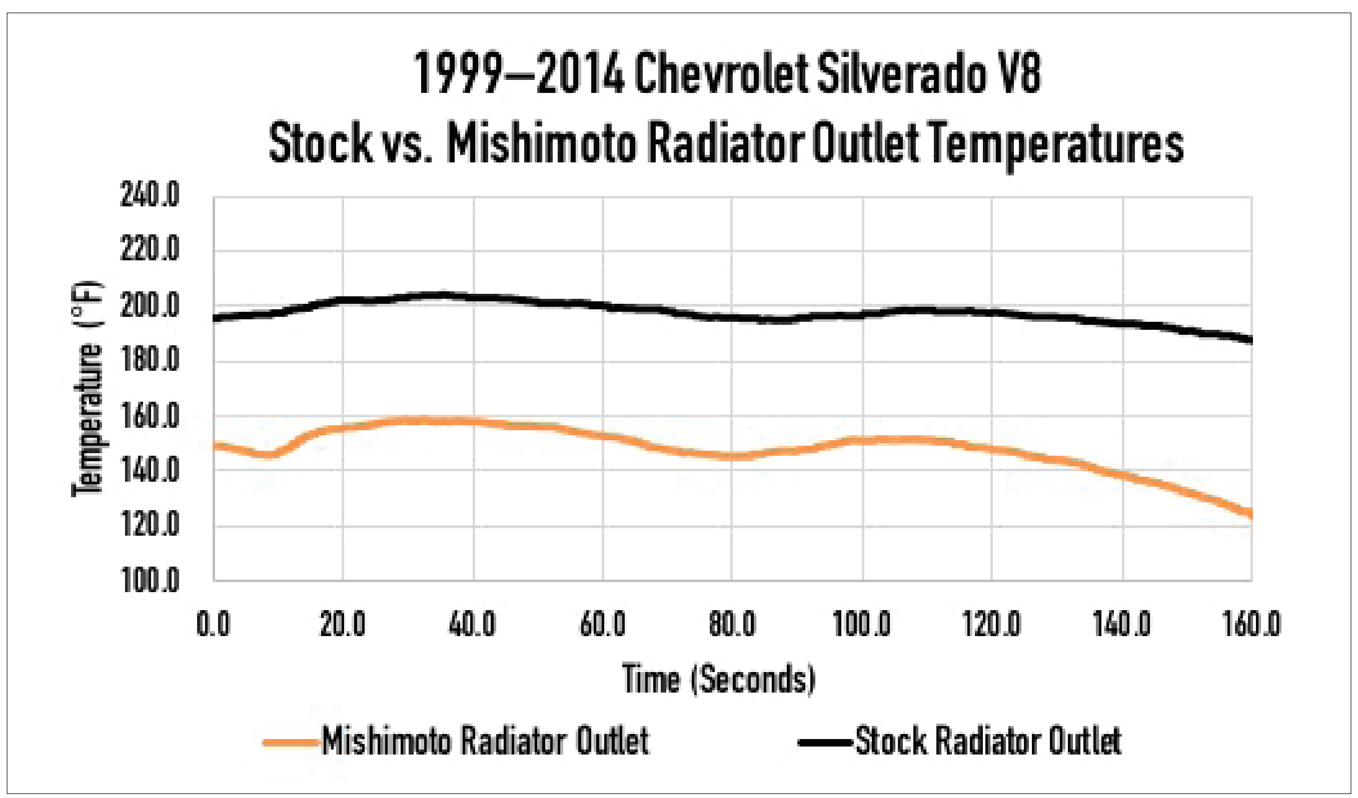

FIGURE 10: *Radiator temperature data comparing the outlet temperatures of both the stock and Mishimoto radiators. Notice the consistent reduction of approximately 46˚F (25.5˚C) throughout the entire length of the test.*

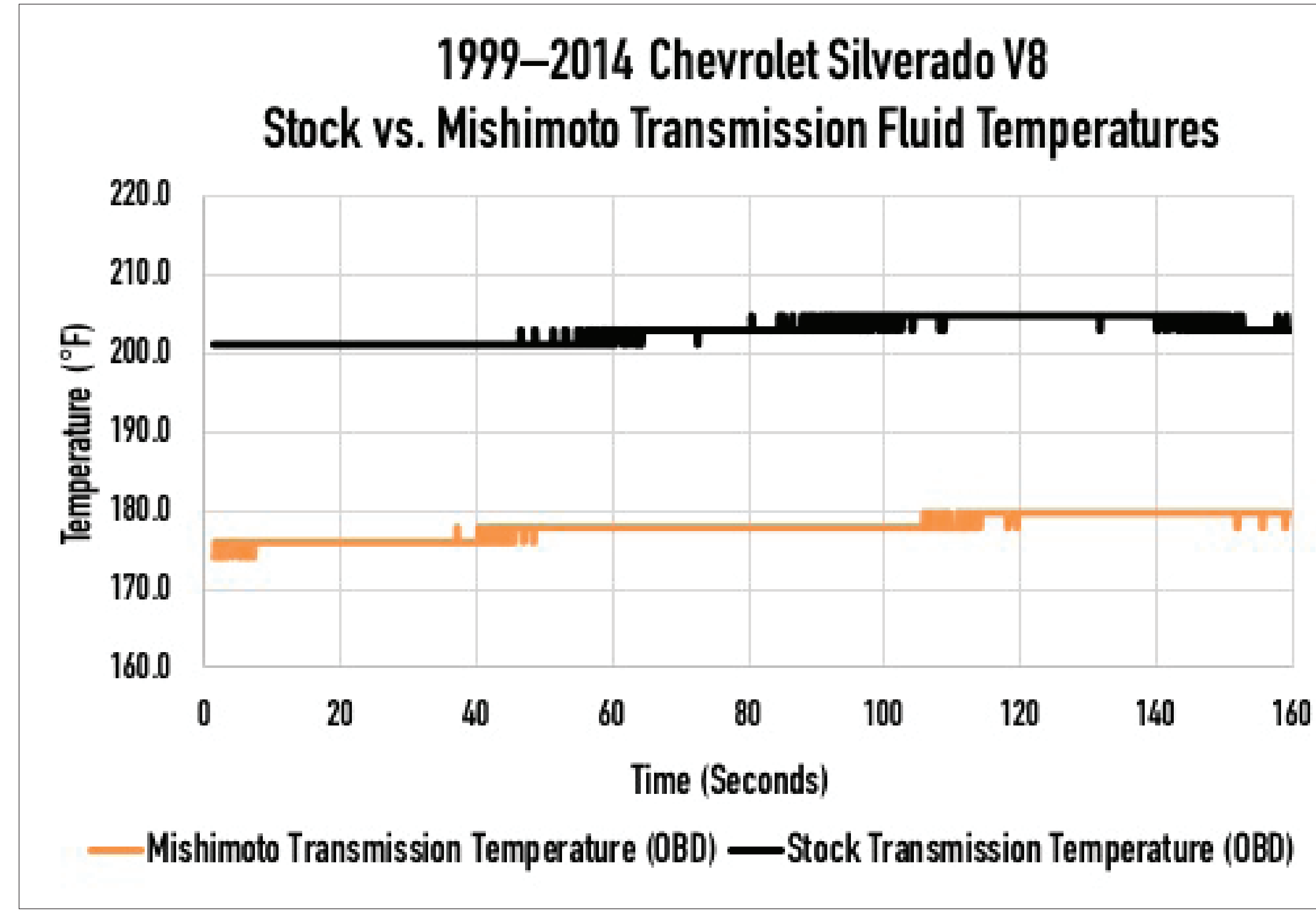

FIGURE 11: *Comparison of transmission fluid temperature data recorded with the stock radiator installed vs. the Mishimoto Performance Radiator installed. Notice the consistent reduction of approximately 25˚F (13.9˚C) throughout the entire length of the test. This reduction in temperature is a result of the cooler radiator outlet temperatures of the Mishimoto Performance Radiator aiding the in-tank transmission cooler.*

Learn more about Engine Cooling on our website.

CONCLUSIONS

The Mishimoto Performance Radiator for the 1999-2014 Chevrolet Silverado V8 was designed to increase cooling capacity as well as decrease coolant temperatures. This radiator lowers coolant and transmission fluid temperatures, has a larger fluid capacity, and features a more durable all-aluminum construction. All these features will help your 1999-2014 Chevrolet Silverado V8 perform better when driving in hot weather and during towing/hauling conditions.

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