MISHIMOTO

ENGINEERING REPORT

2021+ Ford Bronco 2.3L/2.7L High Mount Intercooler | SKU: MMINT-BR-21H

By: Daniel Tafe, *Mishimoto Product Engineer*

REPORT AT A GLANCE

- **Goal:** Create a direct-fit performance intercooler with the largest size possible to fit in the upper grille.
- **Results:** The Mishimoto intercooler reduced outlet air temperatures on the 2.3L Bronco by 21°F (11.6°C) and 15.5°F (8.8°C) on the 2.7L Bronco compared to the stock intercooler. This reduction in outlet temperature led to max power gains of 4.5 hp and 10.8 ft-lbs of torque on the 2.3L Bronco and 8.0 hp and 10.2 ft-lbs of torque on the 2.7L Bronco.
- **Conclusion:** The Mishimoto intercooler is a great upgrade for anyone looking to get the most performance out of their Ford Bronco.

CONTENTS

DESIGN OBJECTIVES

- Create a direct-fit performance intercooler with the largest size possible to fit in the upper grille.
- Mishimoto intercooler must not show a significant pressure loss compared to the stock intercooler.

DESIGN AND FITMENT

We began the R&D process by evaluating the available space behind the upper grille and the stock Ford Bronco intercooler. The stock intercooler is a 10-row tube-and-fin design. In contrast, the Mishimoto intercooler was designed to be a taller, wider, and thinner 15-row bar-and-plate intercooler to increase the amount of cooling surface area and core volume while maintaining an appropriate size to fit the upper grill. This design makes the Mishimoto intercooler 49% larger than the stock Ford Bronco intercooler. Figures 1 and 2 below compare the stock and Mishimoto intercoolers' overall core volumes and fin surface areas. Figure 3 shows a physical comparison of the stock intercooler and the Mishimoto intercooler.

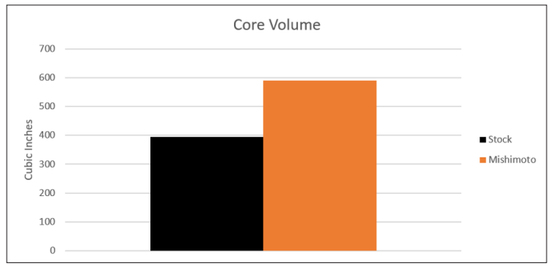

Figure 1: *The Mishimoto intercooler has a 49% increase in overall core volume compared to the stock intercooler.*

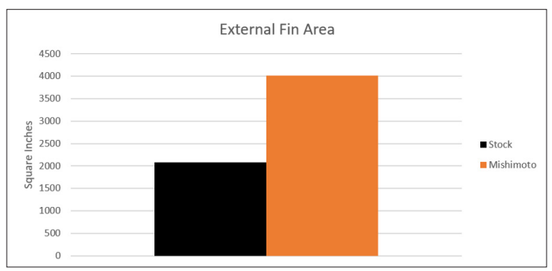

Figure 2: *The Mishimoto intercooler has a 93% increase in fin surface area over the stock intercooler.*

Figure 3: *Side view comparison of the stock intercooler to the Mishimoto performance intercooler.*

APPARATUS

For hardware, Mishimoto chose to use the AEM AQ-1 driven by the AQ-1 Data Acquisition System.

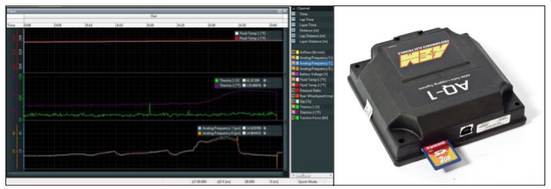

Figure 4: *AEM AQ-1 Data Logging System*

Air temperatures were taken with AEM intake air temperature sensors from the inlet and outlet of the Mishimoto intercooler. Boost pressure was also measured to ensure pressure will remain stable when installing the Mishimoto intercooler. The temperature and pressure baseline were recorded before the Mishimoto intercooler was installed to show how well the intercooler performed.

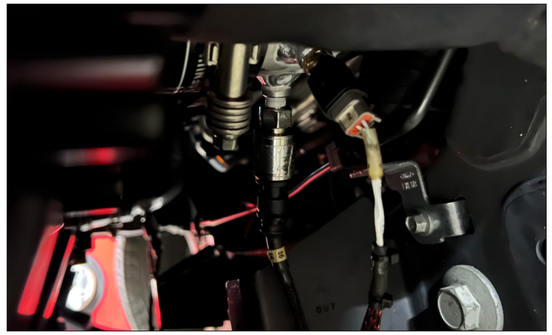

Figure 5: *Pressure and temperature sensors installed in the cold-side intercooler piping.*

PERFORMANCE TESTING

A 2021 Ford Bronco 2.3L and a 2021 Ford Bronco 2.7L were used to test each intercooler setup. The ambient temperature on the day of testing was approximately 75°F (23.9°C). Consistent ramp tests were conducted to test the performance of the intercoolers on each Bronco. A Dynapack™ dynamometer was used to test the 2.3L Bronco, and a DynoJet dynamometer was used to test the 2.7L.

Figure 6: *A Dynapack dynamometer was used for 2.3L testing.*

Figure 7: *A DynoJet dynamometer was used for 2.7L testing.*

The Ford Broncos were brought to an operating temperature of 190°F (88°C) by idling them on the dynos. Once the vehicles were at operating temperature, multiple dyno runs were conducted until consistent figures were recorded. The vehicles were kept idling between runs to maintain a consistent engine coolant temperature for every run. As a final test for each test configuration, dyno runs were made back-to-back to simulate heat-soak conditions. The two configurations we tested on each Bronco were:

Configuration 1: Stock intercooler with stock intercooler piping

Configuration 2: Mishimoto intercooler with stock intercooler piping

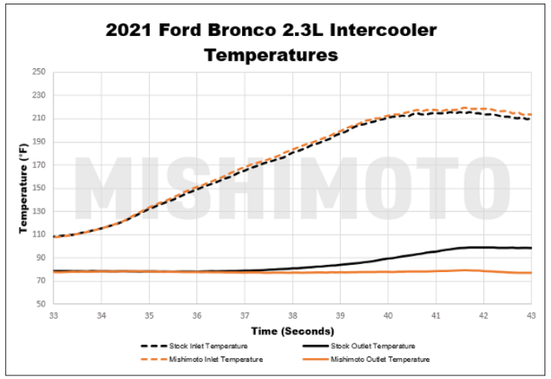

Figure 8: *The Mishimoto intercooler reduced outlet air temps. by 21°F (11.6°C) on the 2.3L Bronco.*

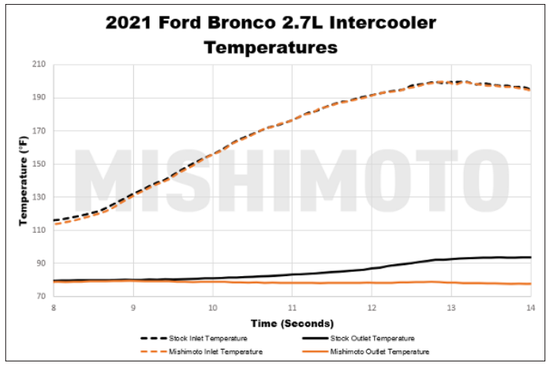

Figure 9: *The Mishimoto intercooler reduced outlet air temps. by 15.5°F (8.8°C) on the 2.7L Bronco.*

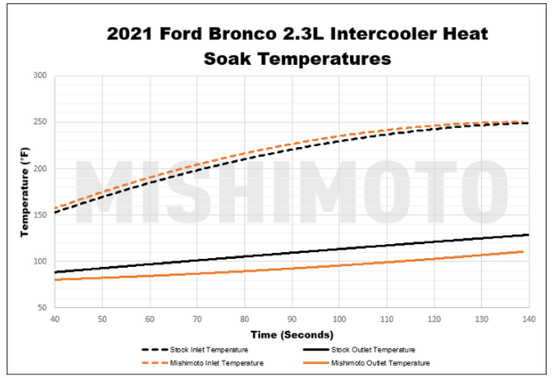

Figure 10: *The Mishimoto intercooler reduced outlet air temps. by 21°F (11.6°C) on the 2.3L Bronco.*

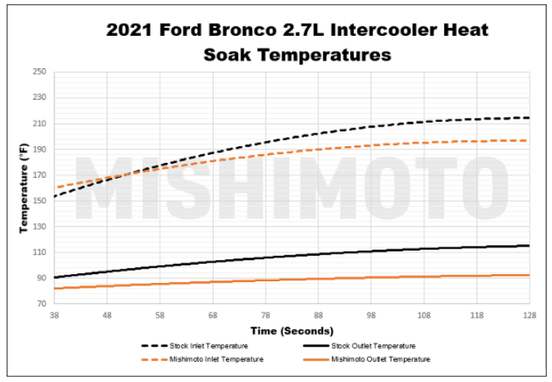

Figure 11: *The Mishimoto intercooler reduced outlet air temps. by 15.5°F (8.8°C) on the 2.7L Bronco.*

In comparison to the stock intercooler, the Mishimoto intercooler reduced the outlet temperature of the 2.3L Bronco by 21˚F (11.6˚C) and the 2.7L Bronco by 15.5˚F (8.8˚C). This reduction in temperature is a result of the Mishimoto intercooler having a 93% increase in fin surface area and a 49% increase in overall core volume.

Along with temperatures, inlet and outlet pressures were monitored to ensure that the Mishimoto intercooler did not add a significant drop in boost pressure from inlet to outlet. An increase in boost pressure drop from inlet to outlet could cause strain on the turbos, as well as add additional heat into the engine cooling and intercooling system, which could result in a loss of horsepower.

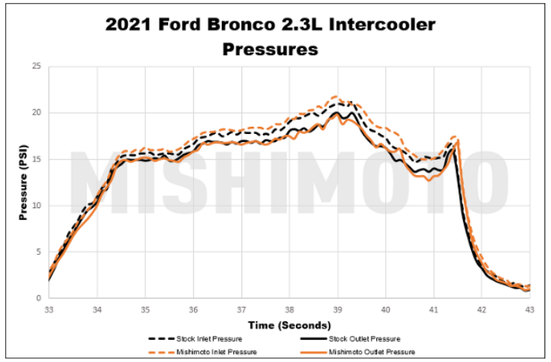

Figure 12: *The Mishimoto intercooler had an additional 1.0 psi of boost pressure drop compared to the stock intercooler on the 2.3L Bronco.*

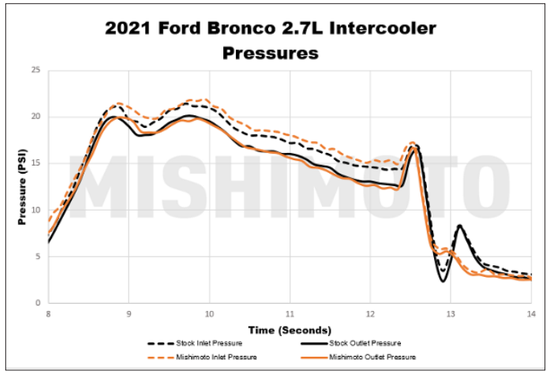

Figure 13: *The Mishimoto intercooler had an additional 1.0 psi of boost pressure drop compared to the stock intercooler on the 2.7L Bronco.*

The Mishimoto intercooler follows the outlet pressure curve to within 1.0 psi of the stock intercooler, as seen in Figures 12 and 13. This is well within an acceptable range and will not have any adverse effects on the intercooling system of the Ford Bronco. The additional pressure drop can be attributed to the intercooler's end tank internal flow geometry. The Mishimoto intercooler's end tanks are sculpted to direct the charge air to the intercooler through the narrow space between the A/C condenser and front bumper.

Additionally, by reducing outlet temperatures, the Mishimoto intercooler yielded max power gains of 4.5 hp and 10.8 ft-lbs of torque on the 2.3L Bronco and 8.0 hp and 10.2 ft-lbs of torque on the 2.7L Bronco. A cooler intercooler charge allows the engine can pack more air and fuel mix into the cylinders, which creates the potential to make a little extra power.

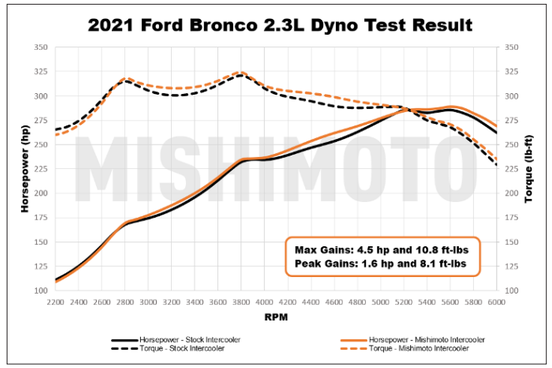

Figure 14: *The Mishimoto intercooler yielded a max gain of 4.5 hp and 10.8 ft-lbs of torque.*

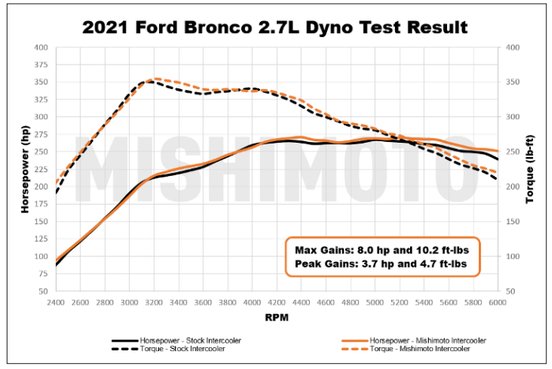

Figure 15: *The Mishimoto intercooler yielded a max gain of 8.0 hp and 10.2 ft-lbs of torque.*

Figure 16: *Mishimoto intercooler installed on the 2.7L Bronco*

An intercooler's primary function is to keep charge-air temperatures low. If the air temperature entering the engine begins to climb, the ECU will reduce power to preserve engine longevity. A performance intercooler will aid in preventing this loss of power. The Mishimoto intercooler reduced outlet temperatures with a minimal increase in boost pressure drop, resulting in a slight gain in horsepower and torque. If an aftermarket tune is loaded onto the vehicle, additional gains can be expected because the tuner can compensate for the reduction in engine air temperature.

TESTING DONE BY:

Daniel Tafe, Mishimoto Product Engineer

FOLLOW US

Mishimoto is very active on social media so we can be in constant contact with our customers. Our Social Media Team is available via Facebook, Instagram, YouTube, our Engineering Blog, and forums. We sponsor contests and promotional events, so be sure to follow us.

GOMISHIMOTO

MISHIMOTO.COM/
ENGINEERING

MISHIMOTO

#MISHIMOTO

CONTACT US

Email
For sales and technical questions, please contact
support@mishimoto.com

By Phone
USA: 877.466.4744
International: +1.302.762.4501
Fax: 302.762.4503

Mail
Mishimoto
7 Boulden Circle,
New Castle, DE 19720

Visit
Mishimoto.com
Mishimoto.co.uk
Mishimoto.eu

MISHIMOTO