ENGINEERING REPORT

2021+ Ford Bronco Direct-Fit Intercooler | SKU: MMINT-BR-21

By: Daniel Tafe, *Mishimoto Product Engineer*

REPORT AT A GLANCE

- **Goal:** Create a direct-fit performance intercooler that outperforms the stock intercooler.
- **Results:** The Mishimoto intercooler reduced outlet air temperatures on the 2.3L Bronco by 21.2°F (11.8°C) and 15.8°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 5.7 hp and 5.3 ft-lbs of torque on the 2.3L Bronco and 6.5 hp and 6.5 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.

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DESIGN OBJECTIVES

- Create an intercooler that performs better than the stock intercooler.
- Mishimoto intercooler must not show a significant pressure loss when compared to the stock intercooler.

DESIGN AND FITMENT

We began the R&D process by evaluating the stock Ford Bronco intercooler to find potential room for improvement. The stock intercooler is a 3.15" thick, 10-row tube-and-fin design. The Mishimoto intercooler was designed as a much larger, 4.72" thick, 13-row bar-and-plate intercooler to increase the amount of cooling surface area and core volume. This design makes the Mishimoto intercooler 77% larger than the stock Ford Bronco intercooler. Figures 1 and 2 below show a comparison of overall core volumes and fin surface areas for the stock and Mishimoto intercoolers. Figures 3 shows a physical comparison of the stock intercooler and the Mishimoto intercooler.

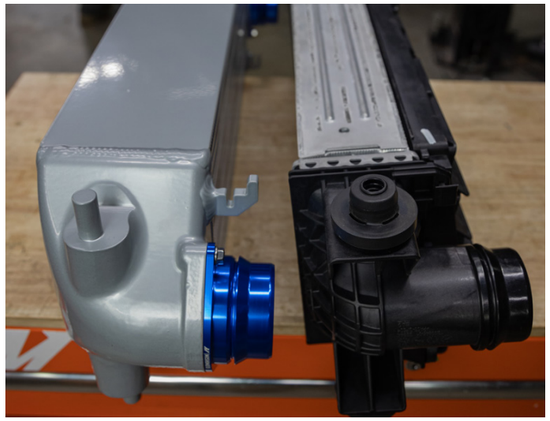

Figure 3: *Side view comparison of the stock intercooler to the Mishimoto intercooler.*

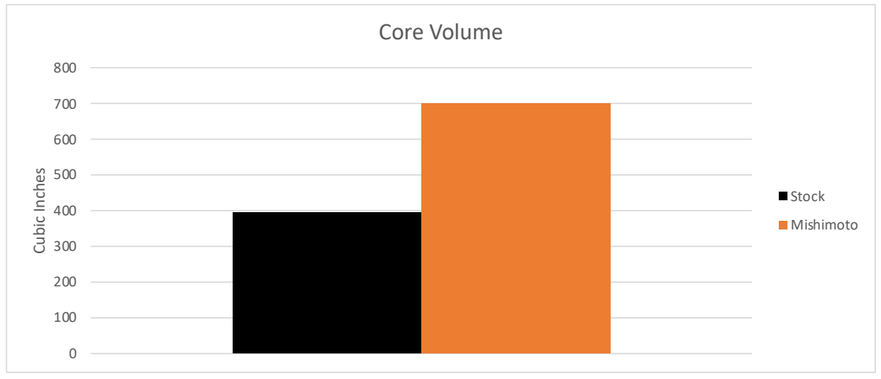

Figure 1: *The Mishimoto intercooler has a 77% increase in overall core volume compared to the stock intercooler.*

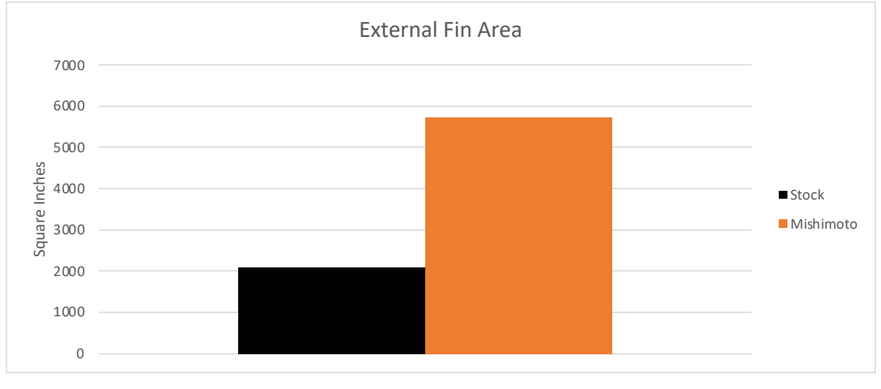

Figure 2: *The Mishimoto intercooler has a 175% increase in fin surface area over the stock intercooler.*

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 that no dramatic pressure drop will occur when installing the Mishimoto intercooler. A baseline of the temperature and pressure was recorded before the Mishimoto intercooler was installed. This allowed us to see how well the intercooler performed.

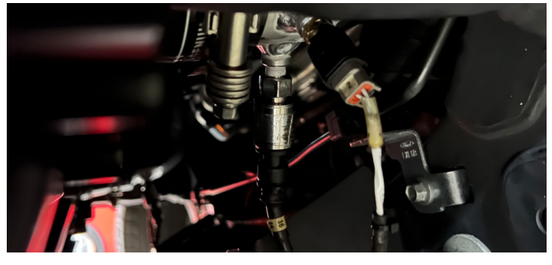

Figure 5: *Pressure and temperature sensors installed in the cold-side intercooler piping.*

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). To test the performance of the intercoolers, a Dynapack™ dynamometer was used to conduct consistent ramp tests on the 2.3L Bronco and a DynoJet dynamometer was used to conduct consistent ramp tests on the 2.7L.

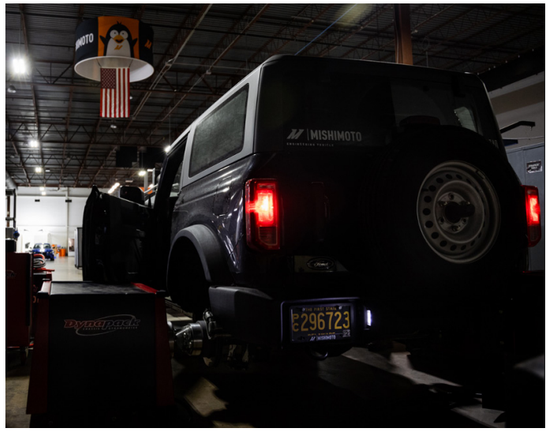

Figure 6: *A Dynapack dynamometer was used for 2.3L testing.*

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

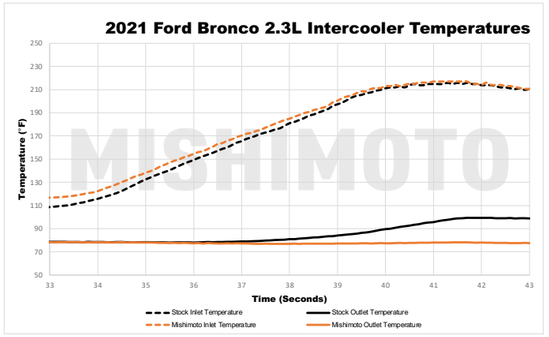

Figure 8: *The Mishimoto intercooler reduced outlet air temperatures by 21.2°F (11.8°C) on the 2.3L Bronco.*

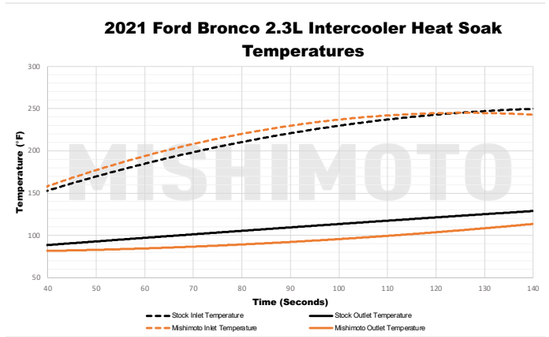

Figure 10: *The Mishimoto intercooler reduced outlet air temperatures by 20°F (11.3°C) on the 2.3L Bronco.*

Figure 9: *The Mishimoto intercooler reduced outlet air temperatures by 15.8°F (8.8°C) on the 2.7L Bronco.*

Figure 11: *The Mishimoto intercooler reduced outlet air temperatures by 15°F (8.3°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 21.2˚F (11.8˚C) and the 2.7L Bronco by 15.8˚F (8.8˚C). This reduction in temperature is a result of the Mishimoto intercooler having a 175% increase in fin surface area and a 77% 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.

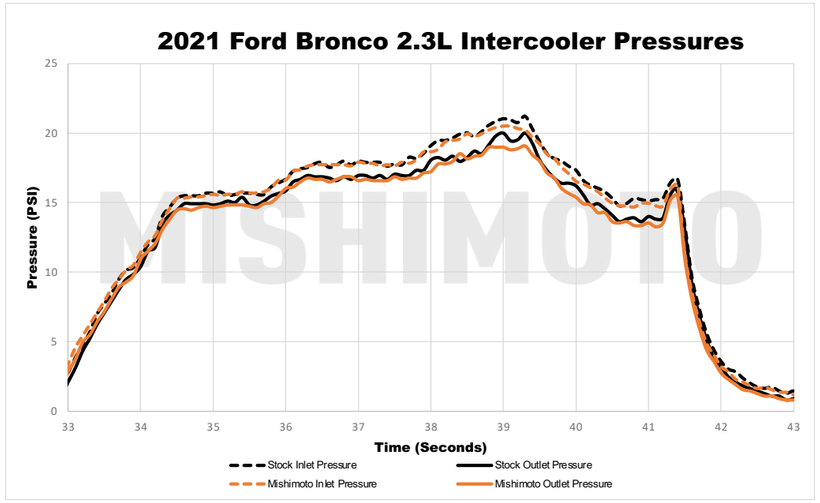

Figure 12: *The Mishimoto intercooler had an additional 0.3 psi of boost pressure drop compared to the stock intercooler on the 2.3L Bronco.*

Figure 13: *The Mishimoto intercooler had an additional 0.3 psi of boost pressure drop compared to the stock intercooler on the 2.7L Bronco.*

As seen in Figures 12 and 13, the Mishimoto intercooler follows the outlet pressure curve to within 0.3 psi of the stock intercooler. This is well within an acceptable range and will not have any adverse effects on the intercooling system of the Ford Bronco.

As a bonus to go along with the reduction in outlet temperatures, the Mishimoto intercooler yielded max power gains of 5.7 hp and 5.3 ft-lbs of torque on the 2.3L Bronco and 6.5 hp and 6.5 ft-lbs of torque on the 2.7L Bronco. With a cooler intercooler charge, the engine can pack more air and fuel mix into the cylinders, which creates the potential to make a little extra power.

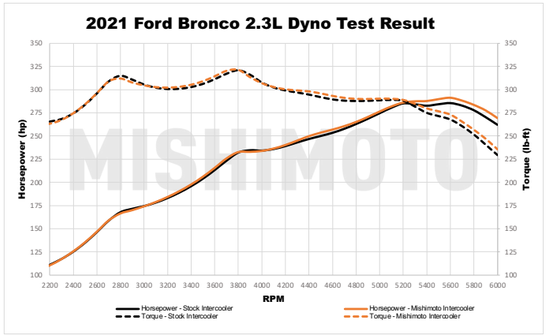

Figure 14: *The Mishimoto intercooler yielded a max gain of 5.7 hp and 5.3 ft-lbs of torque.*

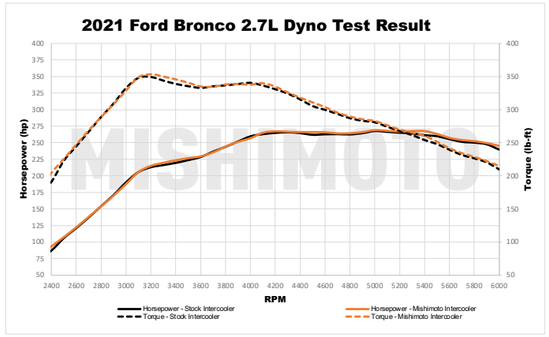

Figure 15: *The Mishimoto intercooler yielded a max gain of 6.5 hp and 6.5 ft-lbs of torque.*

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 is able to compensate for the reduction in engine air temperature.

Daniel Tafe, Mishimoto Product Engineer

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

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