MISHIMOTO

ENGINEERING REPORT

2016+ Ford Focus RS Intercooler & Piping | SKU: MMINT-RS-16, MMICP-RS-16KBK

By Daniel Tafe, *Mishimoto Engineer*

REPORT AT A GLANCE

- **Goal:** Create a direct-fit performance intercooler that outperforms the stock intercooler. The intercooler must also fit without trimming or modifying any other parts on the car.
- **Results:** The Mishimoto intercooler reduced outlet air temperatures by 40°F (22.2°C) compared to the stock intercooler when installed with the stock intercooler piping. When installed with the Mishimoto intercooler piping, this reduction in temperature is increased to 43°F (23.8°C). The reduction in outlet temperature led to max power gains of 7 hp and 8 ft-lb of torque with stock intercooler piping and 9 hp and 10 ft-lb of torque with the Mishimoto intercooler piping.
- **Conclusion:** The Mishimoto intercooler is a great upgrade for anyone looking to get the most performance out of their Focus RS.

CONTENTS

DESIGN OBJECTIVES

The design requirements assigned to this project are as follows:

- Create an intercooler that performs better than the stock intercooler.
- Must be a direct fit with no cutting or permanent modification necessary.
- Mishimoto intercooler must not show a significant pressure loss when compared to the stock intercooler.

DESIGN AND FITMENTS

We began the R&D process by evaluating the standard Ford Focus RS intercooler to find potential room for improvement. The stock intercooler is a 3.25" thick, 11-row tube-and-fin design. The Mishimoto intercooler was designed as a much larger 5.12" thick, 13-row bar-and-plate intercooler to increase the amount of cooling surface area and core volume. This design makes the Mishimoto intercooler 80% larger than the stock Focus RS intercooler. Figures 1 and 2 below show a comparison of overall core volumes and fin surface areas for the stock and Mishimoto intercoolers.

We also evaluated the stock intercooler piping and found that we could adjust the inside diameters of both to increase flow and reduce pressure drop. See Figures 3 through 6 for comparisons of pressure drop and volume between the stock and Mishimoto intercooler piping. Altering the geometry of the hot-side intercooler pipe was especially challenging because the stock pipe routing sits close to the rear of the engine oil pan and sits right above a duct in the bottom splash shield that aids in directing airflow to a heat sink on the bottom of the power transfer unit (PTU). We overcame this challenge by casting the section of piping that sits in this area and shaped it in a way that helps airflow to the PTU. See Figures 7 and 8 for images of the Mishimoto hot-side intercooler pipe routing near the PTU.

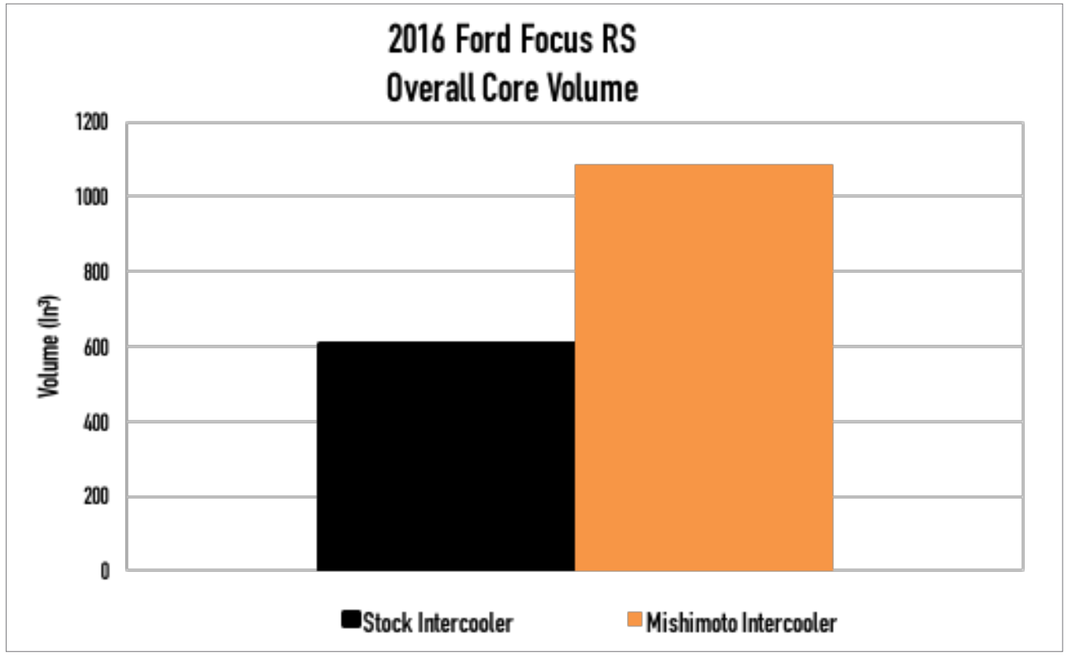

FIGURE 1: *The Mishimoto intercooler has an 80% increase in overall core volume compared to the stock intercooler.*

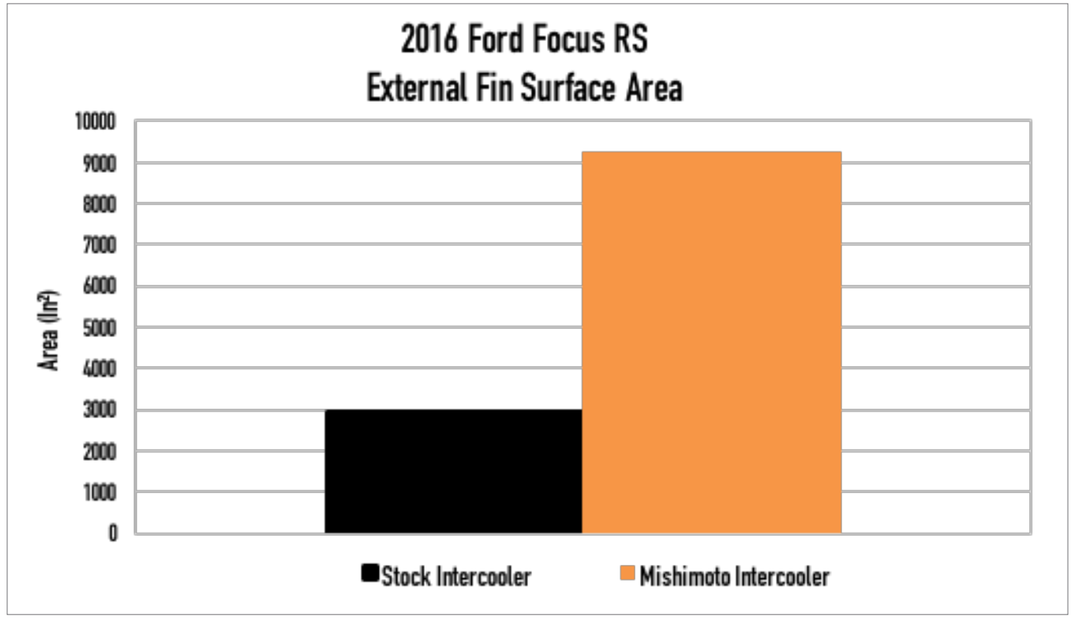

FIGURE 2: *The Mishimoto intercooler has a 214.5% increase in fin surface area over the stock intercooler.*

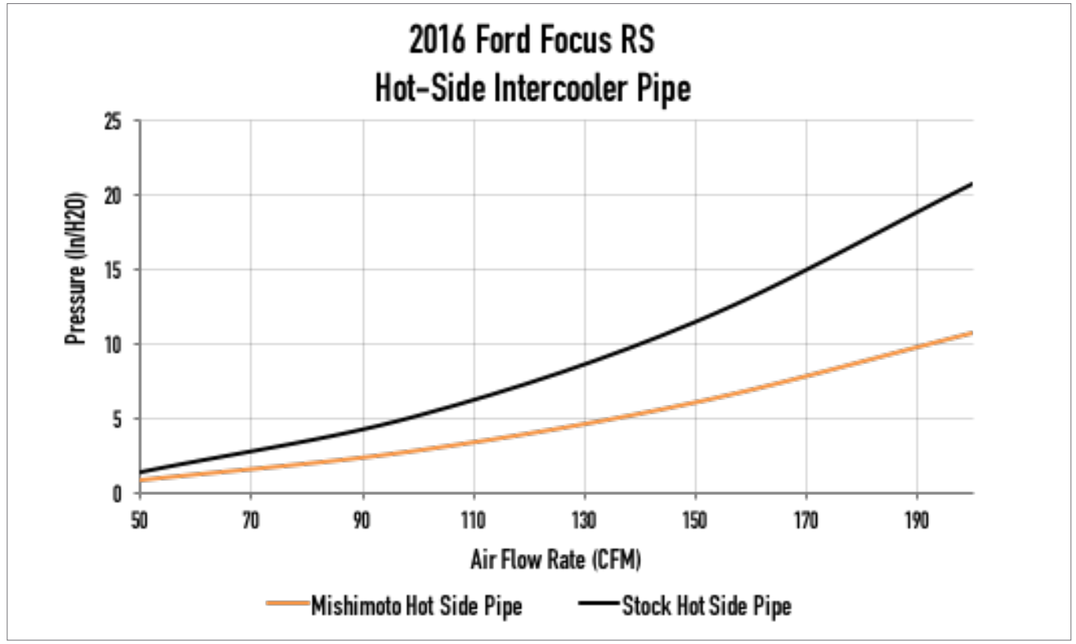

FIGURE 3: *The Mishimoto intercooler pipe reduced pressure drop by 45% over the stock intercooler pipe.*

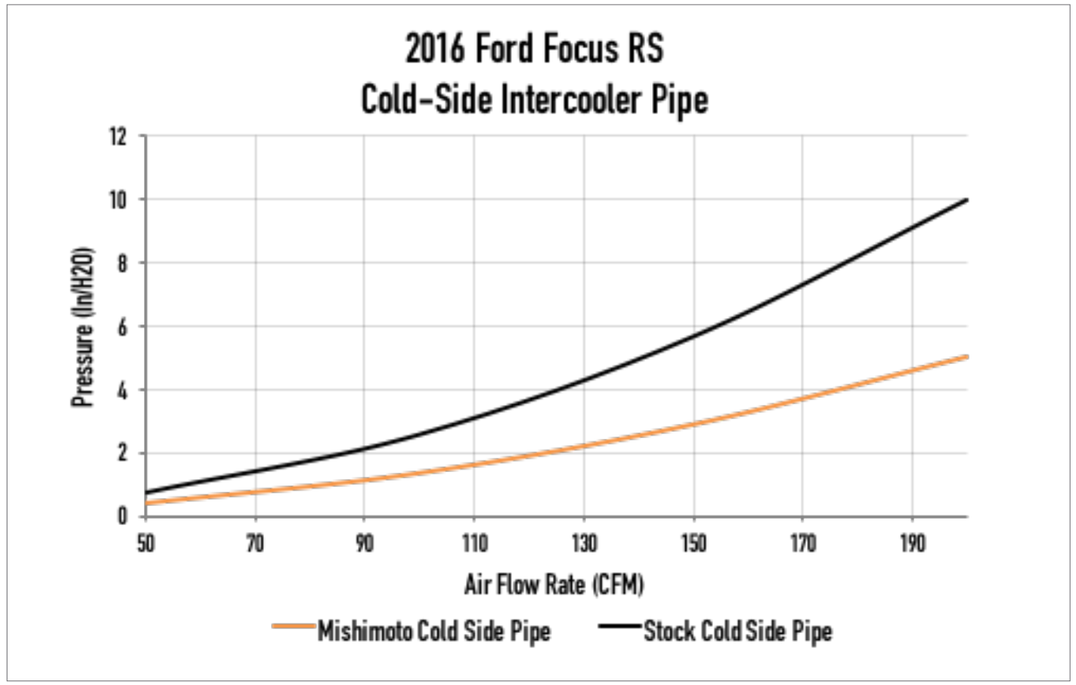

FIGURE 4: *The Mishimoto intercooler pipe reduced pressure drop by 46% over the stock intercooler pipe.*

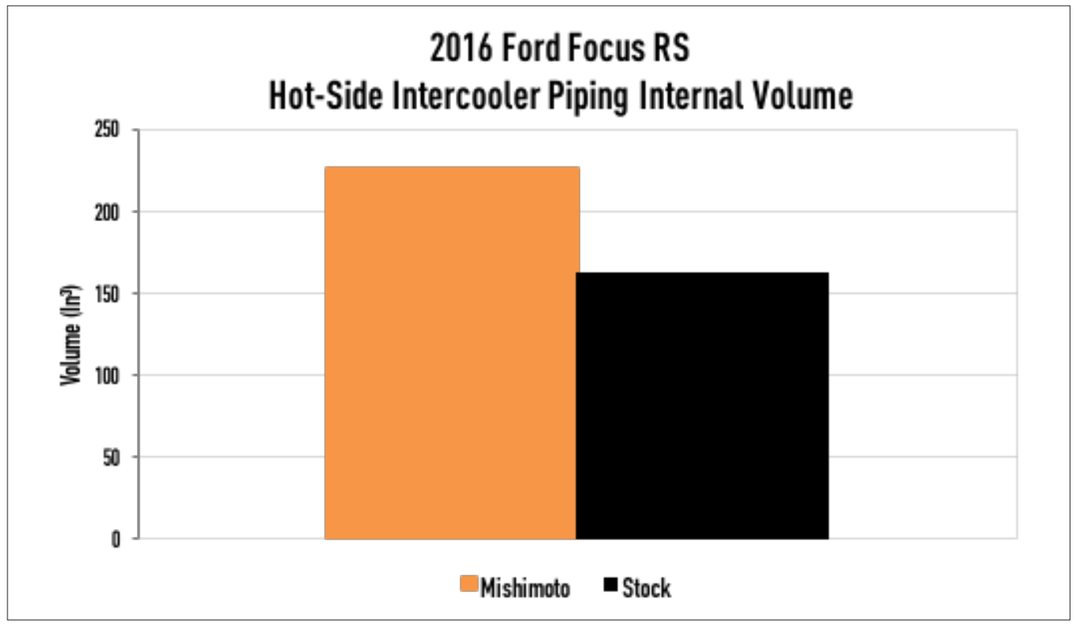

FIGURE 5: *The Mishimoto intercooler pipe has a 40% increase in internal volume over the stock intercooler pipe.*

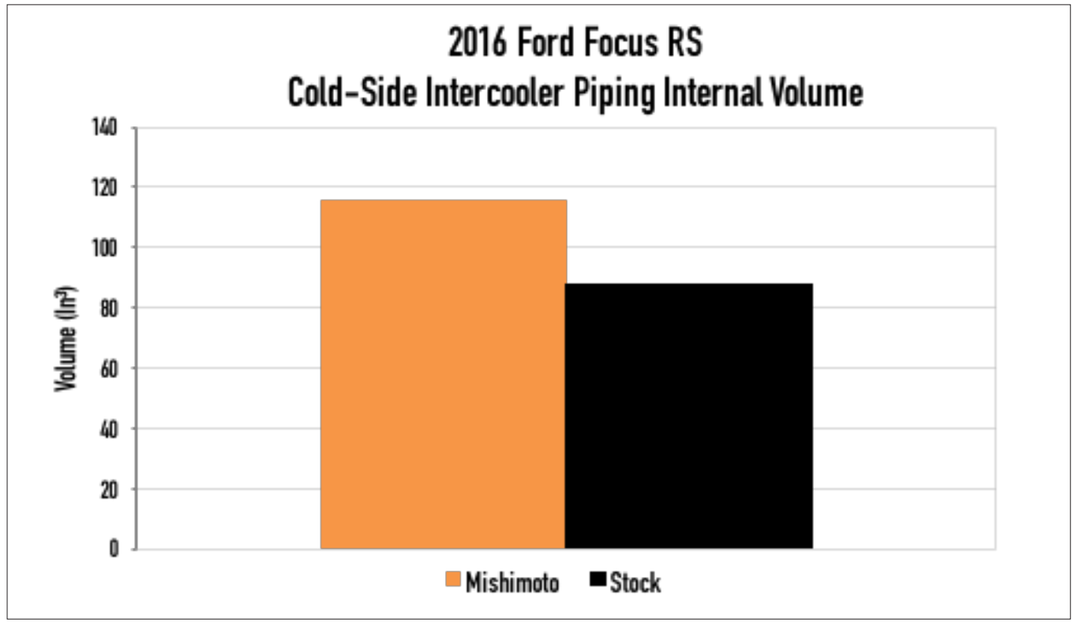

FIGURE 6: *The Mishimoto intercooler pipe has a 31.5% increase in internal volume over the stock intercooler pipe.*

FIGURE 7: *Image of the Mishimoto hot-side intercooler pipe installed.*

FIGURE 8: *Image of the Mishimoto hot-side intercooler pipe installed with the lower splash shield in place showing that it does not obstruct airflow to the heat sink on the bottom of the PTU.*

APPARATUS

For hardware Mishimoto chose to use the AEM AQ-1 driven by the AQ-1 Data Acquisition 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 occurs when installing the Mishimoto intercooler. A baseline temperature and pressure were recorded before the Mishimoto intercooler was installed. This allowed us to see how well the intercooler performed.

FIGURE 9: *AEM AQ-1 Data Logging System*

PERFORMANCE TESTING

A 2016 Ford Focus RS was used to test each intercooler setup. The ambient temperature on the day of testing was approximately 65°F (18.33°C). To test the performance of the intercoolers, a Dynapack™ dynamometer was used to conduct consistent ramp tests.

The Focus RS was warmed up by idling it on the dyno until the coolant temperature reached 180°F (82.22°C). Once the car was warmed up, dyno runs were conducted until multiple consistent runs were recorded. The car was kept running between runs to maintain a consistent engine coolant temp for every run. This test was then repeated with the Mishimoto intercooler installed. The dyno testing results are shown in Figures 11–21.

FIGURE 10: *A Dynapack dynamometer was used for vehicle testing.*

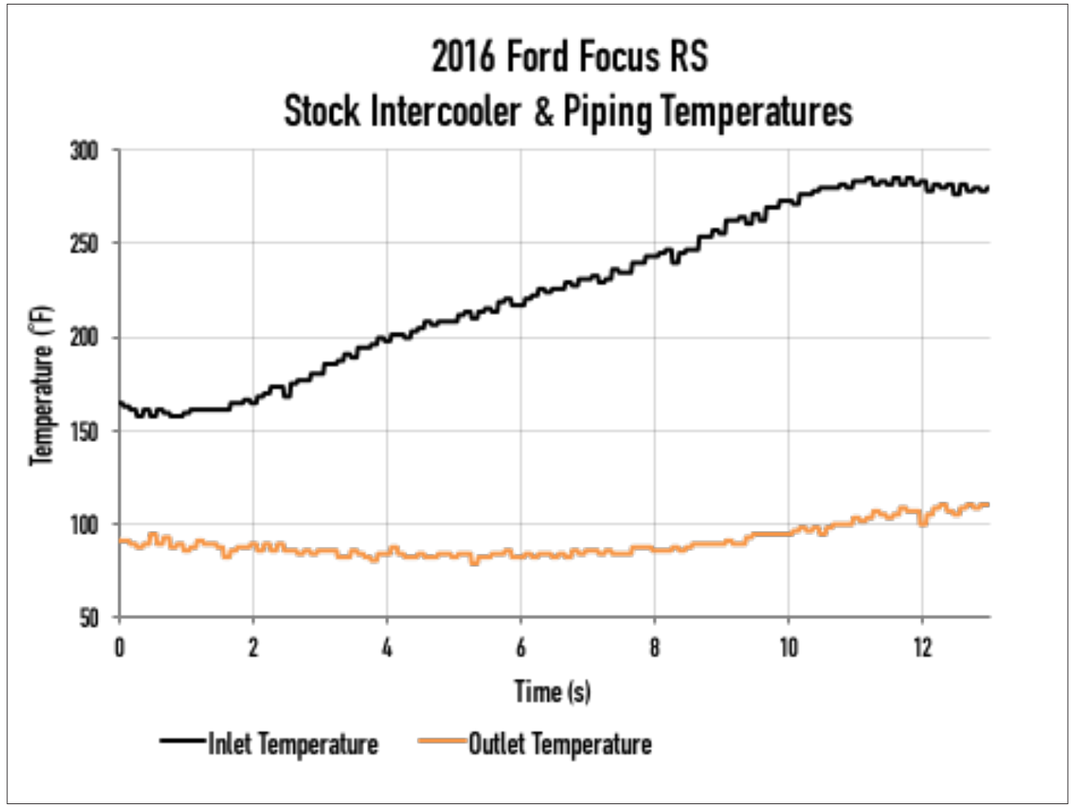

FIGURE 11: *Stock intercooler with stock intercooler piping inlet and outlet temperature data.*

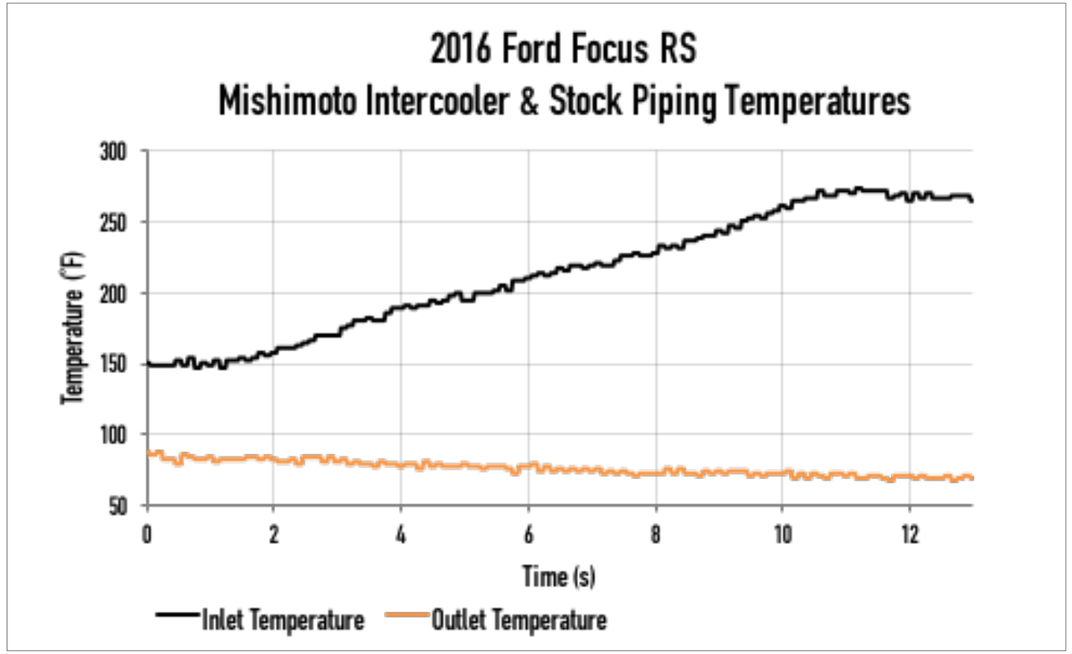

FIGURE 12: *Mishimoto intercooler with stock intercooler piping inlet and outlet temperature data.*

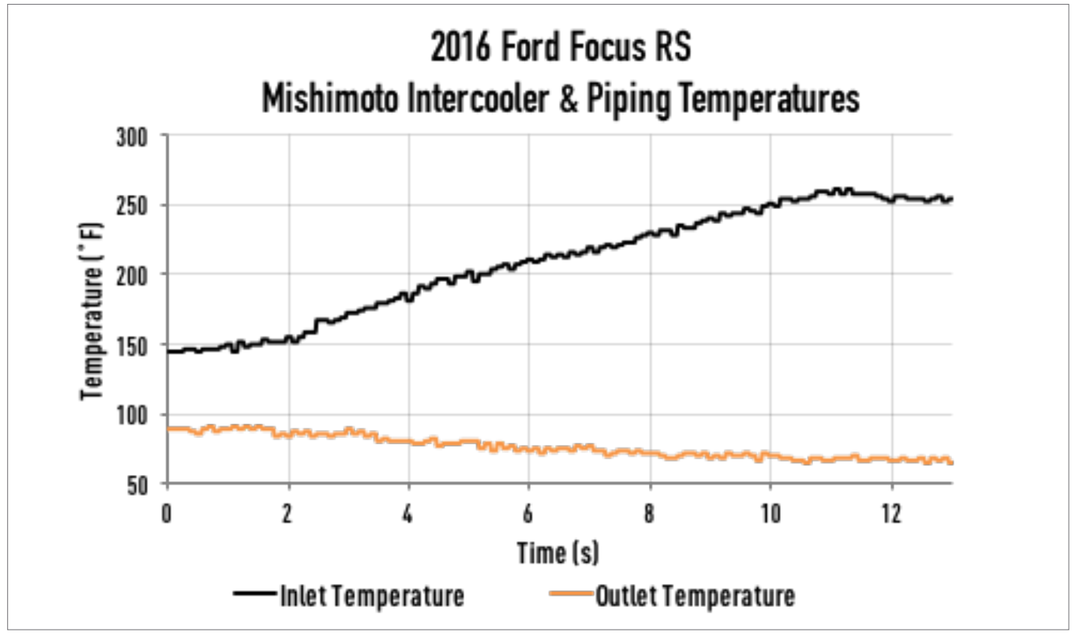

FIGURE 13: *Mishimoto intercooler with Mishimoto intercooler piping inlet and outlet temperature data.*

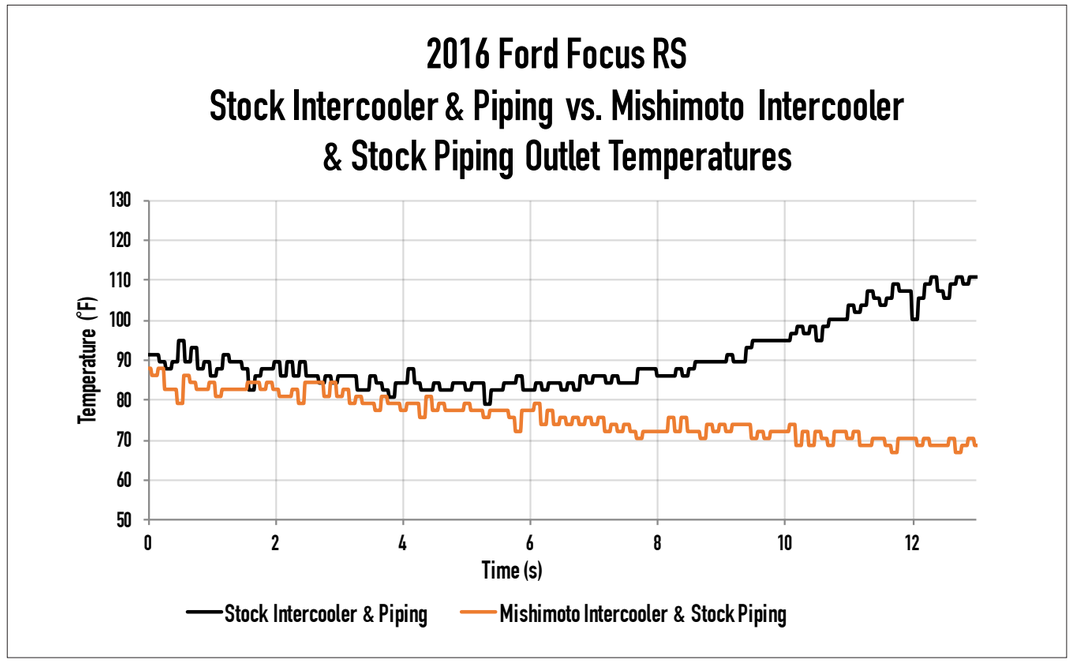

FIGURE 14: *The Mishimoto intercooler with stock intercooler piping reduced the outlet temperatures about 40°F (22.2°C) compared to the stock intercooler piping.*

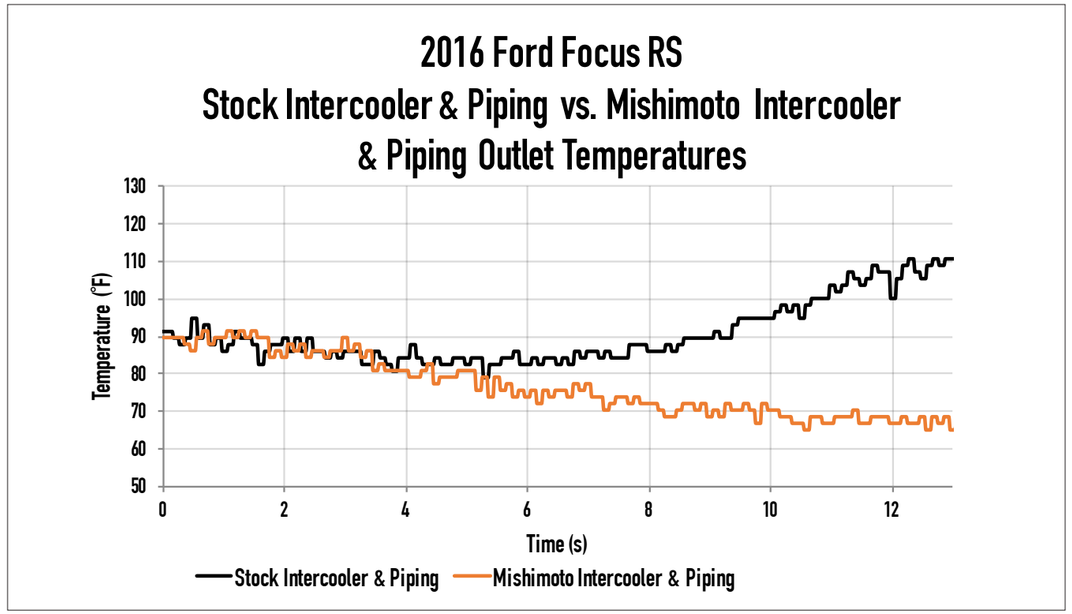

FIGURE 15: *The Mishimoto intercooler with Mishimoto intercooler piping reduced the outlet temperatures about 43°F (23.8°C) compared to the stock intercooler and piping.*

The Mishimoto intercooler reduced the outlet temperature by 40˚F (22.2˚C) compared to the stock intercooler. This reduction in temperature is a result of the Mishimoto intercooler having a 214.5% increase in fin surface area and an 80% increase in core volume. With the Mishimoto intercooler piping installed, this temperature reduction increased to 43˚F (23.8˚C).

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. A large decrease in boost pressure could cause the turbo to work harder, resulting in additional heat entering the engine's cooling and intercooling systems, while also resulting in decreased horsepower.

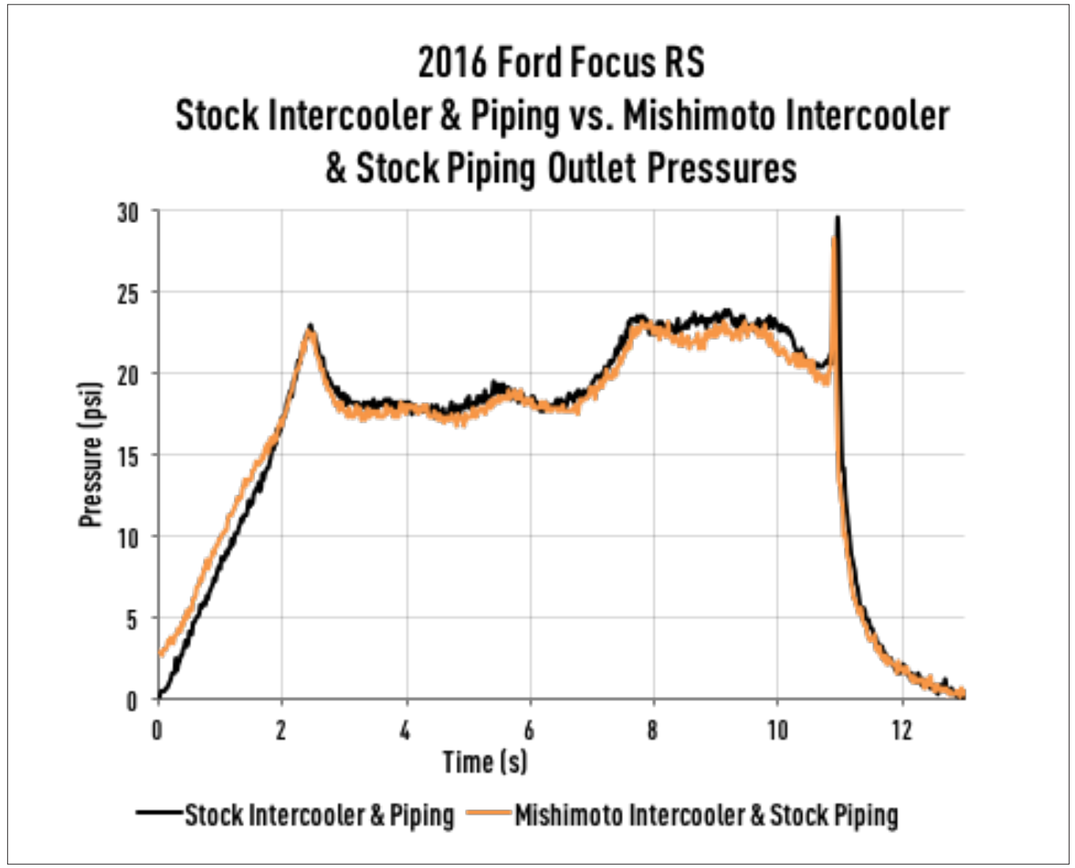

FIGURE 16: *The Mishimoto intercooler with stock intercooler piping had an additional 0.50psi of boost pressure drop compared to the stock intercooler and piping.*

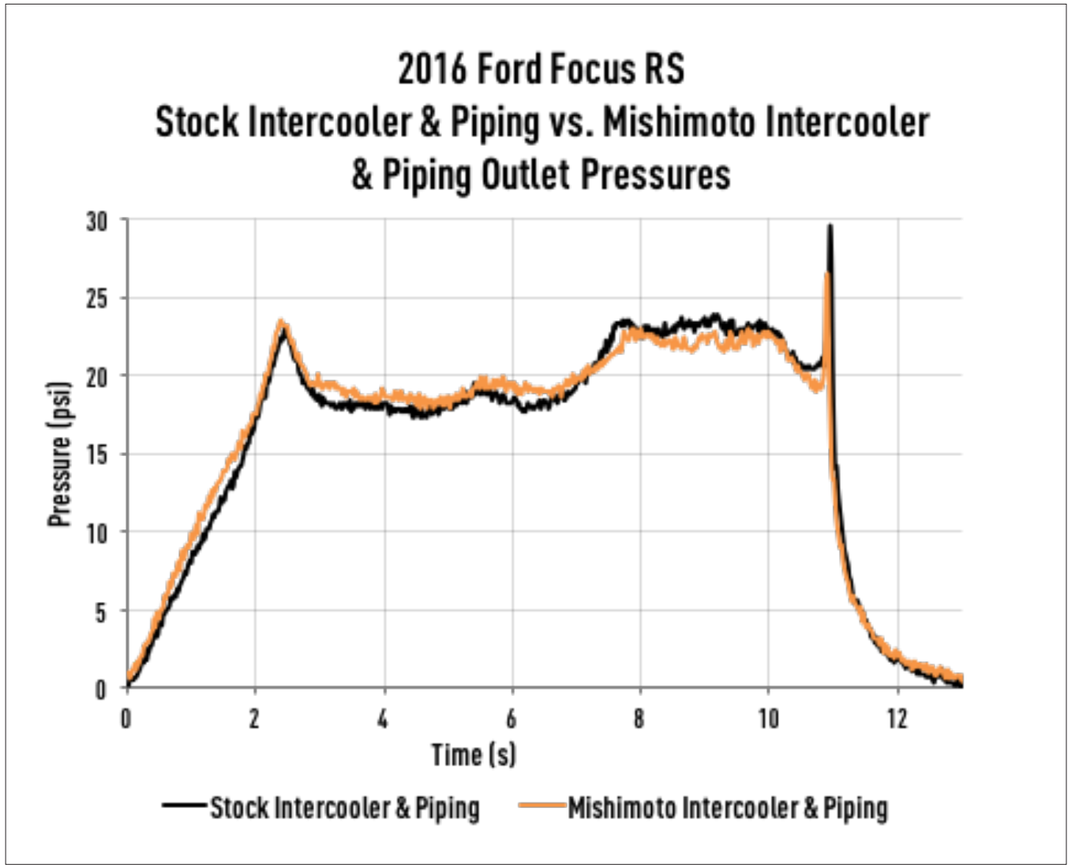

FIGURE 17: *The Mishimoto intercooler with Mishimoto intercooler piping had an additional 1.0 psi of boost pressure drop compared to the stock intercooler and piping.*

As seen in Figures 16 and 17, the Mishimoto intercooler follows the outlet pressure curve to within 0.5 psi of the stock cooler when coupled to the stock intercooler piping and is within 1.0 psi of this curve when coupled with the Mishimoto intercooler piping. This is well within an acceptable range and will not have any adverse effects on the intercooling system of the Focus RS.

As a bonus to go along with the reduction in outlet temperatures, the Mishimoto intercooler yielded maximum power gains of 7 hp and 8 ft-lb of torque when coupled with the stock intercooler. With the Mishimoto intercooler piping installed, these max power gains increased to 9 hp and 10 ft-lb of torque. With a cooler intercooler charge, the engine can pack more air and fuel mix into the cylinders, which creates the potential for a little extra power.

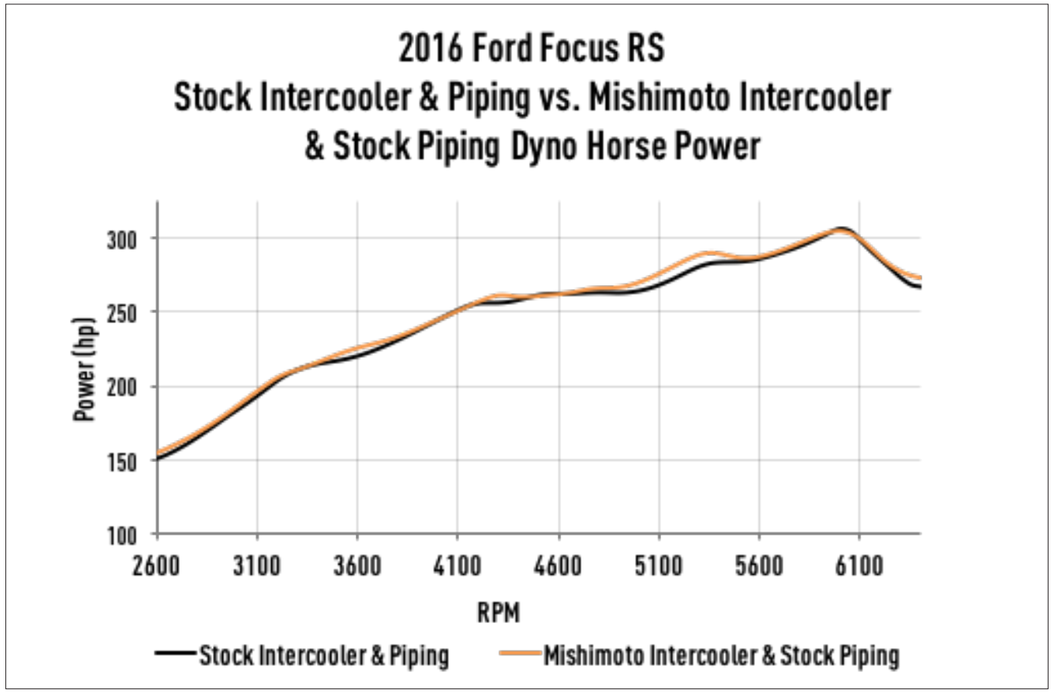

FIGURE 18: *The Mishimoto intercooler caused a max horsepower gain of 7 hp.*

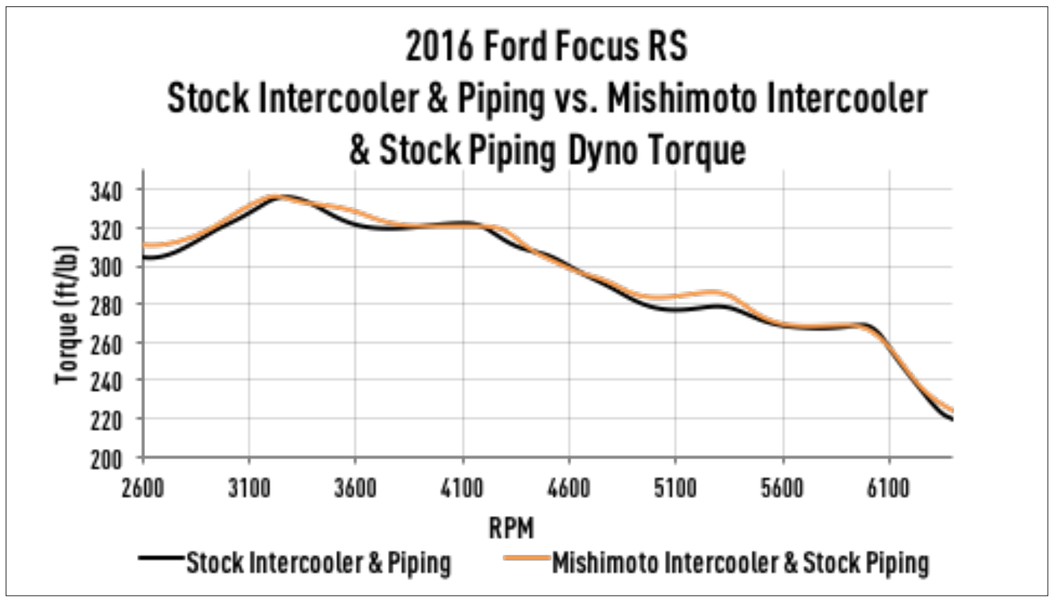

FIGURE 19: *The Mishimoto intercooler caused a max torque gain of 8 ft-lb.*

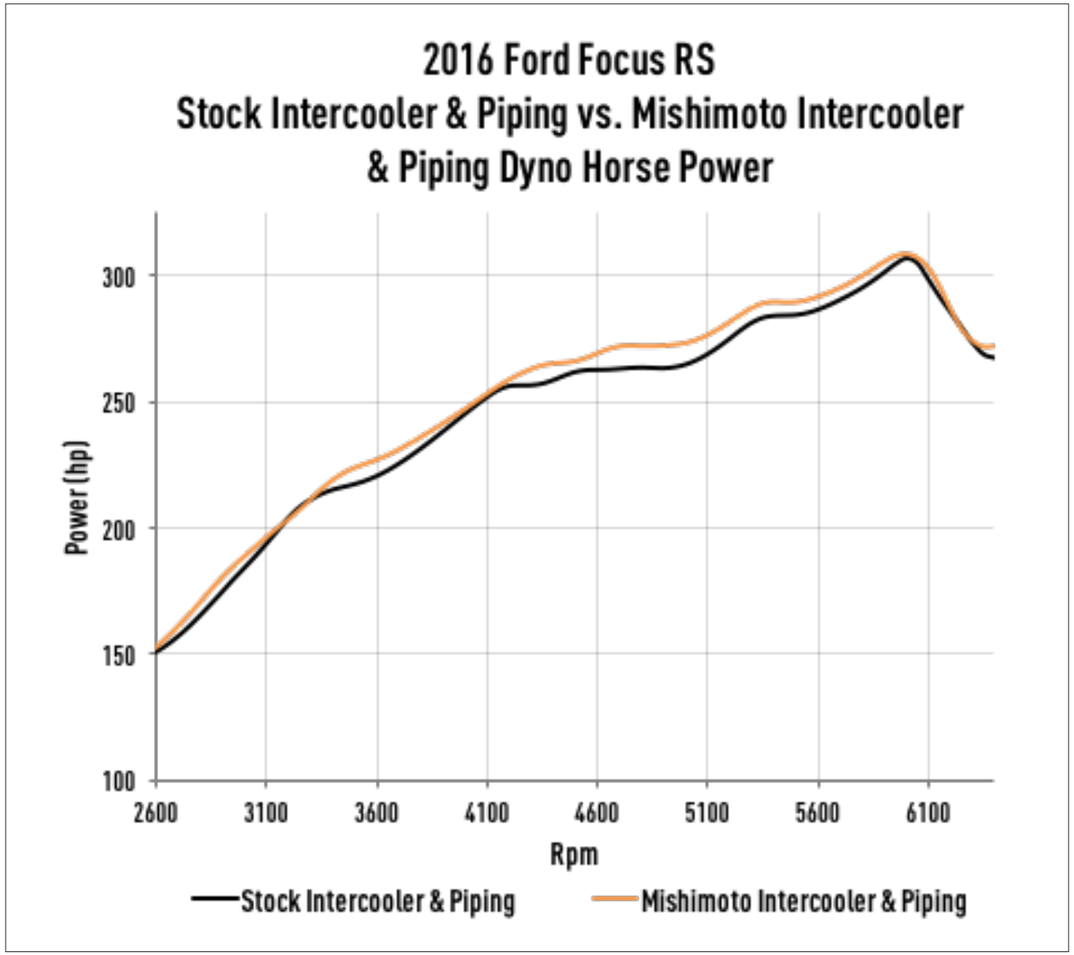

FIGURE 20: *The Mishimoto intercooler and piping caused a max horsepower gain of 9 hp.*

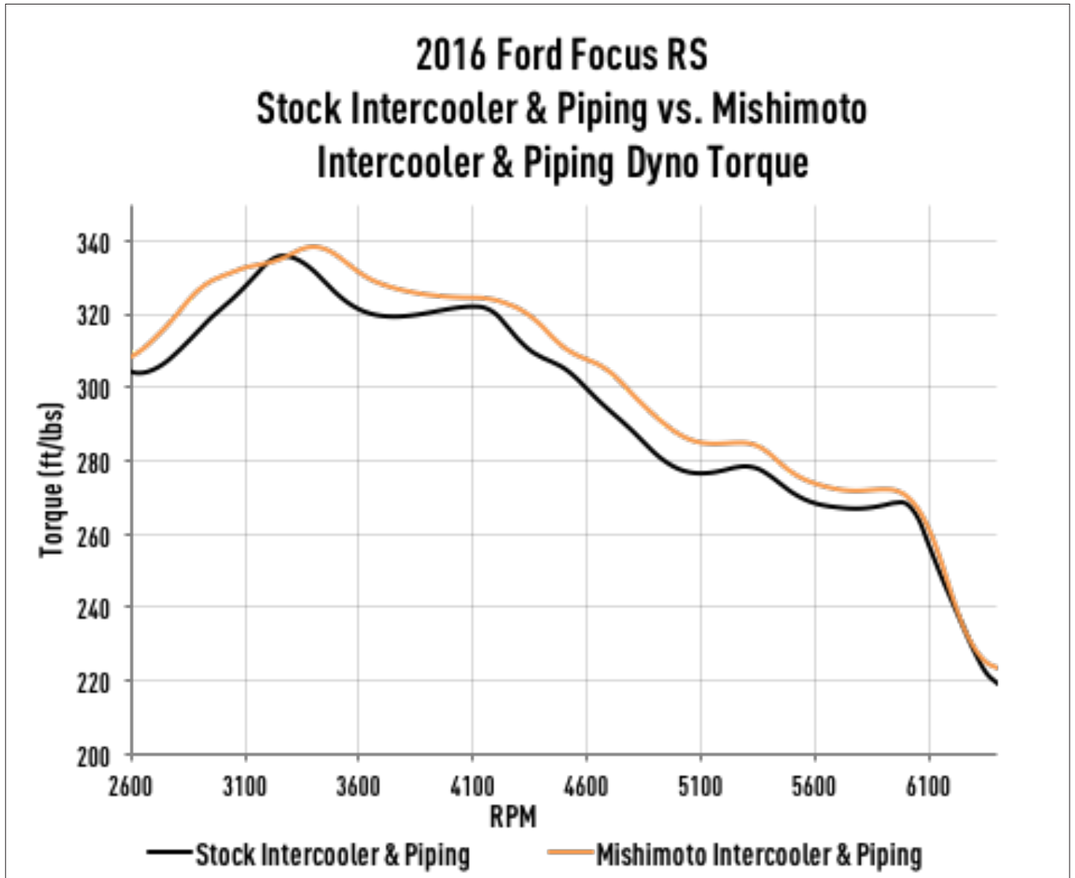

FIGURE 21: *The Mishimoto intercooler and piping caused a max torque gain of 10 ft-lb.*

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 on a completely stock tune.

The Mishimoto intercooler reduced outlet temperatures with a minimal increase in boost pressure drop, resulting in a slight gain in horsepower and torque with the stock tune. If an aftermarket tune is being 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
Product Engineer, Mishimoto Automotive

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