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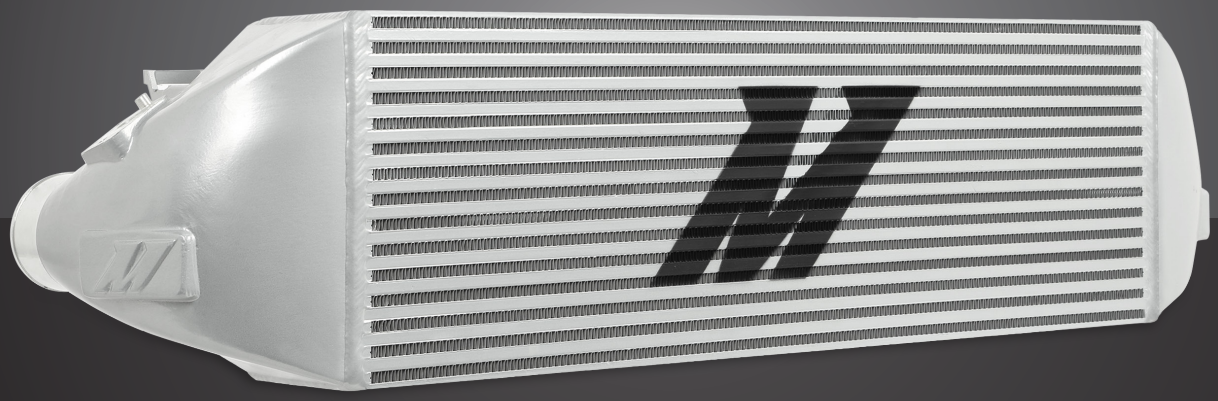

ENGINEERING REPORT

2013+ Ford Focus ST Intercooler | SKU: MMINT-FOST-13

By Steve Wiley, *Mishimoto Engineer*

REPORT AT A GLANCE

- **Goal:** Design a direct-fit intercooler that keeps charge-air temperatures and pressure drop across the core as low as possible.
- **Results:** The Mishimoto intercooler showed temperature drops of up to 34°F (19°C) when compared to the stock intercooler. This reduction was achieved with an overall pressure drop of less than 1 psi.
- **Conclusion:** The Mishimoto direct-fit intercooler is an excellent upgrade for Focus ST owners who want a well-balanced intercooler that will resist heat-soak, preserve power levels, and significantly reduce charge-air temperatures.

CONTENTS

DESIGN OBJECTIVES

The design requirements assigned to this project are as follows:

- Design a performance intercooler that reduces charge-air temperatures when compared to the stock cooler.
- Must be a direct fit with no cutting or permanent modification necessary.
- Intercooler should not show a significant increase in pressure drop when compared to stock.

DESIGN AND FITMENTS

We began the R&D process by evaluating the stock intercooler and finding potential room for improvement. The stock intercooler is relatively thin with a hollow tube-and-fin design. After evaluating the internal construction of the core, it was evident that this unit was likely susceptible to heat-soak. The Mishimoto performance intercooler was designed to increase overall core volume and fin surface area while retaining a direct fitment. The Mishimoto intercooler increases overall core volume by 128% and internal fin surface area by 120% when compared to stock. (See Figures 1 and 2.)

Along with improving overall core construction, end-tank geometry was adjusted to ensure efficient and equally distributed flow throughout the core. CFD analysis was used to simulate air flow and showed that an organicly shaped, swept end tank promoted the most laminar flow and will therefore aid the most in preventing high pressure drops.

More information on the R&D process for the intercooler can be found on the Mishimoto engineering blog

MISHIMOTO ENGINEERING BLOG

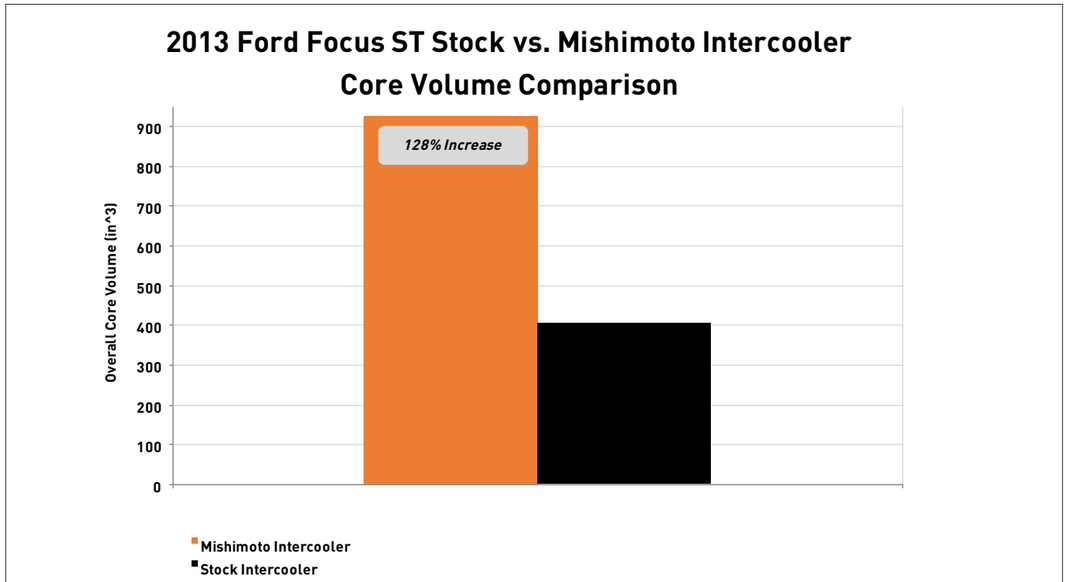

FIGURE 1: *The Mishimoto intercooler increases overall core size by 128% when compared to stock.*

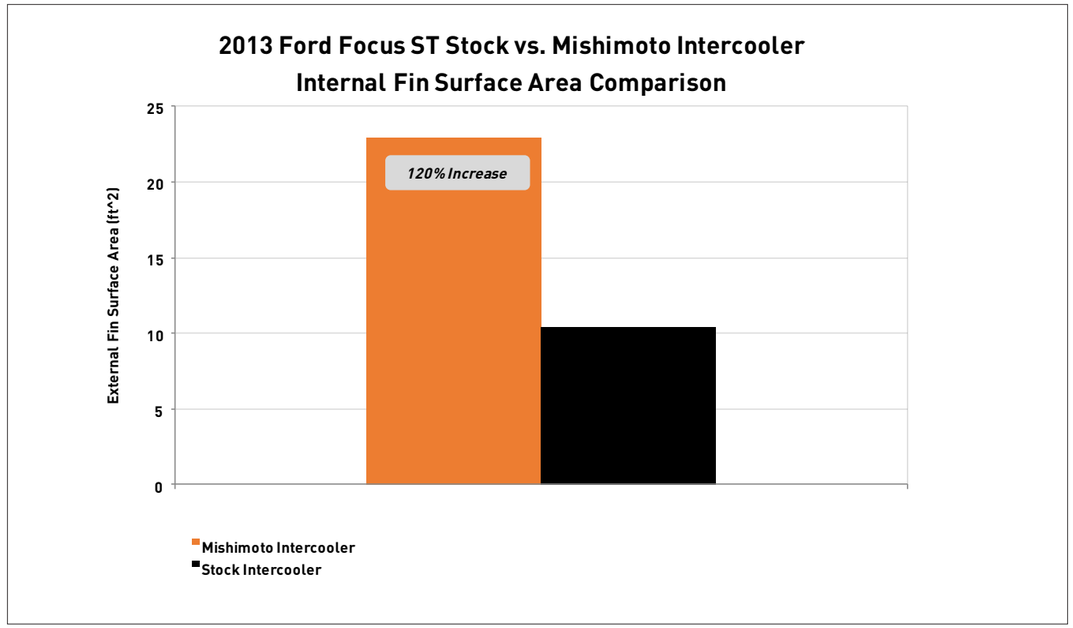

FIGURE 2: *Internal fin surface area is increased by 120% to improve heat rejection capabilities of the intercooler.*

PERFORMANCE TESTING

A 2013 Focus ST with a Mishimoto intake installed and stock tune was used for testing. The ambient temperature on the day of testing was approximately 72°F (22°C) with 58% humidity. To test the performance increases of the intercooler, a Dynapack™ dynamometer was used to apply a constant and repeatable load on the Focus.

To test the performance gains of the Mishimoto intercooler, the Focus was set on the Dynapack, and baseline pulls were made on the stock intercooler. To simulate harsh on-road conditions, five consecutive runs were made at wide-open throttle, up to 6300 rpm, with cooling for one minute between each pull. This test was then repeated on two different Mishimoto intercooler cores. The testing results in Figures 4 and 5 show the outlet temperature and pressure drop comparison of the stock intercooler to the chosen Mishimoto intercooler.

FIGURE 3: *A Dynapack dynamometer was used to apply a repeatable load on the Focus ST during testing.*

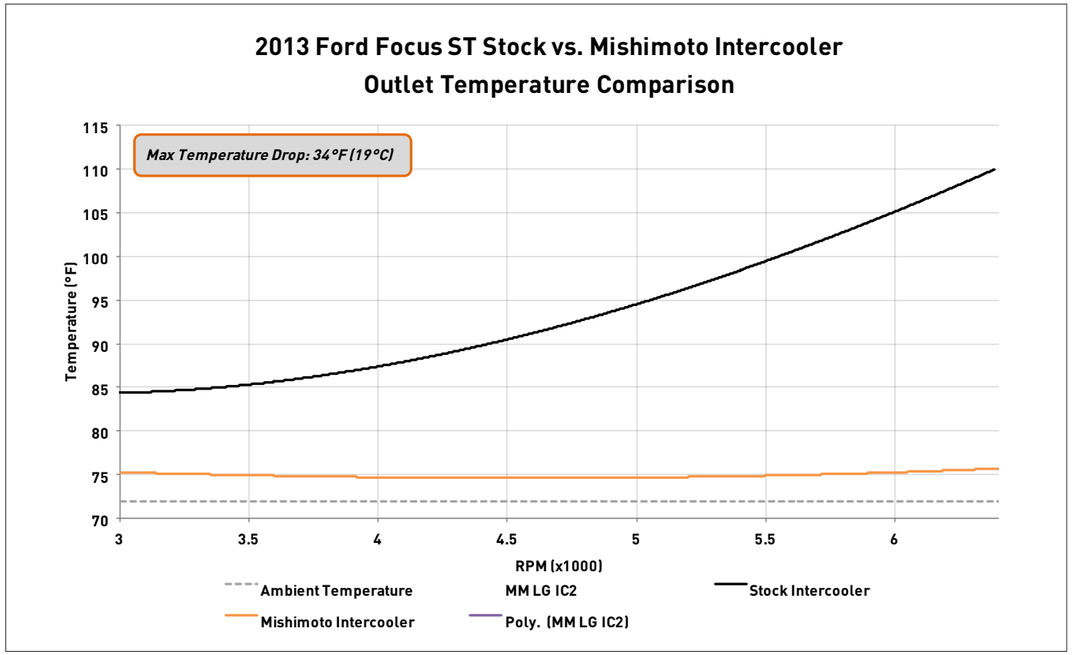

FIGURE 4: *The outlet temperatures of the stock and Mishimoto intercoolers are shown after the fifth consecutive dyno pull. It's clear that the Mishimoto unit is superior at resisting heat-soak.*

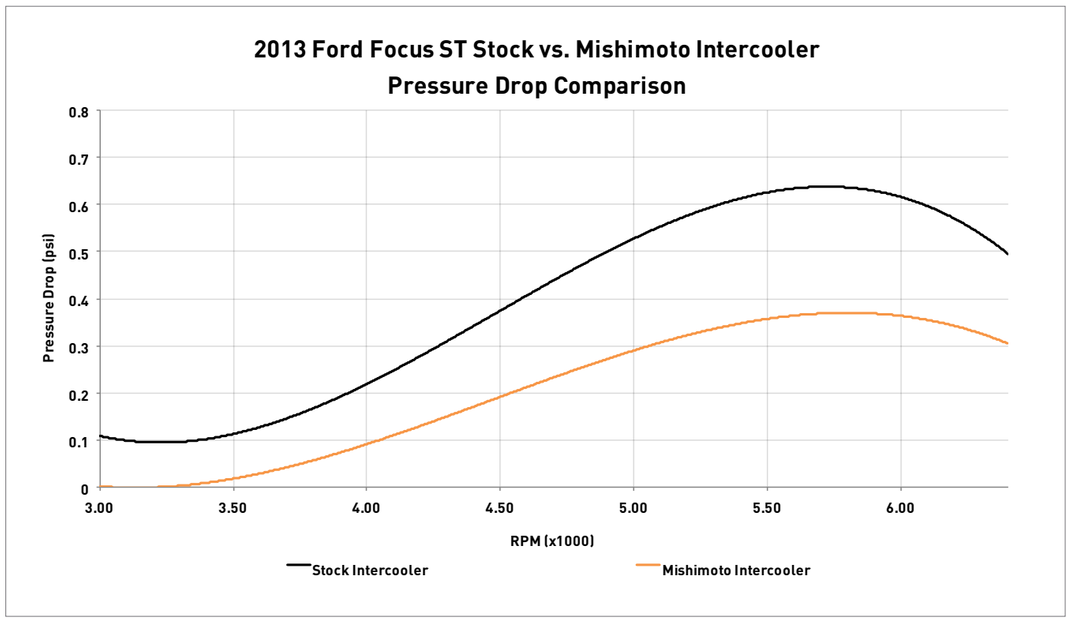

FIGURE 5: *The Mishimoto intercooler showed an overall pressure drop of less than 0.5 psi which is well within the desirable range.*

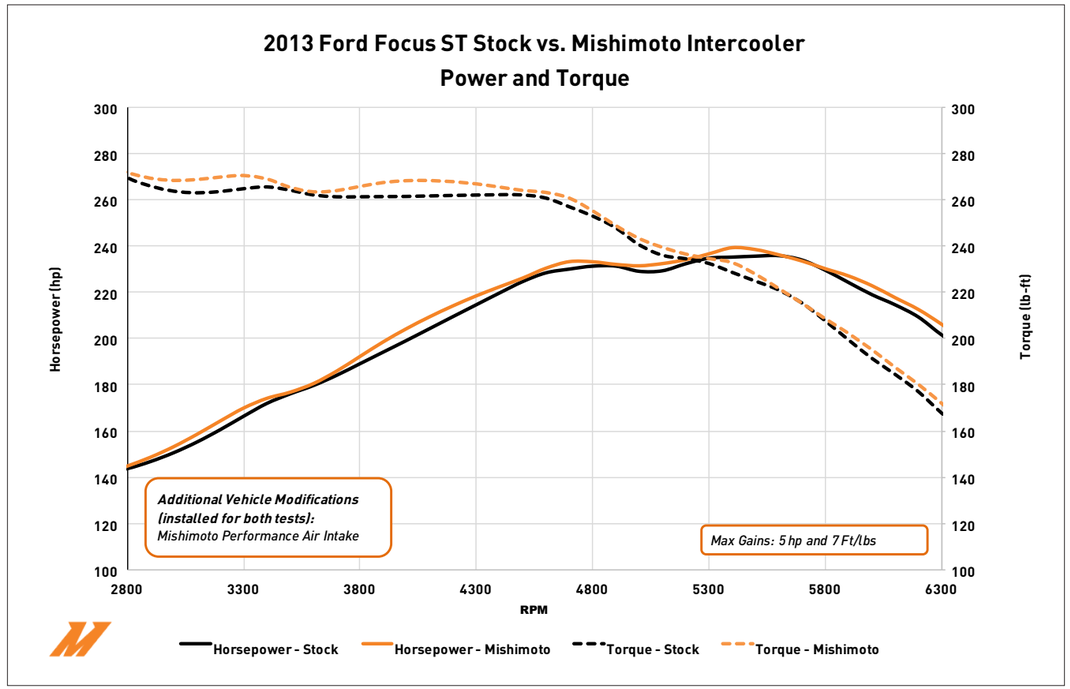

FIGURE 6: *The Mishimoto intercooler showed power gains over stock due to an increase in internal flow volume and lower outlet charge-air temperatures.*

As seen in Figures 4 and 5, the chosen Mishimoto intercooler showed temperature drops of up to 34°F (19°C) compared to the stock intercooler, while showing minimal signs of heat-soak throughout the entire testing process. This was achieved with an overall pressure drop of less than 0.5 psi.

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 if it effectively prevents charge-air temperatures from increasing.

As seen above in Figure 6, the Mishimoto intercooler showed power gains of up to 5 hp and torque gains of up to 7 ft/lb. This is likely due to a combination of lower charge-air temperatures and an increase in internal volume. These gains are shown on a stock tune and can be expected to significantly increase when a more aggressive tune is applied and the boost levels are increased.

The Mishimoto intercooler is an excellent upgrade for all Focus ST owners who are driving in hot climates, have a performance tune loaded, or want power levels to remain consistent under hard driving conditions

Steve Wiley
Product Engineer, Mishimoto Automotive

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ENGINEERING REPORT

2013+ Ford Focus ST Intercooler Pipe Kit | SKU: MMICP-FOST-13K

By Steve Wiley, *Mishimoto Engineer*

REPORT AT A GLANCE

- **Goal:** Design direct-fit intercooler piping that reduces system restriction and improves durability over the stock components.
- **Results:** The Mishimoto intercooler piping showed respectable power gains of up to 8 hp and 10 ft-lb of torque. This increase is likely due to the mandrel-bent aluminum piping's ability to reduce overall system restriction, and its resistance to expansion under full boost.
- **Conclusion:** This piping kit is far more durable than the stock plastic and rubber pieces, and will fit in the Focus ST without any cutting or permanent modification needed. The Mishimoto intercooler pipes help to improve power and flow and increase durability.

CONTENTS

DESIGN OBJECTIVES

The design requirements assigned to this project are as follows:

- Design intercooler piping that improves flow and reduces overall system restriction
- Must be a direct fit with no cutting or permanent modification necessary

DESIGN AND FITMENTS

We began the R&D process by evaluating the stock piping and finding potential room for improvement. The stock hot-side pipe is relatively small until it reaches the intercooler inlet. The Mishimoto hot-side pipe increases internal volume by 14% and is made to reduce bends where possible to improve flow. The same approach was used when designing the cold-side hose. Internal volume was increased by 10% and the hose was made from silicone due to fitment constraints.

More information on the R&D process for the intercooler piping can be found on the Mishimoto engineering blog:

MISHIMOTO ENGINEERING BLOG

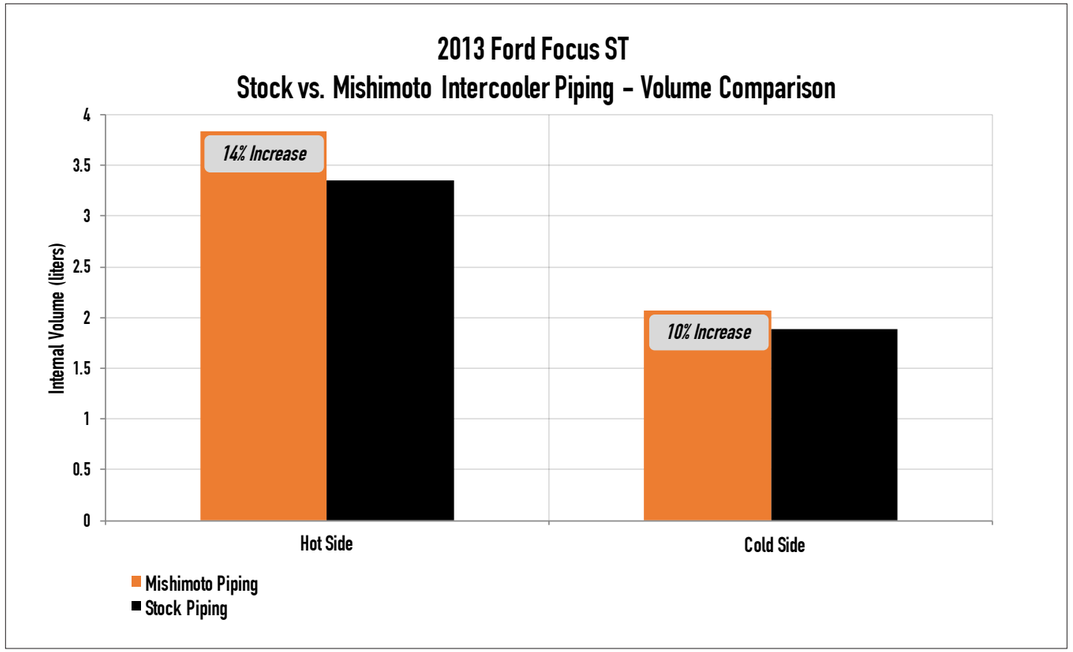

FIGURE 1: *Internal volume increases can be seen on both the cold-side and hot-side pipes when compared to stock.*

PERFORMANCE TESTING

FIGURE 2: *A Dynapack dynamometer was used for vehicle testing.*

A 2013 Focus ST with Mishimoto intake and intercooler was used for testing the stock piping as well as the Mishimoto piping. The ambient temperature on the day of testing was approximately 72°F (22°C) with 65% humidity. To test the performance increases of the intercooler pipes, a Dynapack™ dynamometer was used to record horsepower (HP) and torque (TQ) output of the vehicle.

To test the performance gains of the Mishimoto intercooler piping, the Focus ST was bolted to the Dynapack, and baseline pulls were made on the car. The same test was performed with both the Mishimoto hot-side and cold-side pipes installed. The average dyno plot was chosen and plotted against the average baseline pull. These results are shown in Figure 3 below.

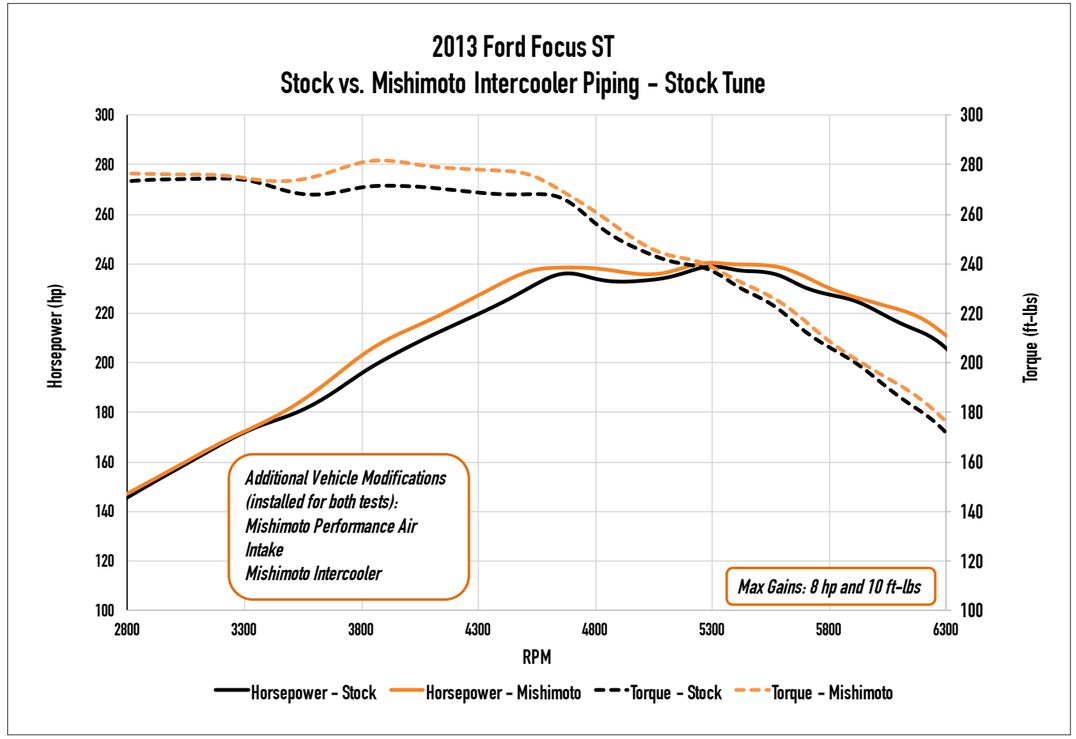

FIGURE 3: *The Mishimoto intercooler piping showed power and torque gains when compared to the stock piping.*

The Mishimoto intercooler piping created power over stock throughout the entire power band.

Due to less overall restriction in the system and a more free-flowing design, the Mishimoto intercooler piping made max gains of 8 hp and 10 ft-lb of torque.

Because the Mishimoto intercooler piping kit is made from mandrel-bent aluminum and wire-reinforced 5-ply silicone, it better resists expansion under high boost pressures when compared to the stock rubber hose portions.

A flow bench was also used to determine the increase in flow provided by the Mishimoto intercooler piping. The flow bench can measure pressure drop at a specified flow and can therefore show a relative change from the stock to Mishimoto intercooler piping design. The cold-side comparison showed that the Mishimoto design outflows the stock hose by 40%. The hot-side piping showed a flow increase of up to 26%, which is likely due to the increased volume and smoother bend angles. The results for flow testing can be seen below in Figures 4 and 5.

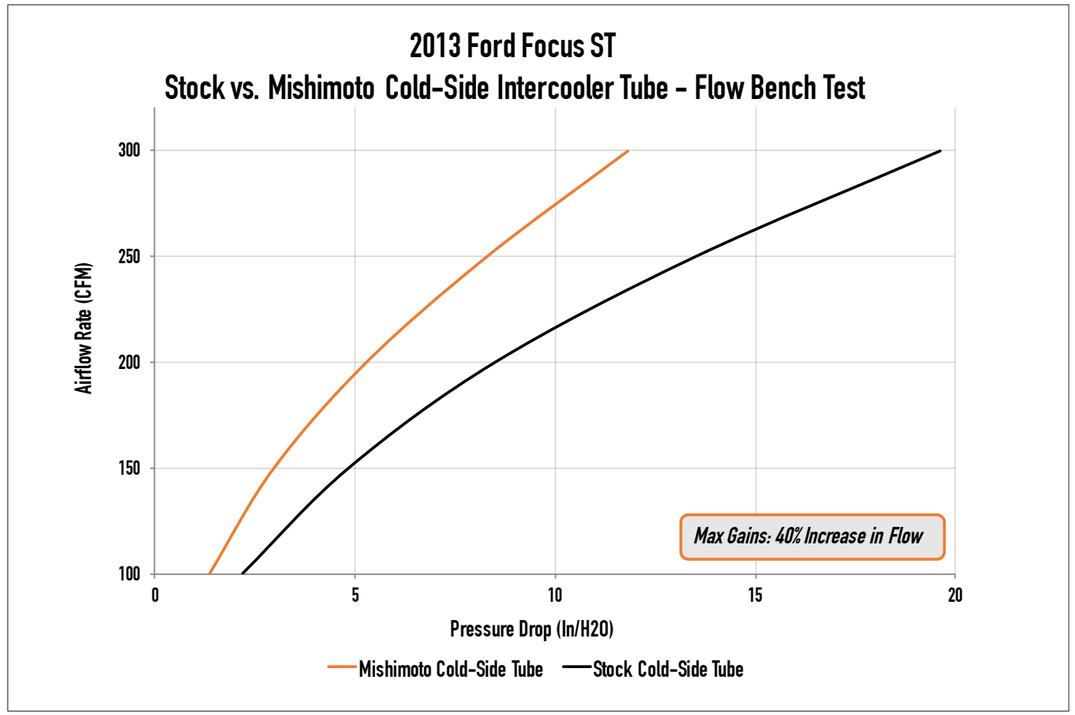

FIGURE 4: *The Mishimoto cold-side hose flows up to 40% better than the stock design.*

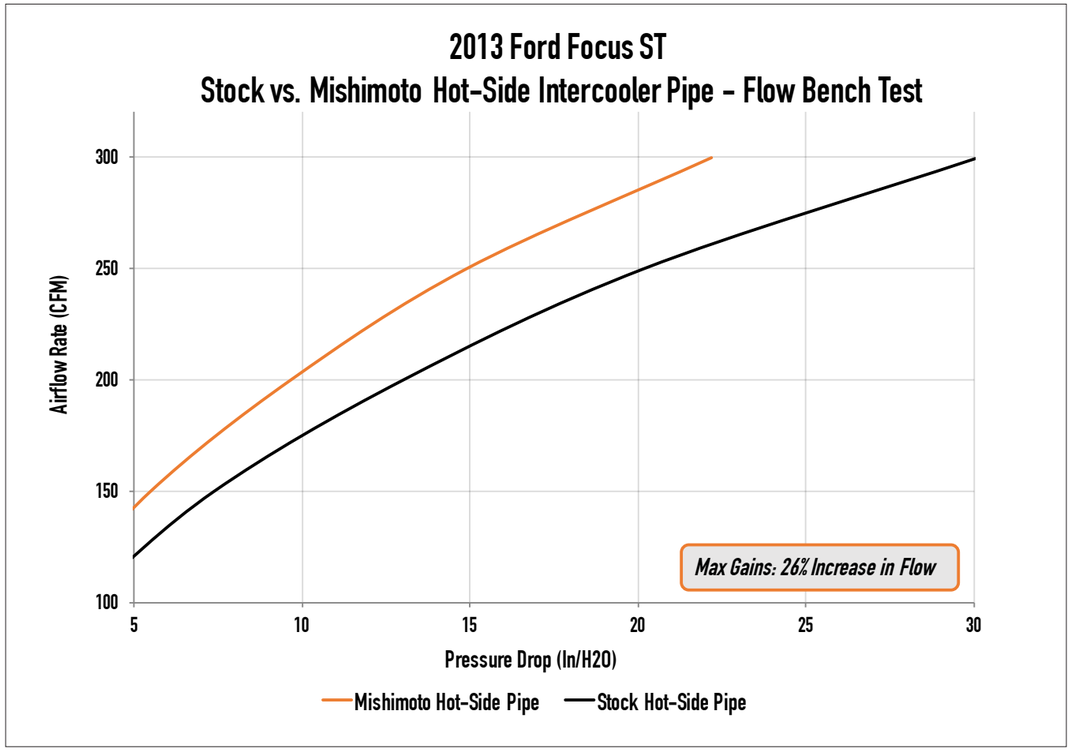

FIGURE 5: *The Mishimoto hot-side piping reduces overall restriction by up to 26% when compared to stock.*

The Mishimoto intercooler piping reduces pressure drop, which translates to reduced restriction. This reduced restriction allows the engine to breathe better as it requires less effort to move the air from the turbo to the throttle body.

Steve Wiley
Product Engineer, Mishimoto Automotive

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