MISHIMOTO

ENGINEERING REPORT

2011–2014 Ford F-150 EcoBoost Intercooler | SKU: MMINT-F150-11

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 50°F (28°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 F-150 EcoBoost™ 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
- Must work with models that both feature and exclude a stock bypass valve

DESIGN AND FITMENTS

We began the R&D process by evaluating the stock intercooler and finding potential room for improvement. The stock intercooler is a relatively 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 internal core volume by 66% and external fin surface area by 40% when compared to stock.

Proper airflow through the core is critical in the design of any convection-based heat exchanger. The cooling fluid (ambient air) must pass over the external fins and draw heat from the charge air inside of the intercooler. To ensure that the ambient air is passing through the core and not around it, shrouding is often used to guide the airflow. The F-150 has a rather large grille opening that allows air to flow through all of its heat exchangers. The Mishimoto intercooler features shrouding that ensures a large portion of this cool, ambient air makes its way through the core and effectively cools the charge air before entering the engine. The shrouding can be seen below in Figure 1.

FIGURE 1: *The Mishimoto intercooler features shrouding to direct ambient airflow through the core for maximum temperature reduction.*

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

MISHIMOTO ENGINEERING BLOG

PERFORMANCE TESTING

A completely stock 2013 F-150 was used for testing. The ambient temperature on the day of testing was approximately 75°F (24°C) with 50% humidity. A Dynojet™ dynamometer was used to apply a constant and repeatable load on the F-150.

To test the performance gains of the Mishimoto intercooler, the F-150 was strapped to the Dynojet, and baseline pulls were made on the completely stock truck. To simulate harsh on-road conditions, the truck was run at wide open throttle up to 6200 RPM for consecutive runs and was cooled for one minute in between each pull. This test was repeated for two different Mishimoto intercooler cores. Once testing was completed on a stock tune, a performance tune was loaded onto the F-150. This performance tune increased power and boost pressures, which in turn generated significantly more heat when compared to the stock tune. The same test was performed again on all three intercoolers (stock and two Mishimoto cores). Outlet charge-air temperatures and pressure drop across the core from the fifth pull of each test are shown below in Figures 3-5.

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

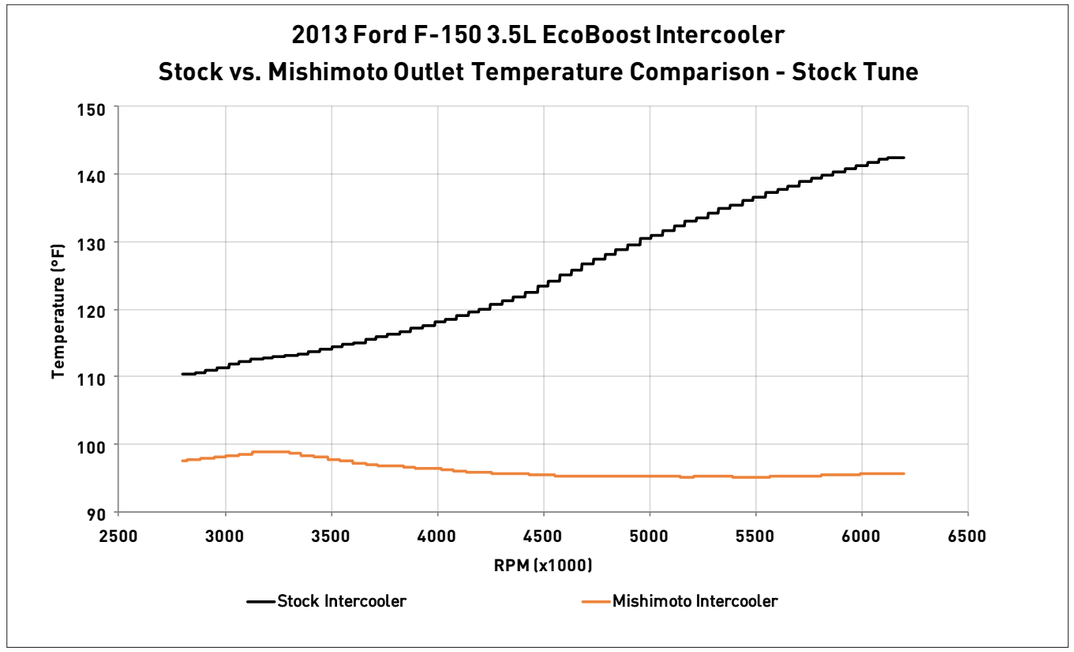

FIGURE 3: *Outlet temperatures for each core are compared on the stock tune and after the fifth dyno run of each test.*

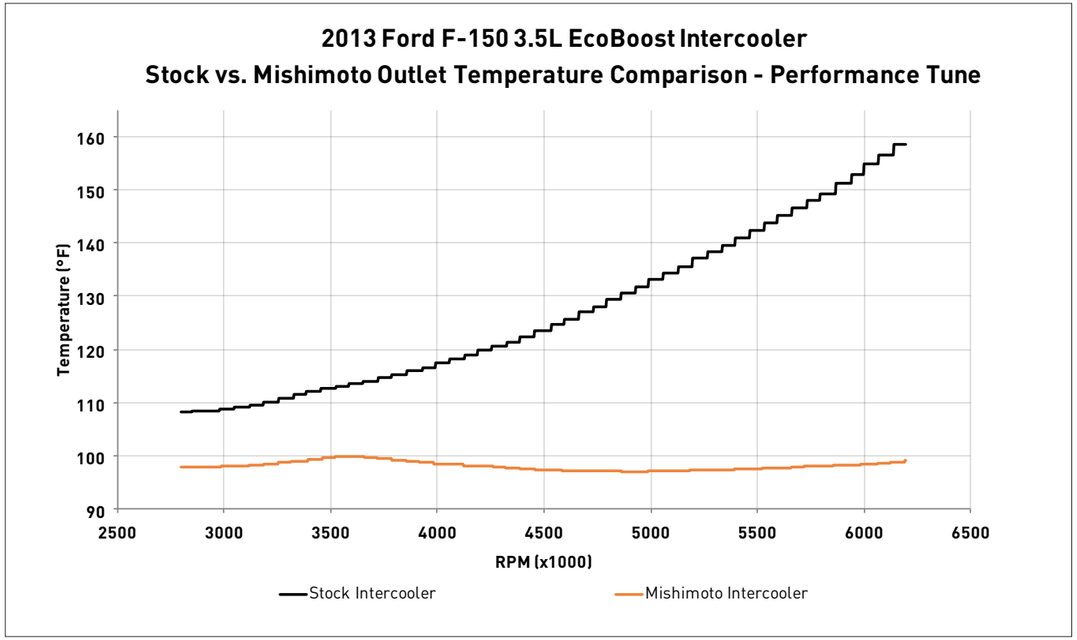

FIGURE 4: *Outlet temperatures for each core are compared on a performance tune after the fifth dyno pull. The performance tune increased boost pressure and heat generation.*

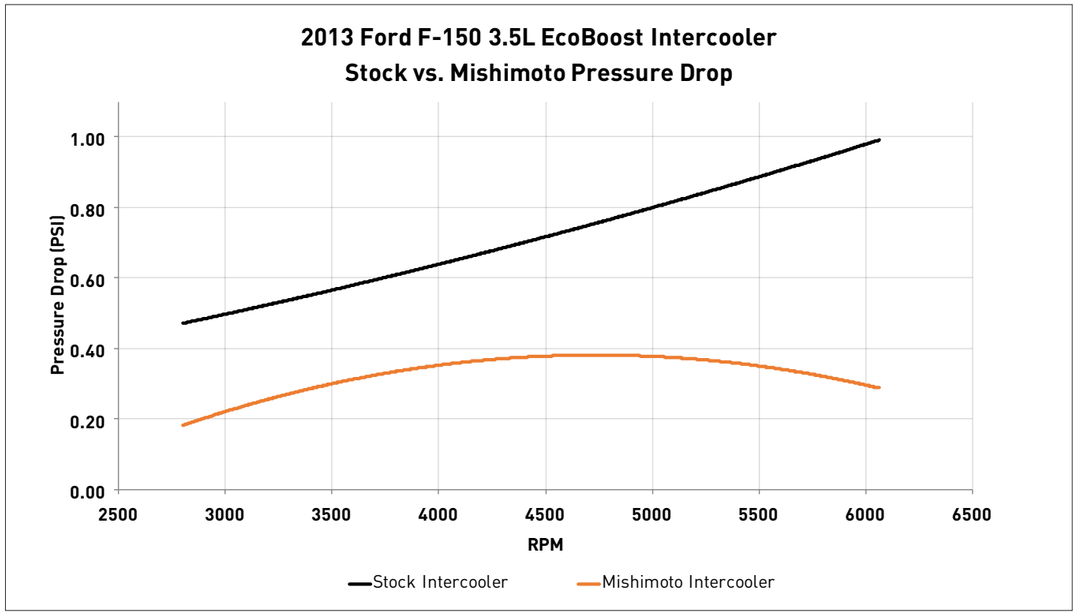

FIGURE 5: *The Mishimoto intercooler showed slightly less pressure drop across the core when compared to stock. These are desirable results for a performance intercooler.*

The chosen Mishimoto intercooler showed temperature drops of up to 50°F (28°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 1 psi.

These are excellent results for a direct-fit intercooler.

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. Testing on the F-150 showed this to be true as power began to noticeably decline with the stock intercooler installed. This is shown in Figures 6 & 7 below.

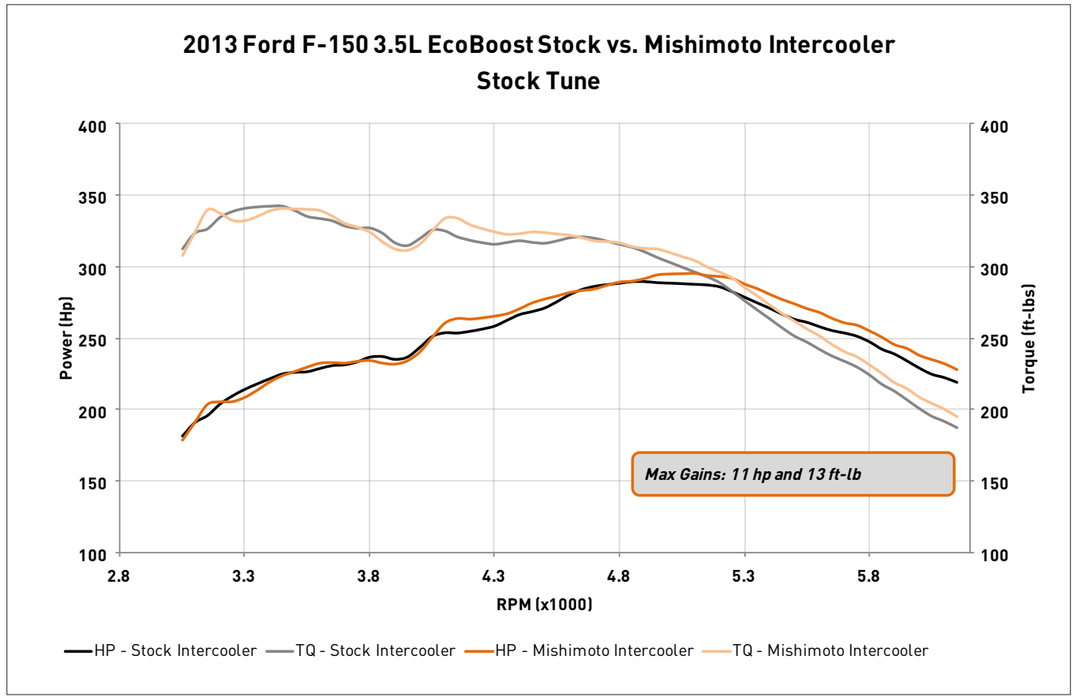

FIGURE 6: *Power and torque were reduced as the stock intercooler heat-soaked and charge-air temperatures climbed. The Mishimoto intercooler showed consistent power curves throughout all five pulls.*

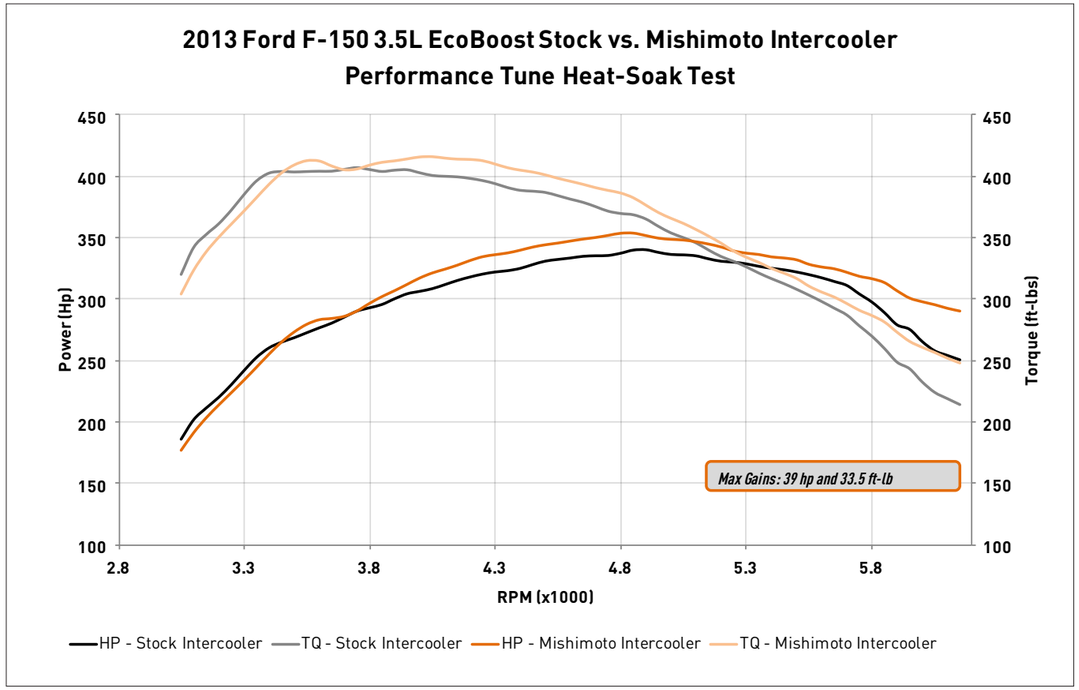

FIGURE 7: *The stock intercooler could not provide the required heat rejection of the performance tune, and therefore power and torque declined significantly by the fifth pull.*

It's important to remember that the dyno results shown compare the fifth pull of the stock and chosen Mishimoto intercooler. On the first pull of each test, power and torque levels showed similar results. Power levels began to steadily decline with the stock intercooler installed, as it could no longer keep up with the required heat rejection. The Mishimoto intercooler held outlet temperatures and power levels at a steady rate even under harsh heat-soak testing. This is an excellent upgrade for 2011–2014 F-150 3.5L EcoBoost owners who drive in hot climates, have a performance tune loaded, tow heavy loads, or want power levels to remain consistent under hard driving conditions.

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