ENGINEERING REPORT

2012–2016 BMW F22/F30 Performance Intercooler | SKU: MMINT-F30-12

By Jason Wettig, *Mishimoto Product 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 45°F (7.22°C) when compared to the stock intercooler. A gain in 10 hp and 8 ft-lb of torque over the stock core was also achieved. This reduction was accomplished with an overall pressure drop of less than 2 psi.
- **Conclusion:** The Mishimoto direct-fit intercooler is an excellent upgrade for BMW owners who want a well-balanced intercooler in terms of performance and fitment.

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DESIGN OBJECTIVES

The design requirements assigned to this project are as follows:

- Design an intercooler that reduces charge-air temperatures when compared to the stock cooler.
- Must be able to adapt to the stock intercooler piping.
- 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 intercooler and finding potential room for improvement. The stock intercooler is a relatively hollow tube-and-fin design. It mounts low on the front bumper and does not protrude to the top grille. The stock cooler sits below the radiator and does not block the cooling stack. We wanted to increase the height with a stepped core but didn't want to negatively impact the cooling system on the car. Adding a slight forward angle to the intercooler allowed for better mixing of clean cool air entering the radiator from the top grille and warmer air leaving the top of the intercooler. After evaluating the internal construction of the core, it was evident that this unit was susceptible to heat-soak. The Mishimoto Performance Intercooler was designed to increase overall core volume and fin surface area while retaining a direct fitment. As shown in Figures 1 and 2, the Mishimoto intercooler increases core volume by 96% and fin surface area by 130% when compared to stock.

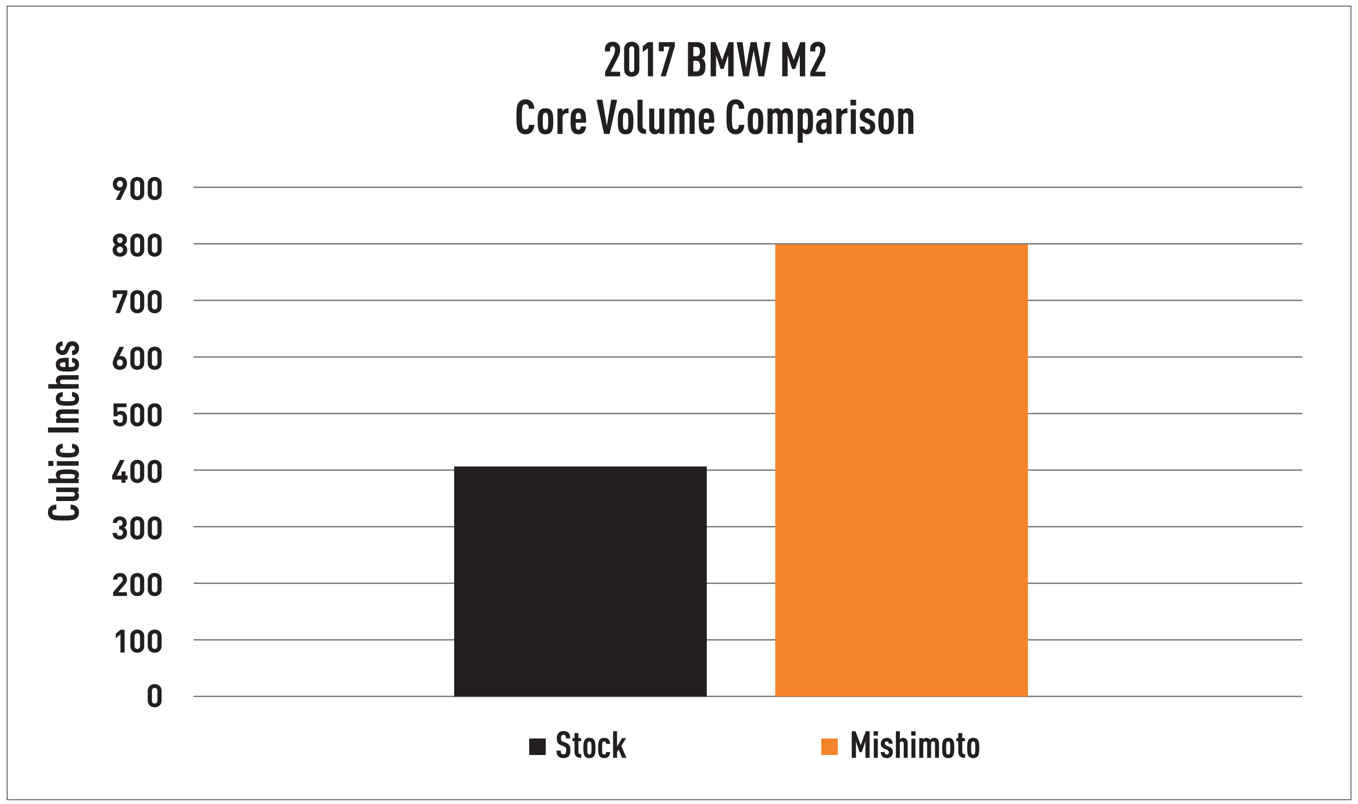

FIGURE 1: *The Mishimoto intercooler core is 96% larger than stock while maintaining a factory fit.*

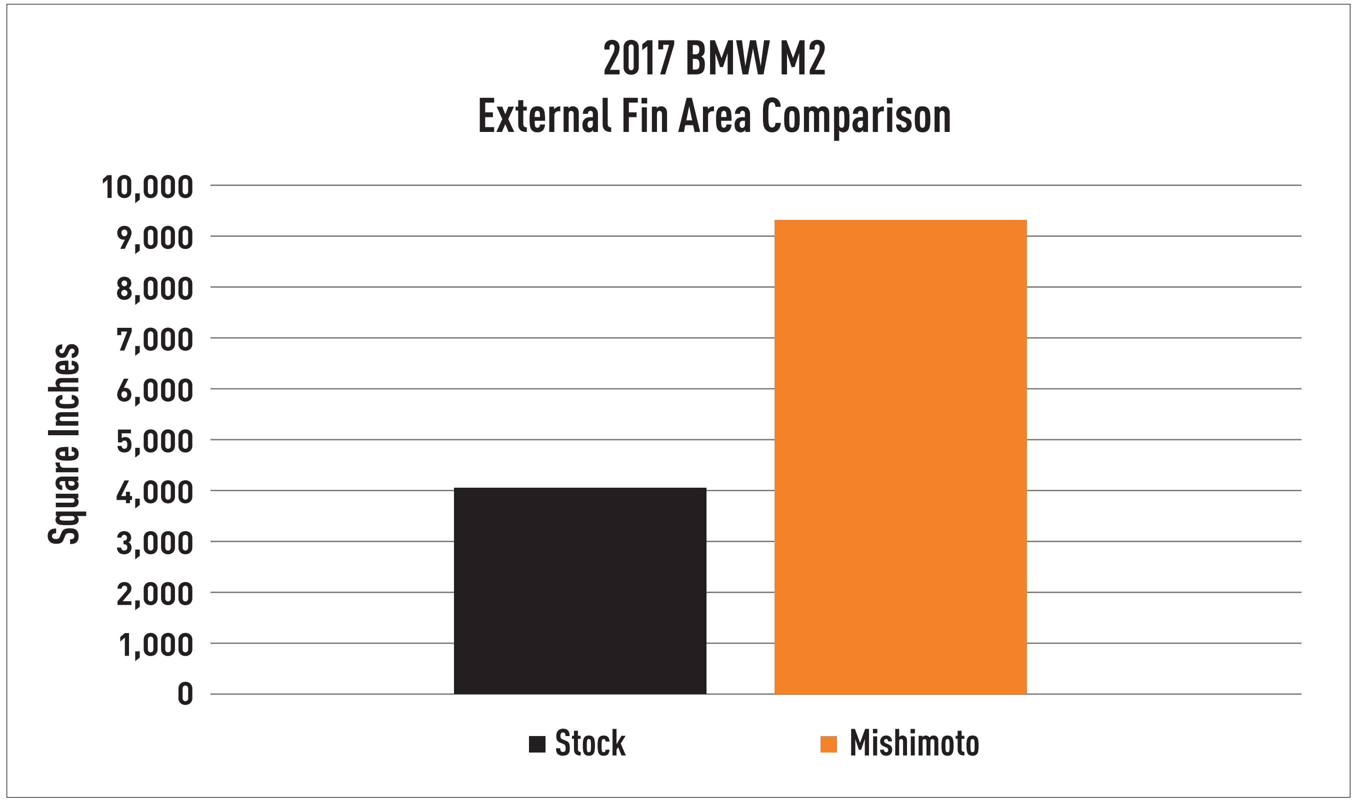

FIGURE 2: *By reducing fin height and pitch, the surface area was increased by 130% compared to the stock core.*

The BMW M2 is used for many purposes, including: road use, daily driving, and racing. We wanted to offer an intercooler that would be the best under all conditions. To achieve that, three cores would be specked out and tested. All the cores were bar-and-plate construction. Bar-and-plate provides increased strength, allowing the intercooler to live up to the extreme demands of these performance machines.

PERFORMANCE TESTING

A BMW M2 with an exhaust and intake was used for testing. The ambient temperature on the day of testing was approximately 72°F (22.2°C) with 50% humidity. To test the performance increases of the intercooler and heat-soak, a Dynojet™ dynamometer was used to apply a constant and repeatable load on the M2.

The BMW M2 was loaded onto the Dynojet and baseline pulls were made of the stock intercooler setup. These single pulls, while generating heat, did not demonstrate how an intercooler can heat-soak over time. A new test was designed to heat-soak the intercooler. With the car on the dyno, four consecutive dyno pulls were performed in 5rd gear with a 40 second wait inbetween each run. This allowed the intercooler to heat-soak. This more closely an simulated real world conditions.

From testing, it was clear that the Mishimoto intercooler outperformed the stock intercooler in terms of temperature drop and resistance to heat-soak. The Mishimoto intercooler was able to handle the heat much better than the stock intercooler while keeping the pressure drop below 2 psi. Outlet temperatures were much more constant and very close to the ambient temperature with only a slight rise during a run for the heat-soak test. A gain of 10 hp and 8 ft-lb torque were seen. The results for temperature drops and power numbers from testing on a stock tune can be seen in Figures 4–6.

FIGURE 3: *A Dynojet™ dynamometer was used for vehicle testing.*

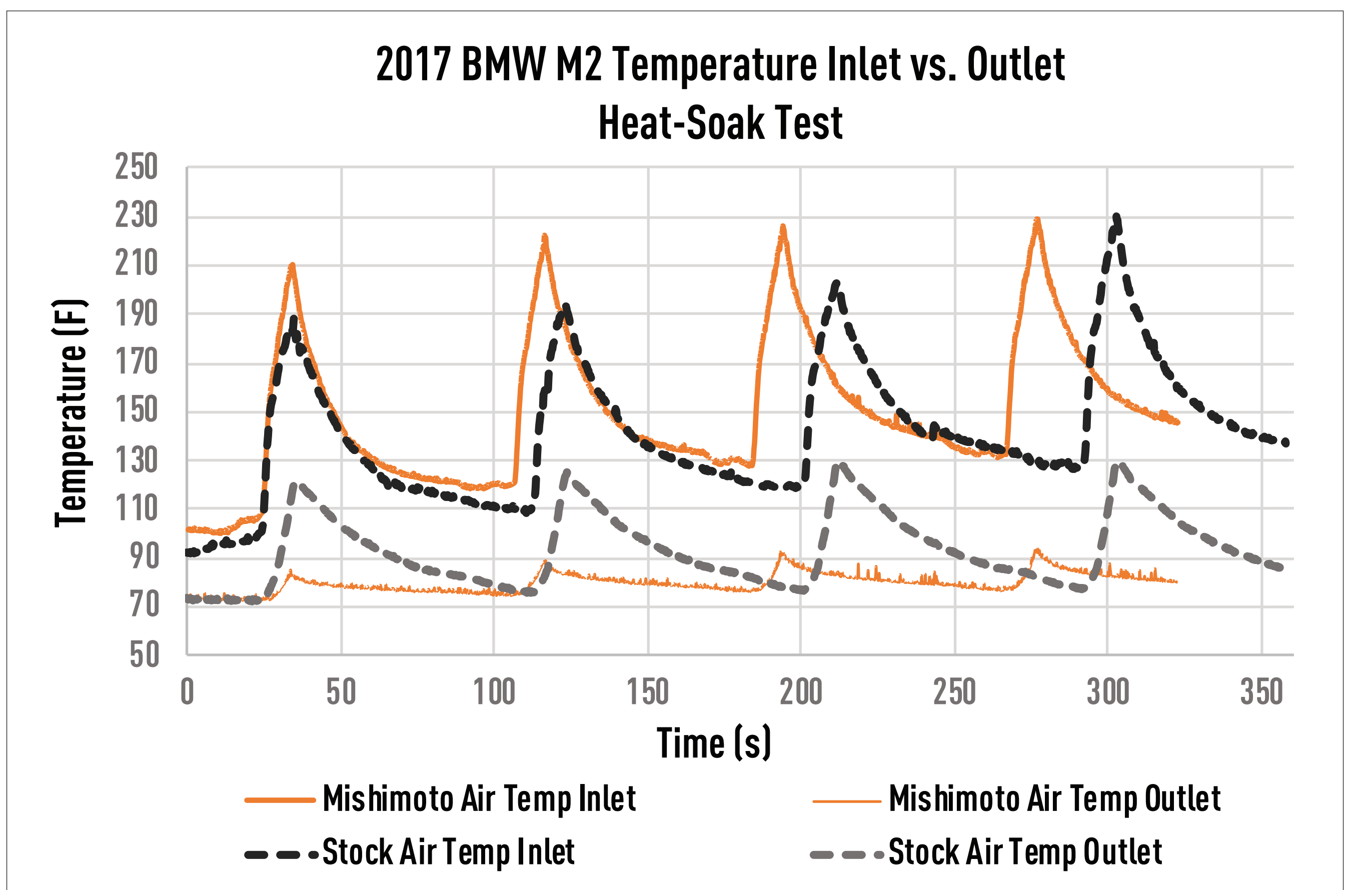

FIGURE 4: *The chosen Mishimoto Intercooler vs the stock intercooler. Notice how the stock outlet rises quite high during the dyno pull while the Mishimoto Intercooler does not.*

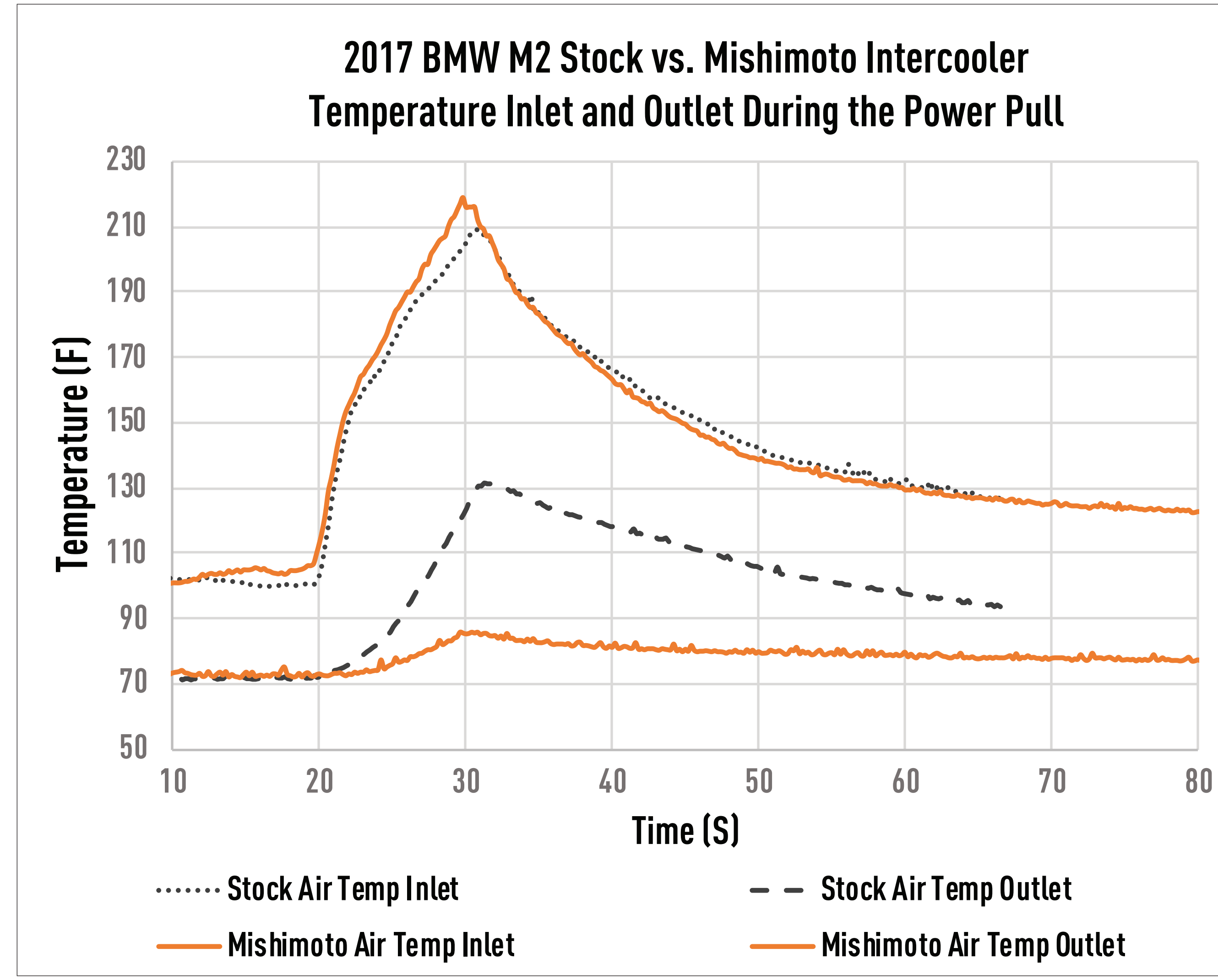

FIGURE 5: *Mishimoto Intercooler temperature drop across the intercooler during a dyno pull. At the peak of the run there is a 45°F difference.*

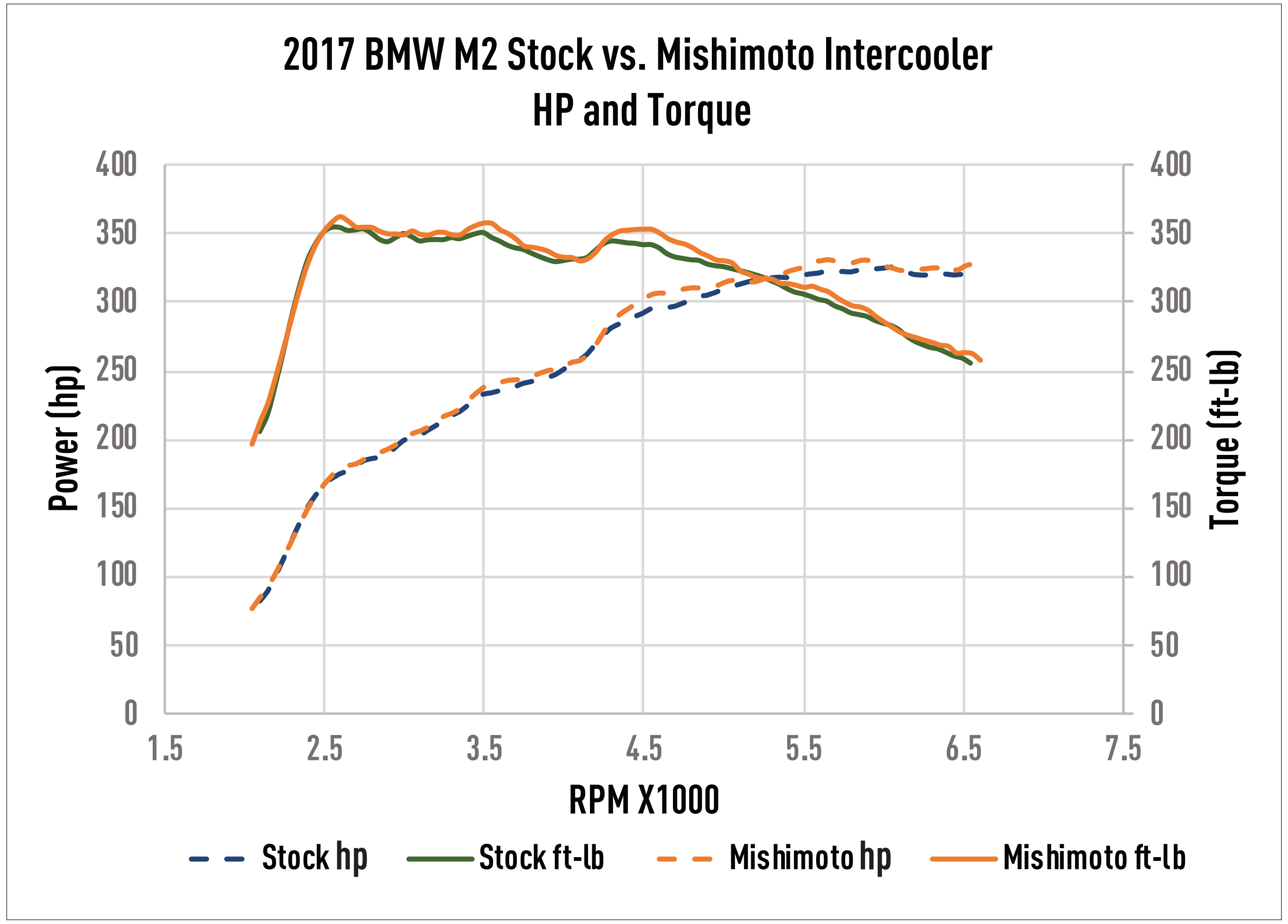

FIGURE 6: *Stock intercooler vs. Mishimoto Intercooler power pull. The lower charge-air temperatures helped to achieve more power and torque over the entire dyno run.*

Power levels did increase with this introduction of the intercooler. An intercooler's primary function is to keep charge-air temperatures low, thus allowing for an increase in the amount of dense air that enters the vehicle. The lower charge-air temperature allows the ECU to adjust parameters that lead to the engine running more efficiently. This efficiency is the reason for the increase in power over the stock intercooler.

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