ENGINEERING REPORT

2015–2020 BMW F8X Intercooler, Heat Exchanger, and Charge Pipes
SKUS: MMINT-F80-15, MMHE-F80-15, MMICP-F80-15H

By Jason Wettig, *Mishimoto Product Engineer*

REPORT AT A GLANCE

- **Goal:** Create an intercooler, heat exchanger, and intercooler pipes that outperform the stock units. The Mishimoto parts should fit directly into the BMW without any cutting or modification required.

- **Results:** The Mishimoto components installed together showed a peak horsepower gain of 31 hp and a peak torque gain of 10 lb-ft. The Mishimoto system also outperformed the stock system in both horsepower and torque over the entire run. On the 6th and final heat soak run, peak horsepower was up by 11 hp and peak torque was up by 8 lb-ft. On the flow bench, the intercooler showed a 16% increase in flow and a 29% increase in core volume. On the continuous load test the intake manifold temperature was 12°F lower than stock. The intercooler pipes flowed 1.13% better than stock.

- **Conclusion:** The Mishimoto components flow better and cool better, which offer improved power in all conditions. It is a valuable upgrade for BMW owners who drive their vehicles on tracks or in hot climates.

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DESIGN OBJECTIVES

The design requirements assigned to this project are as follows:

- Create an intercooler, heat exchanger, and intercooler pipe kit that increases horsepower and torque while reducing internal flow.
- Must be a direct fit, with no cutting or permanent modification necessary.

DESIGN AND FITMENT

The R&D process began by evaluating the stock system and understanding how the team at BMW chose to package the intercooler. We needed to understand the layout and available space before the core could be increased in size. A good understanding of how the stock system works was also required. A spare core was purchased so we could cut into it and see the internal coolant fins. At this point we decided to try a dual pass and a single pass like the stock system in reference to the coolant side of the air-to-water intercooler. The reason for the two types of cores is simple. With a dual pass there are two chances for the coolant to exchange heat with the hot air. However, the down side to a dual pass system is a larger pressure drop in the coolant. Also, due to the way the intercooler was packaged and the orientation of the fins, a dual pass allows for less fin surface area in the air channels. We tested to see how large of a role this played on heat transfer and power. In the end, we decided not to go with the dual pass and stick with the stock configuration.

The heat exchanger was designed to maximize size and fit between the cross brace and the radiator. For this, a 42mm thick core was used. The DCT cooler sits behind the lengthened Mishimoto Heat Exchanger. To help promote airflow to the DCT cooler, a looser fin pitch and taller fin height was used on the lower portion of this heat exchanger. A stone guard was added to improve protection for the tubes on the heat exchanger.

The intercooler pipes route through some tricky and tight geometry. The airbox and engine cover both come extremely close to the pipes themselves. In order to provide clearance, a cast section was created on the front intercooler pipe. The cross-sectional area remains constant throughout the bend of the pipe to ensure no pressure restriction is created.

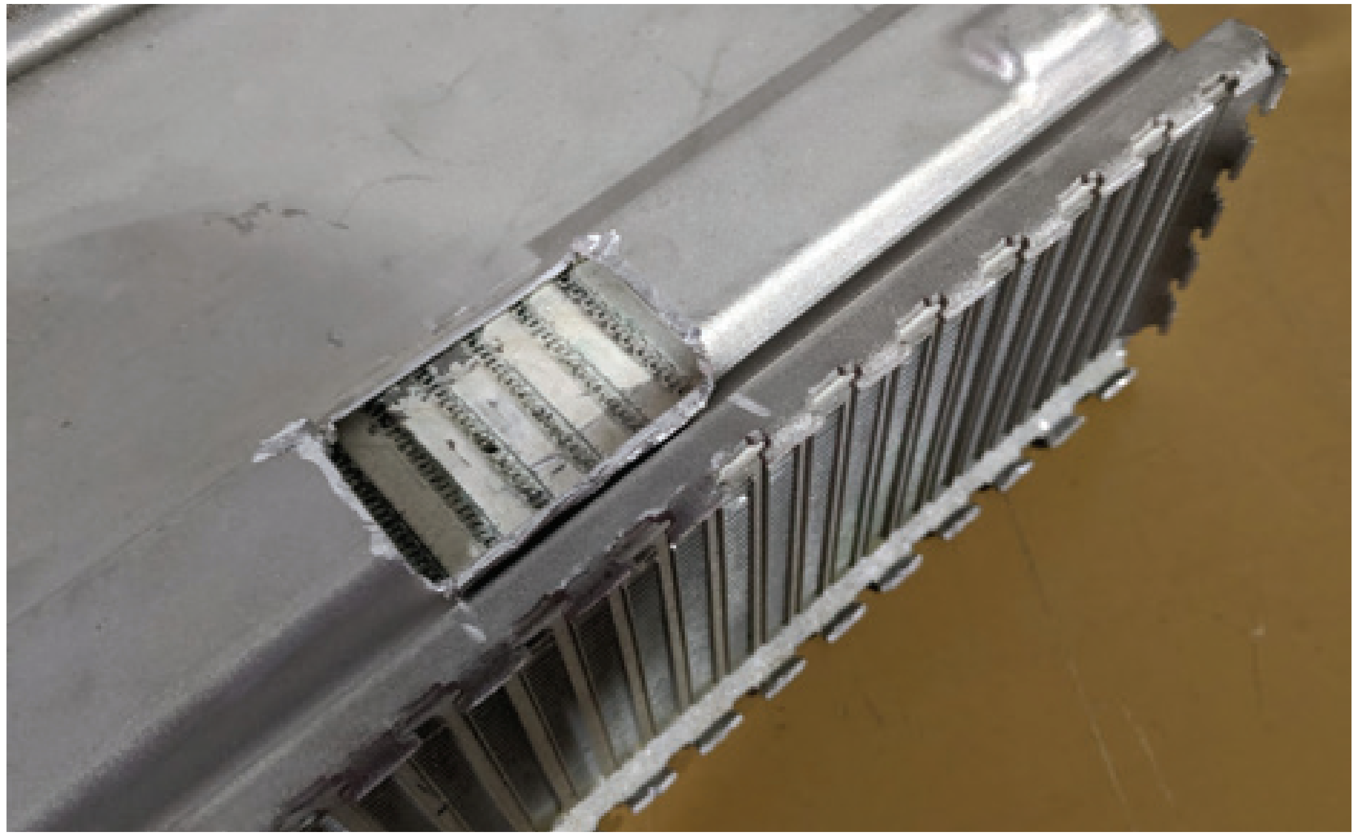

FIGURE 1: *The stock intercooler's internal coolant fins and the orientation of the air passages.*

The Mishimoto BMW F80 intercooler is increased in size over stock. The intercooler is both thicker and longer. Due to the difference in size, there is more potential for heat transfer. The larger core also allows for less pressure drop through the internal fins. The flow bench showed an increase of 16%. Figure 2 below shows the flow bench results between the stock and Mishimoto intercoolers.

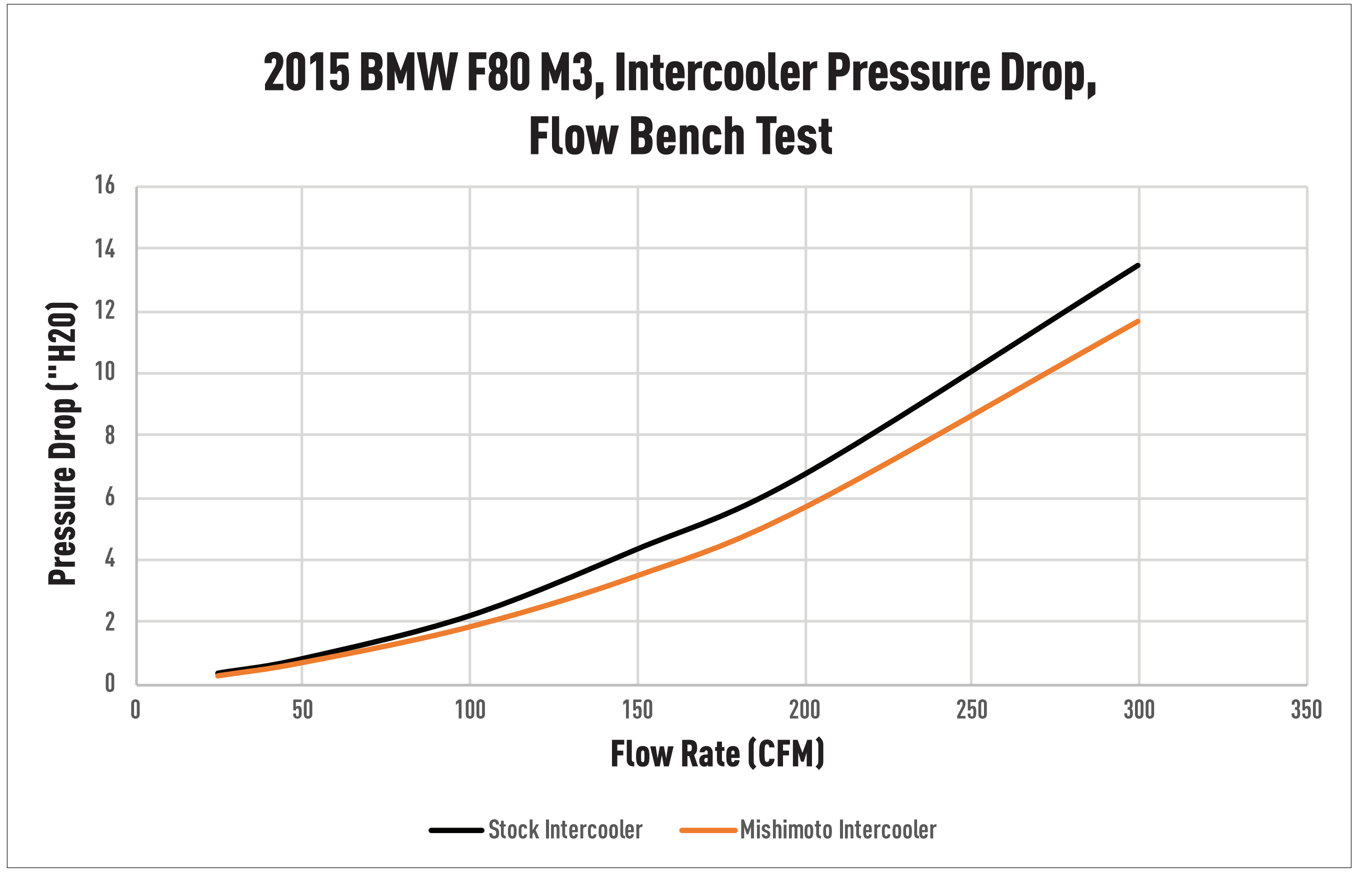

FIGURE 2: *The Mishimoto intercooler has a larger volume and more optimally designed internal fins to promote better heat transfer and lower pressure drop.*

The Mishimoto intercooler also saw a core volume increase of 29% when compared to stock. Figure 2 shows this comparison.

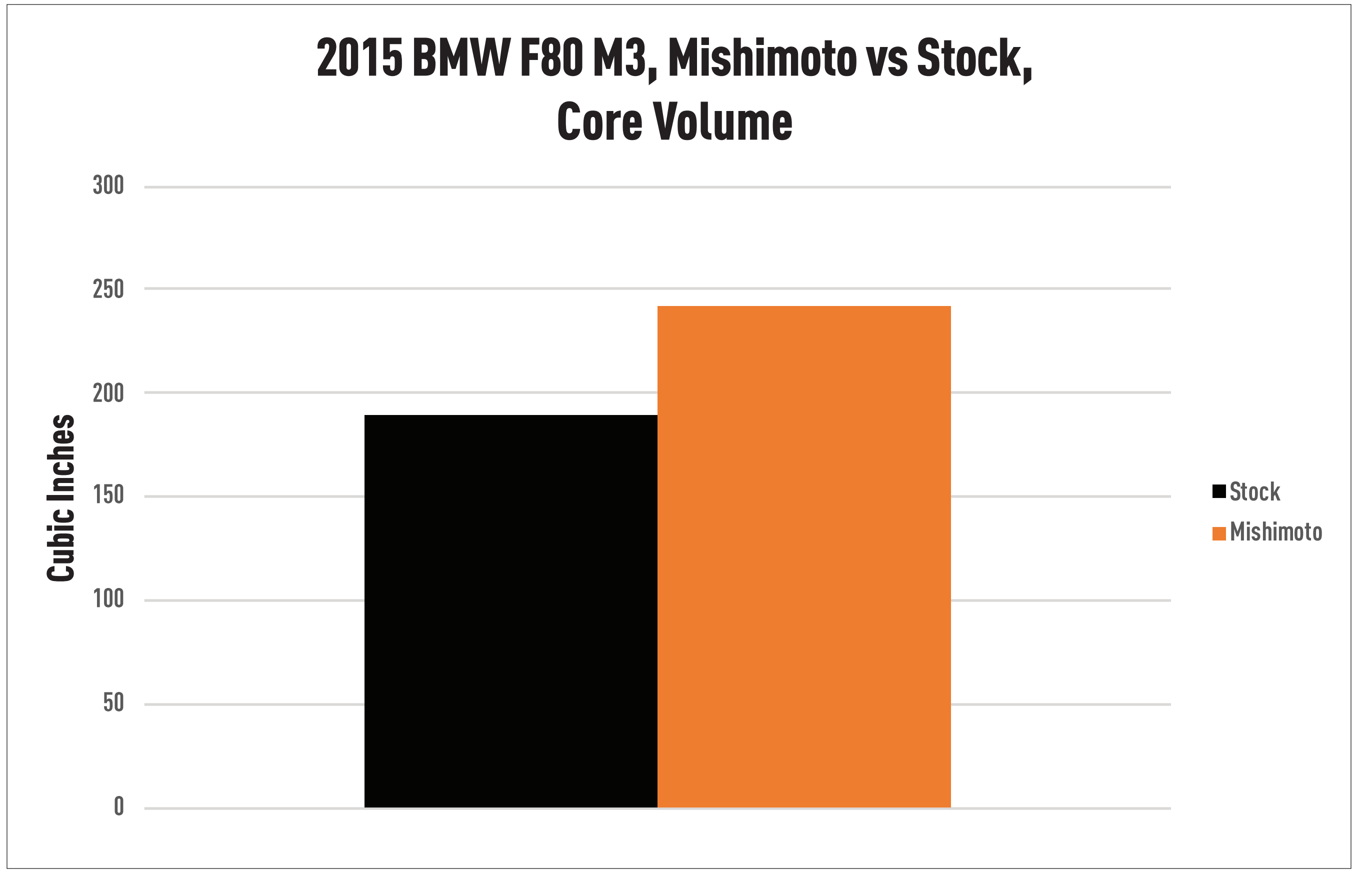

FIGURE 3: *The Mishimoto Heat Exchanger features an increase in fin surface area, which promotes greater heat transfer.*

The Mishimoto heat exchanger increases fin surface area by 180% when compared to stock. With the thicker core and more rows, a larger amount of fin surface area can be created. Figure 4 displays this difference between the stock and Mishimoto heat exchanger.

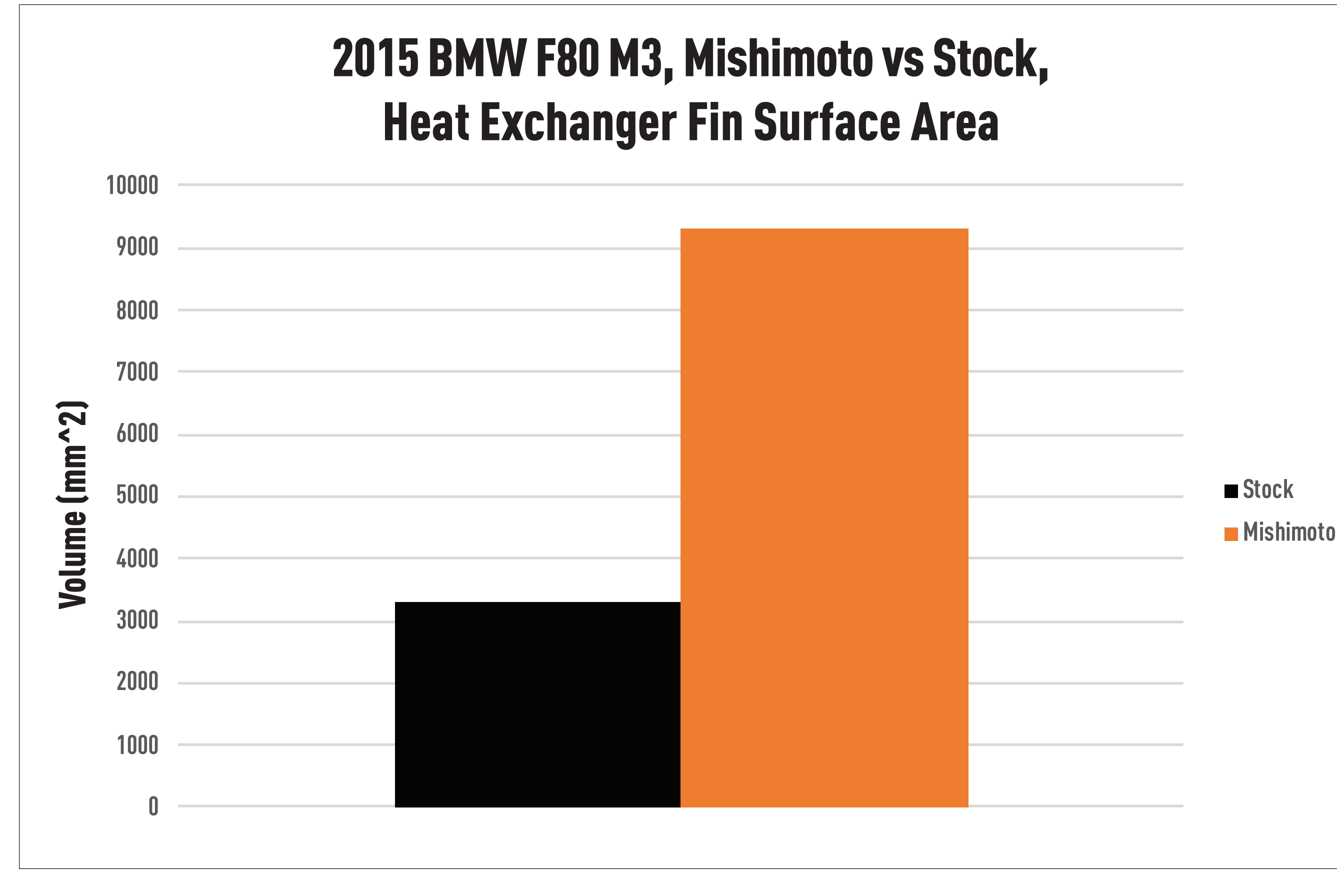

FIGURE 4: *The Mishimoto heat exchanger features an increase in fin surface area, which promotes greater heat transfer.*

Core volume has also been increased by 117.3% over the stock unit. Again, the increase in core size was directly responsible for this difference. Figure 5 shows the increase in core volume.

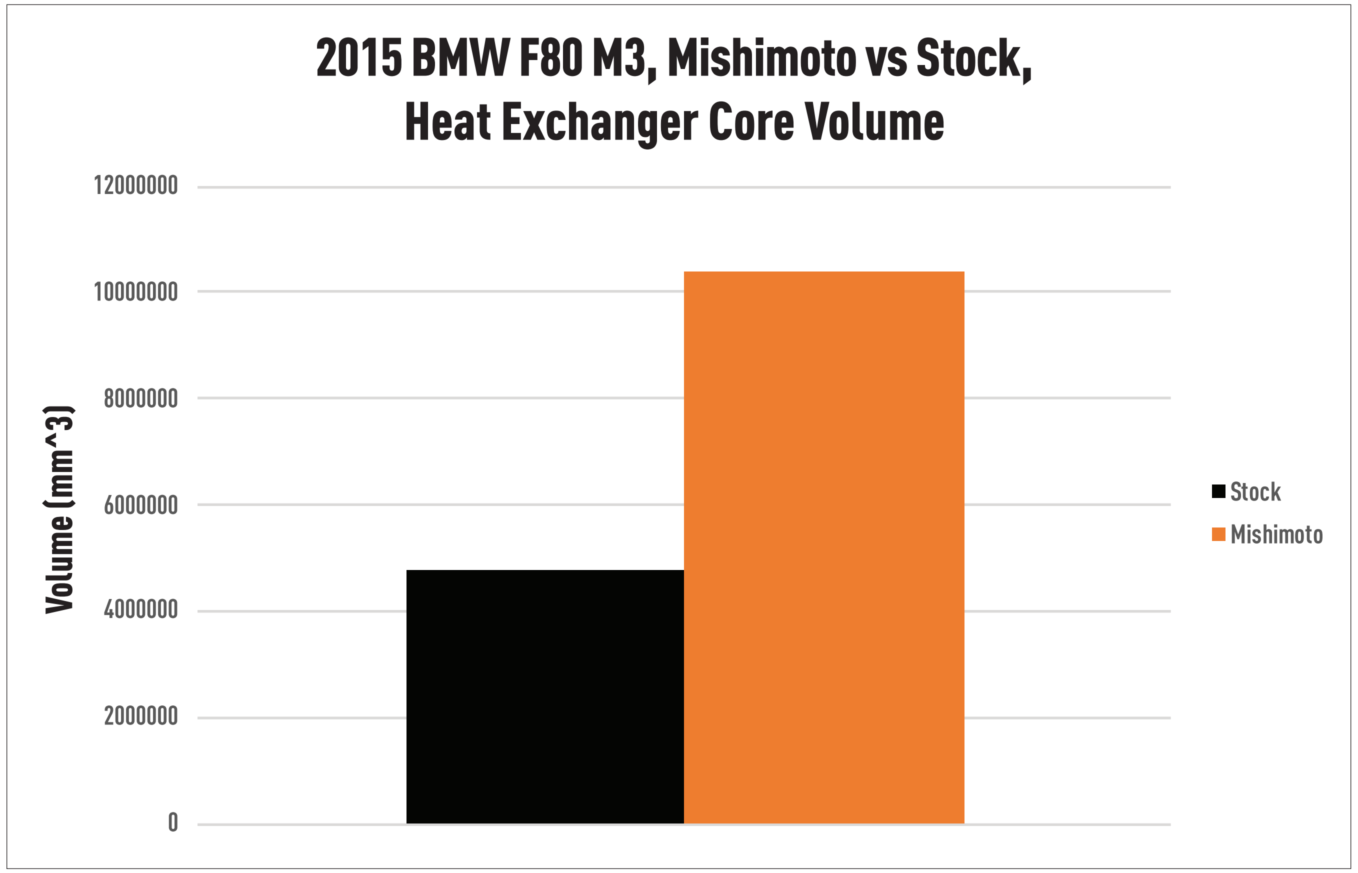

FIGURE 5: *The Mishimoto heat exchanger features an increase in core volume, which promotes greater heat transfer.*

The Mishimoto intercooler pipes also provide a performance gain. They flow 1.13% better than the stock pipes and are made from durable aluminum.

PERFORMANCE TESTING

Each component was tested individually to ensure that no negative effects were produced. A JB4 was installed and a Stage 1 map was run on the vehicle. The final test consisted of the entire suite of products. Two major tests were performed while monitoring power and torque. The first tested gains of power and torque over the stock setup. The results can be seen in Figure 6. The next was a heat soak where six back-to-back runs were performed. Over those consecutive runs the Mishimoto products maintained more power. Figure 7 shows the power and torque graphs on the sixth and final run. Figures 8 and 9 show peak gains for all heat soak runs.

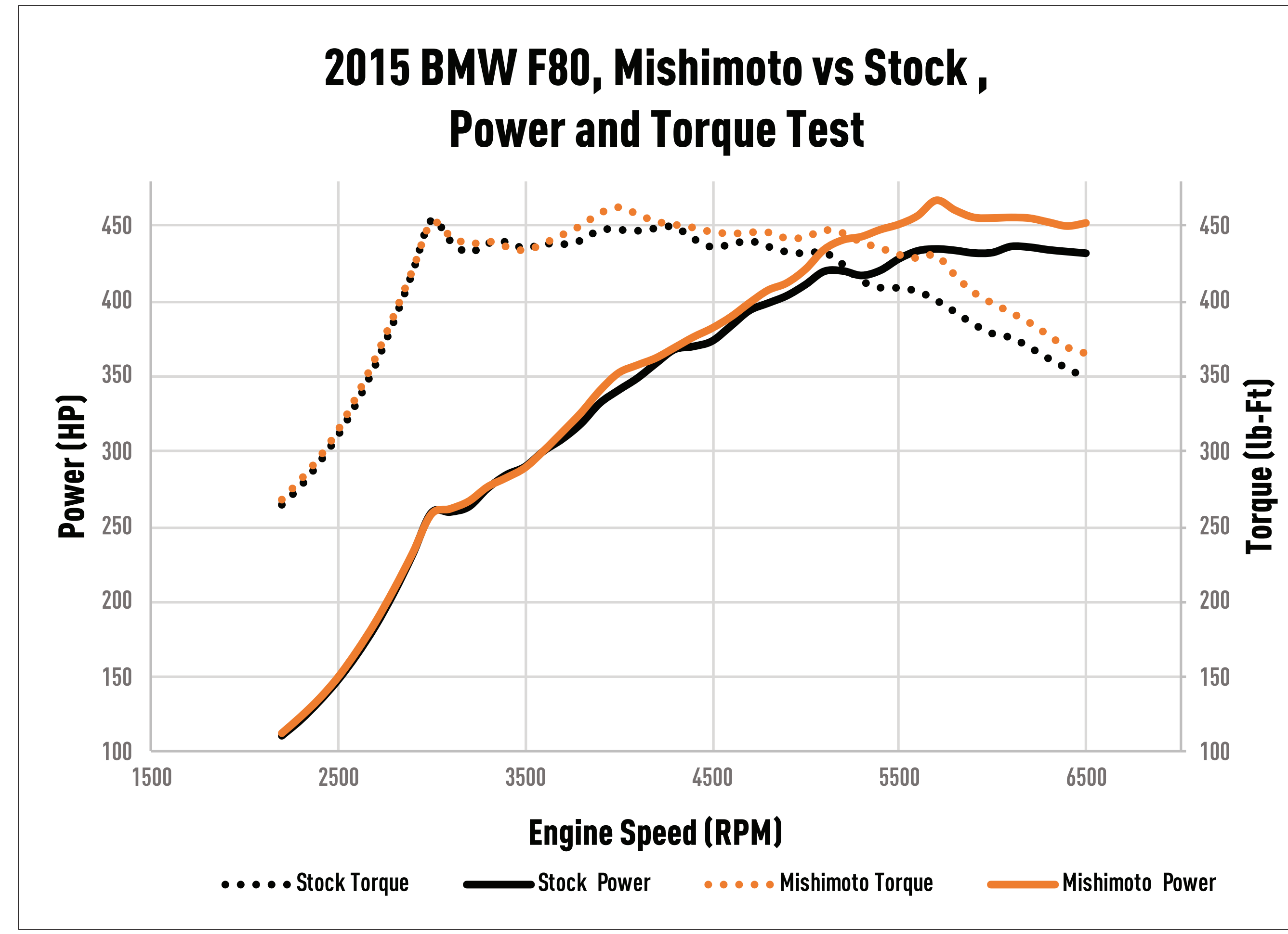

FIGURE 6: *The Mishimoto components vs the stock components. The power gains for the complete system are shown above.*

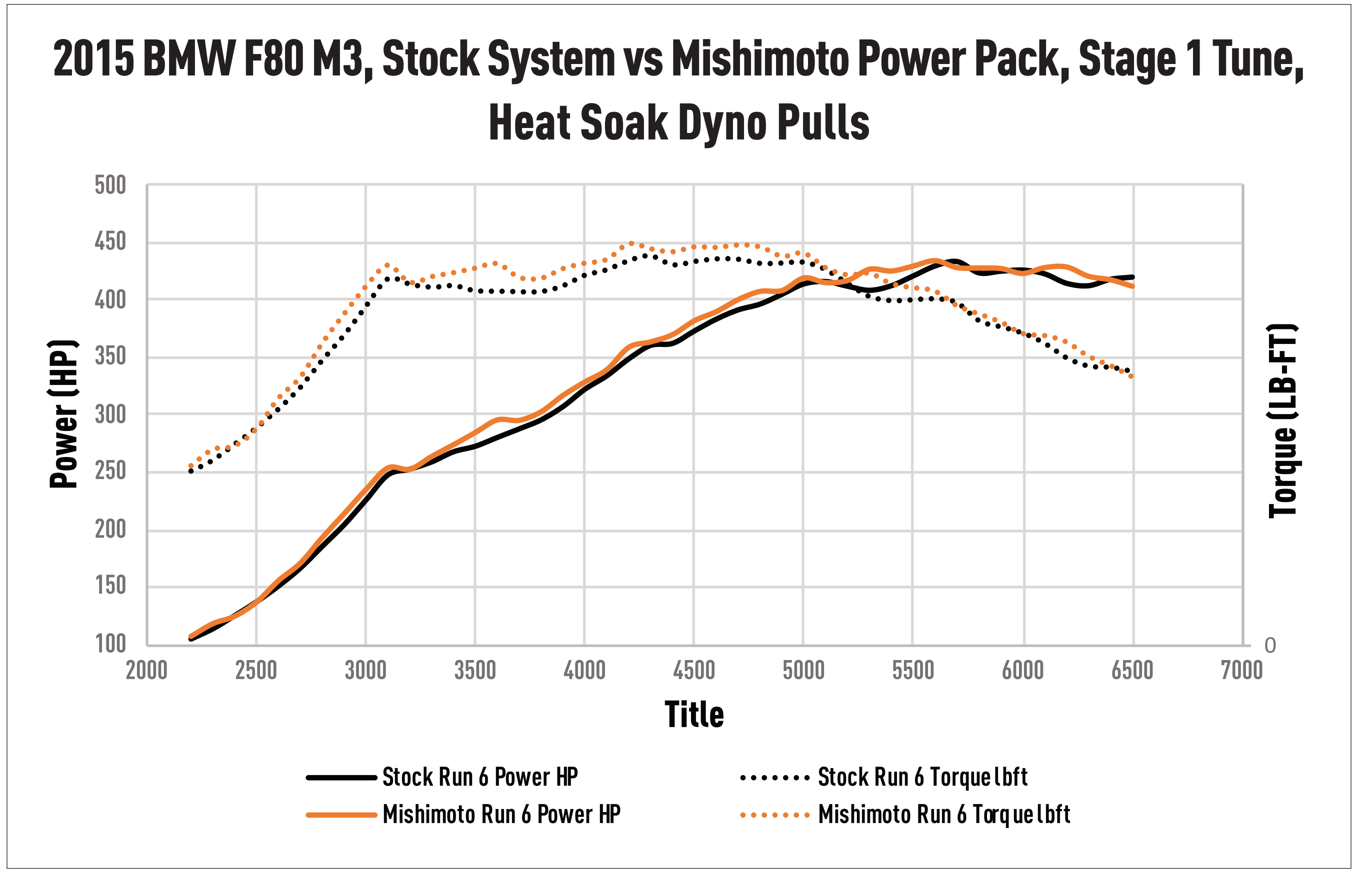

FIGURE 7: *The Mishimoto components helped fight the effects of heat soak on an engine by keeping the charge air cooler when entering the engine.*

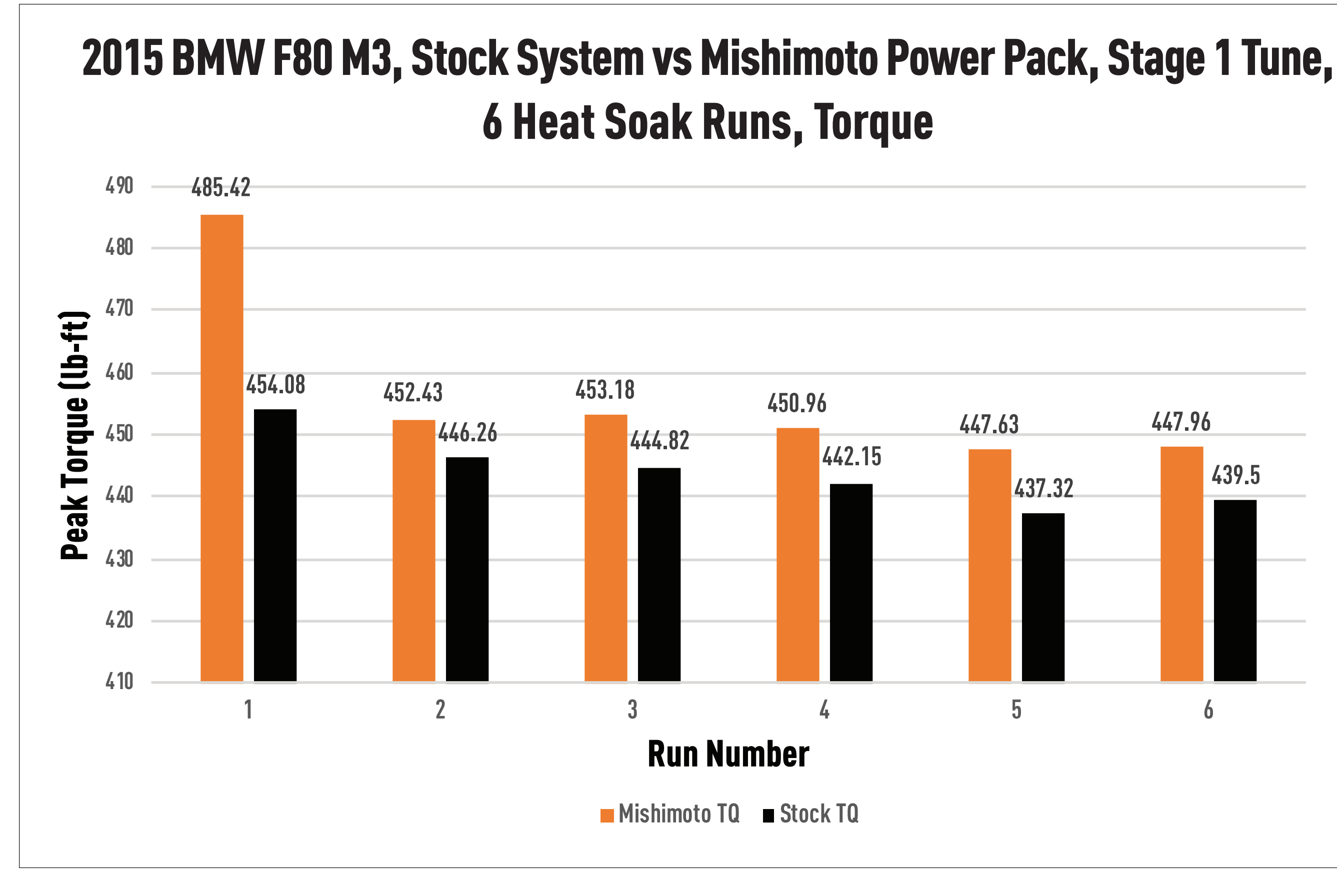

FIGURE 8: *The Mishimoto components helped fight the effects of heat soak on an engine. Above we see the peak torque numbers for each of the six heat soak runs.*

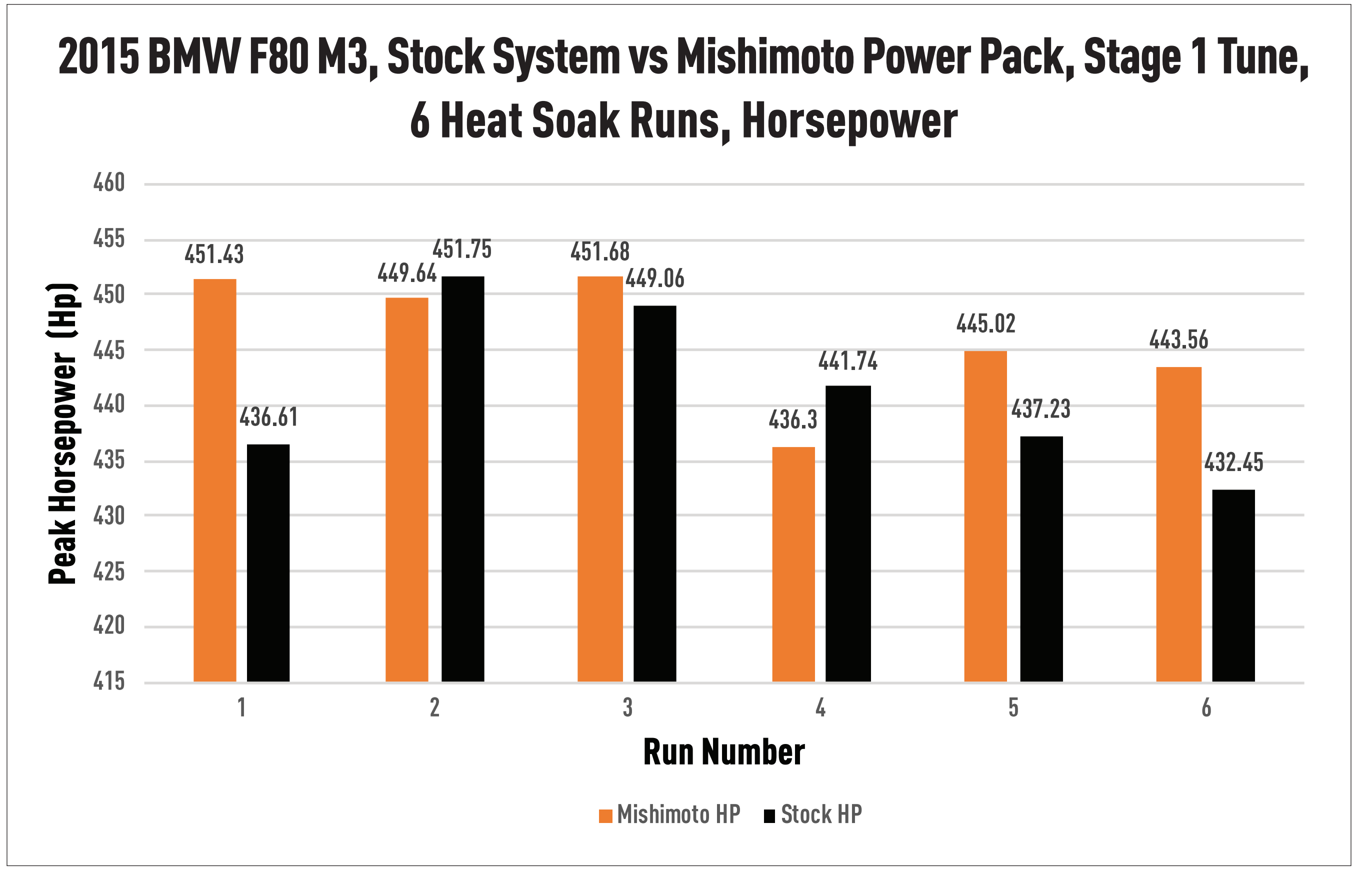

FIGURE 9: *The Mishimoto components helped fight the effects of heat soak on an engine above we see the peak torque numbers for each of the six heat soak runs.*

With all the Mishimoto components installed, a continuous load test was also performed. This test was designed to push the intercooler and heat exchanger to show temperature deltas. The engine coolant temperatures and secondary cooling system were all at the same initial temperature for the beginning of the test.

Figure 10 shows how over a continuous load test the Mishimoto heat exchanger keeps the global secondary cooling system cooler. Figure 11 shows how this has a direct correlation to the manifold temperature as this coolant cools the charge air through the Mishimoto intercooler.

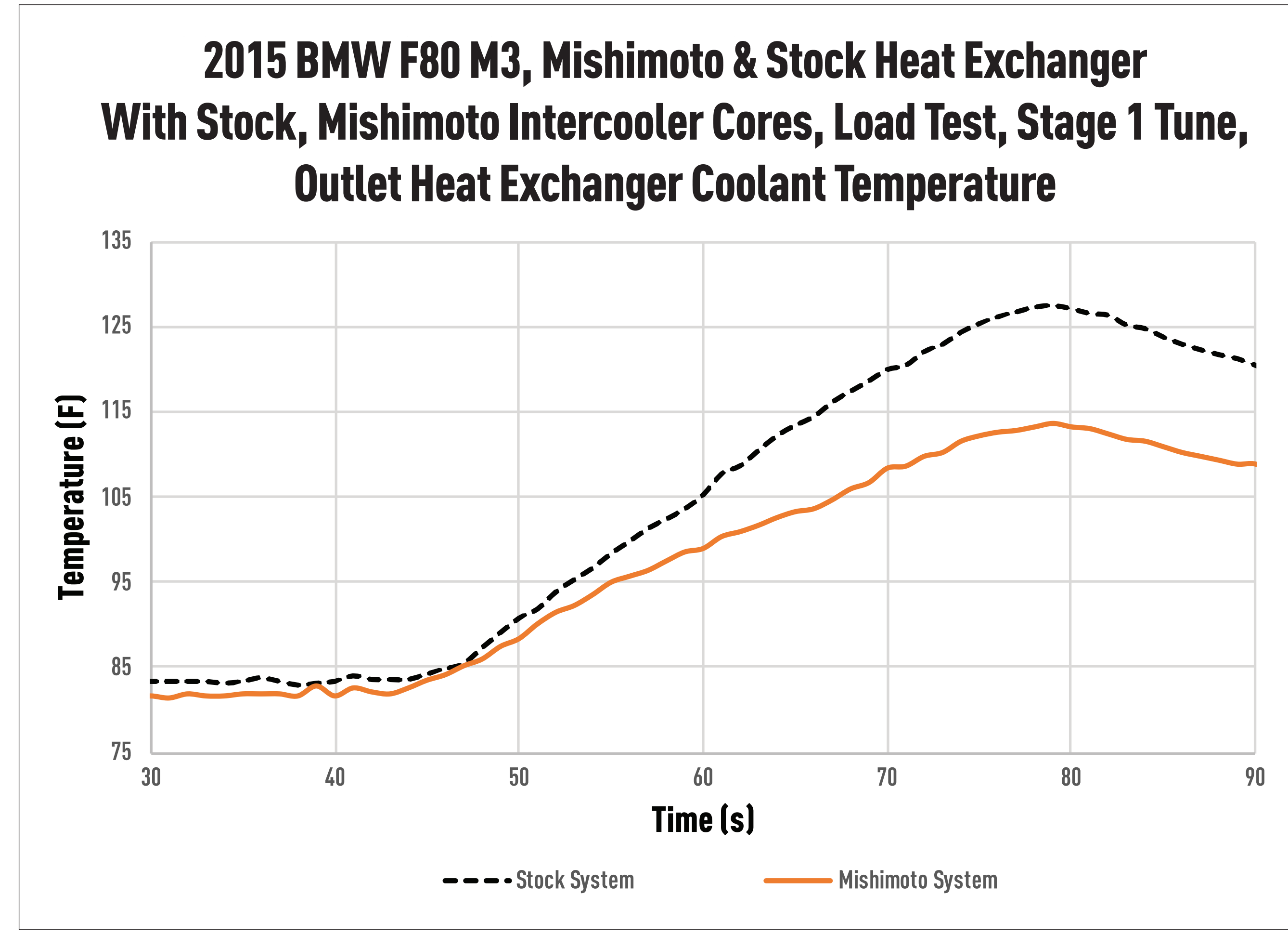

FIGURE 10: *The Mishimoto components keep the secondary cooling system cooler, which helps with charge air temperatures.*

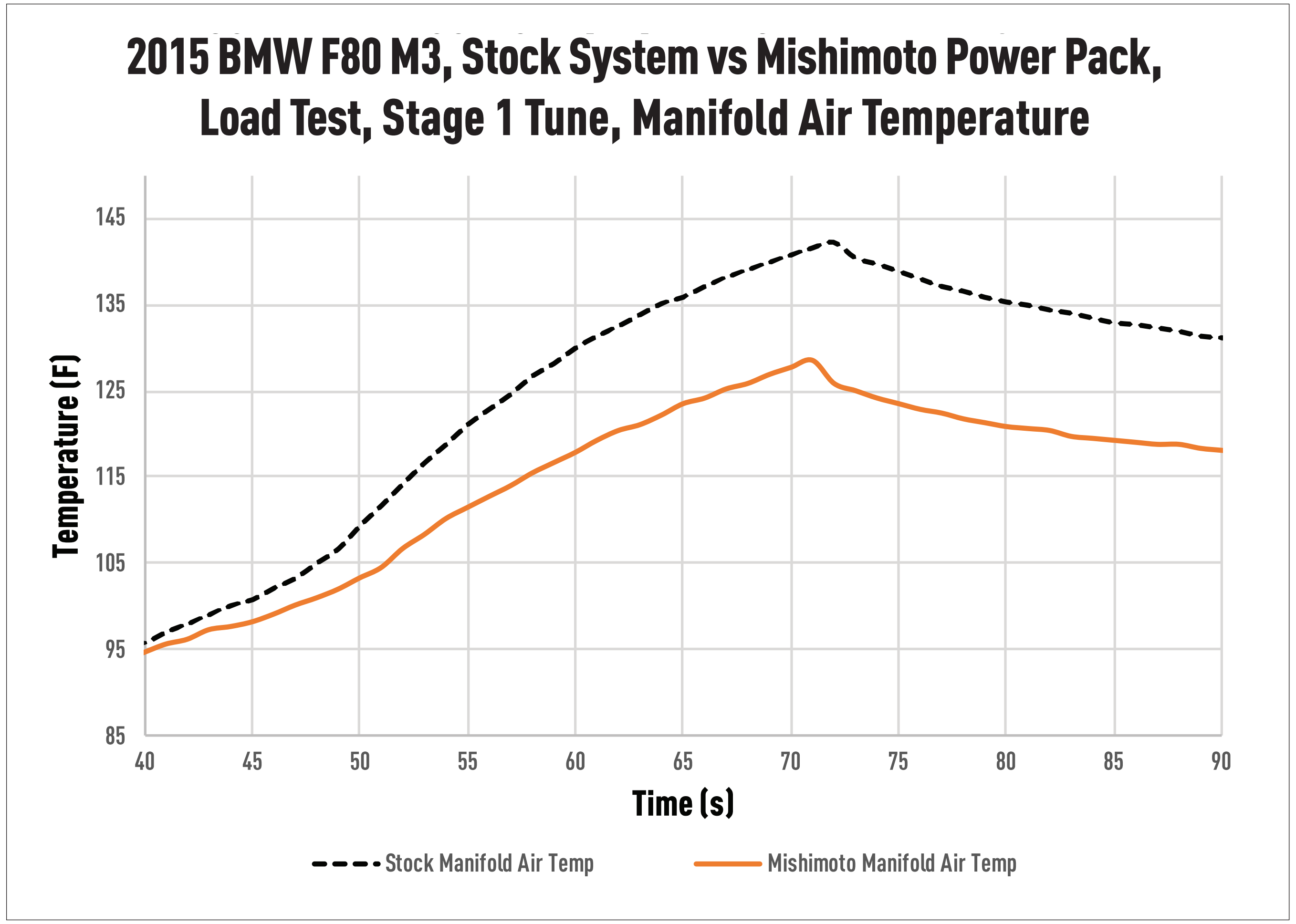

FIGURE 11: *The Mishimoto components helped fight the effects of heat soak on an engine by keeping the charge air cooler when entering the engine.*

CONCLUSION

The complete Mishimoto suite of products helps the F80 platform get the most out of this driving machine. The increase in size and flow of these components allows drivers to get more out of this vehicle under harsher conditions. The ability to prevent the onset of heat soak with the larger heat exchanger and the greater flow of the intercooler allows for a sharper throttle response and greater increase in peak torque and power.

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