ENGINEERING REPORT

2015+ Volkswagen MK7 Golf TSI/GTI/R Intercooler | SKU: MMINT-MK7-15

By Ye Liu, *Mishimoto Product Engineer*

REPORT AT A GLANCE

- **Goal:** Create a direct-fit performance intercooler that outperforms the stock intercooler and can work with stock intercooler piping.
- **Results:** The Mishimoto intercooler reduced outlet temperature by 23°F, with a horsepower and torque gain of 14.16 hp and 12.28 ft-lb compared to the stock intercooler.
- **Conclusion:** The Mishimoto intercooler is a well-rounded upgrade for MK7 owners who are seeking to maximize core volume and gain more cooling capacity and power performance while preserving a clean, OEM-like fitment.

CONTENTS

DESIGN OBJECTIVES

The design requirements assigned to this project are as follows:

- Create an intercooler that outperforms the stock intercooler in power, torque, and charged-air temperature
- A direct-fit design with no permanent modification required for installation
- Uses a bar-and-plate style for the core design
- Fits with both Mishimoto and stock intercooler pipes
- Integrated air diverter in hot-side end tank

DESIGN AND FITMENT

The MK7 platform encompasses two manufacturers and three models (VW GTI, Golf R and Audi S3). Our R&D is based on the Golf R model, which is equipped with a slightly larger stock intercooler compared to the GTI model and sets a higher goal for us to reach.

We first set out to evaluate the stock charged-air cooling system for improvement. The stock intercooler inlet and outlet internal diameters are 52.5 mm, which will theoretically support up to 360 hp without becoming a bottleneck in engine performance. With a CNC-machined, thin-wall inlet and outlet, the Mishimoto intercooler slightly increased the internal diameters to 53.5 mm, and still works with the stock rubber couplers.

The stock intercooler has a tube-and-fin style core crimped onto plastic end tanks. The Mishimoto intercooler core is designed in the more robust and efficient bar-and-plate style. At the price of some additional weight, a bar-and-plate core can support much higher boost pressure and is much less susceptible to damage caused by road debris or long-term deterioration from heat cycles. Bar-and-plate designs also give engineers the freedom to use almost any core dimensions and choose from a wide variety of fin combinations to achieve the best overall performance.

After evaluation of available design space, we settled on a design that increased core thickness and resulted in 89% more core volume compared to the stock intercooler. We added in just two additional rows to the Mishimoto intercooler compared to stock setup to avoid blocking frontal air from sufficiently cooling the radiator mounted behind the intercooler. Heat exchanger calculations gave us the best combination of external and internal fin pitches to reach a balance between increasing cooling capacity and minimizing pressure drop.

FIGURE 1: *Stock intercooler.*

FIGURE 2: *Mishimoto intercooler (prototype).*

To distribute the airflow evenly across the core, two internal air diverter plates are integrated into the inlet-side end tank of the Mishimoto intercooler, as shown in Figure 3. With an inlet port located at the bottom of the end tank, the diverter plates help to "guide" charged airflow to the upper portion of the intercooler core instead of taking a short cut from the bottom rows to reach the other side. These diverter plates also reduce turbulence inside the end tank, which causes unnecessary pressure loss.

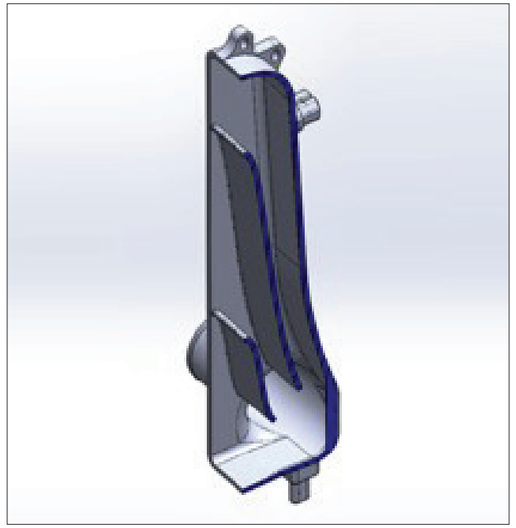

FIGURE 3: *Two internal air diverters are integrated into the hot-side end tank.*

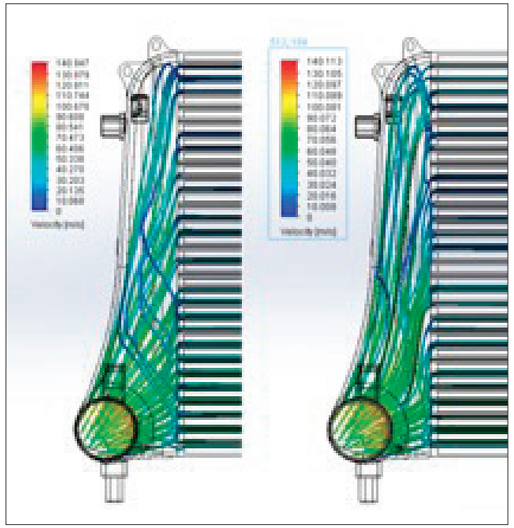

FIGURE 4: *CFD comparison results, before and after the air diverters are added into the design.*

PERFORMANCE TESTING

Our testing vehicle is a 2018 VW Golf-R with AWD and six-speed manual transmission. All tests are performed in fourth gear with dyno mode engaged, which temporarily disables AWD and traction control functions, allowing the vehicle to be tested without triggering drive control errors.

All dyno tests are performed in-house on our DynaPack™ chassis dynamometer. The AEM AQ-1 data acquisition system is used to gather intercooler-specific data from two temperature and pressure sensors installed in the intercooler near the inlet and outlet. Critical OBD-II channels such as coolant temperature and ambient air temperature are monitored to ensure realistic and consistent results.

Once warmed up to 180–200°F coolant temperature, a set of six dyno runs were conducted with both Mishimoto intercooler and stock intercooler configurations. As shown in Figure 5, the Mishimoto intercooler yielded a max power gain of 14.16 hp and max torque gain of 12.28 ft-lb due to the lower charged-air temperature compared to stock intercooler. The boost pressure drop across the Mishimoto intercooler is 2.42 psi compared to stock intercooler's 2.24 psi, with an increase in restriction of only 0.18 psi. Pressure data can be found in Figure 6. At only 0.9% of max boost pressure, this is well within acceptable range and will not cause any adverse effect on turbo and engine performance.

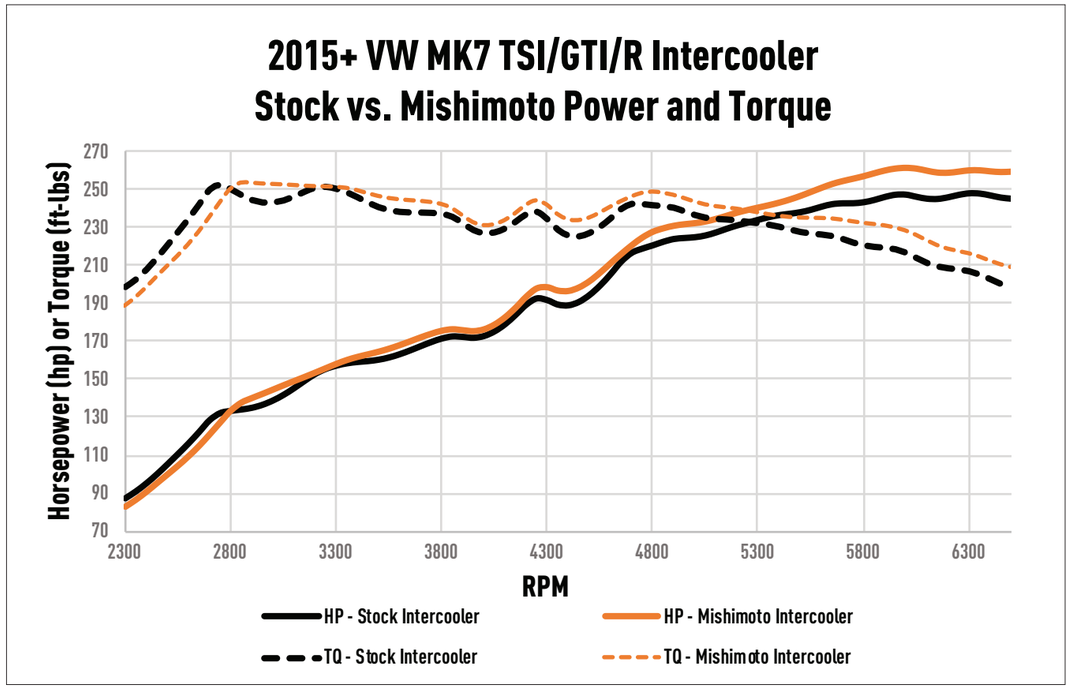

FIGURE 5: *Dyno results.*

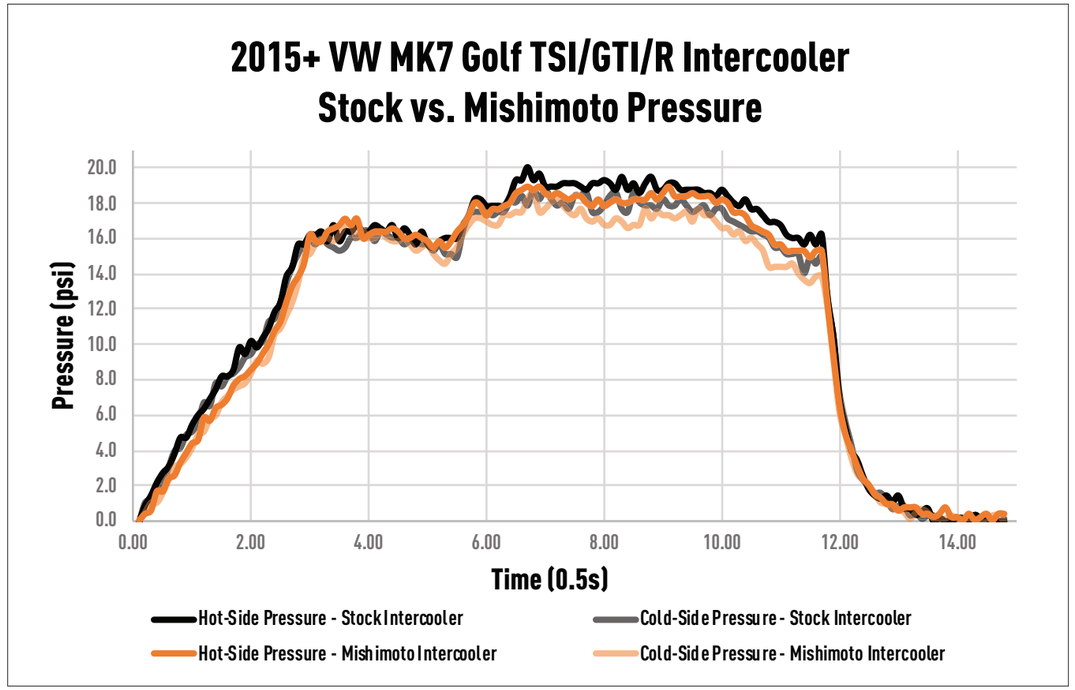

FIGURE 6: *Pressure drop comparison.*

Heat-soak performances of both intercoolers are evaluated in another test where five to six dyno runs are conducted back-to-back with the intention of significantly raising charged-air temperature in a short amount of time to mimic real-world racing situations. Heat-soak tests for both intercoolers started with a 95°F inlet temperature and reached up to 210°F at full boost. Under these conditions, the Mishimoto intercooler outlet temperature stabilized at around 90°F throughout the test, whereas the stock intercooler outlet temperature spiked up to 118 °F by the fifth run. The Mishimoto intercooler lowered outlet temperature by 23°F compared to the stock intercooler in the first run. Plots of the heat-soak test are shown in Figures 7 thru 9.

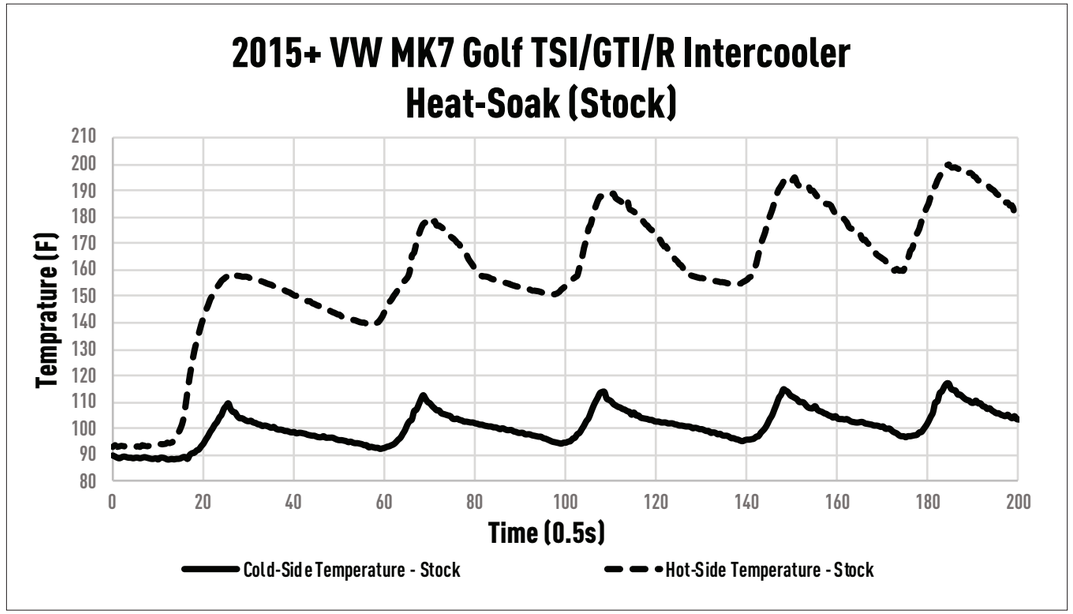

FIGURE 7: *Heat-soak test.*

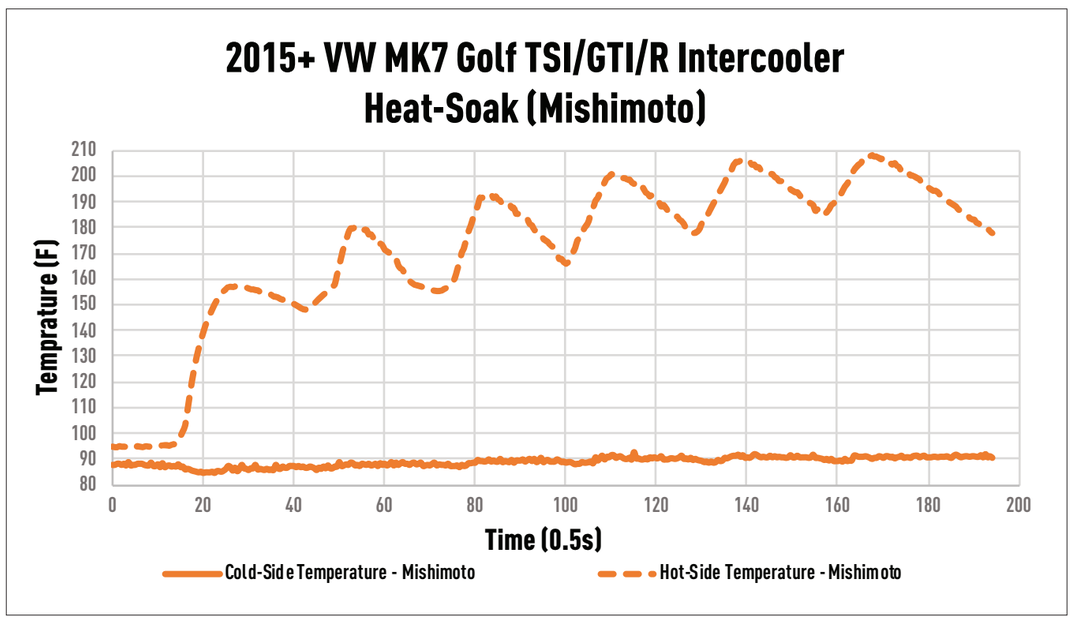

FIGURE 8: *Heat-soak test.*

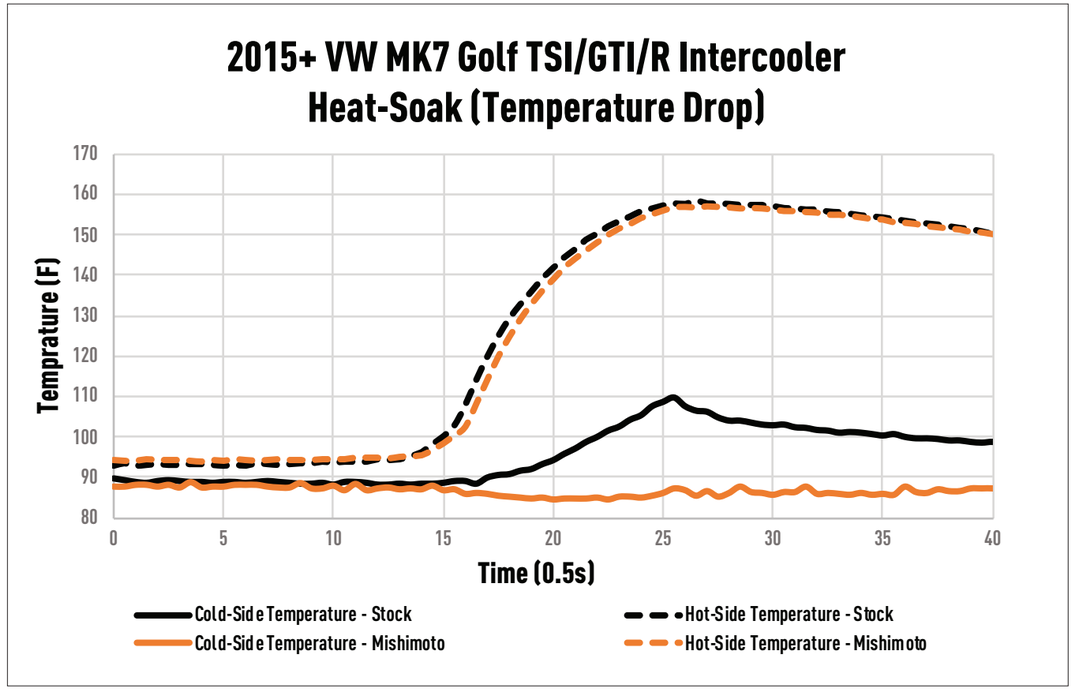

FIGURE 9: *Temperature drop comparison during heat-soak test.*

In conclusion, with significantly lower charge-air temperature and minimal boost pressure drop, the Mishimoto intercooler is a well-rounded upgrade that will unleash more potential for the MK7 platform.

INSTALLATION NOTES

The MK7 platform encompasses two manufacturers and three models (VW GTI, Golf R and Audi S3). Our R&D is based on the Golf R model, which is equipped with a slightly larger stock intercooler compared to the GTI model and set a higher goal for us to reach.

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