MISHIMOTO

ENGINEERING REPORT

2023+ Toyota GR Corolla Performance Intercooler | SKU: MMINT-GRC-23

By: Dan Tafe, *Mishimoto Product Engineer*

REPORT AT A GLANCE

- **Goal:** Create a direct-fit performance intercooler that out performs the stock intercooler.
- **Results:** The Mishimoto intercooler reduced outlet air temps by 38.5°F (21.38°C) compared to the stock intercooler. This reduction in outlet temperature led to max gains of 11.42 hp and 14.93 ft-lbs. Peak gains were 8.52 hp and 9.01 ft-lbs.
- **Conclusion:** The Mishimoto intercooler is a great upgrade for anyone looking to get the most performance out of their GR Corolla.

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DESIGN OBJECTIVES

- Create an intercooler that performs better than the stock intercooler.
- 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 Toyota GR Corolla intercooler to find potential room for improvement. The stock intercooler is a 3.15" thick, 9-row tube-and-fin design. The Mishimoto intercooler was designed as a much larger, 3.94" thick, 12-row bar-and-plate intercooler to increase the amount of cooling surface area and core volume. This design makes the Mishimoto intercooler 52% larger than the stock Toyota GR Corolla intercooler. Figures 1 and 2 below show a comparison of overall core volumes and external fin surface areas for the stock and Mishimoto intercoolers. Figure 3 shows a physical comparison of the stock intercooler and the Mishimoto intercooler. Figure 4 shows the difference in flow restriction of the stock intercooler and Mishimoto Intercooler.

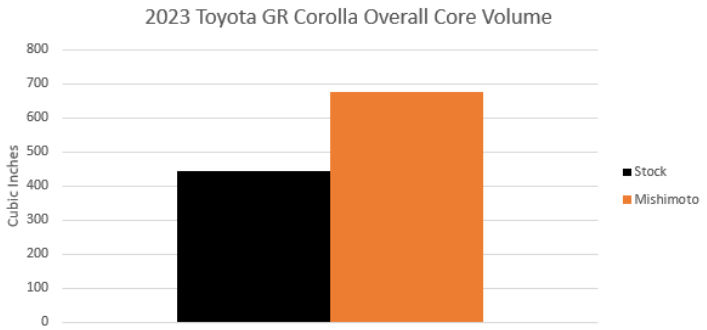

Figure 1: *The Mishimoto intercooler has a 52% increase in overall core volume compared to the stock intercooler.*

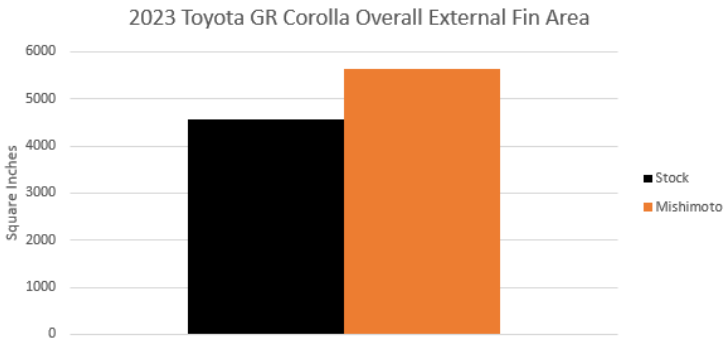

Figure 2: *The Mishimoto intercooler has a 24% increase in fin surface area over the stock intercooler.*

Figure 3: *Comparison of the stock intercooler to the Mishimoto intercooler.*

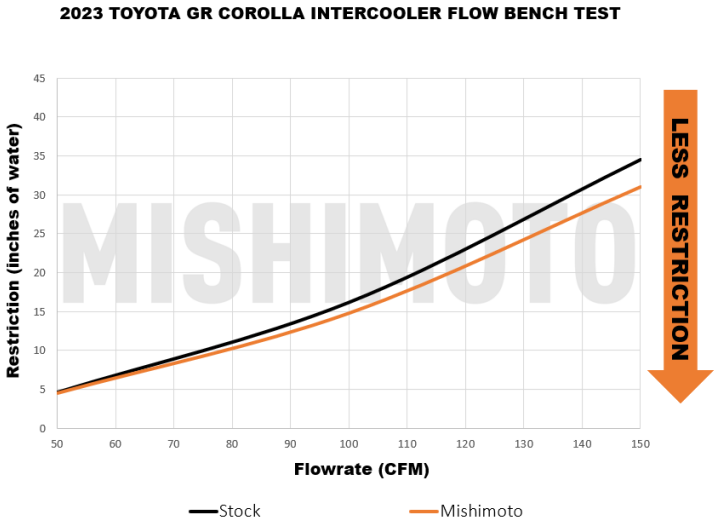

Figure 4: *The Mishimoto intercooler is 10% less restrictive compared to the stock intercooler.*

APPARATUS

For hardware, Mishimoto chose to use the AEM AQ-1 driven by the AQ-1 Data Acquisition System.

Figure 5: *AEM AQ-1 Data Logging System*

PERFORMANCE TESTING

A 2023 Toyota GR Corolla was used to test each intercooler setup. The ambient temperature on the day of testing was approximately 75°F (23.8°C). To test the performance of the intercoolers, a Dynapack™ dynamometer was used to conduct consistent ramp tests.

Figure 6: *A Dynapack dynamometer was used for vehicle testing.*

The Toyota GR Corolla was brought to an operating temperature of 190°F (87.78°C) by idling it on the dyo. Once the vehicle was at operating temperature, multiple dyno runs were conducted until consistent figures were recorded. The car was kept running between runs to maintain a consistent engine coolant temperature for every run. As a final test for each test configuration, dyno runs were made back-to-back with just 15 seconds between runs to simulate heat-soak conditions. The two configurations we tested were:

Configuration 1: Stock intercooler with stock intercooler piping

Configuration 2: Mishimoto intercooler with stock intercooler piping

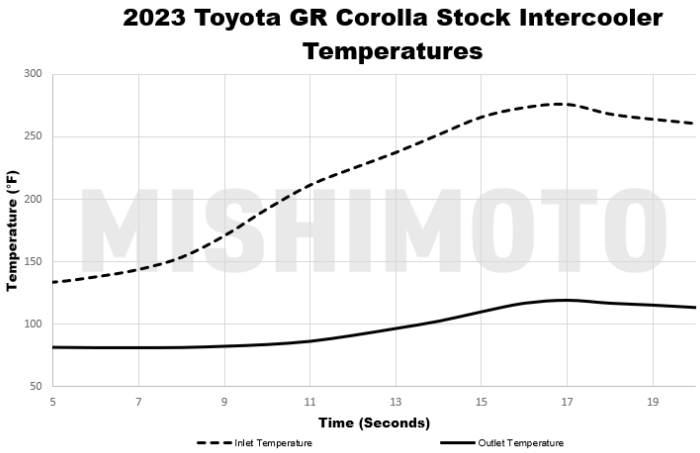

Figure 7: *Stock intercooler inlet and outlet temperature data.*

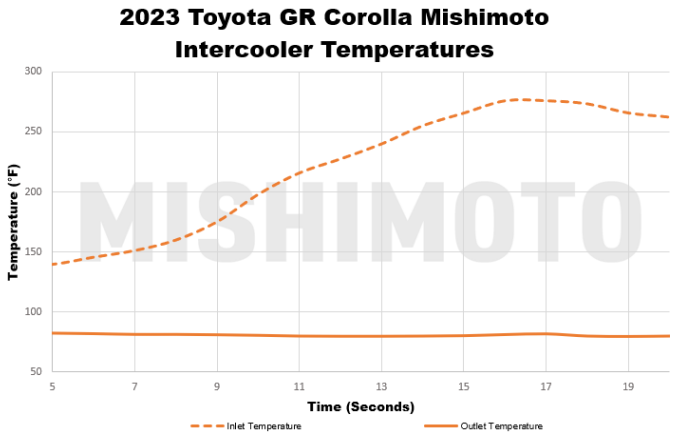

Figure 8: *Mishimoto intercooler inlet and outlet temperature data.*

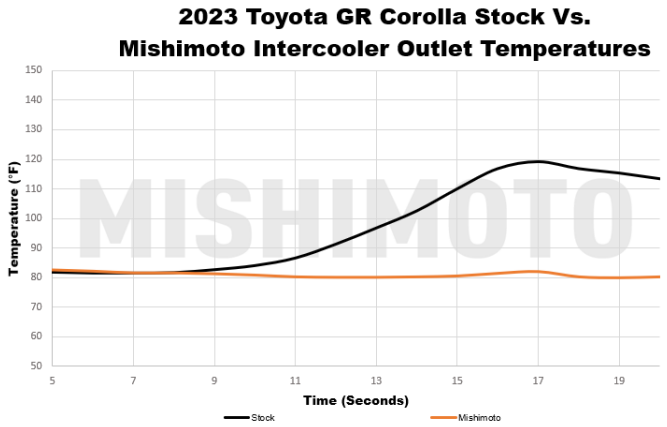

Figure 9: *The Mishimoto intercooler reduced the outlet temperatures by about 38.5°F (21.38°C) compared to the stock intercooler.*

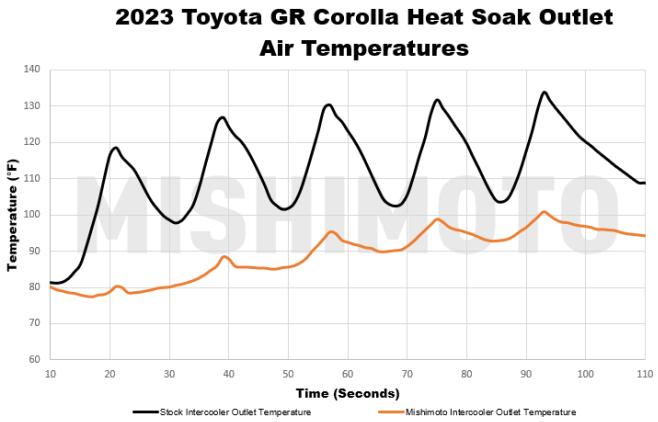

Figure 10: *The Mishimoto intercooler reduced the outlet temps about 33°F (18.33°C) compared to the stock intercooler (heat soak test).*

In comparison to the stock intercooler, the Mishimoto intercooler reduced the outlet temperature by 38.5°F (21.38°C). This reduction in temperature is a result of the Mishimoto intercooler having a 24% increase in fin surface area and a 52% increase in overall core volume, as well as 10% less restrictive compared to the stock intercooler.

Along with temperatures, inlet and outlet pressures were monitored to ensure that the Mishimoto intercooler did not add a significant drop in boost pressure from inlet to outlet. A large decrease in boost pressure could cause strain on the turbos, as well as add additional heat into the engine cooling and intercooling system, which could result in a loss of horsepower.

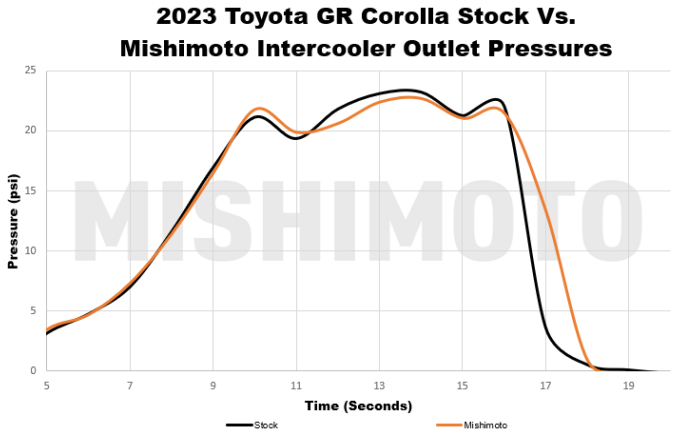

Figure 11: *The Mishimoto intercooler had an additional 1.1 psi of boost pressure drop compared to the stock intercooler.*

As seen in Figure 11, the Mishimoto intercooler follows the outlet pressure curve to within 1.1 psi of the stock intercooler. This is well within an acceptable range and will not have any adverse effects on the intercooling system of the Toyota GR Corolla. With a cooler post-intercooler charge, the engine can operate at a greater efficiency rate.

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. The Mishimoto intercooler reduced outlet temperatures with a minimal increase in boost pressure drop, resulting in a slight gain in horsepower and torque.

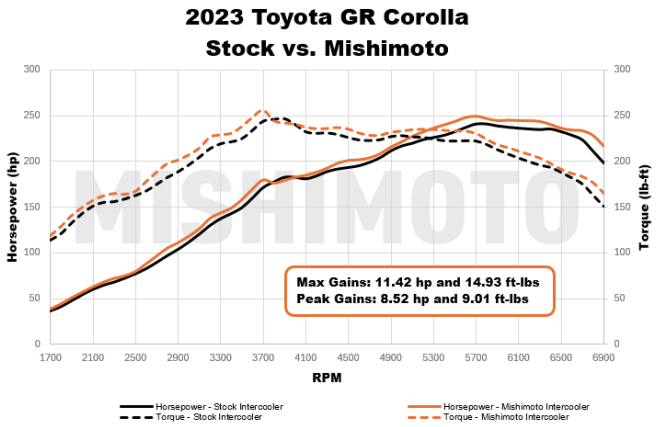

Figure 12: *The Mishimoto intercooler yielded a max gain of 11.42 hp and 14.93 ft-lbs as well as a peak gain of 8.52 hp and 9.01 ft-lbs over the stock intercooler.*

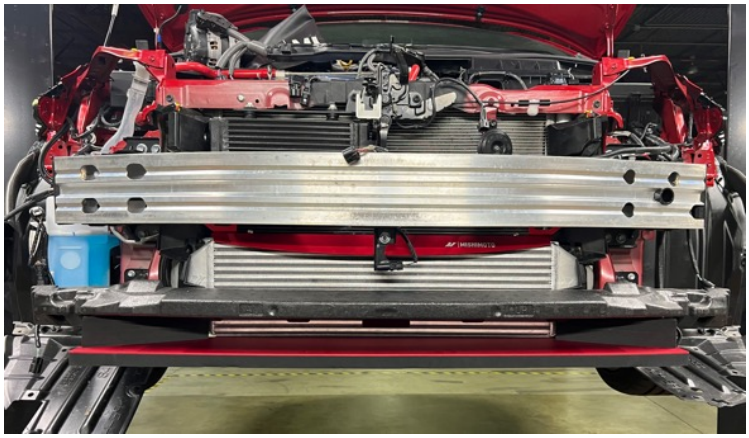

Figure 13: *Mishimoto intercooler installed on the car.*

TESTING DONE BY:

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