

ENGINEERING REPORT

2016+ Camaro 2.0T/2013–2019 Cadillac ATS 2.0T Intercooler | SKU: MMINT-CAM4-16

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 61°F (34°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 Camaro 2.0T owners who want a well-balanced intercooler that will resist heat-soak, preserve power levels, and significantly reduce charge-air temperatures.

CONTENTS

PG	1	— DESIGN OBJECTIVES
		— DESIGN AND FITMENTS
PG	2	— PERFORMANCE TESTING

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

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 thin and 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 overall core volume by 78% and external fin surface area by 239% when compared to stock, as shown in Figures 1 and 2.



During the initial design phase of the intercooler, a good deal of attention was focused on utilizing the entire core as air flowed internally through it. The inlet and outlet ports are mounted low on the core, and CFD analysis showed that much of the air preferred to travel through the lower channels. To take advantage of the upper portion of the core, various internal diverters were modeled and simulated until reaching a well-balanced design. The result is shown below in Figure 3.

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

[MISHIMOTO ENGINEERING BLOG](#)

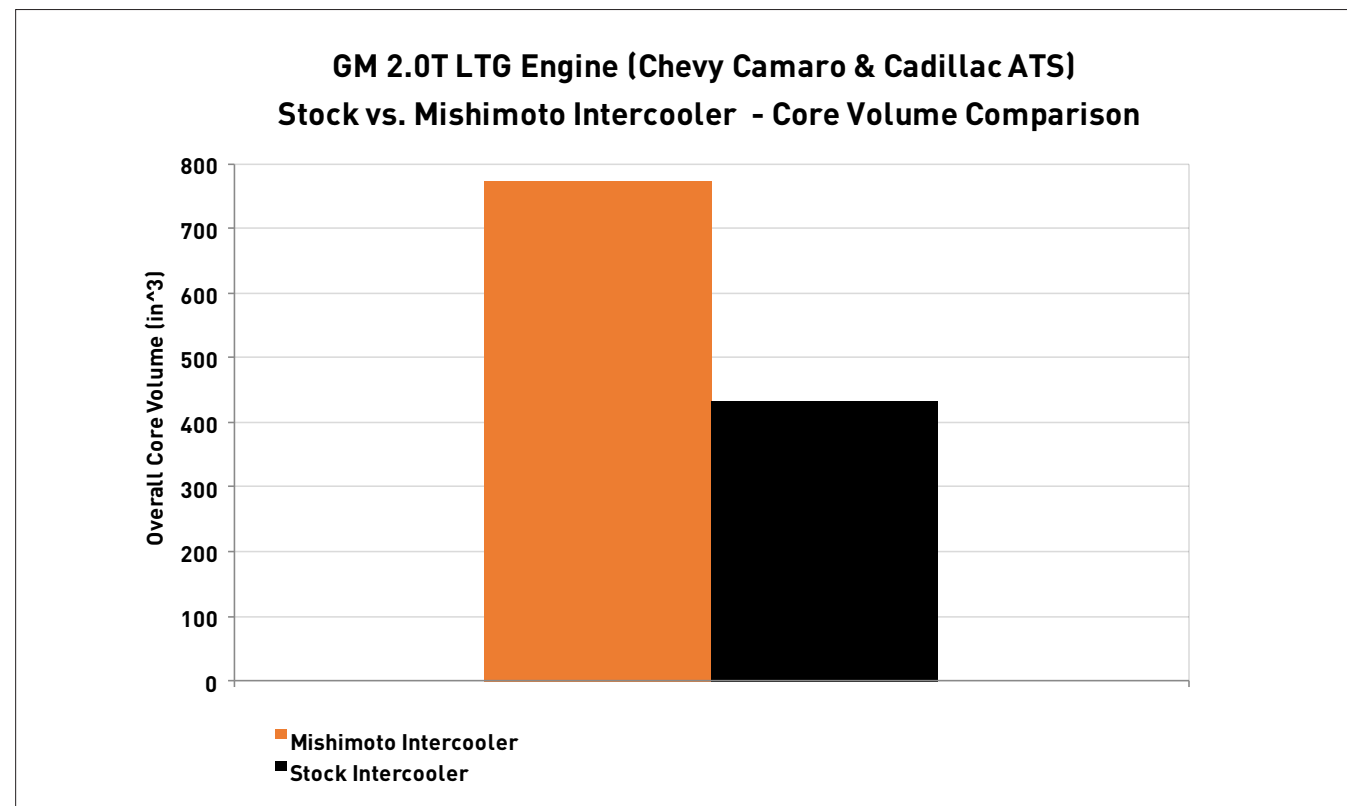


FIGURE 1: The Mishimoto intercooler increases overall core size by 78% when compared to stock

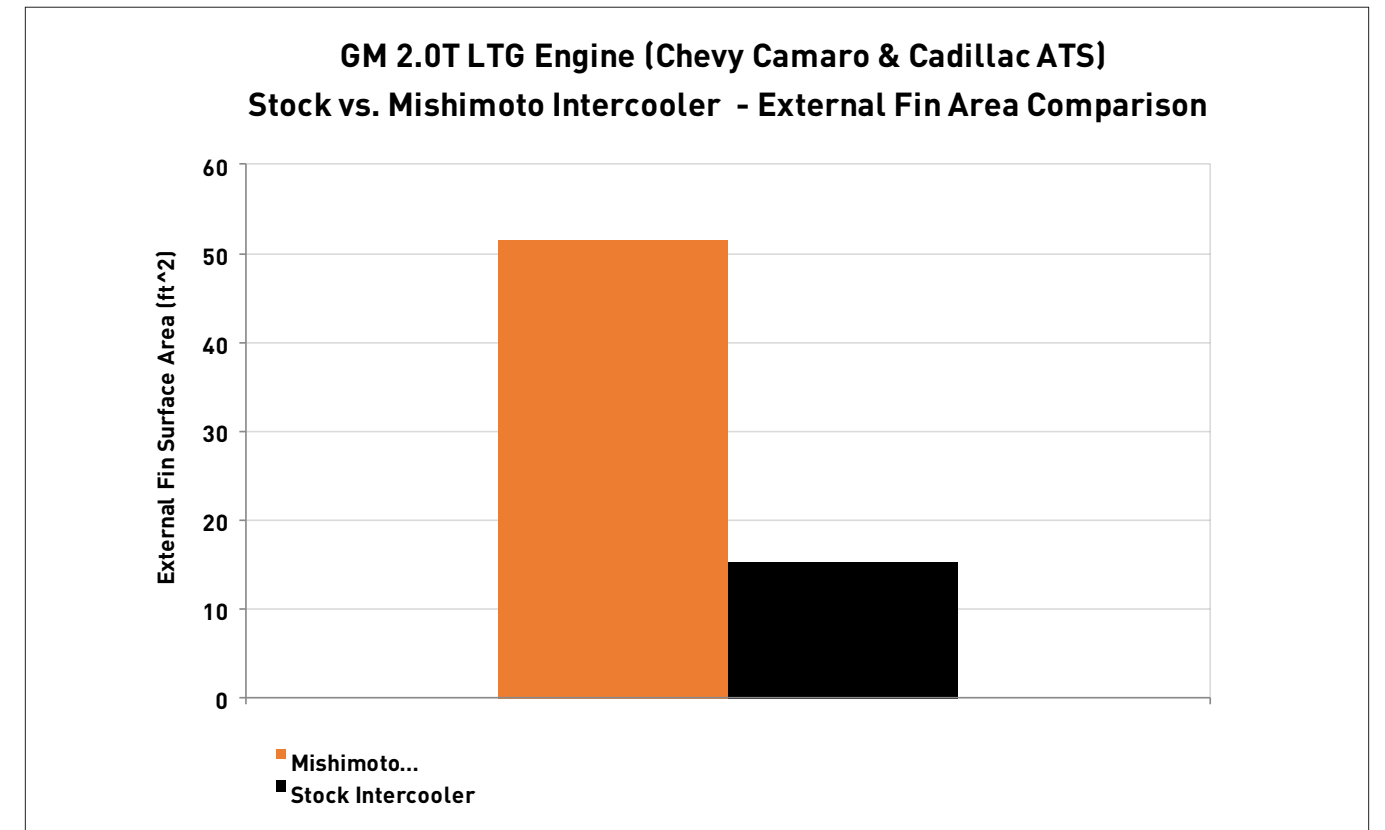


FIGURE 2: External fin surface area is increased by 239% to improve heat rejection capabilities of the intercooler.

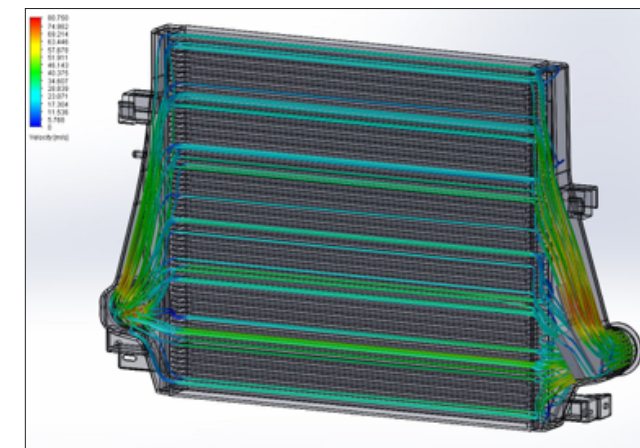


FIGURE 3: Air diverters are added to the inlet end tank of the Mishimoto intercooler to ensure the entire core is utilized.

PERFORMANCE TESTING

A completely stock 2016 Chevy Camaro 2.0T was used for testing. The ambient temperature on the day of testing was approximately 68°F (20°C) with 50% humidity. To test the performance increases of the intercooler, a Dynapack™ dynamometer was used to apply a constant and repeatable load on the Camaro.

The Camaro was set on the Dynapacks, and baseline pulls were made on the stock intercooler. To simulate harsh on-road conditions, the car was run at wide open throttle, up to 6500 RPM, five times in a row and was cooled for one minute in between each pull. This test was then repeated on two different Mishimoto intercooler cores. The testing results below show the outlet temperature and pressure drop comparison of the stock intercooler to the chosen Mishimoto intercooler.



FIGURE 4: A Dynapack dynamometer was used to apply a repeatable load on the Camaro during testing.

As shown in Figure 5, the chosen Mishimoto intercooler had temperature drops of up to 25°F (14°C) compared to the stock intercooler, while demonstrating 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. The results from pressure drop testing can be seen in Figure 6.

Once redline testing was completed, a load test was performed to heat-soak the stock and Mishimoto intercoolers as aggressively as possible. The car was held at full throttle for ten seconds while the Dynapacks held the engine at 4,000 RPM. As shown in Figure 7, the stock intercooler heat-soaks quickly and outlet temperatures

climb dramatically, while the Mishimoto intercooler shows no signs of increasing outlet temperatures.

The chosen Mishimoto intercooler showed temperature drops of up to 61°F (34°C) compared to the stock intercooler, while showing no signs of heat-soak throughout the entire testing process.

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.

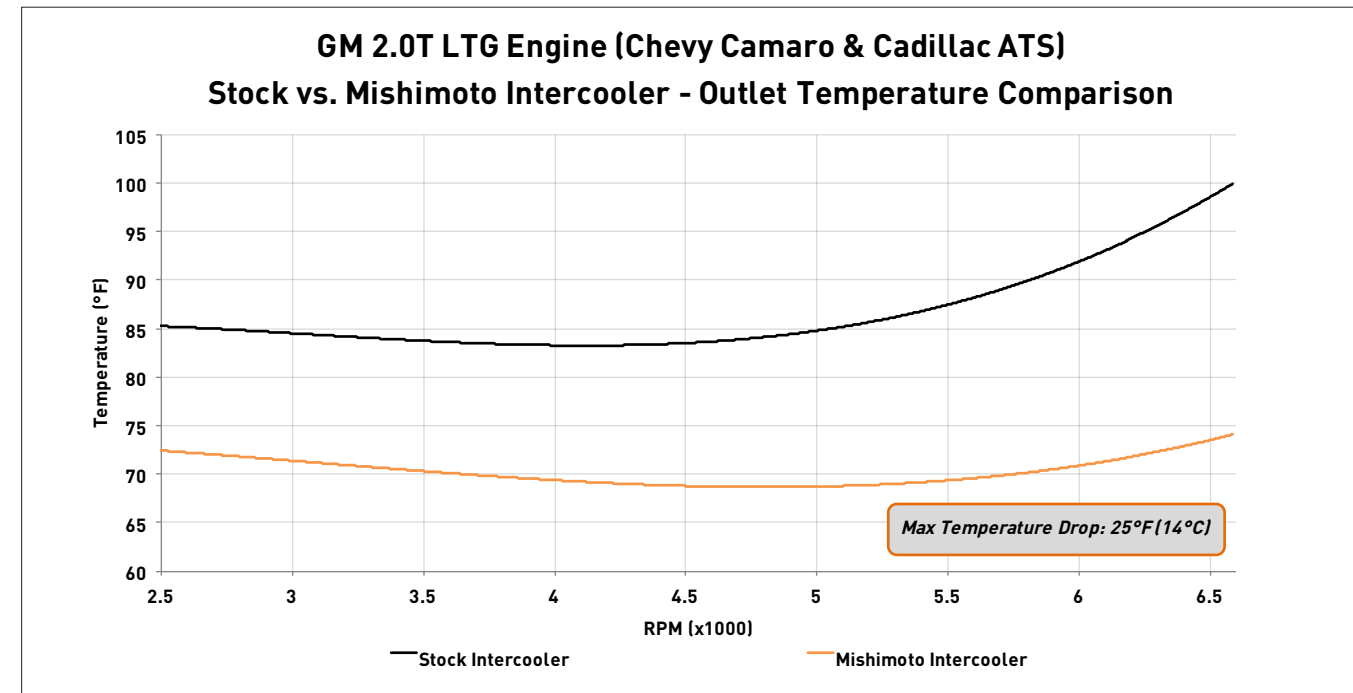


FIGURE 5: The outlet temperatures of the stock and Mishimoto intercoolers are shown after the fifth consecutive dyno pull. It's clear that the Mishimoto intercooler is superior at resisting heat-soak.

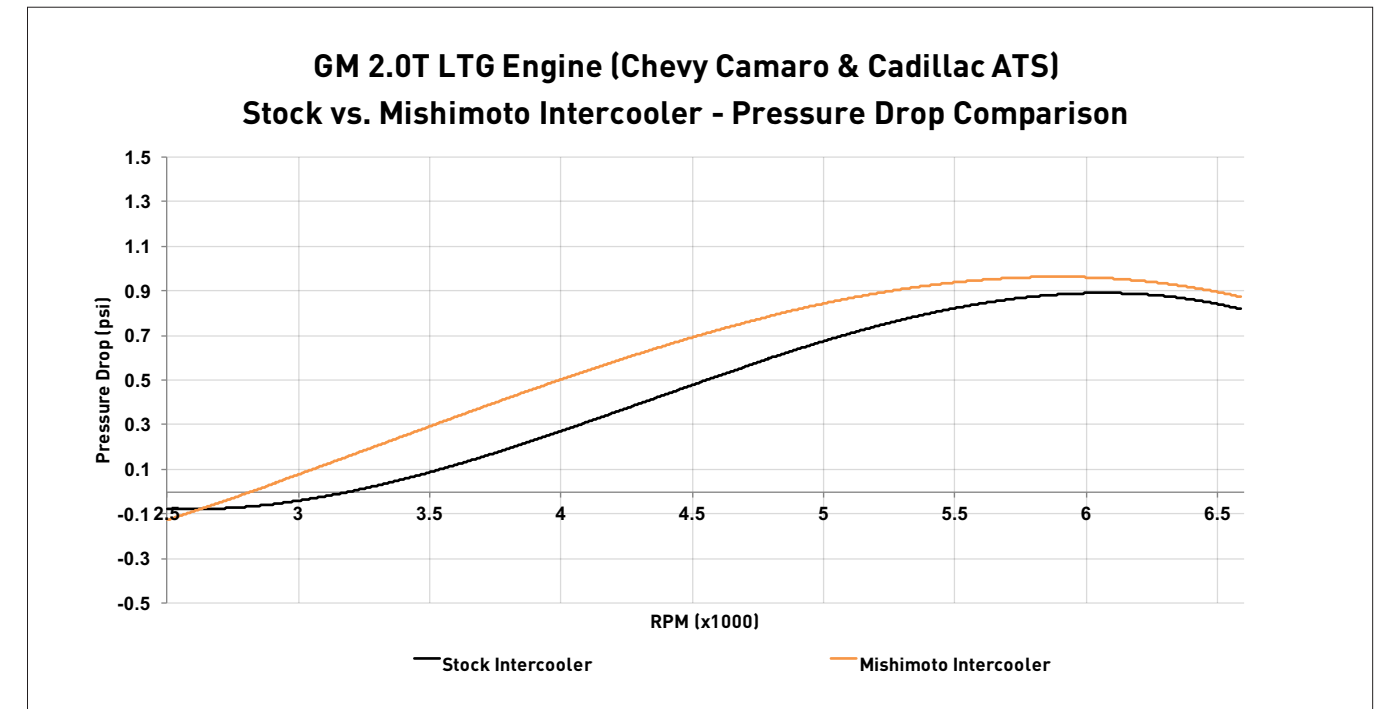


FIGURE 6: The Mishimoto intercooler showed an overall pressure drop of less than 1 psi, which is well within the desirable range.

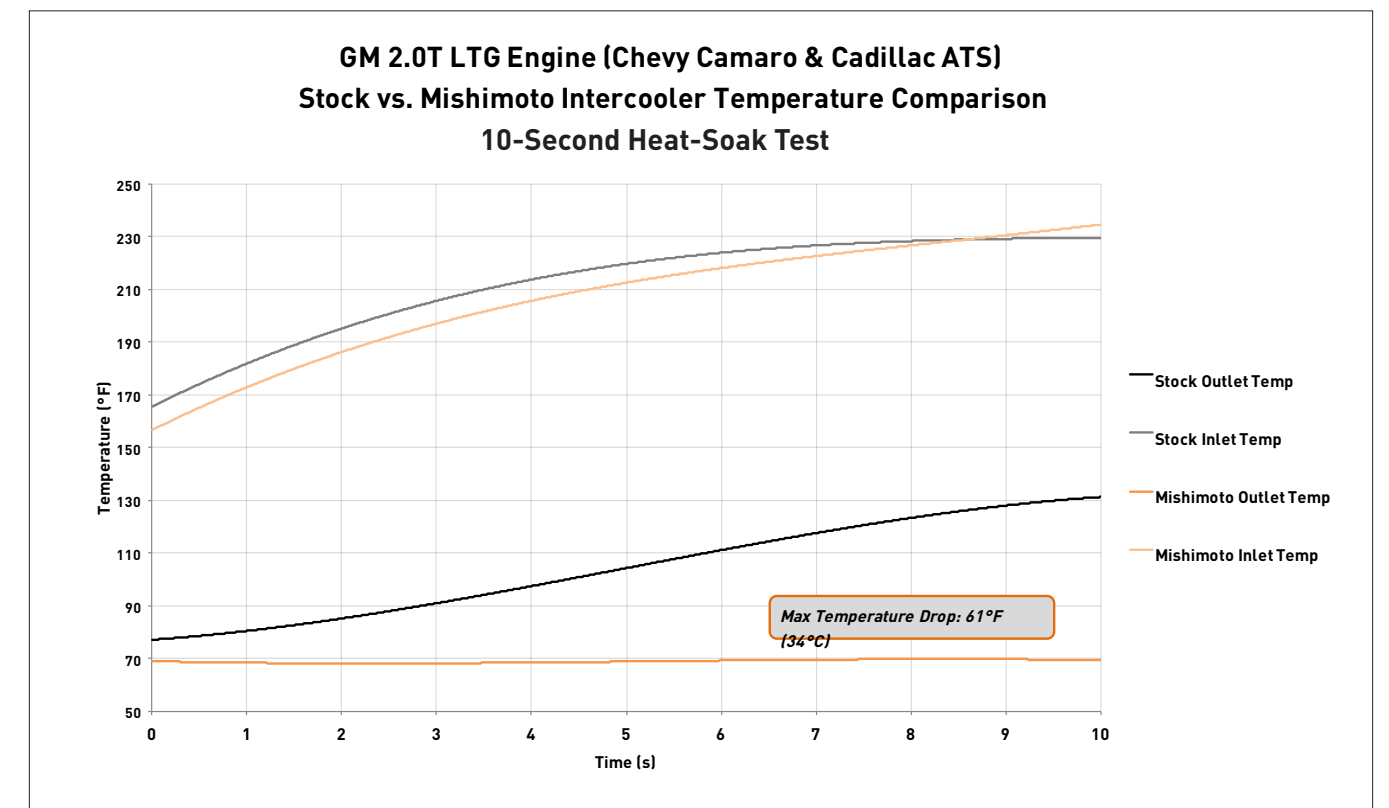


FIGURE 7: Both intercoolers were held at full throttle for ten seconds to heat soak each core as much as possible.

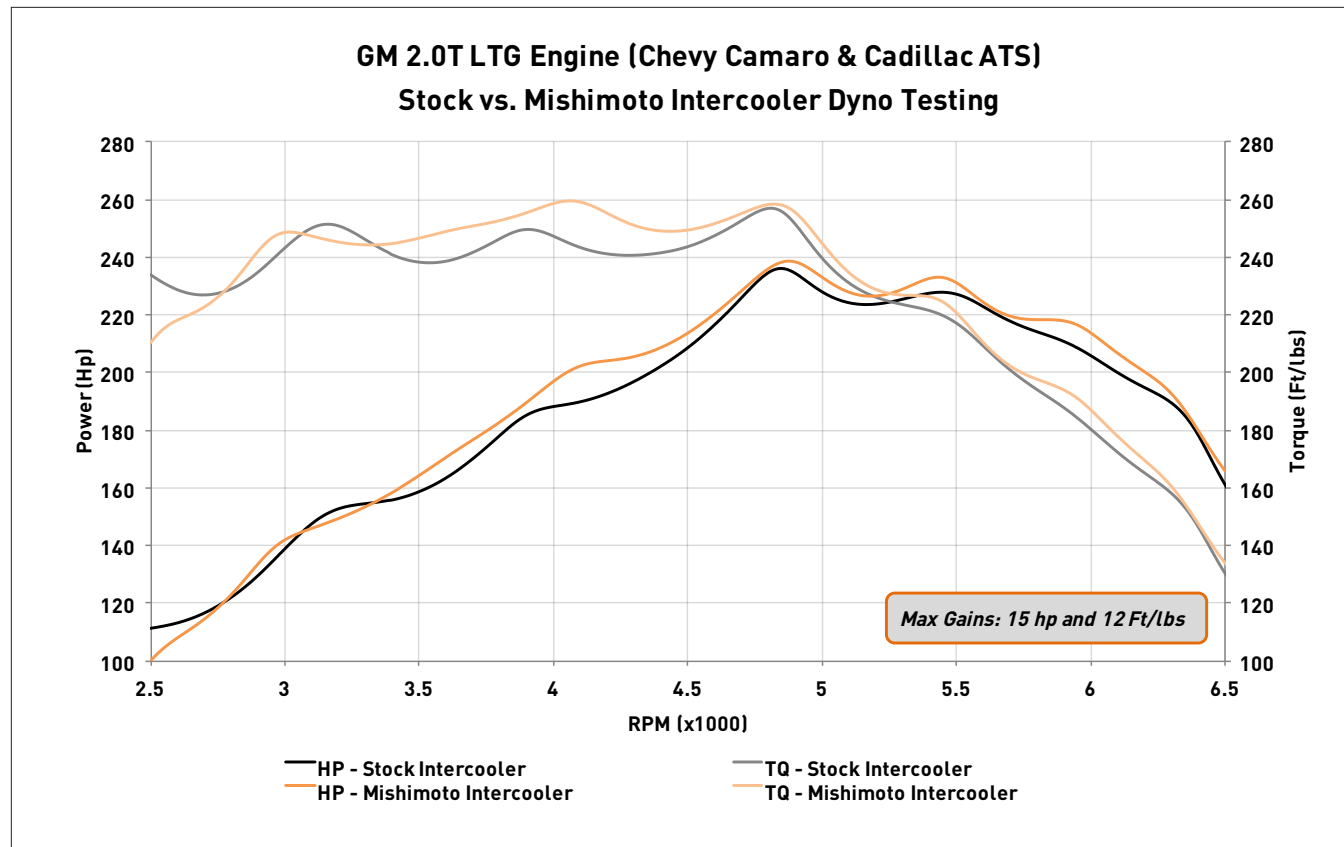


FIGURE 8: The Mishimoto intercooler showed power gains over stock due to an increase in internal flow volume and lower outlet charge-air temperatures.

As seen above in Figure 8, the Mishimoto intercooler showed power gains of up to 15 hp and torque gains of up to 12 ft-lb. This is likely due to a combination of lower charge-air temperatures and an increase in internal volume.

The Mishimoto intercooler is an excellent upgrade for all Camaro 2.0T owners who are driving in hot climates, have a performance

tune loaded, or want power levels to remain consistent under hard driving conditions.

Steve Wiley
Product Engineer, Mishimoto Automotive

FOLLOW US

Mishimoto is very active on social media so we can be in constant contact with our customers. Our Social Media Team is available via Facebook, Instagram, Twitter, YouTube, Google+, our Engineering Blog, and forums. We sponsor contests and promotional events, so be sure to follow us.



GoMishimoto



#Mishimoto



Mishimoto



+Mishimoto



Mishim0t0



Engineering.
Mishimoto.com

CONTACT US

EMAIL

For sales and technical questions please contact support@mishimoto.com

BY PHONE

USA: 877.466.4744
International: +1.302.762.4501
Fax: 302.762.4503

MAIL

Mishimoto
18 Boulden Circle, Suite 10
New Castle, DE 19720

VISIT

Mishimoto.com
Mishimoto.co.uk
Mishimoto.eu





ENGINEERING REPORT

2016+ Chevy Camaro 2.0T Intercooler Piping | SKU: MMICP-CAM4-16

By Steve Wiley, *Mishimoto Engineer*

REPORT AT A GLANCE

- **Goal:** Design direct-fit intercooler piping that reduces system restriction and improves durability over the stock components.
- **Results:** The Mishimoto intercooler piping showed respectable power gains of up to 11 hp and 9 ft-lb of torque. This increase is likely due to the mandrel-bent aluminum piping's ability to reduce overall system restriction, and its resistance to expansion under full boost.
- **Conclusion:** This piping kit is far more durable than the stock plastic and rubber pieces, and will fit in the Camaro without any cutting or permanent modification needed. The Mishimoto intercooler pipes help to improve power and flow, increase durability, and create a more aesthetically pleasing engine bay.

CONTENTS

PG	1	— DESIGN OBJECTIVES
		— DESIGN AND FITMENTS
PG	2	— PERFORMANCE TESTING

DESIGN OBJECTIVES

The design requirements assigned to this project are as follows:

- Design intercooler piping that improves flow and reduces overall system restriction.
- Must be a direct fit with no cutting or permanent modification necessary.
- Piping should include an NPT-tapped bung to allow customers to run a methanol injection system if desired.

DESIGN AND FITMENTS

We began the R&D process by evaluating the stock piping and finding potential room for improvement. The stock hot-side pipe is relatively small and includes bends that can be reduced. The Mishimoto pipe increases internal volume by 29% and is made to reduce bends where possible to improve flow. The same approach was used when designing the cold-side piping. Internal volume was increased by 31% and an NPT-tapped bung was included in the design of the cold-side pipe to support a methanol injector if desired.



FIGURE 1: The Mishimoto intercooler piping is made from mandrel-bent aluminum piping to reduce bend angles and improve flow.

As shown in Figure 1, the Mishimoto intercooler piping features mandrel-bent aluminum, silicone couplers, and CNC quick-disconnect fittings to ensure a reliable and direct fit.

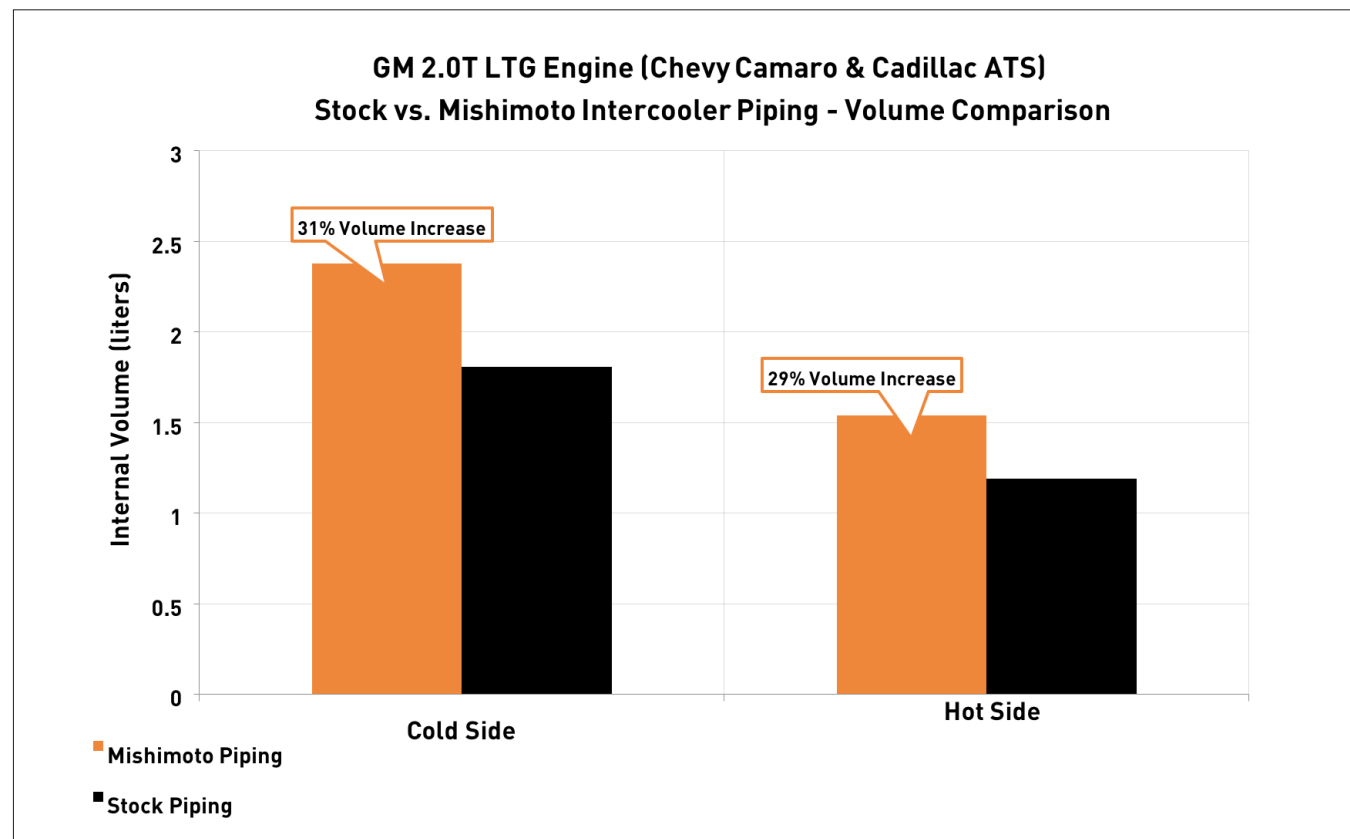


FIGURE 2: The Mishimoto intercooler piping increases internal volume when compared to stock. This helps to reduce system restriction caused by the piping.

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 2016 Chevy Camaro was used for testing. The ambient temperature on the day of testing was approximately 65°F (18°C) with 45% humidity. To test the performance increases of the intercooler pipes, a Dynapack™ dynamometer was used to record horsepower (HP) and torque (TQ) output of the vehicle.

To test the performance gains of the Mishimoto intercooler piping, the Camaro was bolted to the Dynapack, and baseline pulls were made on the completely stock car. The same test was performed with both the Mishimoto hot-side and cold-side pipes installed. The average dyno plot from each test was chosen and plotted against the average baseline pull. These results are shown in Figure 4 below.



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

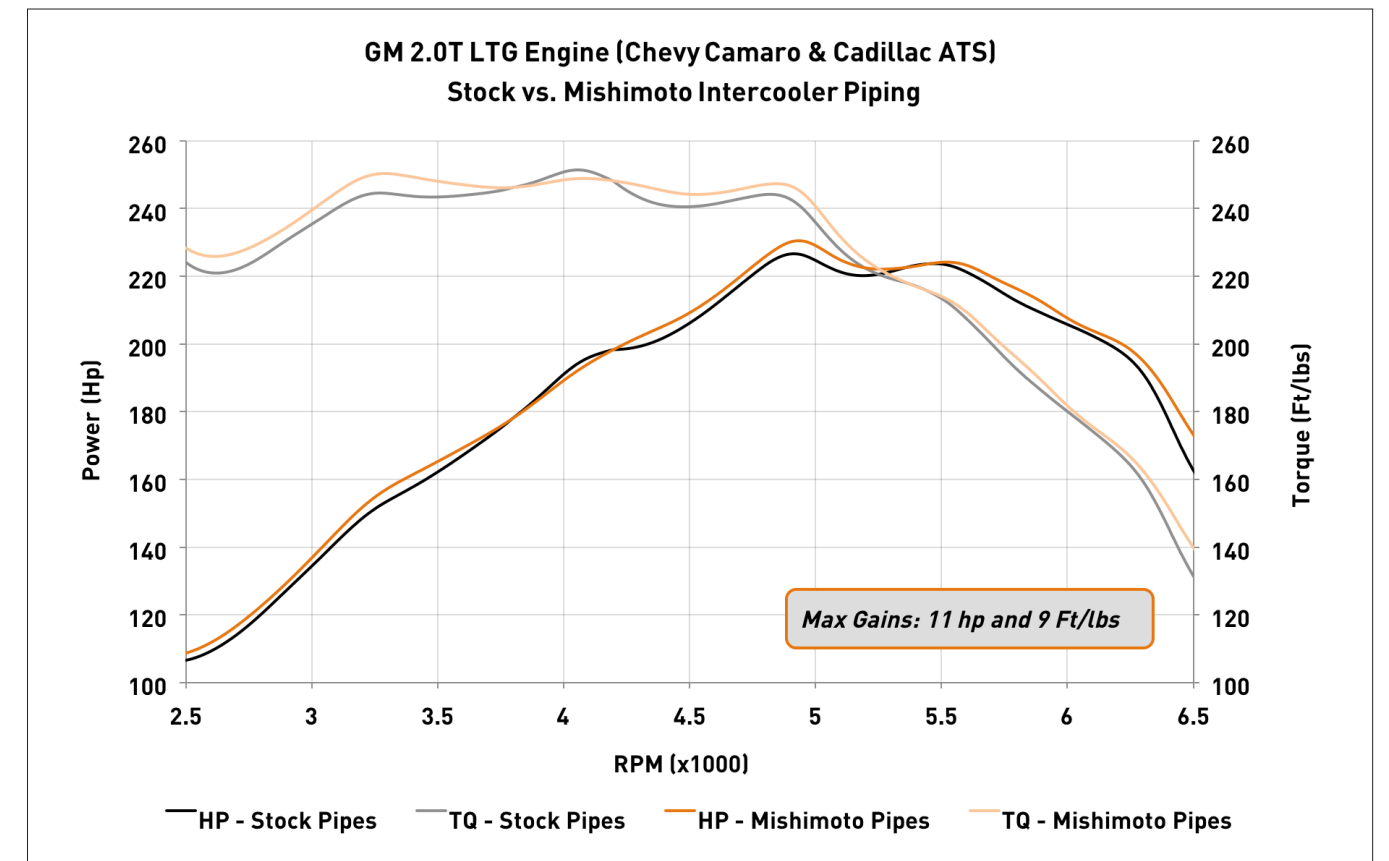


FIGURE 4: The Mishimoto intercooler piping showed top-end power and torque gains when compared to a fully stock car.

The Mishimoto intercooler piping created power over stock, especially as the engine approached redline.

Due to less overall restriction in the system and a more free-flowing design, the Mishimoto intercooler piping made max gains of 11 hp and 9 ft-lb of torque.

Because the Mishimoto piping is made from mandrel-bent aluminum and 5-ply silicone, it will better resist expansion under high boost pressures when compared to the stock rubber hose portions.

A flow bench was used to determine the increase in flow provided by the Mishimoto intercooler piping. The flow bench can measure pressure drop at a specified flow and can therefore show a relative change from the stock to Mishimoto intercooler piping design. The

cold-side piping showed similar results, which was expected as the packaging of the Camaro does not allow for much reduction of bend angles. The hot-side piping showed a flow increase of up to 20%, which is likely due to the increased volume that immediately follows the turbo outlet. The results for flow testing can be seen below in Figure 5.

The Mishimoto intercooler piping reduces pressure drop, which translates to reduced restriction. This reduced restriction will allow the engine to breathe better as it requires less effort to move the air from the turbo to the throttle body.



Steve Wiley
Product Engineer, Mishimoto Automotive

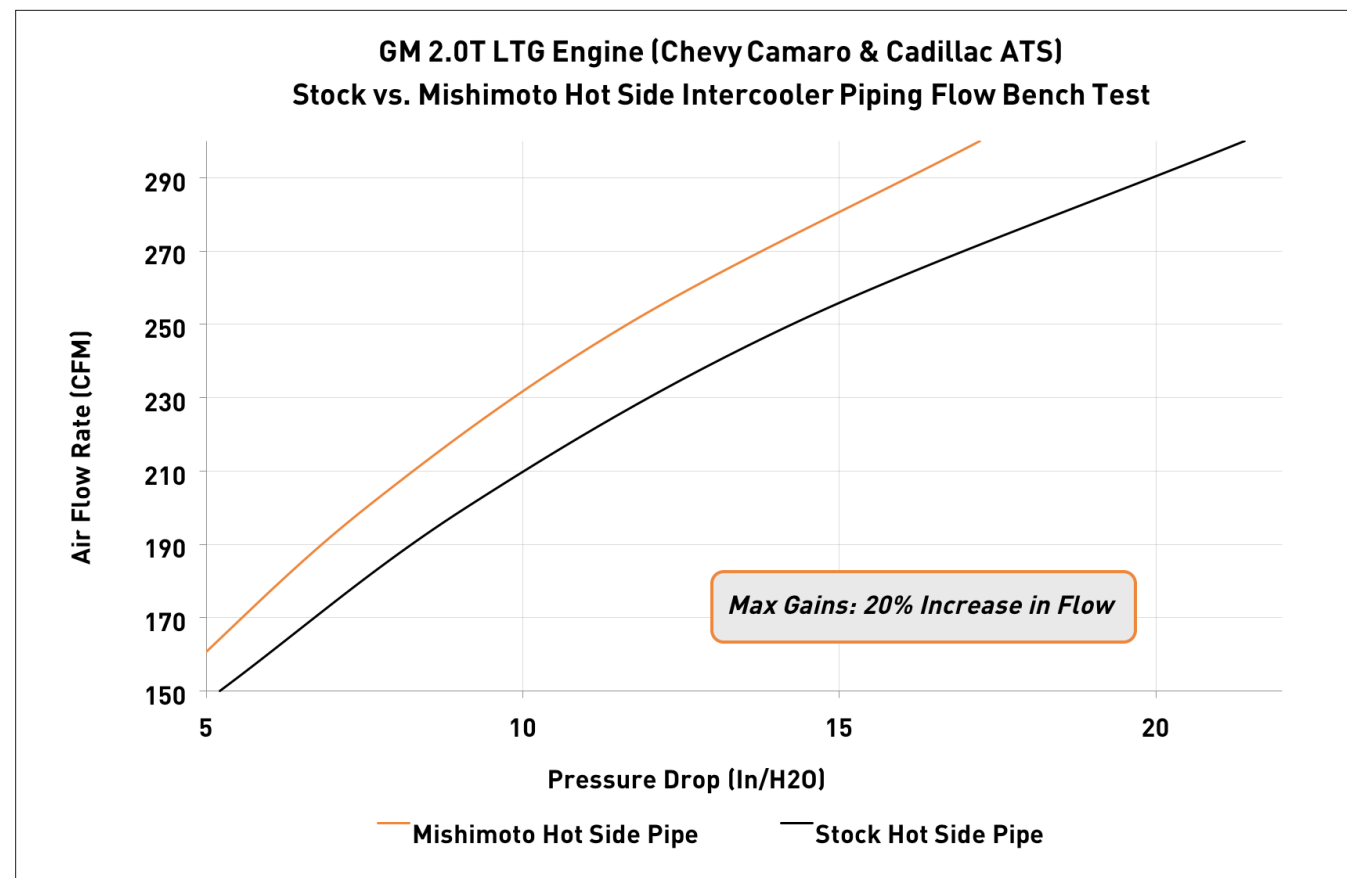


FIGURE 5: The Mishimoto intercooler piping flows up to 20% better than the stock design

FOLLOW US

Mishimoto is very active on social media so we can be in constant contact with our customers. Our Social Media Team is available via Facebook, Instagram, Twitter, YouTube, Google+, our Engineering Blog, and forums. We sponsor contests and promotional events, so be sure to follow us.



CONTACT US

EMAIL

For sales and technical questions please contact support@mishimoto.com

BY PHONE

USA: 877.466.4744
International: +1.302.762.4501
Fax: 302.762.4503

MAIL

Mishimoto
18 Boulden Circle, Suite 10
New Castle, DE 19720

VISIT

Mishimoto.com
Mishimoto.co.uk
Mishimoto.eu

