Revised AEM-21-699 DRYFLOW Cold Air Intake
2007-2010 MINI Cooper S and Clubman S 1.6L Turbo
Engineering R&D Summary

Updated: 05/10/2012

The 1.6L engine in the MINI Cooper S and Clubman S may be small, but it is packed with the latest technology. An intercooled twin-scroll turbocharger feeds air into the direct-injected engine with variable valve timing to produce over 173HP at the crank. To extract even more power from MINI's already award-winning turbocharged engine, AEM engineering decided to capitalize on the non-functional hood vent on the MINI Cooper S --by making it functional, of course. Initially, a prototype intake was designed from sheet metal with a "half-clam shell" hood scoop mounted under the hood, similar to a competitor intake. But it was unsuccessful, resulting in high IAT's (Intake Air Temperatures) due to extreme underhood heat. So a new design was conceived to keep IAT's near outside ambient air temperature with the following new features:

- A Cold-Air Hood Scoop was designed using CFD analysis and made from a high-temperature, light-weight composite material. The hood scoop was mounted under the hood to create a "ram-air" effect, directing cool outside air through vehicle hood vent and into a large AEM NO OIL DRYFLOW filter mounted inside a sealed air box.
- The restrictive stock grill behind the vehicle hood vent was removed to allow full air flow into the AEM Cold Air Hood Scoop.
- The OE MAF sensor housing was enclosed in the new AEM air box to protect it from underhood heat.
- A large "split grommet" designed to allow the MAF sensor connector to pass into the new airbox while sealing out hot underhood air from the AEM airbox.
- An aerospace grade silicone foam gasket seal was added between the AEM Hood Scoop and the airbox to further seal out engine heat. A special catalyst bonding process was used to ensure no peeling of the gasket in service.
- A larger bulb edge seal was added at the Cold Air Hood Scoop inlet to further seal out hot underhood air.
- A powder-coated multi-layer aluminum heat shield was mounted over the turbocharger to further protect the composite AEM Hood Scoop and incoming air from high engine temperatures.
- Two contoured elbow couplers were designed using CFD analysis and made from durable OEM-grade rubber to direct cool intake air smoothly into the airbox and then into the turbocharger.
- CFD analysis was also used to optimize the size and number of pleats on the AEM NO OIL DRYFLOW air filter and to determine the size of the aluminum intake tube, maximizing mid-range torque and high-end power.
- An AEM Filter Minder Gauge was added to indicate when it's time to clean the reusable synthetic DRYFLOW filter.
- Flow bench testing of rapid-part prototypes was used to validate the basic design, confirming a clean MAF signal and maximizing air flow over the stock intake.
- For extreme weather conditions, our AEM 1-4007 Pre-Filter Air Filter Wrap is available for added peace of mind.

The MINI Cooper S test vehicles were instrumented with an on-board DAQ (Data Acquisition) system and thermocouples mounted in several critical locations, then road tested to further optimize the design. The final results were IAT's consistently 25-30°F lower than stock at the MAF sensor and 10-15°F lower than stock entering the intake manifold (after the turbocharger and intercooler). See Figures 1, 2, and 3.

Figure1: Rapid Prototype AEM Intake with Cold-Air Hood Scoop instrumented with thermocouples for temperature testing:

Figure 2: IAT's at MAF sensor after warm-up. AEM's intake ran up to 48 degrees cooler than stock on a 65˚F day.

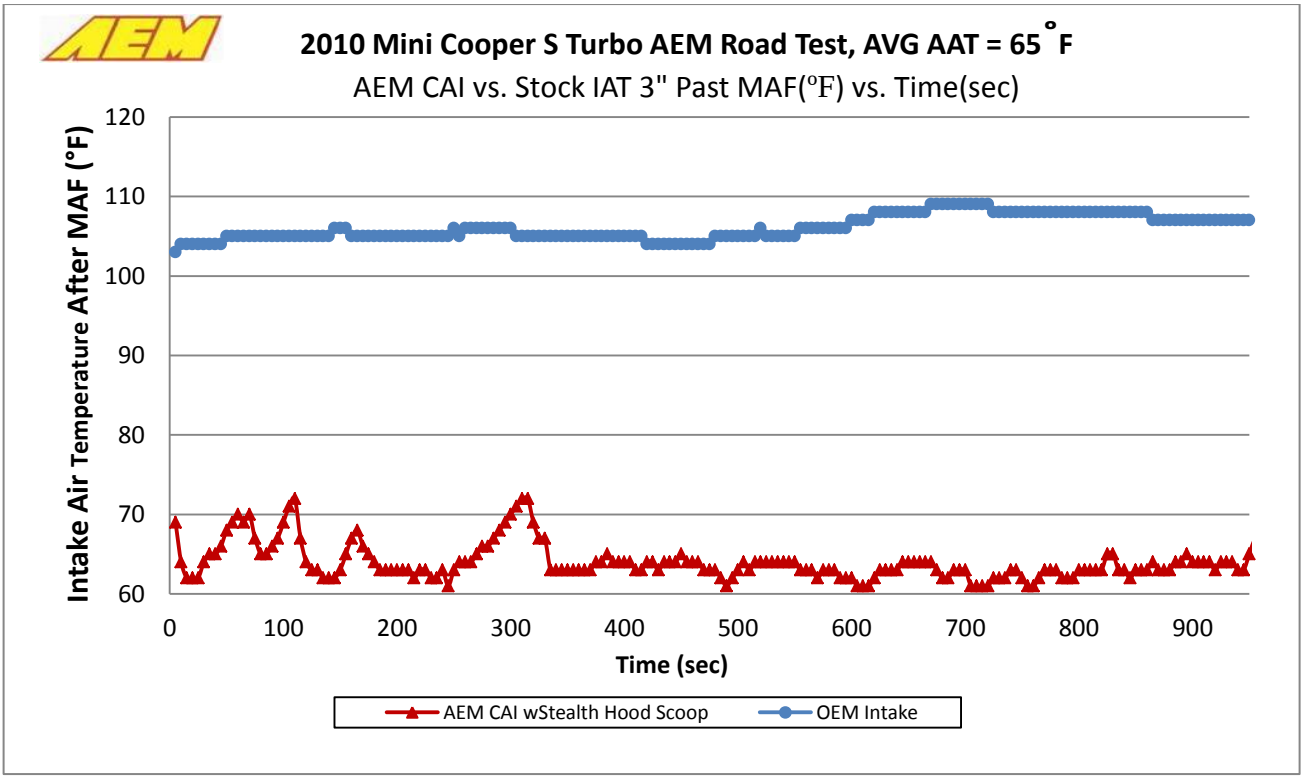


Figure 3: Intake Manifold Air Temperature, AEM Cold Air Intake vs. stock intake.

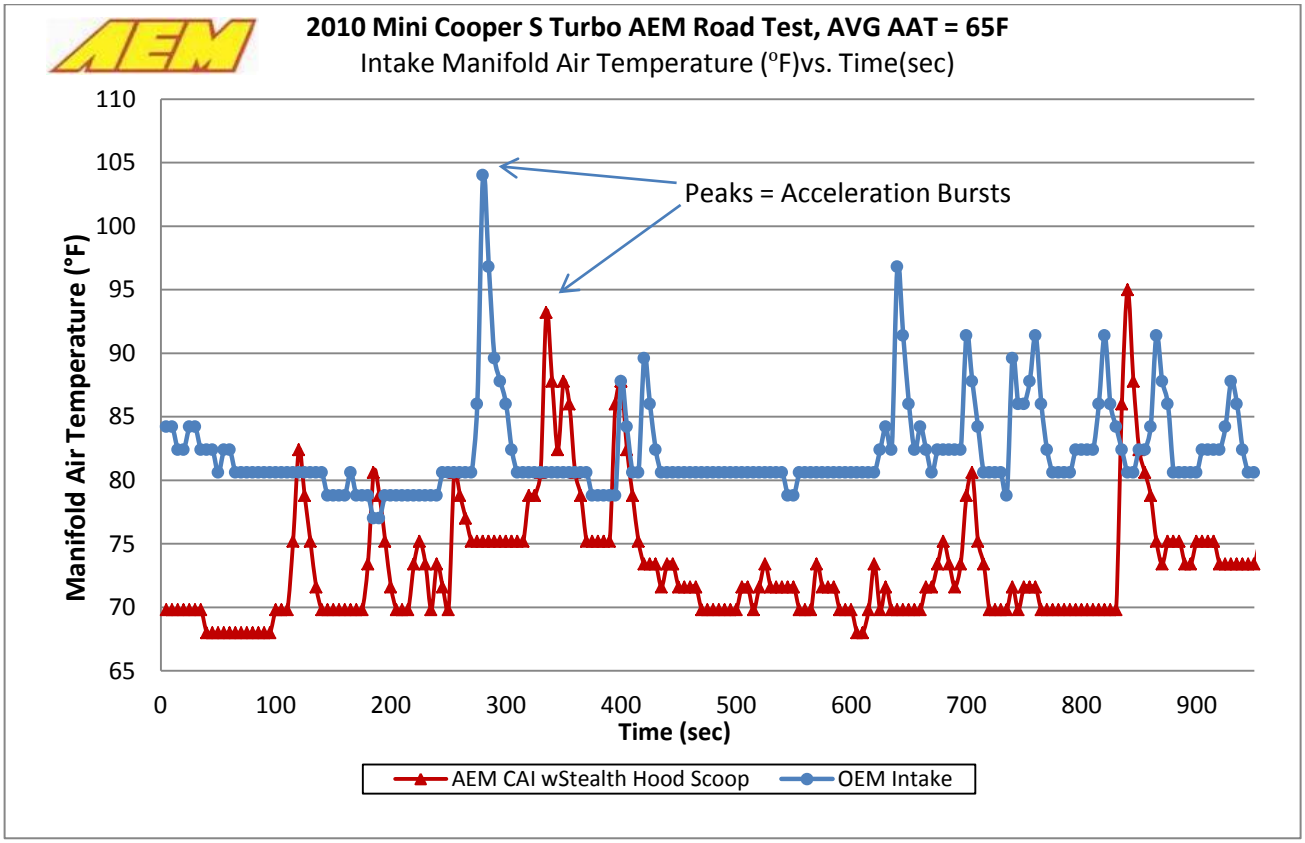


Figure 4: CFD Analysis of AEM-21-699 Intake with Cold Air Hood Scoop for Mini Cooper S Turbo. Note that color represents air velocity.

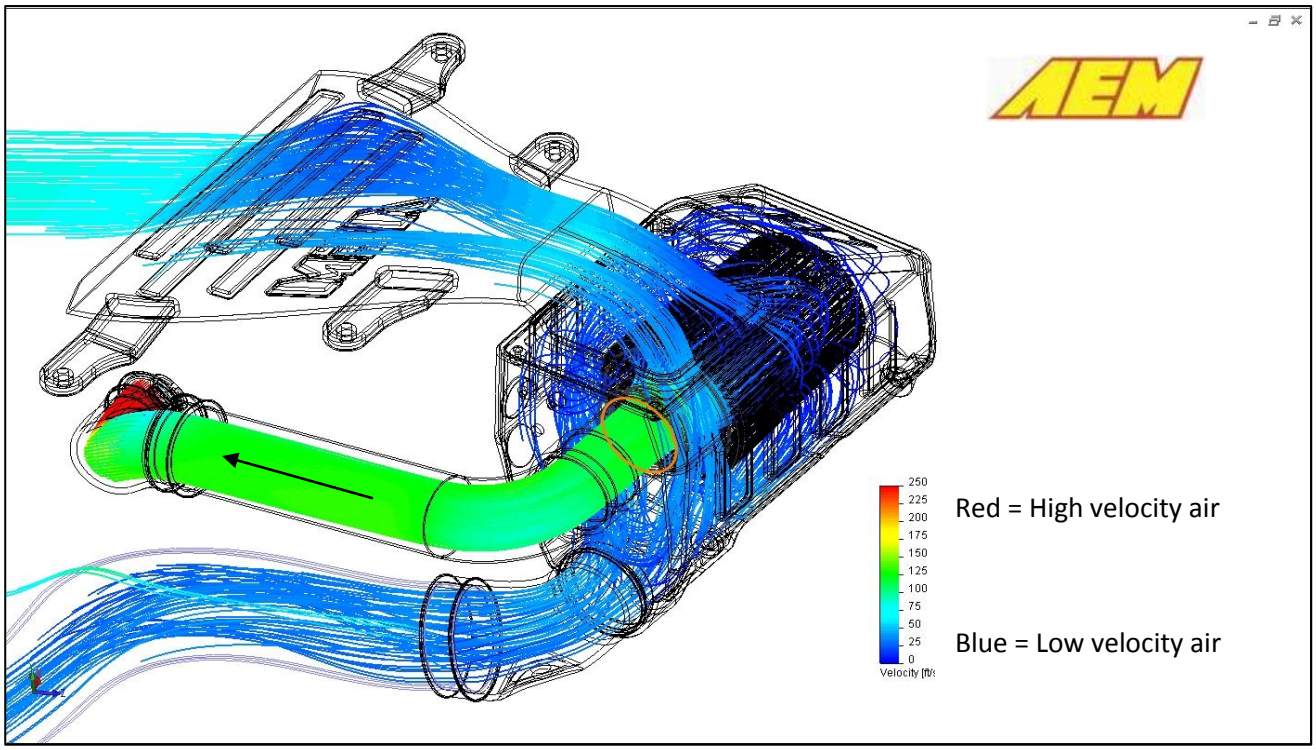


Figure 5: Road test data confirmed that the AEM-21-699 Cold Air Intake ran well within stock fuel trims. No tuning required.

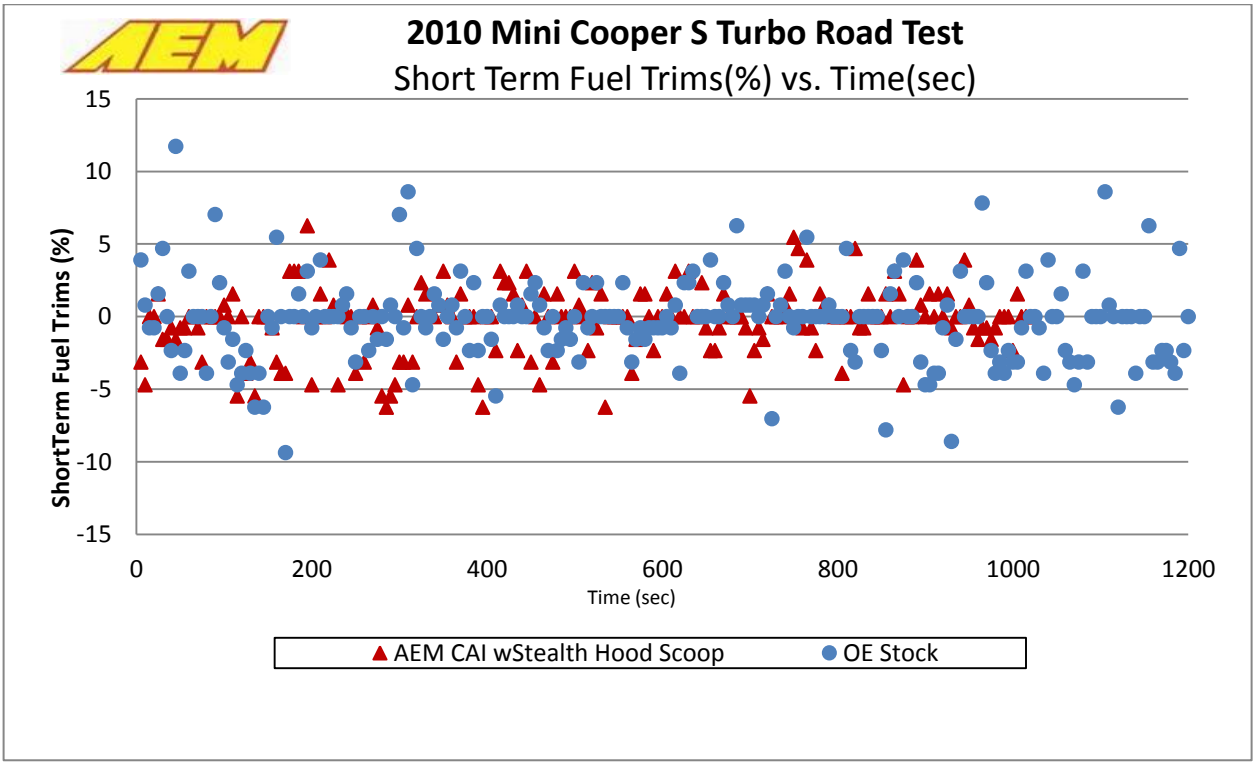
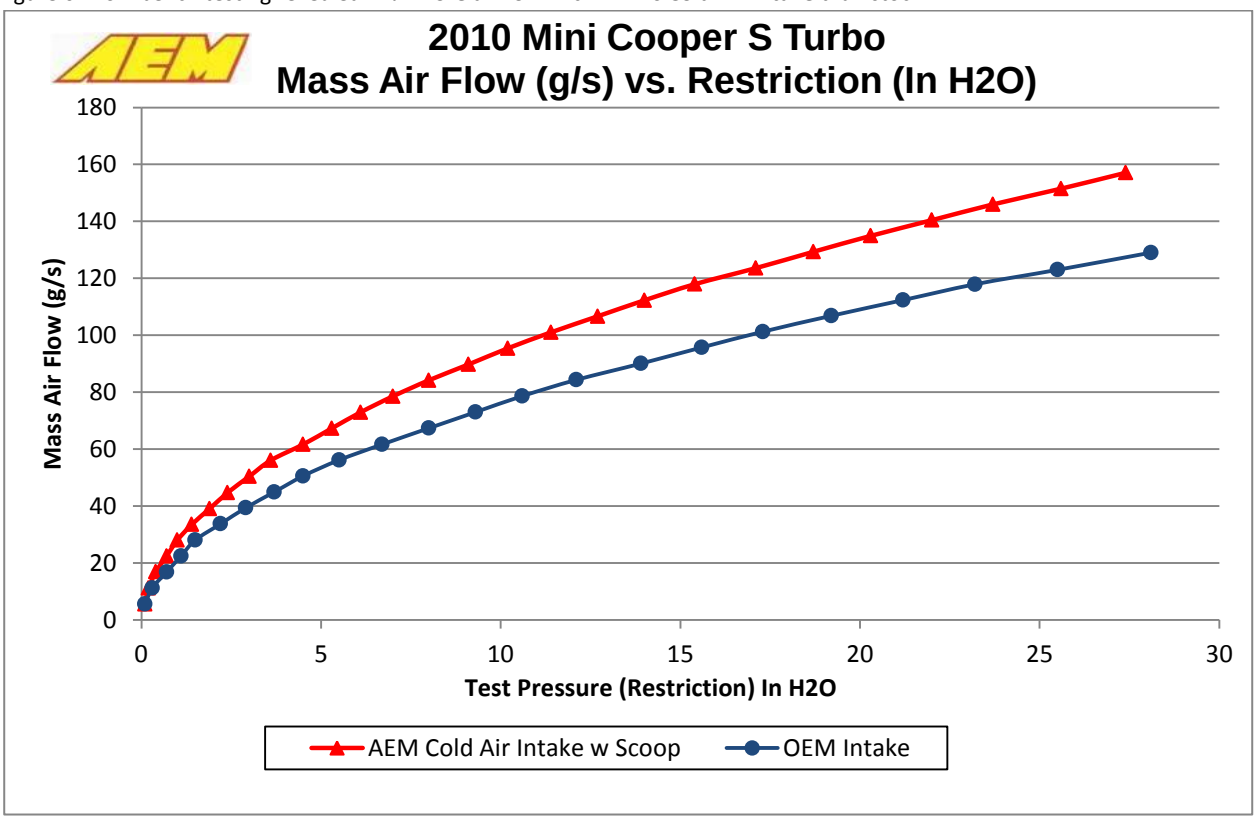


Figure 6: Flow bench testing revealed **22% more airflow with AEM's Cold Air Intake** than stock.



Vehicle dyno testing with the AEM intake yielded maximum gains of **14.14HP** at 5400RPM and **11.3 ft-lbs** of torque at 3400RPM over the stock intake. Peak HP and torque also increased from 152HP and 131 ft-lbs stock to **164HP** and **137 ft-lbs** at the wheels with the AEM Cold Air Intake. Click here for Dyno Chart. No additional tuning is required. Finally, no CEL's (Check Engine Lights) were encountered after over 60 road tests and dyno pulls. Overall, eight new vehicle-specific parts were designed and engineered for the AEM-21-699-1 Mini Cooper S and Clubman S Turbo Cold Air Intake kit. (See Figure 7) Just bolt it on, plug it in, and GO!

Figure 7: Final AEM-21-699 Cold Air Intake System, Released May 2012