

SAE J1723 Compliant Supercharger Test Rig

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Abstract

Superchargers are expected to meet the standards established by the Society of Automotive Engineers (SAE). As such, aftermarket suppliers must undergo rigorous testing of their superchargers to ensure compliance with the SAE-J1723 standard test. It has been the intent of this project to design and build a test rig that will run this standard test on a variety of systems, thereby providing Whipple with accurate data on their superchargers and giving them the tools necessary to improve them.

The test rig will be powered by a variable-frequency drive and controlled using LabVIEW, enabling the operator to control the motor speed, display the data, and perform calculations. The exhaustive design process includes numerous iterations of finite element and fluid dynamic analyses, integrating proper instrumentation, withstanding high motor speeds, and accommodating multiple interfaces. The final prototype will incorporate these elements, and seamlessly integrate the manufactured parts with the purchased equipment.

Whipple Superchargers Setup



Twin Screw Whipple Supercharger

Incomplete Test Rig

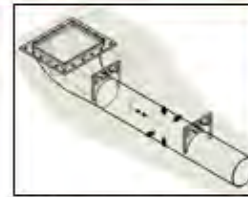
Model	HP	Inlet Flow Rate (m³/min)	Inlet Flow Rate (lb/min)	Max Flow Rate (m³/min)	Max Flow Rate (lb/min)	Temp (°F)
W200AR	10000.00	12.1087	82.272	12.217	82.679	19.89
W200AR	10000.00	12.1087	82.272	12.217	82.679	24.14
W200AR	10000.00	12.1087	82.272	12.217	82.679	28.37
W200AR	10000.00	12.1087	82.272	12.217	82.679	32.60
W200AR	10000.00	12.1087	82.272	12.217	82.679	36.83
W200AR	10000.00	12.1087	82.272	12.217	82.679	41.06
W200AR	10000.00	12.1087	82.272	12.217	82.679	45.29
W200AR	10000.00	12.1087	82.272	12.217	82.679	49.52
W200AR	10000.00	12.1087	82.272	12.217	82.679	53.75
W200AR	10000.00	12.1087	82.272	12.217	82.679	57.98
W200AR	10000.00	12.1087	82.272	12.217	82.679	62.21
W200AR	10000.00	12.1087	82.272	12.217	82.679	66.44
W200AR	10000.00	12.1087	82.272	12.217	82.679	70.67
W200AR	10000.00	12.1087	82.272	12.217	82.679	74.90
W200AR	10000.00	12.1087	82.272	12.217	82.679	79.13
W200AR	10000.00	12.1087	82.272	12.217	82.679	83.36
W200AR	10000.00	12.1087	82.272	12.217	82.679	87.59
W200AR	10000.00	12.1087	82.272	12.217	82.679	91.82

Motor Operating Characteristics

Preliminary Designs



A sliding mechanism was designed so that the system can be moved until the motor and supercharger pulleys are inline.



Exhaust design with a smooth transition.



Exhaust design with a plenum



Initial test rig assembly. The exhaust system was moved to under the table to add more work space.

Final Assembly



Sliding table design with rail and L-bracket supports



Back view of assembled super-charger



Side view of assembled super-charger

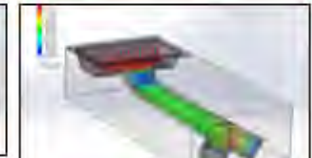


Front view of assembled super-charger

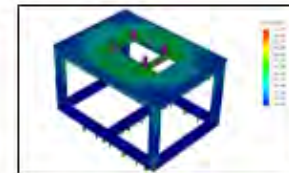
Simulations



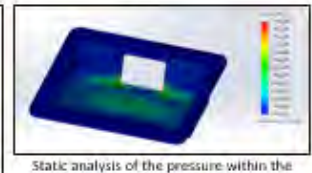
Flow analysis of the pressure in the inlet of the system



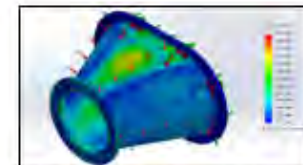
Flow analysis of the pressure in the exhaust of the system



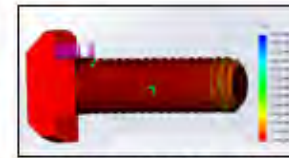
Static analysis of the table top and supports



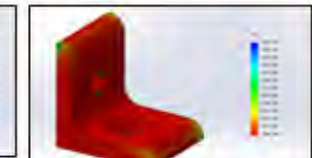
Static analysis of the pressure within the plenum



Static analysis of the pressure within the inlet transition



Static analysis of the bolts used for the sliding table support



Static analysis of the L-bracket used for the sliding table support



Static analysis of the railing used for the sliding table support