

**PROJECT PROFILE**

EQUIPMENT: Radiator, Oil Cooler and Charge Air Cooler Calorimeter

Customer: U.S. ARMY (TARDEC)

Location: Warren, MI

Year Completed: 2012



1.0 EQUIPMENT DESCRIPTION

Climatic Testing Systems (CTS) has designed, manufactured and installed a Calorimeter Test Facility for testing large Radiators, Oil Coolers, Intercoolers and Charge Air Coolers used in military vehicles. The state of the art test facility is designed to automatically test military heat exchangers with capacities up to 528 kW (1,800,000 BTUH).

The test facility includes a recirculating wind tunnel with airflow capacities up to 50,000 CFM, temperature conditioning system, radiator fluid test loop, oil test loop, charge air test loop, instrumentation and controls, LabVIEW Control Software.

This equipment was also used to provide 12,000 cfm of air to the filtration lab where air filters for military vehicles were tested. The filtration lab was also designed, manufactured and installed by CTS.

2.0 PERFORMANCE SPECIFICATIONS

2.1 Calorimeter Air Flow Conditioning and Re-Circulation	
<ul style="list-style-type: none"> Dry Bulb Temperature Range (Inlet to UUT) 	Ambient to 250°F (Heating of air for Radiator Testing by UUT)
<ul style="list-style-type: none"> Air Flow Range (Re-Circulated with ambient Air Make-Up) 	1,000 SCFM to 50,000 SCFM Parallel Blowers 12,000 & 40,000 SCFM
<ul style="list-style-type: none"> Relative Humidity Range (Filtration Testing Only) 	30 to 65% RH ±2%RH @ 70 to 90°F±2°F Dew Point low limit: 41°F For variable air flow 1,000 SCFM to 12,000SCFM
<ul style="list-style-type: none"> Cyclic Air Flow for Filtration Tests apparatus 	Discrete Steps within 1,000 to 12,000 SCFM Max. Deceleration rate of 40% speed change in 10 sec. Max. Acceleration rate of 80% speed change in 10 sec.
<ul style="list-style-type: none"> Secondary Duct Circuit Cooling (Return to Filtration Lab) 	Provisions to extract up to 12,000 SCFM after the coils. Provisions for return of up to 12,000 SCFM at the inlet of calorimeter UUT
<ul style="list-style-type: none"> UUT Differential Pressure 	0 to 20" H ₂ O for Air Flow > 12,000 SCFM 0 to 80" H ₂ O for Air Flow < 12,000 SCFM
<ul style="list-style-type: none"> Air Flow Control Stability 	±1.0% of Flow @ Steady State
<ul style="list-style-type: none"> Air Flow Measurement Accuracy 	±0.5% of Flow
<ul style="list-style-type: none"> Temperature Control Stability 	±1.0°F @ Steady State

2.1 Calorimeter Air Flow Conditioning and Re-Circulation	
• Temperature Measurement Accuracy (Before & After UUT)	±0.5°F (Psychrometric Sampler before and after UUT)
• Relative Humidity Control Stability (Filtration Air Only)	±2.0%RH
• Relative Humidity Measurement Accuracy (Filtration Air Only)	±1.0%RH
• Air Flow Measurement Method	ASHRAE Std. 33 Code Tester Tunnel Automatic Selection of Nozzles Total 6 Nozzles (7.000", 7.500", 10.500", 10.500", 14.000", 18.000", 24.000")

2.2 Coolant supply Loop Specifications – Radiator Test	
• Coolant	Water with 3% rust inhibitor 100% Ethylene Glycol 100% Propylene Glycol 100% Glycerin Any Mix in between or other coolants.
• Flow Rate	10 to 300 GPM
• UUT Differential Pressure	0 to 25 PSI
• Flow Rate Control Stability	±1.0% of Flow rate @ Steady State
• Flow Rate Measurement Accuracy	±0.5% of Flow rate
• Coolant Inlet Temperature to UUT	125°F to 350°F
• Maximum Heat Rejection	30,000 BTU/min
• Temperature Control Stability	±1.0°F @ Steady State
• Temperature Measurement Accuracy (Before & After UUT)	±0.5°F
• Coolant Pressure at UUT Inlet	0 to 125 PSI
• Coolant Pressure Control Stability	±1.0 PSI
• Pressure Measurement Accuracy (Before & After UUT)	±0.15 % of range

2.3 Coolant Supply Loop Specifications – Intercooler Test	
• Coolant	Water with 3% rust inhibitor 100% Ethylene Glycol 100% Propylene Glycol 100% Glycerin Any Mix in between or other coolants.
• Flow Rate	10 to 300 GPM
• UUT Differential Pressure	0 to 25 PSI
• Flow Rate Control Stability	±1.0% of Flow rate @ Steady State
• Flow Rate Measurement Accuracy	±0.5% of Flow rate
• Coolant Inlet Temperature to UUT	125°F to 350°F
• Maximum Cooling Capacity	18,000 BTU/min
• Temperature Control Stability	±1.0°F @ Steady State
• Temperature Measurement Accuracy (Before & After UUT)	±0.5°F

2.4 Charge Air Supply Test Loop	
• Charge Air Flow Rate	30 to 150 lbs/min
• UUT Differential Pressure	0 to 200" H ₂ O
• Flow Rate Control Stability	±1.0% @ Steady State
• Flow Rate Measurement Accuracy	±0.5% of Flow rate
• Inlet Pressure Range	15 to 90 PSIG
• Inlet Pressure Control	±1.0 PSI
• Inlet Temperature to UUT	150°F to 650°F
• Inlet Temperature Control Stability	±2.0°F @ Steady State
• Temperature Measurement Accuracy (Before & After UUT)	±1.0°F
• Maximum heating Capacity	18,000 BTU/min

2.5 Oil Supply System Test Loop Specifications	
• Oil Types	Transmission Oil Engine Oil
• Flow Rate	10 to 150 GPM
• UUT Differential Pressure	0 to 150 PSI
• Flow Rate Control Stability	±1.0% of Flow rate @ Steady State
• Flow Rate Measurement Accuracy	±0.5% of Flow rate
• Oil Inlet Temperature to UUT	175°F to 350°F
• Temperature Control Stability	±1.0°F @ Steady State
• Temperature Measurement Accuracy (Before & After UUT)	±0.5°F
• Oil System Pressure	0 to 350 PSI
• Oil System Pressure Control Stability	±1.0 PSI
• Pressure Measurement Accuracy (Before & After UUT)	±0.15 % of range

3.0 CONTROLS

The calorimeter system utilized an Allen-Bradley CompactLogix Programmable Logic Controller to perform all machine control and alarm monitoring. A large color touch panel HMI was supplied to provide the operator with manual control of the systems.

CTS provided a National Instruments data acquisition system and a LabView applications program to automatically execute all test sequences, collect all data, perform calculations and create report.