U.S. ARMY

DEVCOM GROUND VEHICLE SYSTEMS CENTER

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND GROUND VEHICLE SYSTEMS CENTER

Propulsion System Laboratory (PSL) - Capabilities Overview

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Ground Vehicle Power & Mobility Test & Integration

Always Moving

Building 212A & 212B
Detroit Arsenal

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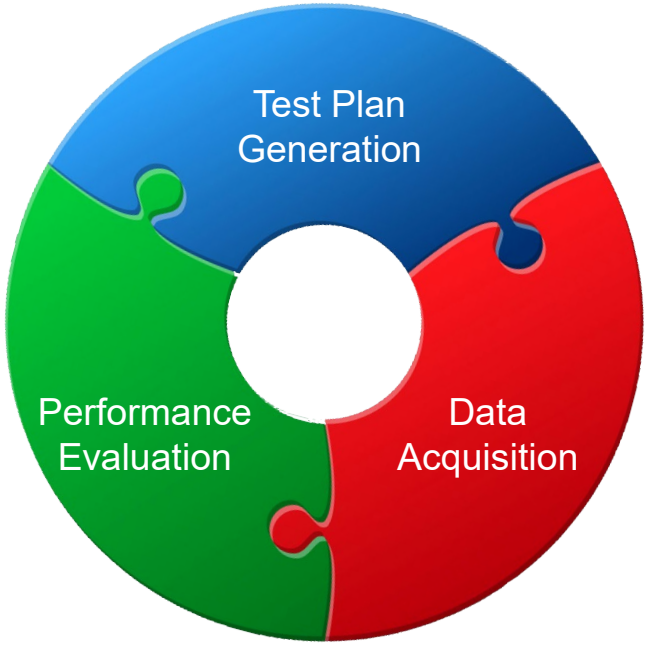
Test & Integration Support

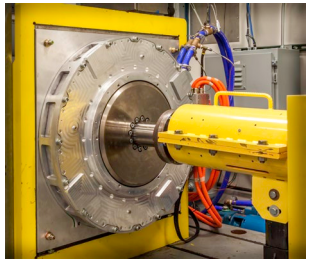
Purpose: Manage, develop, and support integrated life cycle Test and Integration (T&I) services. Provide strategy to innovatively test for performance and reliability of ground systems, and mitigate risks associated with the deployment of ground systems while ensuring timely focus on reliability and maintainability requirements.

- **TRL Maturation**
- **Requirements Testability**
- **Subsystem Integration**
- **Developmental/Operational Test Management**
- **Engineering Change Validation**
- **T&I Efficiencies**



Technology Maturation → ***Subsystem Integration*** (A) → ***System Level DT*** (B) → ***System Level OT*** (C) → ***Engineering Changes***

Best Practices
Similar System Analysis
Efficient / Effective Testing



Increased Utilization of available data (HWIL, M&S, Physical Simulation, Proving Ground)

Propulsion Systems Laboratory

Test / Analyze / Solve / Integrate

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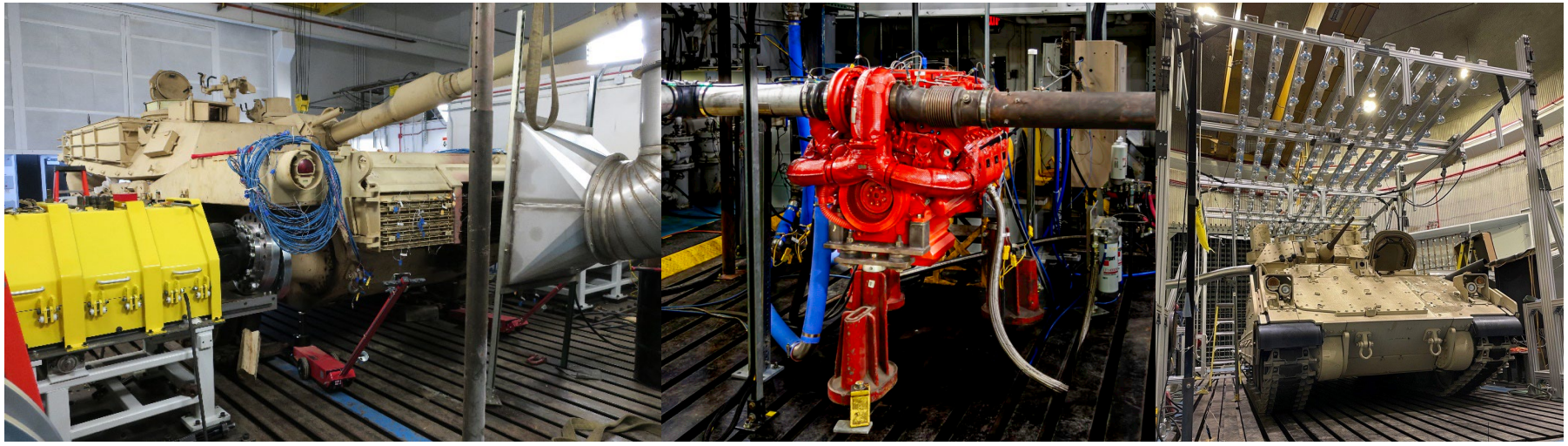
Propulsion Systems Laboratory



The Propulsion Systems Laboratory (PSL) provides the Army and industry partners with dynamometer testing, offering four-quadrant dynamic operation ranging from 50 to 4,000 HP for powertrains, drivetrains, engines, transmissions, transfer cases, axles, and gearboxes across nine environmental test chambers. For electric motor and hybrid applications, PSL features a state-of-the-art DC bus bar system with in-cell taps capable of delivering an impressive 1.25 megawatts (MW) of power, supporting a maximum capacity of 900 VDC and 5,000 AMPs.

The experienced engineers and technicians at the Propulsion Systems Laboratory (PSL) bring over 100 years of combined expertise in testing prime movers. Our well-equipped, 50,000-square-foot facility is capable of testing vehicles, sub-assemblies, and individual components across military, automotive, and heavy on- and off-highway equipment. Full vehicle testing options include cooling system performance, driveline studies, durability assessments, and fuel economy evaluations.

The entire Propulsion Systems Laboratory (PSL) operates using industry-respected commercial software, with control rooms strategically positioned at each test cell. Designed for modularity and flexibility, PSL supports a broad range of testing, from conventional powertrains to electric drive systems, encompassing steady-state operations as well as dynamic simulations.

The Propulsion Systems Laboratory (PSL) is an ISO 17025-accredited facility specializing in DOD test programs. PSL can custom-design test programs to accommodate specific environmental conditions and testing needs, including hot and cold air temperatures, high-temperature fuel supply for engines, and precise cooling system heat rejection control.

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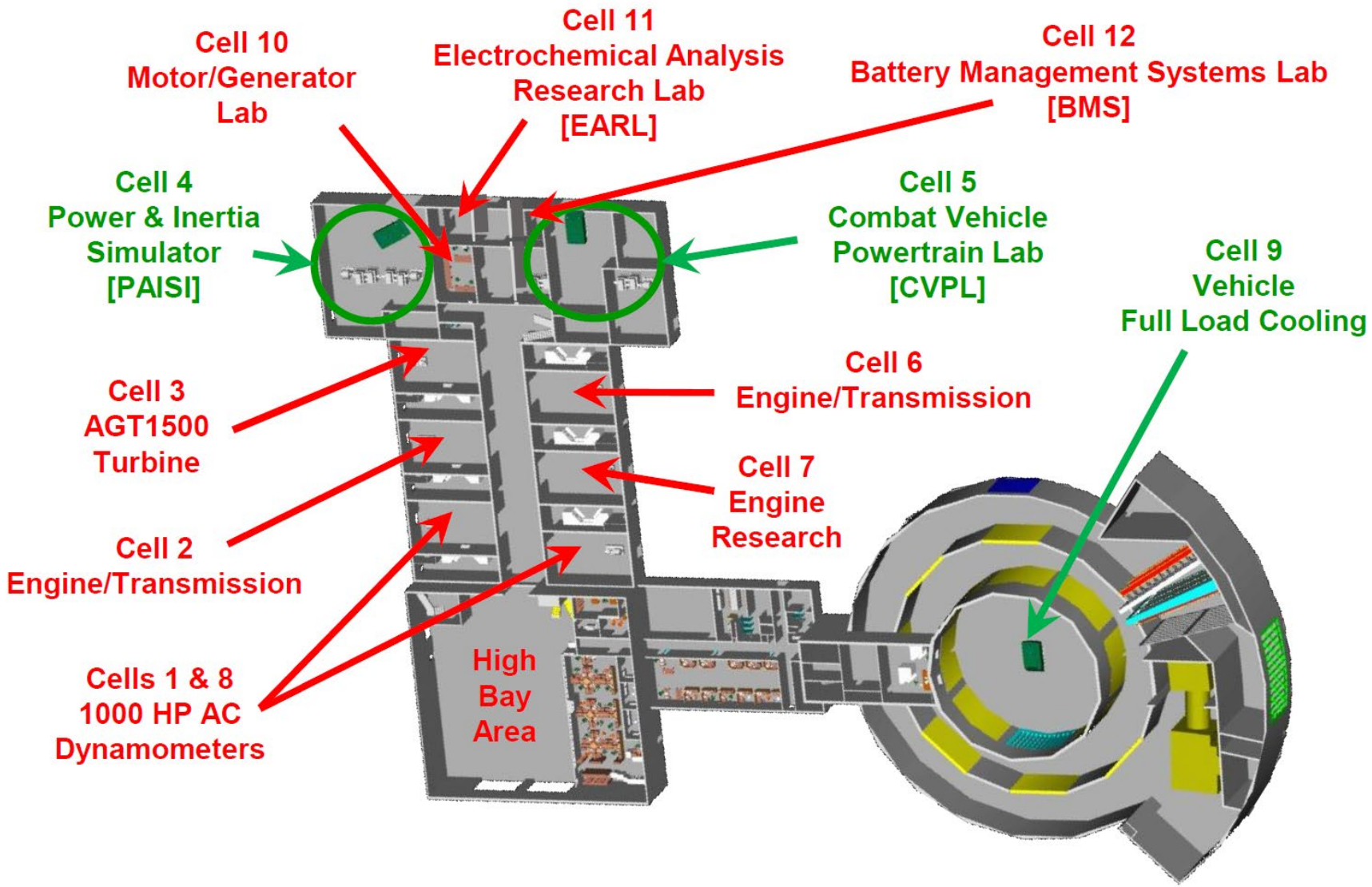

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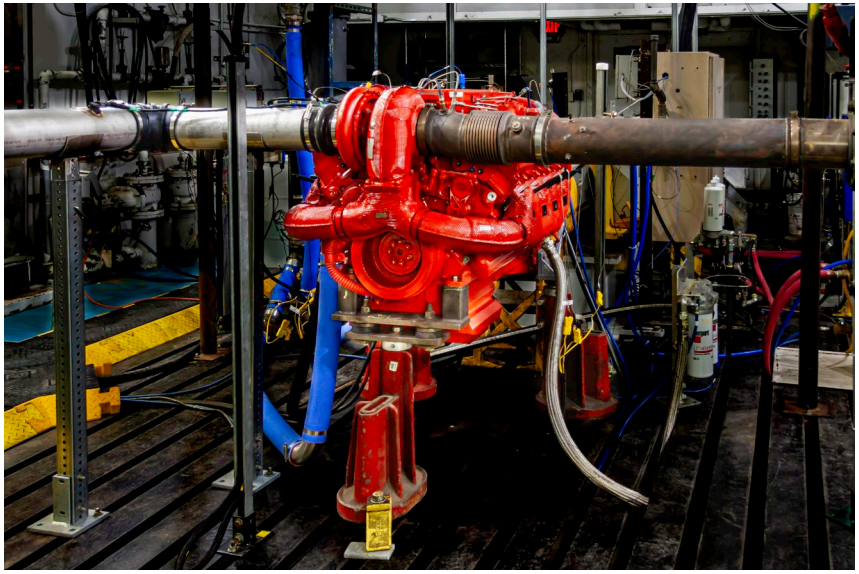
Propulsion Systems Laboratory

1000 HP AC Dynamometers [Absorption & Motoring]



Test Cells 1 & 8 have the ability to support engines, transmissions, and powertrain components needing endurance and performance assessments. The test cells are also very adaptive as they can be configured for both motoring and power absorption. These test cells have custom control and data acquisition for torque, speed, temperature, pressure, flow and electrical power output. Environmental conditions can be simulated with high and ambient temperature.

Capabilities

- Absorption: 1000 HP
- Motoring 900 HP
- Air Temperature Range: Ambient to 160°F
- Airflow Velocity: 5mph
- Water Flow: 900 GPM @ Pressure 50 Psig
- Electrical Service: 440VAC @ 60/100 amps, 100 @ 20 amps, 24VDC @ 200 amps
- Data collection channels up to 150 temperature, 90 analog and CAN communication capability
- Room Size: Width 25ft X Length 40ft X Height 20ft
- Crane Capacity: 5 Ton

Competence

- NATO 400-hour Endurance Test, RAM TOP 01-01-030
- SAE J1995
- MIL-STD-810F
- Performance Testing
- Fuel Map Testing
- Heat Rejection Testing
- Mechanical Friction Runs
- Engine Controls, Calibration and Development

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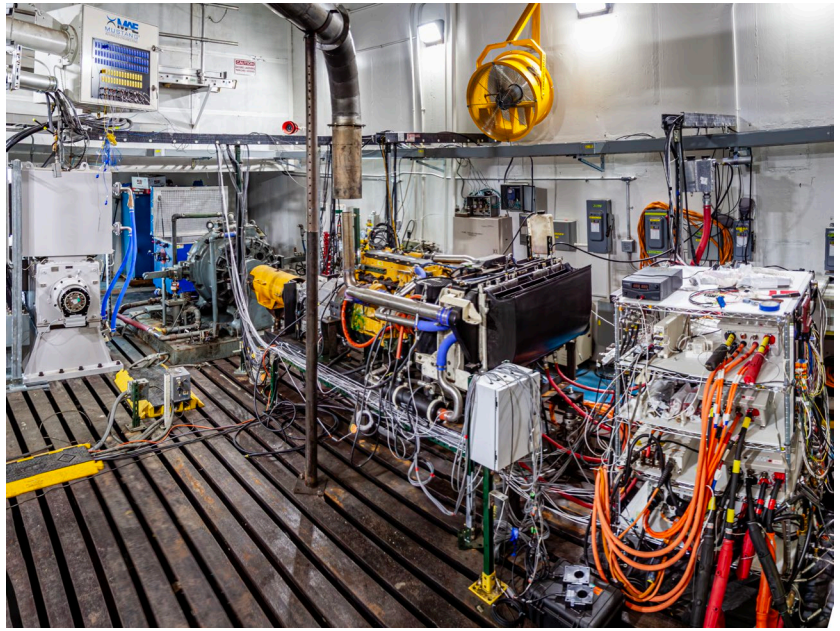
Propulsion Systems Laboratory

1000 kW AC Dynamometer [Absorption & Motoring]



Test Cell 2 has the ability to support engines, transmissions, and powertrain components needing endurance and performance assessments. The test cell is also very adaptive as it can be configured for both motoring and power absorption. The cell has the capability to support research, development, characterization and testing of high-voltage, high-power components necessary for military vehicle electrification and hybrid-electric technology. The test cell has custom control and data acquisition for torque, speed, temperature, pressure, flow and electrical power output. Environmental conditions can be simulated with high and ambient temperature.

Capabilities

- Absorption: 1000 kW (1341 HP)
- Motoring 970 kW
- Air Temperature Range: Ambient to 160°F
- Airflow Velocity: 5mph
- Water Flow: 900 GPM @ Pressure 50 Psig
- Electrical Service: 440VAC @ 60/100 amps, 100 @ 20 amps, 24VDC @ 200 amps
- AV900 Load Bank Voltage: 8 to 900V, current: +/- 1000 ADC, Power: +/- 250kW
- Data collection channels up to 150 temperature, 90 analog and CAN communication capability
- Room Size: Width 25ft X Length 40ft X Height 20ft
- Crane: 5 Ton

Competence

- NATO 400-hour Endurance Test, RAM TOP 01-01-030
- SAE J1995
- MIL-STD-810F
- Performance Testing
- Fuel Map Testing
- Heat Rejection Testing
- Mechanical Friction Runs
- Engine Controls, Calibration and Development
- Powertrain Development

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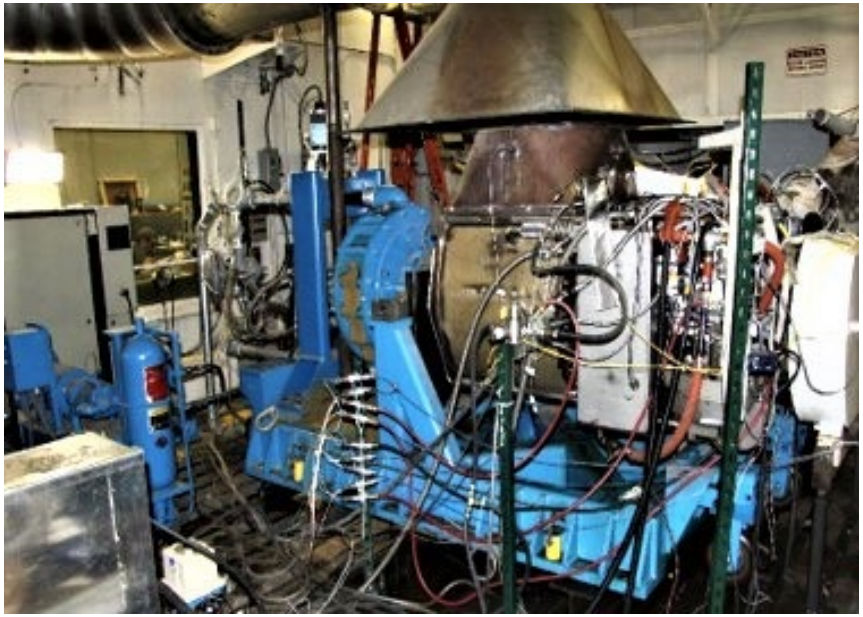
Propulsion Systems Laboratory

Engine & Component Testing [Absorption]



Test Cell 3 has the ability to support multiple types of engines ranging from small auxiliary power units to the Abrams turbine engine. This test cell has custom control and data acquisition of torque, speed, temperature, pressure, flow and electrical power output. Environmental conditions can be simulated with high and ambient temperature.

Capabilities

- Absorption from 175 to 3000 HP
- Air Temperature Range: Ambient to 160°F
- Airflow Velocity: 5mph
- Water Flow: 900 GPM @ Pressure 50 Psig
- Electrical Service: 440VAC @ 60/100 amps, 100 @ 20 amps, 24VDC @ 200 amps
- Data collection channels up to 150 temperature, 90 analog and CAN communication capability
- Room Size: Width 25ft X Length 40ft X Height 20ft
- Door Size: Width 12ft X Height 12ft
- Crane: 5 Ton

Competence

- NATO 400-hour Endurance Test, RAM TOP 01-01-030
- SAE J1995
- MIL-STD-810F
- Performance Testing
- 2400-hour Yuma Duty-cycle Test, Abrams Turbine Engine
- Fuel Map Testing
- Heat Rejection Testing
- Engine Controls, Calibration and Development

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Propulsion Systems Laboratory

Medium Combat Vehicle Powertrain Laboratory (MCVPL) [Absorption & Motoring]

Test Cell 4 is a premier laboratory used to develop and test the militaries current and future medium combat powertrains. Powertrains conventional, electric or hybrid are supported by the laboratories auxiliary systems used to simulate fuel, cooling, lubrication, and electrical systems. The cell has the capability to support research, development, characterization and testing of high-voltage, high-power components necessary for military vehicle electrification and hybridization technology.

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Propulsion Systems Laboratory

Medium Combat Vehicle Powertrain Laboratory (MCVPL) [Absorption & Motoring]

The PAISI dynamometer system is designed to operate tracked vehicle powertrains up to 850 HP in steady state or simulated road load operational modes. This test cell has custom control and data acquisition for torque, speed, temperature, pressure, flow and electrical power output. Environmental conditions can be simulated with high and ambient temperature.

Capabilities

- Absorption: 850 HP
- Air Temperature Range: Ambient to 160°F
- Airflow Velocity: 5mph
- Water Flow: 900 GPM @ Pressure 50 Psig
- Electrical Service: 440VAC @ 60/100 amps, 100 @ 20 amps, 24VDC @ 200 amps
- Solar loading up to 1120 W/m2
- Data collection channels up to 150 temperature, 90 analog and CAN communication capability
- Room Size: Width 50ft X Length 53ft X Height 20ft
- Door Size: Width 14ft X Height 20ft
- Crane Capacity: 15 Ton

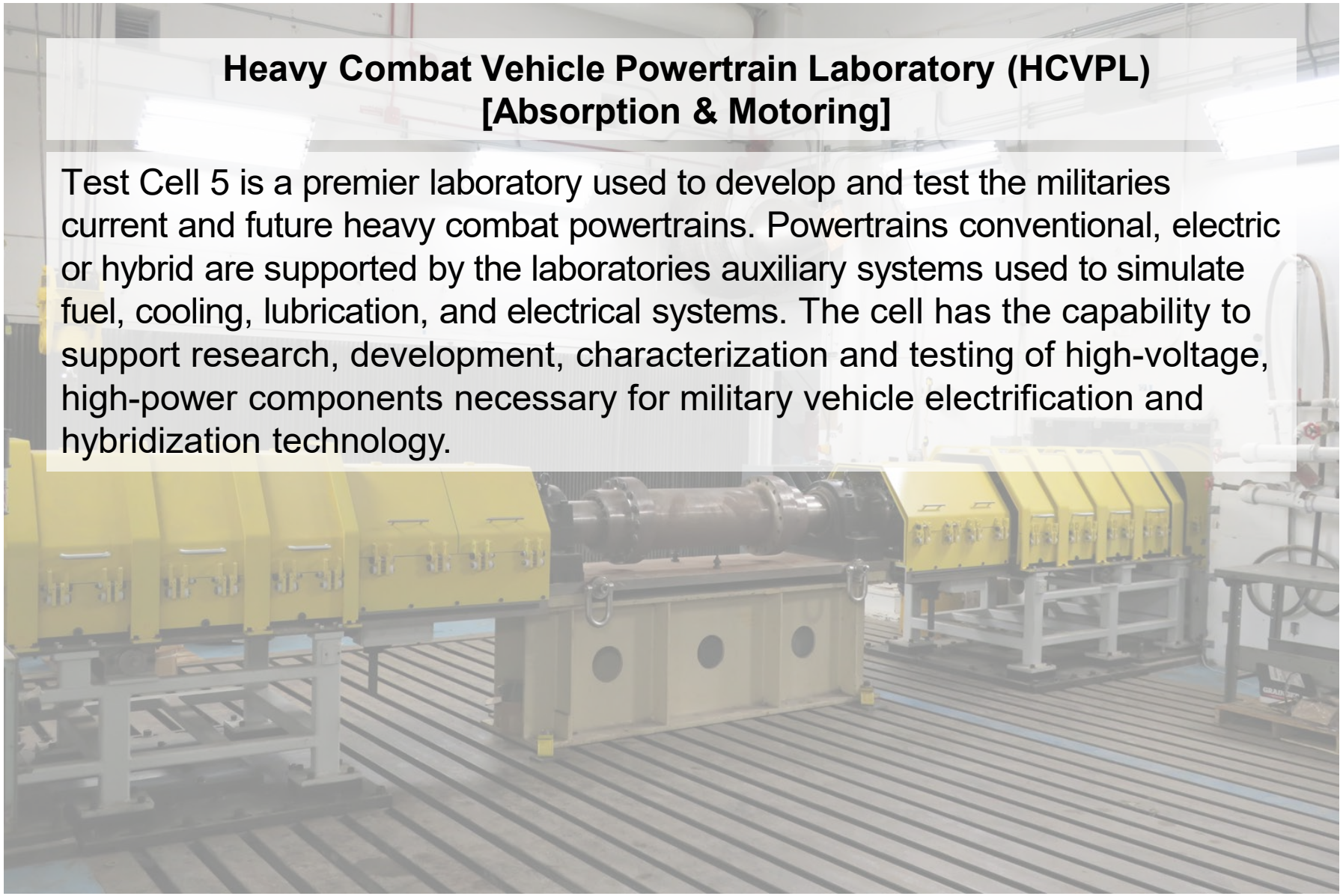
Competence

- Vehicle Powertrain Road Course Simulation
- Cross Drive Transmission Efficiency Assessment and Shift Calibration Development
- Cross Drive Powertrain Performance and Drivability Development
- Propulsion Assist and Silent Mobility System Assessment and Development

Propulsion Systems Laboratory

Heavy Combat Vehicle Powertrain Laboratory (HCVPL) [Absorption & Motoring]

Test Cell 5 is a premier laboratory used to develop and test the militaries current and future heavy combat powertrains. Powertrains conventional, electric or hybrid are supported by the laboratories auxiliary systems used to simulate fuel, cooling, lubrication, and electrical systems. The cell has the capability to support research, development, characterization and testing of high-voltage, high-power components necessary for military vehicle electrification and hybridization technology.



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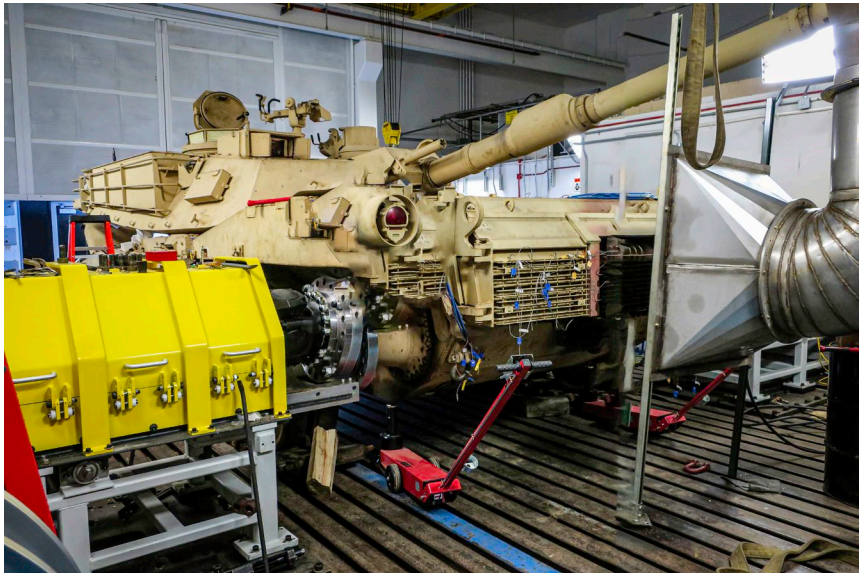
Propulsion Systems Laboratory

Heavy Combat Vehicle Powertrain Laboratory (HCVPL) [Absorption & Motoring]

Test Cell 5 absorbs power output from tracked vehicle powertrains up to 2000 HP in steady state or simulated road load operational modes. This test cell has custom control and data acquisition for torque, speed, temperature, pressure, flow and electrical power output. Environmental conditions can be simulated with high and ambient temperature.



Capabilities

- Loading up to 140,000 ft-lb per side
- Air Temperature Range: Ambient to 160°F
- Airflow Velocity: 5mph
- Water Flow: 900 GPM @ Pressure 50 Psig
- Electrical Service: 440VAC @ 60/100 amps, 100 @ 20 amps, 24VDC @ 200 amps
- Solar loading up to 1120 W/m2
- Data collection channels up to 150 temperature, 90 analog and CAN communication capability
- Room Size: Width 25ft X Length 50ft X Height 20ft
- Door Size: Width 14ft X Height 20ft
- Crane: 15 Ton

Competence

- Vehicle Powertrain Road Course Simulation
- Cross Drive Transmission Efficiency Assessment and Shift Calibration Development
- Cross Drive Powertrain Performance and Drivability Development
- Propulsion Assist and Silent Mobility System Assessment and Development
- TOP 01-01-030
- Full-Load Cooling (TOP 02-2-607)
- Speed on Grade (TOP 02-2-610A)
- HVAC Validation (TOP 02-2-816)
- Alternator Load Testing (TOP 02-2-601)

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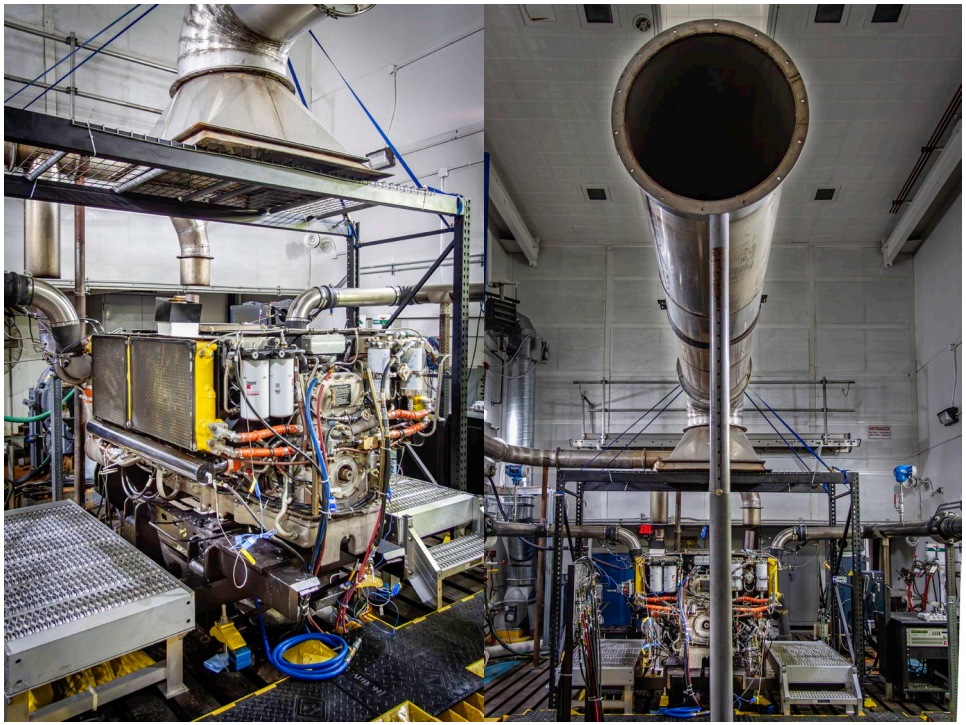
Propulsion Systems Laboratory

Engine & Component Testing [Absorption]

Test Cell 6 has the ability to support multiple types of engines ranging from small auxiliary power units to the Abrams turbine engine. This test cell has custom control and data acquisition of torque, speed, temperature, pressure, flow and electrical power output. Environmental conditions can be simulated with high and ambient temperature.



Capabilities

- Absorption from 175 to 3000 HP
- Air Temperature Range: Ambient to 160°F
- Airflow Velocity: 5mph
- Water Flow: 900 GPM @ Pressure 50 Psig
- Electrical Service: 440VAC @ 60/100 amps, 100 @ 20 amps, 24VDC @ 200 amps
- Data collection channels up to 150 temperature, 90 analog and CAN communication capability
- Room Size: Width 25ft X Length 40ft X Height 20ft
- Door Size: Width 12ft X Height 12ft
- Crane: 5 Ton

Competence

- NATO 400-hour Endurance Test, RAM TOP 01-01-030
- SAE J1995
- MIL-STD-810F
- Performance Testing
- 2400-hour Yuma Duty-cycle Test, Abrams Turbine Engine
- Fuel Map Testing
- Heat Rejection Testing
- Engine Controls, Calibration and Development

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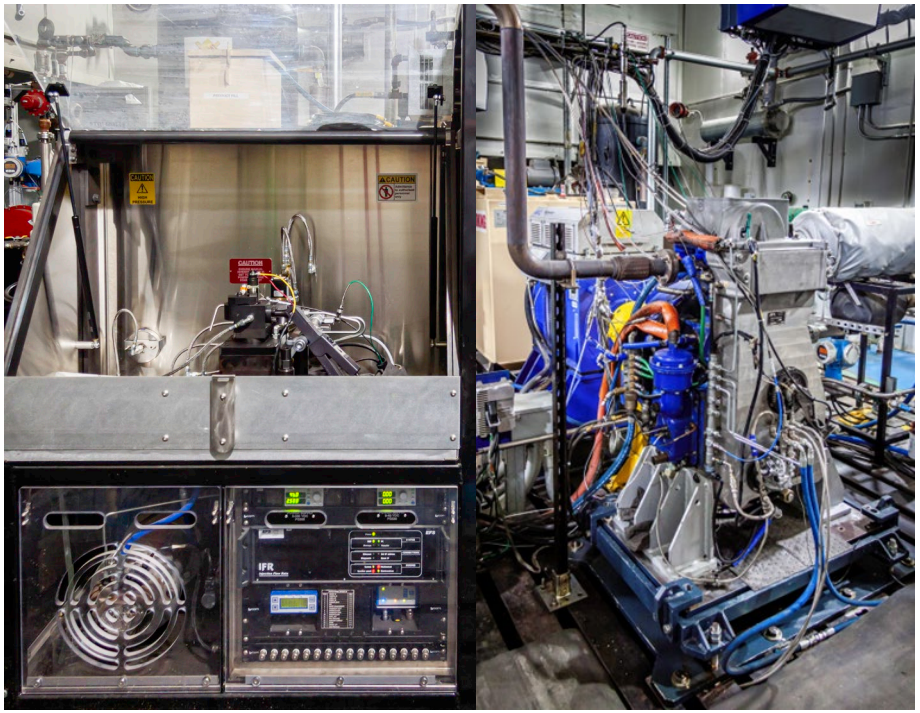
Propulsion Systems Laboratory

Single Cylinder Engine Research

Test Cell 7 is a single cylinder diesel engine research facility resource dedicated to fundamental diesel engine combustion research using a precisely controlled engine system and environmental operating conditions.



Capabilities

- Single cylinder research engine highly instrumented for high and low speed measurements of in-cylinder pressure, start of injection, and injection rate
- Stand alone compressor provides air to simulate turbocharging
- Independently controlled lubrication and coolant subsystems to enable isolation of combustion affecting phenomena
- Research engine includes high firing pressure capability for high power density engine research
- Flexible engine controller for choosing desired injection timing and frequency

Competence

- Combustion research (exhaust emissions and heat release rate)
- In-cylinder pressure research and analysis
- Piston temperature research and analysis
- Fuel effects on combustion research and analysis
- Induction air effects on combustion research and analysis
- Fuel consumption measurement

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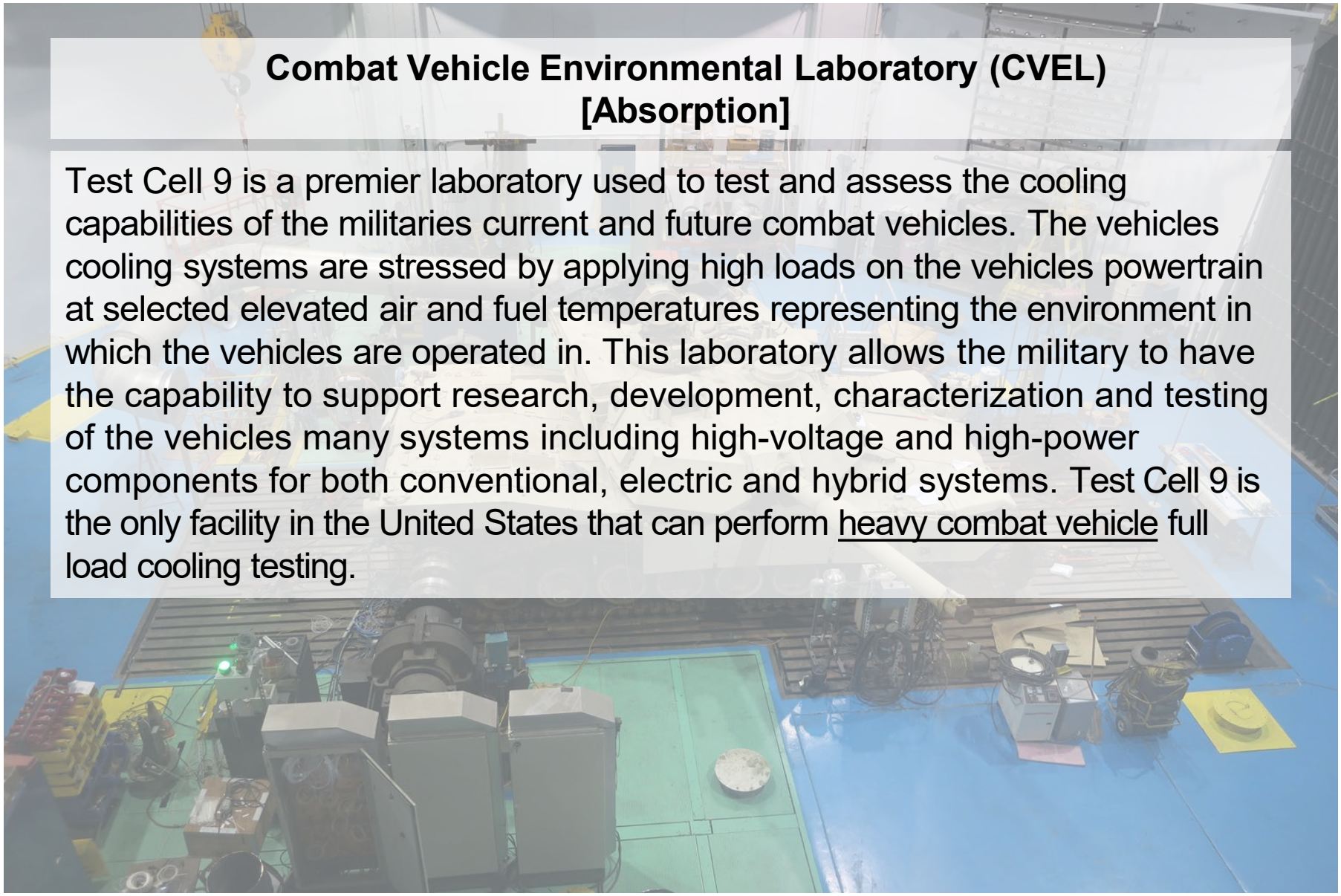
Propulsion Systems Laboratory

Combat Vehicle Environmental Laboratory (CVEL) [Absorption]

Test Cell 9 is a premier laboratory used to test and assess the cooling capabilities of the militaries current and future combat vehicles. The vehicles cooling systems are stressed by applying high loads on the vehicles powertrain at selected elevated air and fuel temperatures representing the environment in which the vehicles are operated in. This laboratory allows the military to have the capability to support research, development, characterization and testing of the vehicles many systems including high-voltage and high-power components for both conventional, electric and hybrid systems. Test Cell 9 is the only facility in the United States that can perform heavy combat vehicle full load cooling testing.



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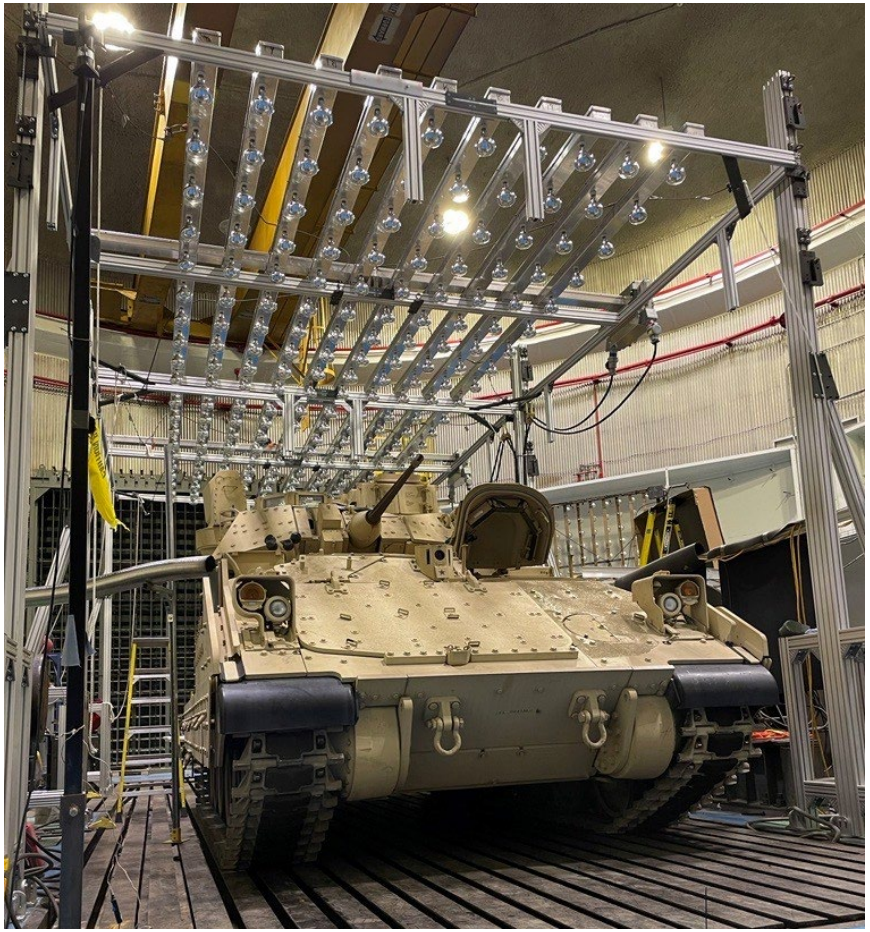
Propulsion Systems Laboratory

Vehicle Full Load Cooling [Absorption]

Test Cell 9 is a climatic chamber with wind and dynamometer capability equipped to evaluate continuous vehicle performance in extreme climates under full load conditions. The lab controls multiple aspects of environmental conditions to enable repeatable testing and vehicle cooling diagnostics



Capabilities

- Absorption 2500 HP per side
- Replicates tracked vehicle loading up to 88,000 lb-ft per side and 128,000 lb-ft per side at stall
- Air Temperature Range: Ambient to 160°F
- Airflow Velocity: 5 to 20 mph
- Water Flow: 900 GPM @ Pressure 50 Psig
- Electrical Service: 440VAC @ 60/100 amps, 100 @ 20 amps, 24VDC @ 200 amps
- Solar loading up to 1120 W/m2
- Exhaust capacity commensurate with turbine air flow performance requirements
- Data collection channels up to 300 analog and digital channels.
- Room Size: Diameter 80ft, height 35ft
- Door Size: 20ftx20ft
- Crane: 5 Ton

Competence

- Full-Load Cooling (TOP 02-2-607)
- Speed on Grade (TOP 02-2-610A)
- HVAC Validation (TOP 02-2-816)
- Alternator Load Testing (TOP 02-2-601)

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FOR FURTHER INFORMATION:

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