U.S. ARMY

DEVCOM GROUND VEHICLE SYSTEMS CENTER

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

GVPM T&I - Capabilities Overview

Dr. Igor Baseski, Division Chief T&E
Steven Beiter, GSPEL Branch Chief
Dean McGrew, Integration Branch Chief
John Hubble, PSL Branch Chief

Ground Vehicle Power & Mobility Test & Integration

Always Moving

Building 212A & 212B
Detroit Arsenal

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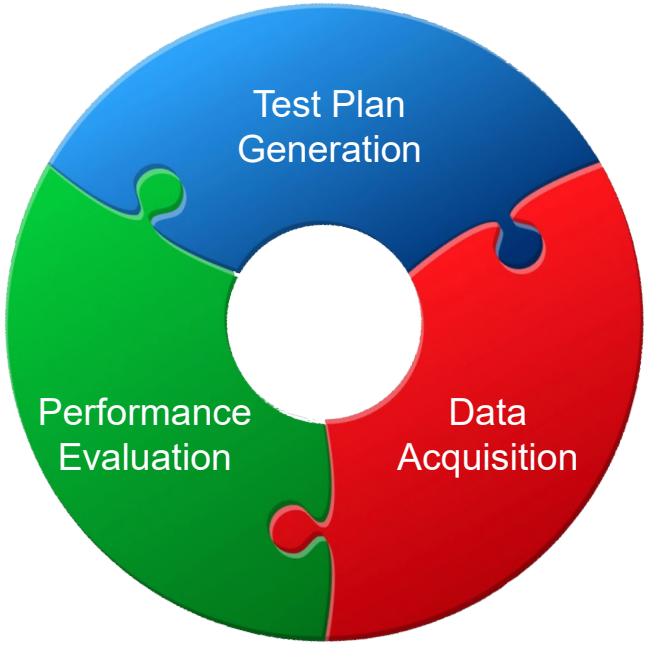
Test & Integration Support

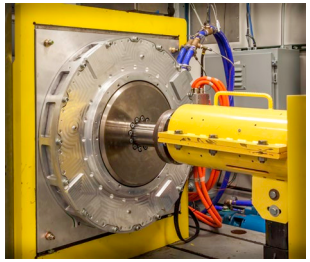
Purpose: Manage, develop, and support integrated life cycle Test and Integration (T&I) services. Provide strategy to innovatively test for performance and reliability of ground systems, and mitigate risks associated with the deployment of ground systems while ensuring timely focus on reliability and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

DEVCOM GROUND VEHICLE SYSTEMS CENTER

GSPEL

Ground Systems Power and Energy Laboratory

The Future of Testing is in GSPEL

Building 212B
Detroit Arsenal

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Ground Systems Power and Energy Laboratory (GSPEL)

The GSPEL is the Army' Centerpiece Laboratory for full vehicle environmental mobility testing, power and energy research and development, integration, and component testing. The GSPEL is composed of five laboratories that provide one-of-a-kind test support to current and emerging classes of ground military and commercial vehicles, wheeled and tracked, manned and unmanned.

- **Air Flow Laboratory - Air Filtration Benches**
  - The Air Flow Laboratory (AFL) - Filtration Benches provide dust testing of air filtration devices to demonstrate and validate new or legacy system capabilities in a controlled environment.
- **Air Flow Laboratory – Calorimeter**
  - The Air Flow Laboratory (AFL) – Calorimeter provides testing of military vehicle heat exchangers to evaluate their cooling capacity, air restriction, and coolant restriction as well as military vehicle ballistic grilles to evaluate their air restriction in a repeatable, controlled environment.
- **Electrical Components Laboratory**
  - The Electrical Components Laboratory (ECL) tests high-voltage/power components for vehicle electrification and hybrid electric power technology integration..
- **Energy Storage Laboratory**
  - The Energy Storage Laboratory (ESL) provides testing for production qualification of batteries and electrochemical technology testing at cell, module and battery pack levels.
- **Power & Energy Vehicle Environmental Laboratory**
  - The Power & Energy Vehicle Environmental Laboratory (PEVEL) tests multi-wheel or tracked military vehicles with road-load simulation under extreme environmental conditions.

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Air Flow Laboratory

Air Flow Laboratory (AFL) an ISO/IEC 17025 accredited laboratory, supports the execution of component level testing on several critical mobility systems in a variety of military vehicles by use of Calorimeter and Air Filtration Testing Systems.

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Air Flow Laboratory

Calorimeter Testing

Benefits

- Evaluate new heat exchangers and ballistic grilles
- Repeatably simulate field environmental conditions
- Test up to three heat exchangers as a pack
- Unique Army testing capability
- Unbiased first-article test and production quality surveillance
- Expedites the development process for vehicle engine and transmission cooling systems

Components and Testing Standards:

- Radiators (MIL-PRF-62259)
- Oil Coolers (MIL-DTL-62006C)
- Charge Air Coolers
- Ballistic Grilles

AFL Calorimeter Test

Air Filtration Testing

Benefits

- Evaluate new air cleaner systems
- Troubleshoot currently fielded systems & failures
- Assess impact of add-on parts to air cleaner systems
- Evaluates proposed vehicle maintenance efficiencies
- Unbiased first-article dust test and production quality surveillance
- Provides first-article dust testing before vehicle implementation.

Components and Testing Standards:

- Air Filters (MIL-PRF-46736F / MIL-PRF-62048C)
- Air Cleaner Assemblies (MIL-PRF-62565)
- Add-on components to air cleaner systems

AFL Filtration Test

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Air Flow Laboratory

Calorimeter Capabilities

Cooling Air

- Air Flow Rate: 800 to 60000 CFM
- Air Flow Velocity: 3000 to 7000 ft/min
- Inlet Air Temperatures: up to 250 °F

Radiator Loop

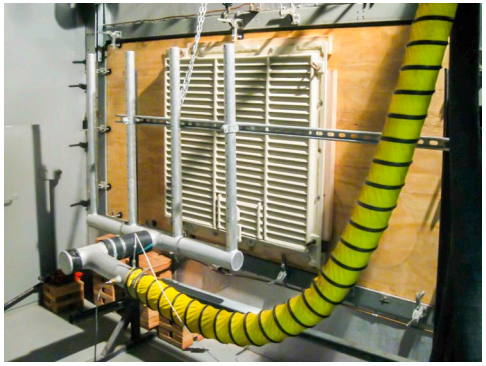
- Coolant Flow Rate: 10 to 300 gal/min
- Coolant Inlet Temperature: 125 to 350 °F
- Coolant Inlet Pressure: 0 to 125 psig

Oil Cooler Loop

- Oil Flow Rate: 10 to 150 gal/min
- Oil Inlet Temperature: 175 to 350 °F
- Oil Inlet Pressure: 0 to 300 psig

Charge Air Cooler Loop

- Charge Air Flow Rate: 30 to 150 lbs/min
- Charge Air Temperature: 150 to 650 °F
- Charge Air Inlet Pressure: 15 to 90 psig



Air Filtration Capabilities

Ambient air conditions are controlled in the Air Filtration laboratory. In addition to controlling temperature, the relative humidity can be set to the desired level.

250 CFM Bench

- Air Flow Rate: 8 to 250 SCFM

2000 CFM Bench

- Air Flow Rate: 80 to 2000 SCFM

5000 CFM Bench

- Air Flow Rate: 320 to 5000 SCFM

12000 CFM Bench

- Air Flow Rate: 800 to 12000 SCFM

Electrical Components Laboratory

The Electric Components Laboratory (ECL), an ISO/IEC 17025 accredited laboratory, supports research, development, characterization and testing of high-voltage, high-power components necessary for military vehicle electrification and hybrid-electric technology. This lab's research extends to a testing cell in the Propulsion Laboratory that has programmable power absorption and supply capabilities with voltage, current and power control, and a 350-horsepower AC dynamometer. Component testing on vehicle is also available. The ECL provides temperature and humidity-controlled environments, as well as 346kW and 373kW AC dynamometers to fully test various components.

ECL - Cell 10

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Electrical Components Laboratory

Components Tested

The ECL can test multiple types of components:

- Advanced Electric Machines
- High Voltage Alternators
- Motor controllers
- Power Inverters
- DC/DC Converters

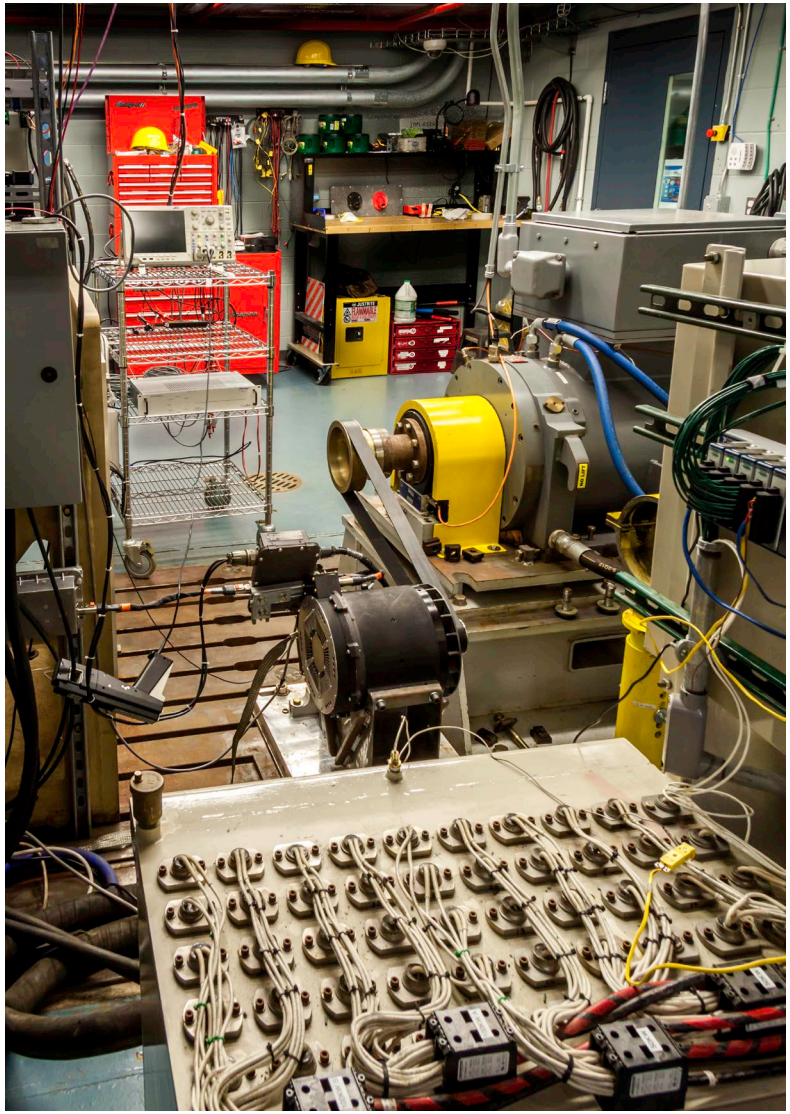
Benefits

- Certified and accredited testing to ISO17025 Standards
- Testing of high voltage, high power components
- Analysis of future electrical power generation and control technologies for the Army
- Provides power quality, transients, and harmonic distortion testing
- Variable coolant temperature and flow rate over a large range
- Thermal chamber for component level testing
- Resistive and Capacitive load banks to simulate a wide variety of load types
- Pressure testing of coolant cooled components using high sensitivity pressure transducers

Testing Standards

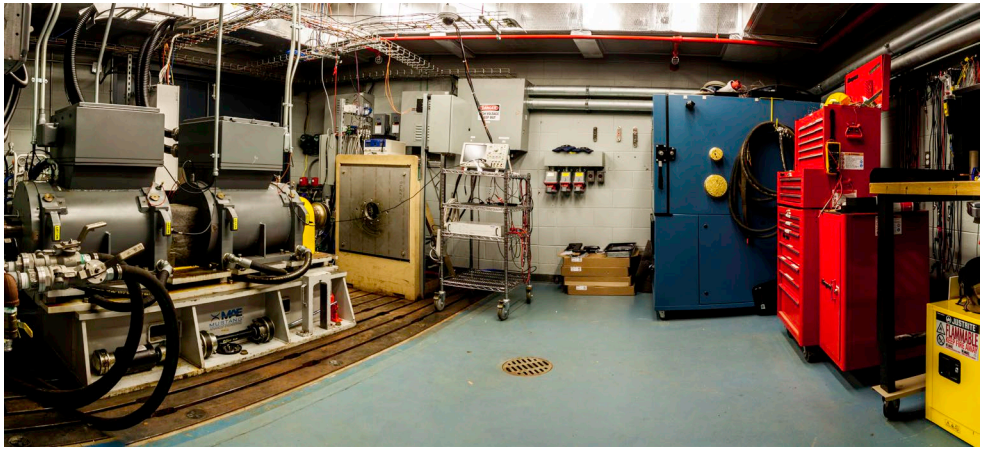
The ECL tests to the following standards / Qualifications / TOPs:

- MIL-PRF-GCS600



Niehoff Alternator 600VDC

Electrical Components Laboratory



ECL Main Laboratory

Acquisition of mechanical and electrical parameters

- Phase to Phase measurements
- Active, apparent and reactive power
- Mechanical power
- Power factor and efficiency
- Fundamental frequency
- Total Harmonic Distortion
- Voltage & Current Transients
- Cooling characteristics; Thermal, pressure, flow rate

ECL Dynamometer

- 373 kW Four Quadrant AC Dynamometer
- 3,321 Nm torque from 0-1000 rpm
- 0 – 12,000 rpm speed range

CELL 10 Dynamometer

- 346 kW Four Quadrant AC Dynamometer
- 1,245 Nm torque from 0-2000 rpm
- 0 – 12,000 rpm speed range

Thermal Chamber

- Temperature range of -30°C to +177°C
- Humidity range of 10% to 95% RH, 85°C Max temp and 4°C minimum dewpoint
- 439 Liter capacity

AV-900 250kW Dual Power Supply

- Voltage: 8 to 900 VDC
- Current: +/- 1000 ADC
- Power: +/- 250 kW

AC and DC Load Banks

- Up to 250 kW power absorption

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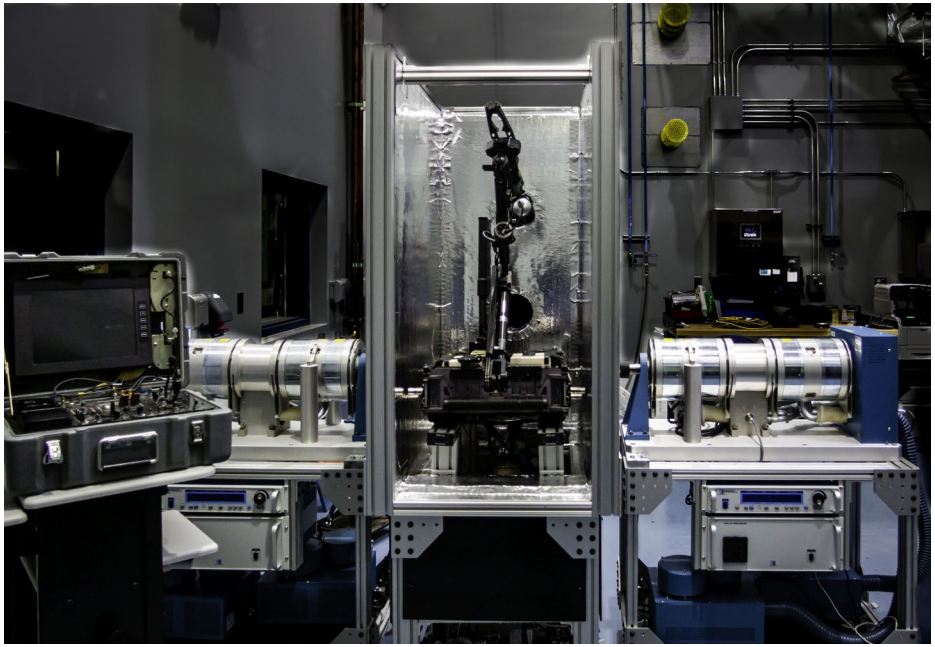
Electrical Components Laboratory

In addition to testing High Voltage and High-Power devices and hybrid-electric components, the ECL tests and evaluates robotic systems using the Robotic – Power and Energy Vehicle Environmental Laboratory, the R-PEVEL. This capability, while new, is already set up to test the QinetiQ TALON series of robots in support of PdM Unmanned Ground Vehicles and GVSC Ground Vehicle Robotics. This testing and evaluation capability also includes environmental control of the test asset.



R-PEVEL V. 1.0

R-PEVEL Dynamometer

- 14 kW Two Quadrant Hysteresis Dynamometer (x2)
- 56.5 Nm torque from 0 – 8,000 rpm
- 0 – 8,000 rpm speed range

Data Collection

- National Instruments cDAQ chassis
- SMBus collection and sampling
- National Instruments LabView

Acquisition of mechanical and electrical parameters

- Phase and DC electrical characteristics
- Active, apparent and reactive power
- Mechanical power
- Power factor and efficiency
- Fundamental frequency
- Total Harmonic Distortion
- Voltage & Current Transients
- Cooling characteristics: Thermal

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Energy Storage Laboratory

The Energy Storage Laboratory (ESL), an ISO/IEC 17025 accredited laboratory, is a specialized research and testing facility dedicated to the advancement of energy storage technologies, with a focus on batteries across multiple levels of integration, including cells, modules, and full battery packs and systems. The ESL provides comprehensive support for the research, development, characterization, validation, and qualification of a wide range of electro-chemical energy storage technologies.

ESL - Control Room

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Energy Storage Laboratory

Capabilities/Benefits

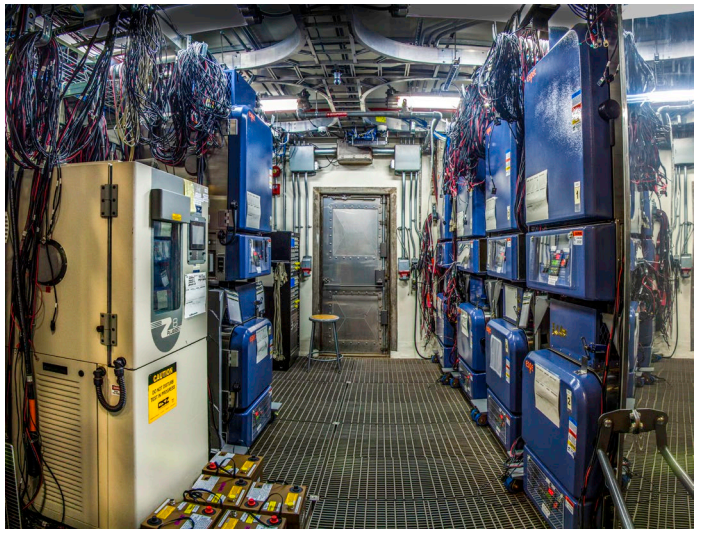
The ESL is comprised of Three (3) Large Battery Test Rooms, two (2) Pack Test Chambers and Battery Storage Rooms.

Multiple cell/battery cyclers on a centralized control system, thermal ovens and temperature-controlled water baths support a variety of electrochemical tests.

Cradle-to-grave R&D and testing support for all DoD ground vehicle energy storage systems, including new technologies and chemistries.

- Performance to specification
- Life Cycle to Failure (Service Life)
- Cold Cranking
- Deep Cycle / High Temperature Deep Cycle
- Reserve Capacity
- Full Charge Capacity
- Hybrid Pulse Power Characterization (HPPC)
- Charge/Discharge Characterizations
- Impact Test

ESL - Cell 103



ESL - Cell 105

Testing Standards

The ESL tests to the following standards / Qualifications / TOPs:

- MIL-PRF-32143
- MIL-PRF-32565
- MIL-B-11188
- GPMH24000-TOP-6T-Lithium-Ion Qualification
- GPMH25000-TOP-6T-VLRA Qualification

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Energy Storage Laboratory

Battery Cyclers

Brand	Model	Quantity of units	# of Channels per unit*	# Thermocouples Channels per unit	Voltage		Current		Temperature	
					Range	Tolerance	Range	Tolerance	Range	Tolerance
Bitrode	LCV3-100-36	1	3	7	±54VDC	±.05VDC	±100ADC	±.1ADC	-40 to 190ºC	±2.5ºC
Bitrode	MCV48-50-5	2	48	48	±5VDC	±.005VDC	±50ADC	±.05ADC	-40 to 190ºC	±2.5ºC
Bitrode	LCV12-50-24	2	12	16	±32VDC	±.036VDC	±50ADC	±.05ADC	-40 to 190ºC	±2.5ºC
Bitrode	LCV4-100-36	1	4	8	±54VDC	±.05VDC	±100ADC	±.1ADC	-40 to 190ºC	±2.5ºC
Bitrode	LCV4-100-60	7	4	8	±60VDC	±.06VDC	±100ADC	±.1ADC	-40 to 190ºC	±2.5ºC
Bitrode	DTV1-2000-24**	1	1	1	-24VDC	±.024VDC	-2000ADC	±2.0ADC	-40 to 190ºC	±2.5ºC
Bitrode	LCV8-100-60	3	8	12	±60VDC	±.06VDC	±100ADC	±.1ADC	-40 to 190ºC	±2.5ºC
Bitrode	LCV2-1000-48	1	2	4	±72VDC	±.07VDC	±1000ADC	±1.0ADC	-40 to 190ºC	±2.5ºC
Aero-Vironment	AV900	3	2	-	±900VDC	±1.35VDC	±300A	±1.13ADC	-	-

*Channels within unit may be placed in parallel for higher currents / **Discharge only

Temperature Conditioners

Brand	Model	Quantity of units	Temperature		Internal Volume	Cooling Change Rate	Heating Change Rate
			Range	Tolerance			
ESPEC	BTZ-175	5	-65 to 150ºC	±.5ºC	1.5 ft^3	5ºC/min	5ºC/min
ESPEC	BTZ-475	5	-65 to 150ºC	±.5ºC	4 ft^3	2.5ºC/min	2.75ºC/min
Cincinnati Sub-Zero	ZPHS-8-1.5-1-H/AC	1	-65 to 150ºC	±.5ºC	8 ft^3	14ºC/min	17ºC/min
Tenney	T10RC-1.5	3	-65 to 150ºC	±.3ºC	10 ft^3	4ºC/min	5.5ºC/min
Russells	GD-64-5-5-AC-EP	1	-65 to 150ºC	±1ºC	64 ft^3	3ºC/min	3.8ºC/min
Thermotron	SE-2000-6-6	1	-65 to 150ºC	±.7ºC	69.3 ft^3	3.4ºC/min	5.3ºC/min
Water bath	-	2	15 to 70ºC	±1ºC	up to 15.7 ft^{3*}	≈.2ºC/min	≈.25ºC/min

*Depth of water can vary from 4 to 17"

ESL - Outdoor Battery Chambers

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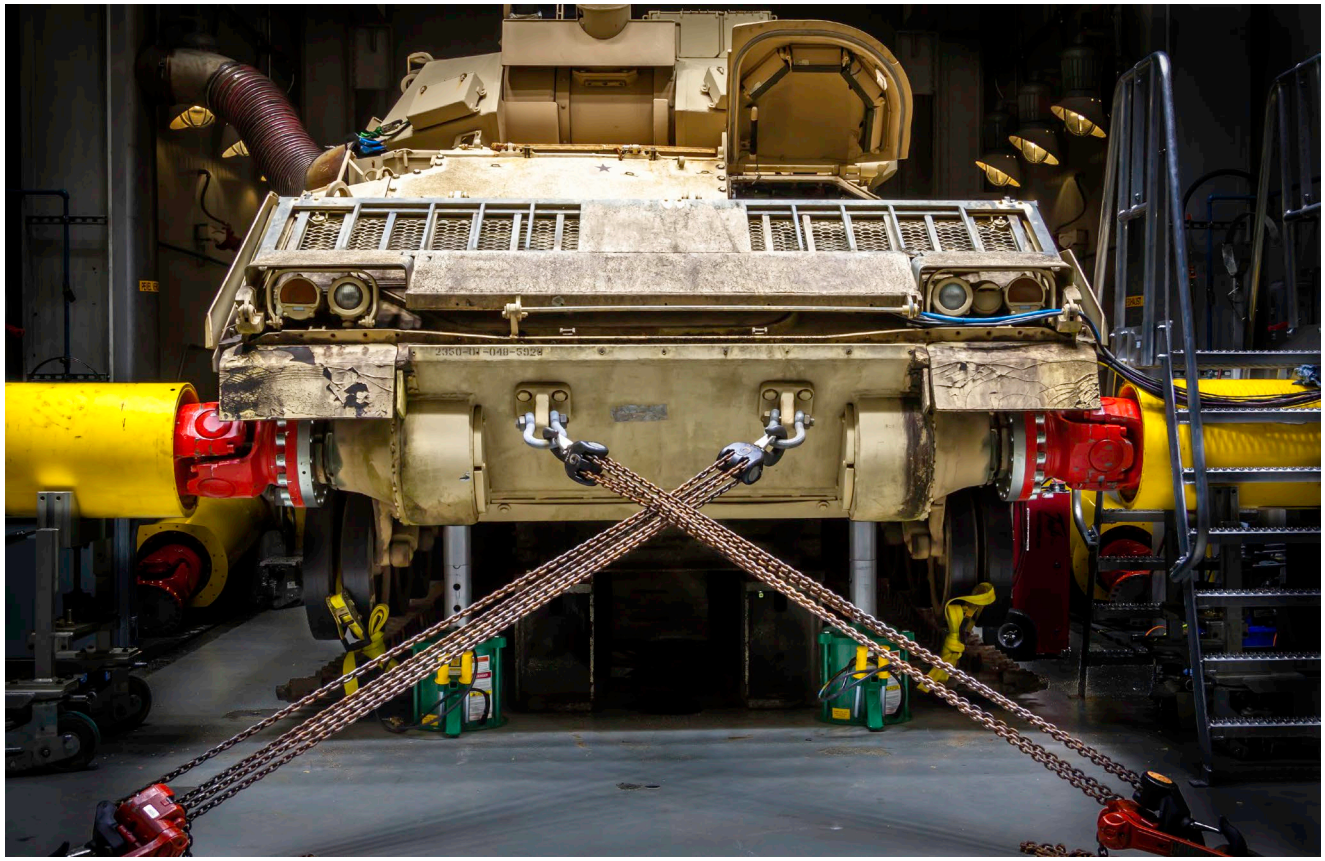
Power and Energy Vehicle Environmental Lab

The Power and Energy Vehicle Environmental Laboratory (PEVEL), an ISO/IEC 17025 accredited laboratory, offers tools for vehicle powertrain assessment. Equipped with multiple dynamometers, the PEVEL provides the tools required for full vehicle powertrain testing, evaluation and assessment of both wheeled and tracked vehicles through external load control and data collection. PEOs/PMs, OEMs, manufacturers, academics and researchers can use these tools to create, assess and validate vehicle design, functionality and utility in a fully controlled and repeatable environment.



PEVEL - Bradley

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Power and Energy Vehicle Environmental Lab

Capabilities

The PEVEL chamber enables testing at temperatures from -60°F to 160°F and humidity levels from 5 to 95% relative humidity. This environmental control makes it possible to produce, repeatable, real-world vehicle performance and capability comparisons. Simulation of wind speed up to 60 mph and solar load up to 1,200 watts/per square meter (W/m^2). Vehicle drivetrain loads of wheeled vehicle with torque up to 34,000 pound-foot (lbf-ft.) and of tracked vehicle torque up to 42,000 lbf-ft. can be provided.). Additionally, vehicle electrical power loads up to 800 kW can be simulated. Compatible fuels for testing in the PEVEL include hydrogen, Diesel, JP-8, F-24, bio-diesel and synthetic blends.

PEVEL - M109A7

Testing Standards

The PEVEL tests to the following Standards / Qualifications / TOPs:

- Transient Road-Load Profiles (TOP 01-01-030 / TOP 01-2-502)
- Vehicle Acceleration (TOP 02-2-602A)
- Fuel Economy (TOP 02-2-603A)
- Full-Load Cooling (TOP 02-2-607)
- Speed on Grade (TOP 02-2-610A)
- HVAC Validation (TOP 02-2-708 / TOP 02-2-816)
- Engine Cold-Start Evaluation (TOP 02-2-650)
- Alternator Load Testing (TOP 02-2-601)

Benefits

- Functions as a test-bed to evaluate vehicle system performance in any operational environment.
- Allows for testing in extreme climates under various loads.
- Performs repeatable tests on components or vehicles, producing real-world vehicle and component performance/capability comparisons.
- Functions as a systems integration laboratory (SIL); fully supports hardware-in-the-loop simulation.
- Addresses the testing gap for multi-axle wheeled vehicles and provides additional evaluation capabilities for vehicle on-road performance.

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Power and Energy Vehicle Environmental Lab

Powertrain Specifications

Wheeled Vehicle Dynamometers

- Speed: 0 - 1,000 RPM
- Torque: 0 - 34,000 lbf-ft. (per wheel)
- Power: 0 - 160 HP (per wheel)
- Wheel Stations: up to 10 wheels (5 axle)

Tracked Vehicle Dynamometers

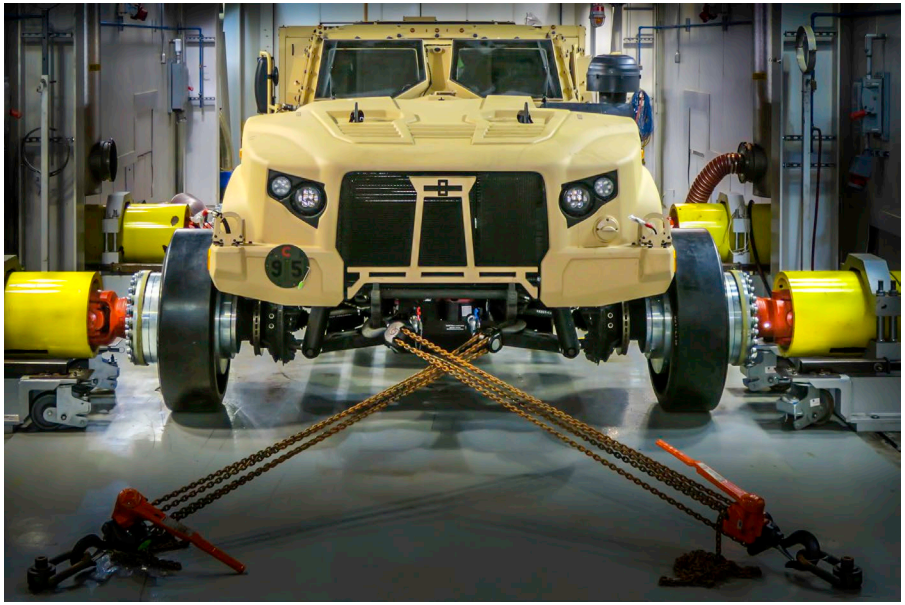
- Speed: 0 - 1250 RPM
- Torque: 0 - 42,000 lbf-ft. (per side)
- Power: 0 - 800 HP (per side)

Environmental Control

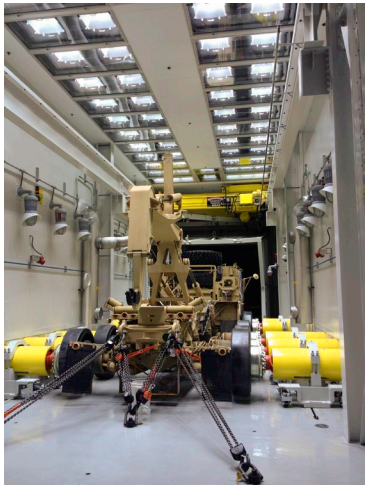
- Temperature: -60°F to 160°F
- Wind: 0 to 60 mph
- Solar: 0 to 1,200 W/m^2
- Humidity: up to 95% RH

General Information

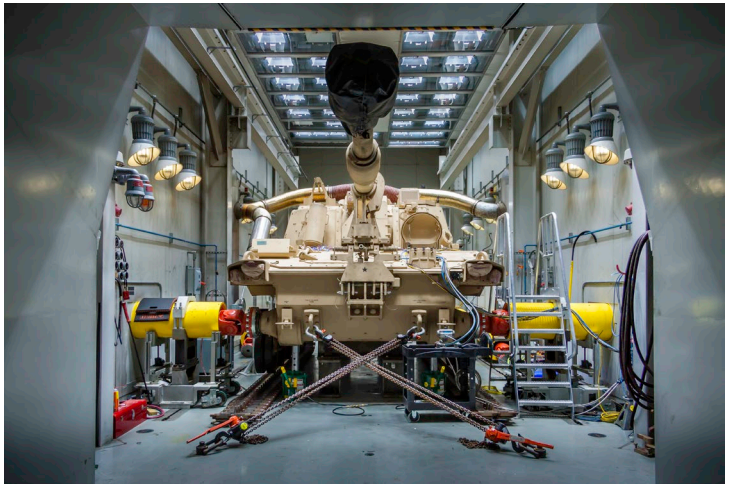
- Chamber Door: 14 ft. (W) x 14 ft. (T)
- Dimensions: 20 ft. (W) x 20 ft. (T) x 75 ft. (L)
- Wheelbases up to 320 in.
- Track Widths up to 120 in.
- Floor Capacity: up to 100 tons
- Crane: 25 tons
- Multiple Vehicle Build-up Bays



PEVEL - JLTV



PEVEL - PLS



PEVEL - M109A7

Integration

Connecting Systems, People, and Ideas

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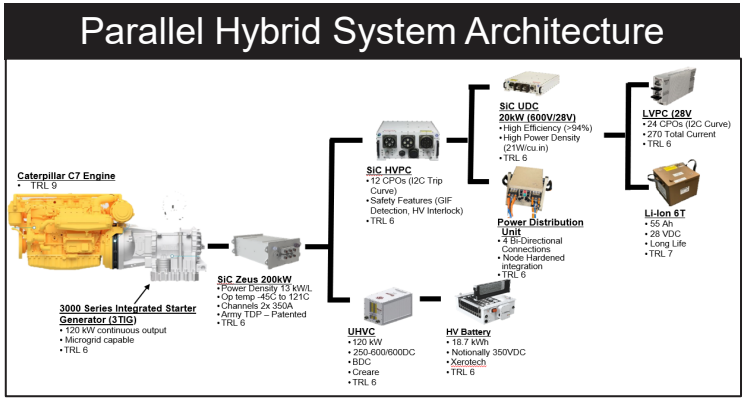
Integration

GVSC's Ground Vehicle Power and Mobility (GVPM) Integration Team is integrating advanced powertrain capabilities to extend operational duration and lethality, improve mobility, and enable advanced warfighting capabilities on combat and tactical platforms. The team has demonstrated capability on Bradley FOV, Stryker, JLTV, FMTV, and HTV. Results include 10-20x power generation capability, 2x operational duration, 120kW power tap (for integration of Directed Energy Weapons/ radar/ missile systems/ C2/ other high-power systems), 60kW of 208VAC 3-phase 5-wire export power, extended engine off operational capability, increased acceleration, increased speed on grade, and fast forming vehicle microgrids.

Integration - Systems Architecture Capabilities

- Parallel Hybrid Systems (in-line or PTO)
- Series Hybrid Systems
- High Power Variants – 10x power
- Model Based Digital Systems Engineering
- Vehicle Controls Software - Auto-coded
- Vehicle Centric Fast Forming Microgrids
- Base Integration of High-power Platforms



Stryker and FMTV Parallel Hybrid System

Integration

Results:

Advance Power Networking

High Power Variant – FMTV A1

- Power Generation:
  - 120 kW Continuous (static)/ vehicle
  - 20 kW Continuous on-the-move
- 2x Operational Duration Increase - static
- Tactical Microgrid Standard (MIL STD 3072) compliant
- Fast Forming Networking - 2 ½ minutes to form & 1 minute to disaggregate and move
- Frees pintles

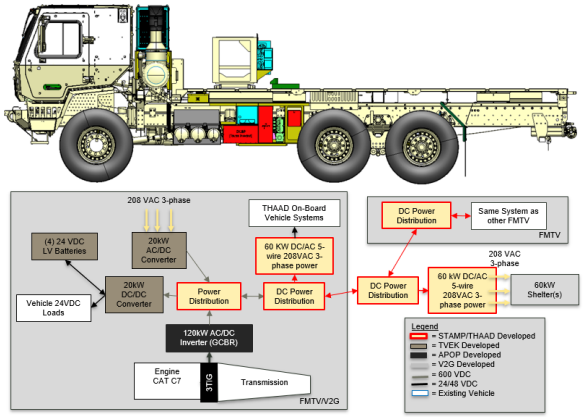
Bradley FOV Parallel Hybrid

- 160kW Power Generation – 10x increase
- ~1.5x sprocket power increase
- Smart Electrified Auxiliaries
- Significantly improved acceleration
- Drive by wire – ready for tele-operations or autonomous package
- 1.5X Increased Operational Duration

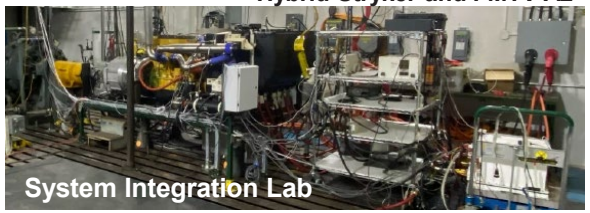
Wheeled Hybrid System

Expected results 2026:

- 2x Operational duration increase
- 40% improved acceleration
- 20% increased peak speed on grade
- 120kW Continuous/ 240kW Peak - single vehicle
- 240kW continuous/360 kW Peak – two vehicles
- ~SWAP-C Neutral
- TMS (MIL STD 3072) Compliant




Hybrid Stryker and FMTV A2


System Integration Lab

Integration

How the Integration Branch supports Tactical and Combat Platforms?

- Develop and Integrate high-power generation systems for increased power
- Hybridize a platform to:
  - Double the operational duration capability
  - Provide silent operations (silent mobility and extended silent watch)
  - Significantly improve mobility (acceleration, speed on grade, peak speed)
  - Enable powering and integration of advanced warfighting capabilities (EW, CUAS/DEW, APS, Mobile Radar, and Highly Mobile Missile Systems)
  - Enable expeditionary power - export power, import power, power networking
- Eliminate thermal challenges with power electronics and rotating equipment
- Increase the maximum power capability of platforms
- Enable networking of platforms into fast forming vehicle centric microgrids
- Enable connectivity with base grids to touchless perform vehicle maintenance, provide grid services, and provide power for continuity of operations
- Significantly improve the Return on Investment for advanced powertrains
- Support PM power systems engineering efforts

Propulsion Systems Laboratory

Test / Analyze / Solve / Integrate

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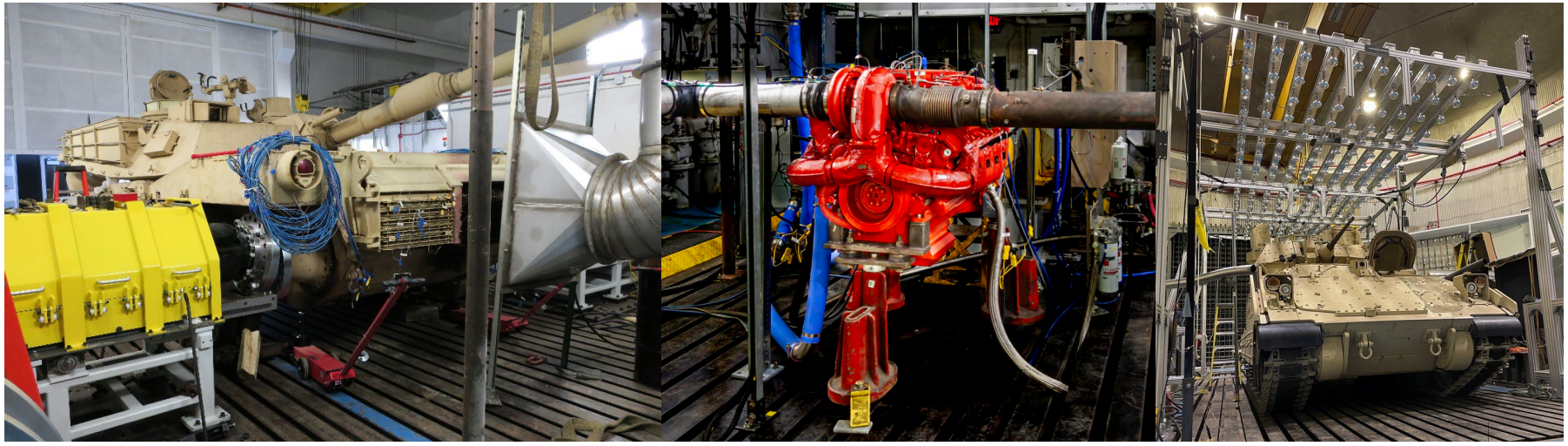
Propulsion Systems Laboratory



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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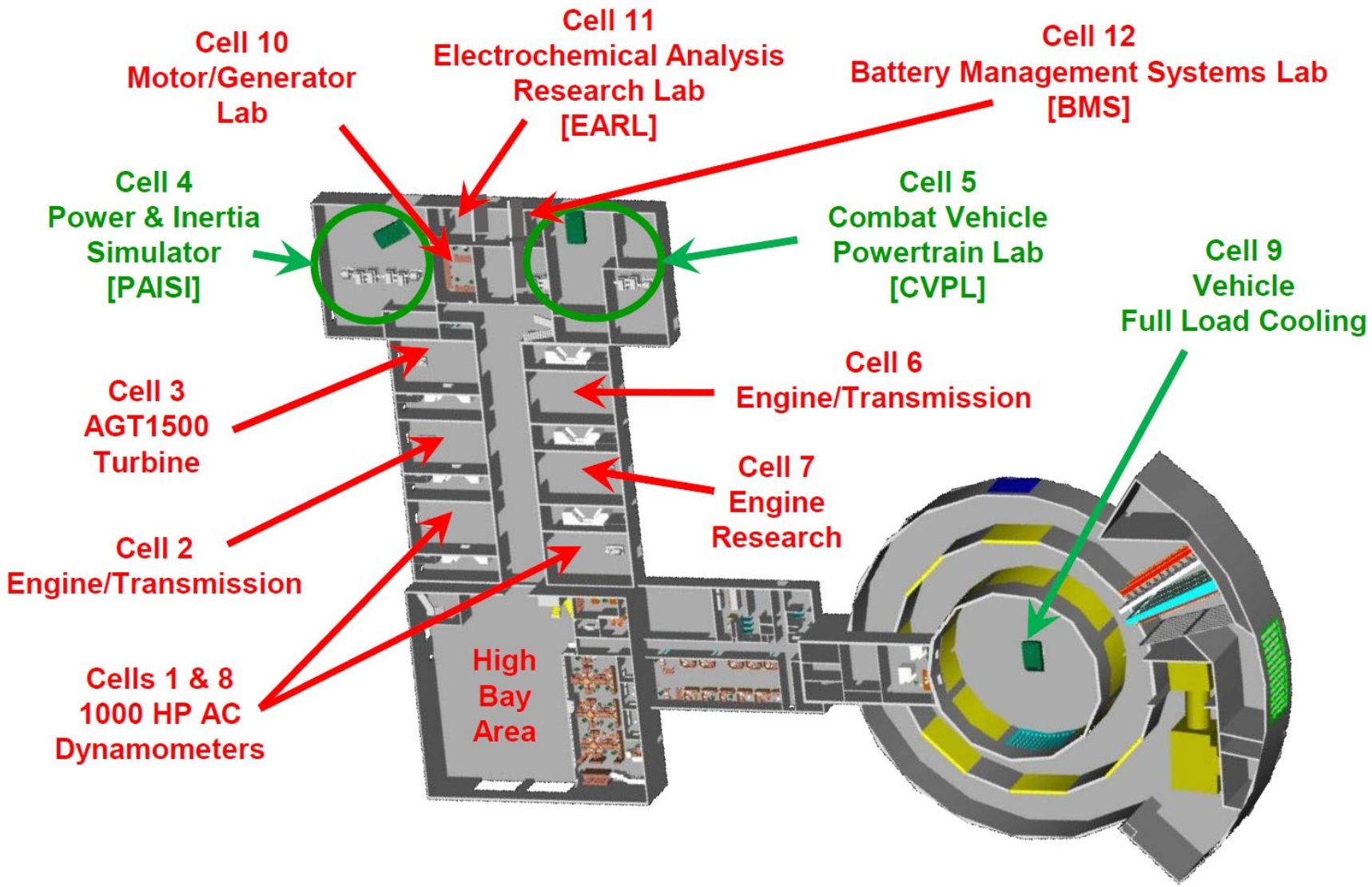
Propulsion Systems Laboratory



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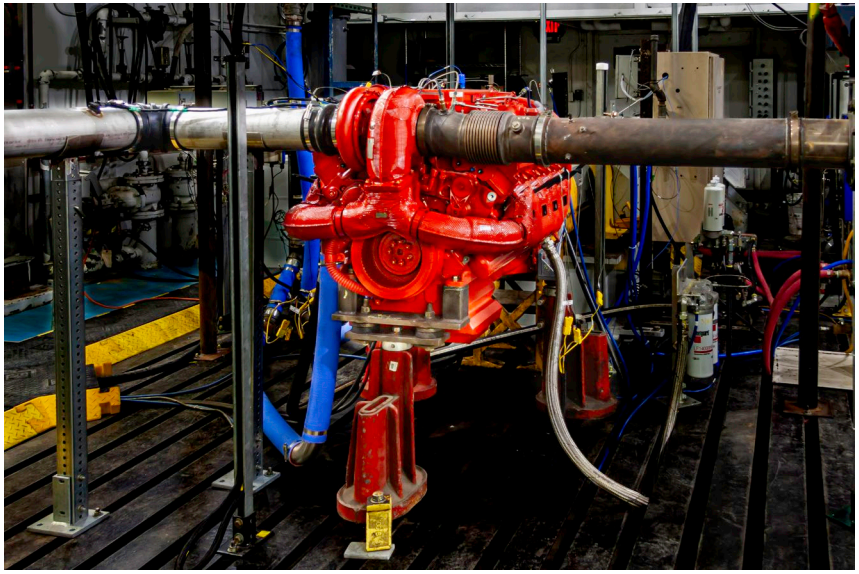
Propulsion Systems Laboratory

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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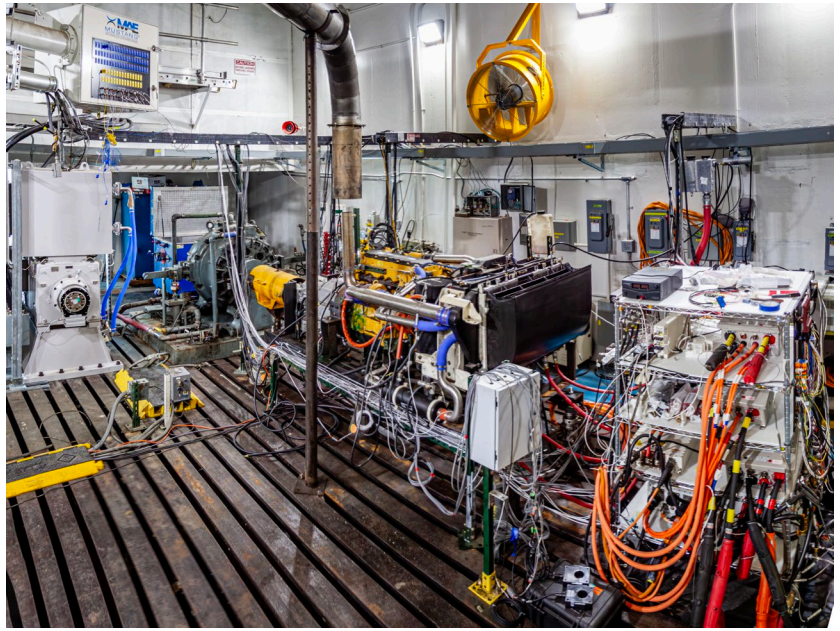
Propulsion Systems Laboratory

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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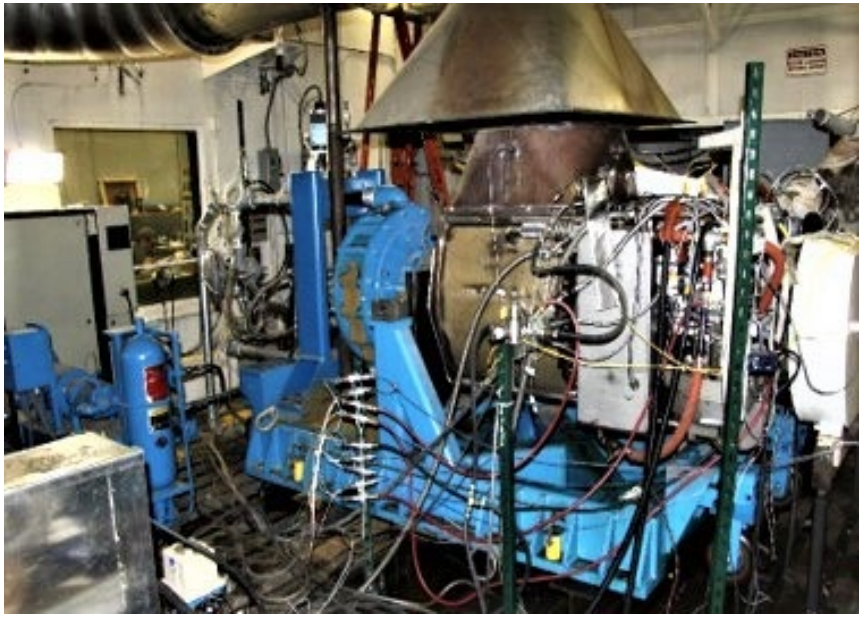
Propulsion Systems Laboratory

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

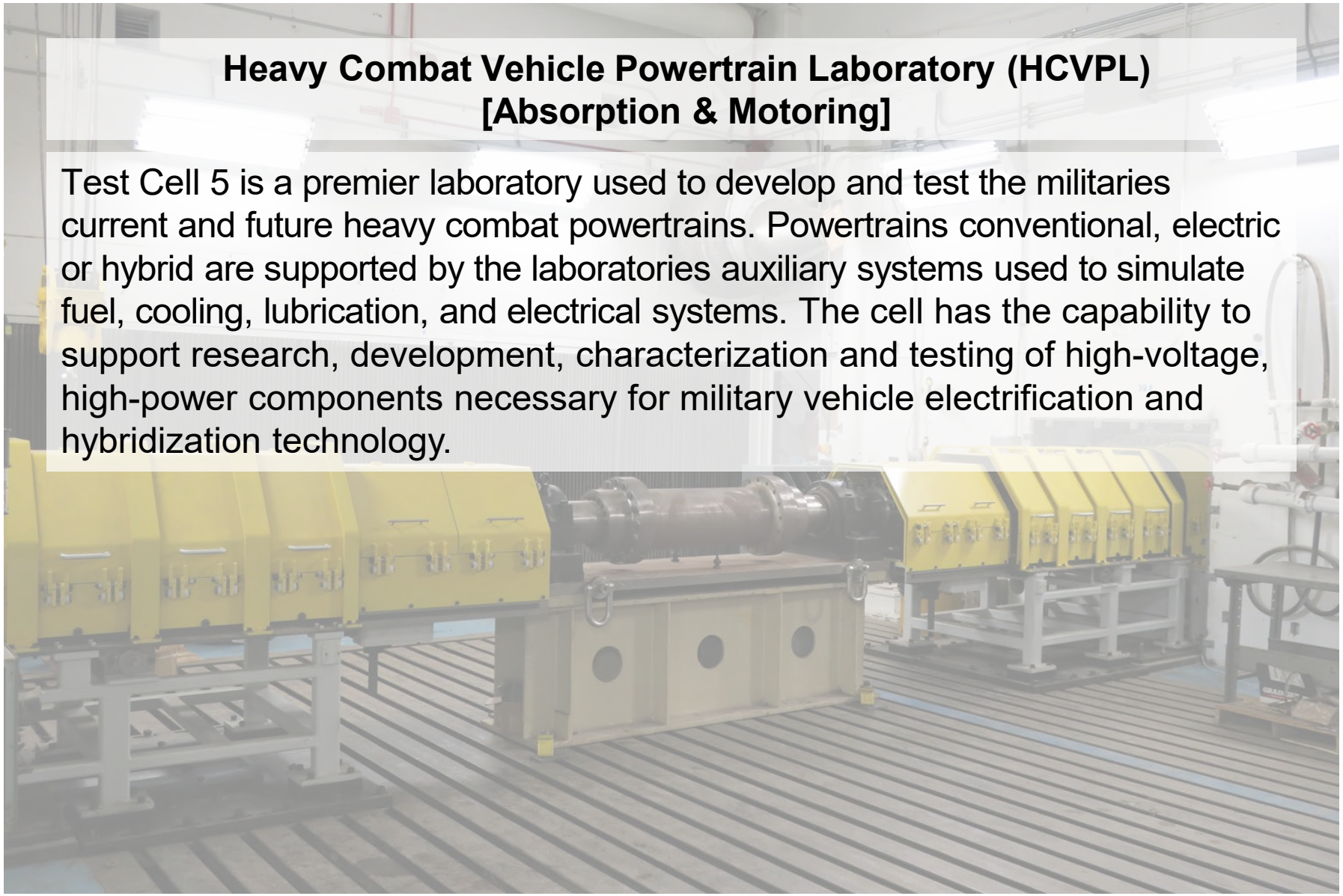
Competence

- 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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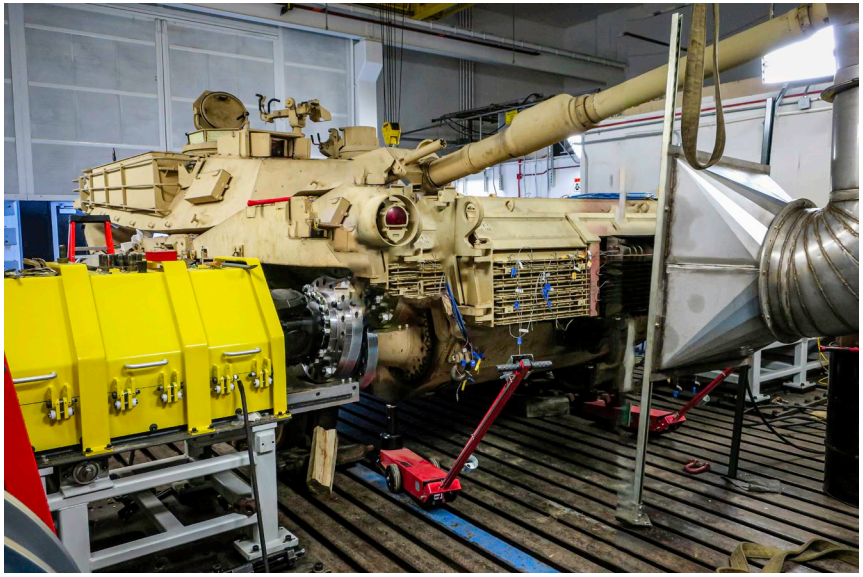
Propulsion Systems Laboratory

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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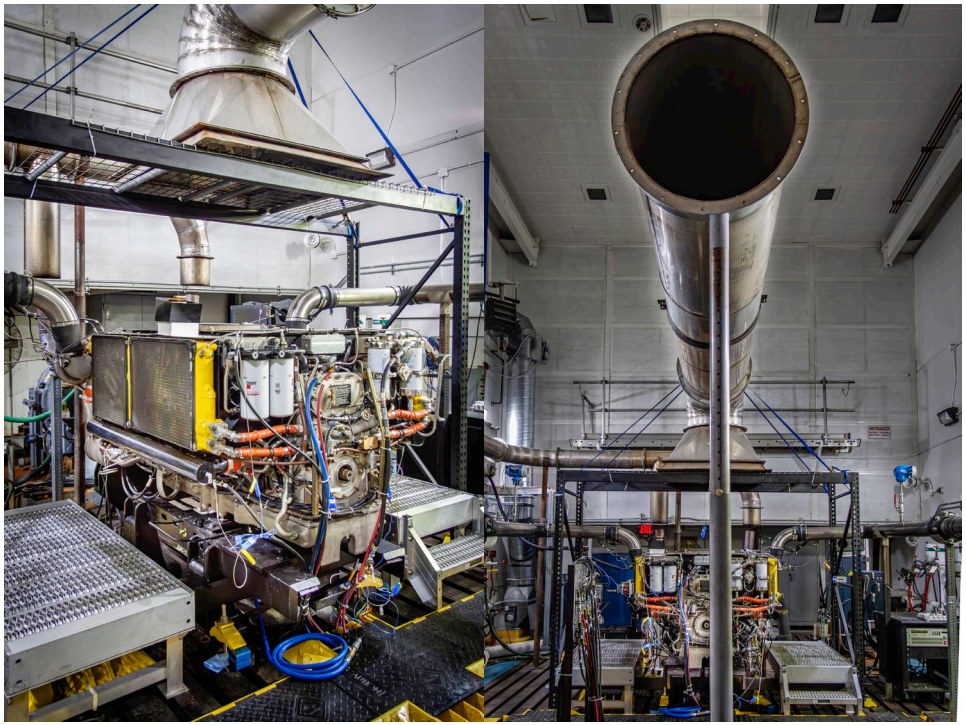
Propulsion Systems Laboratory

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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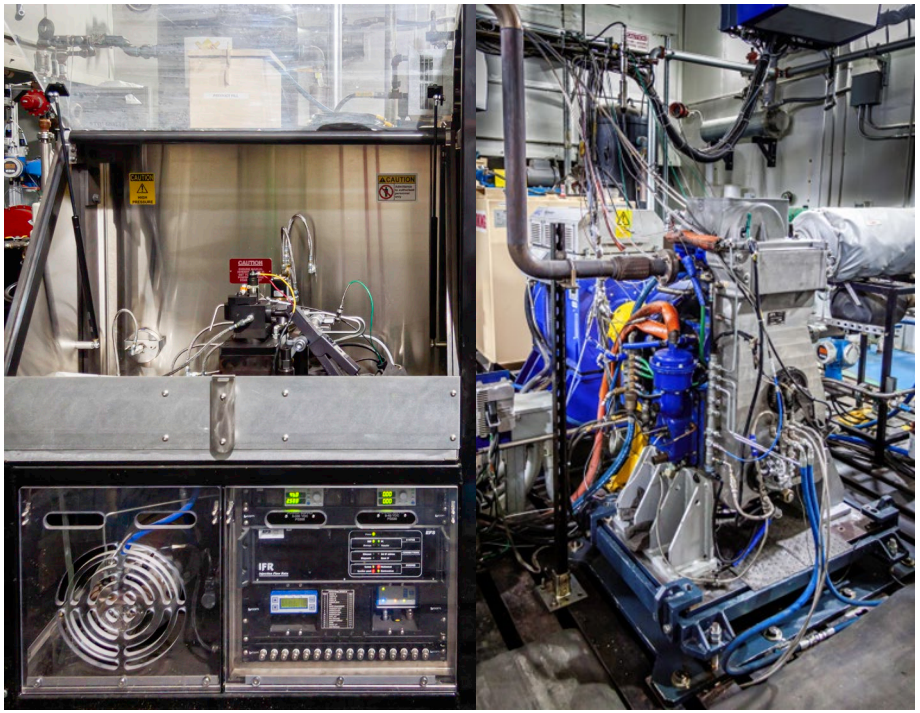
Propulsion Systems Laboratory

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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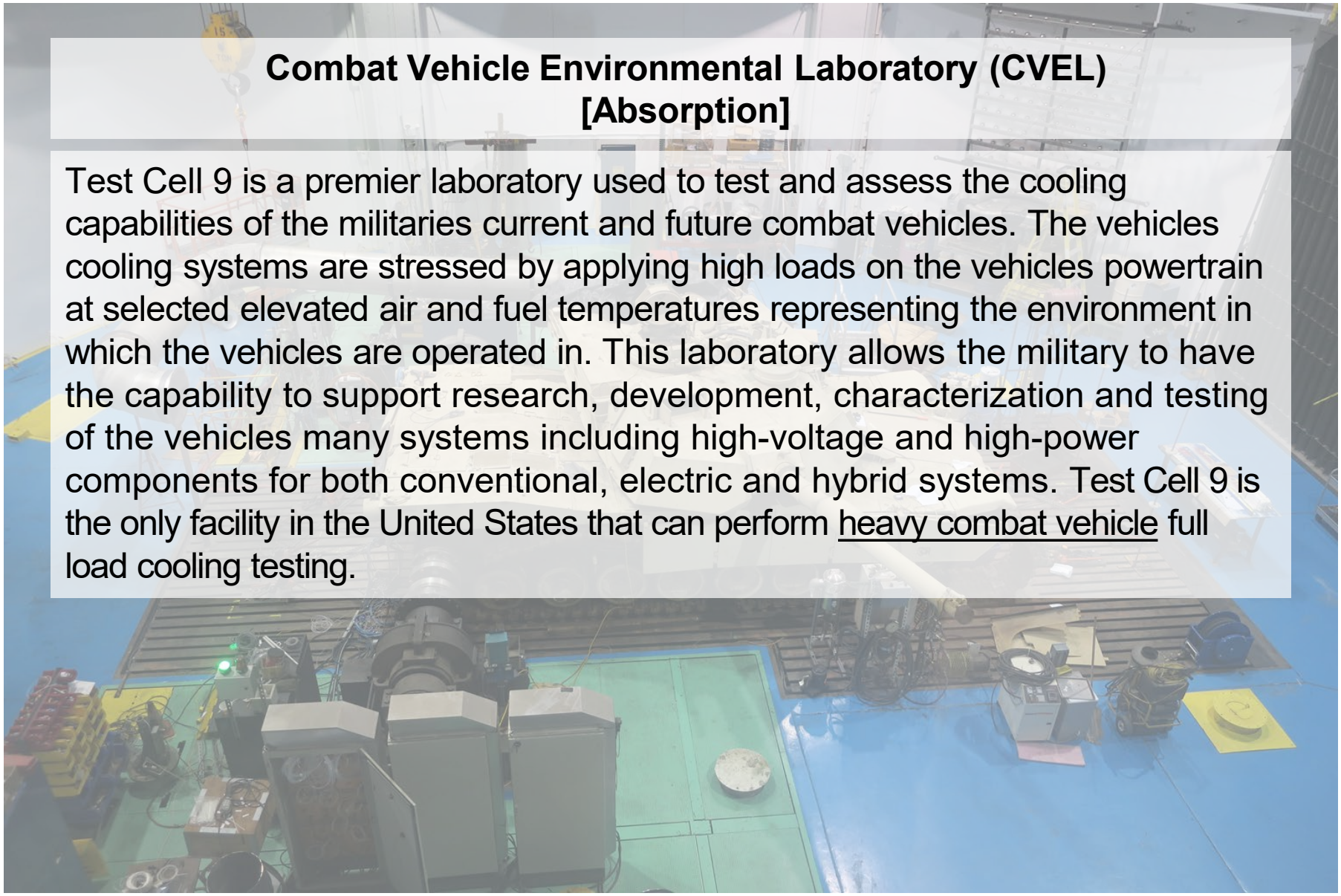
Propulsion Systems Laboratory

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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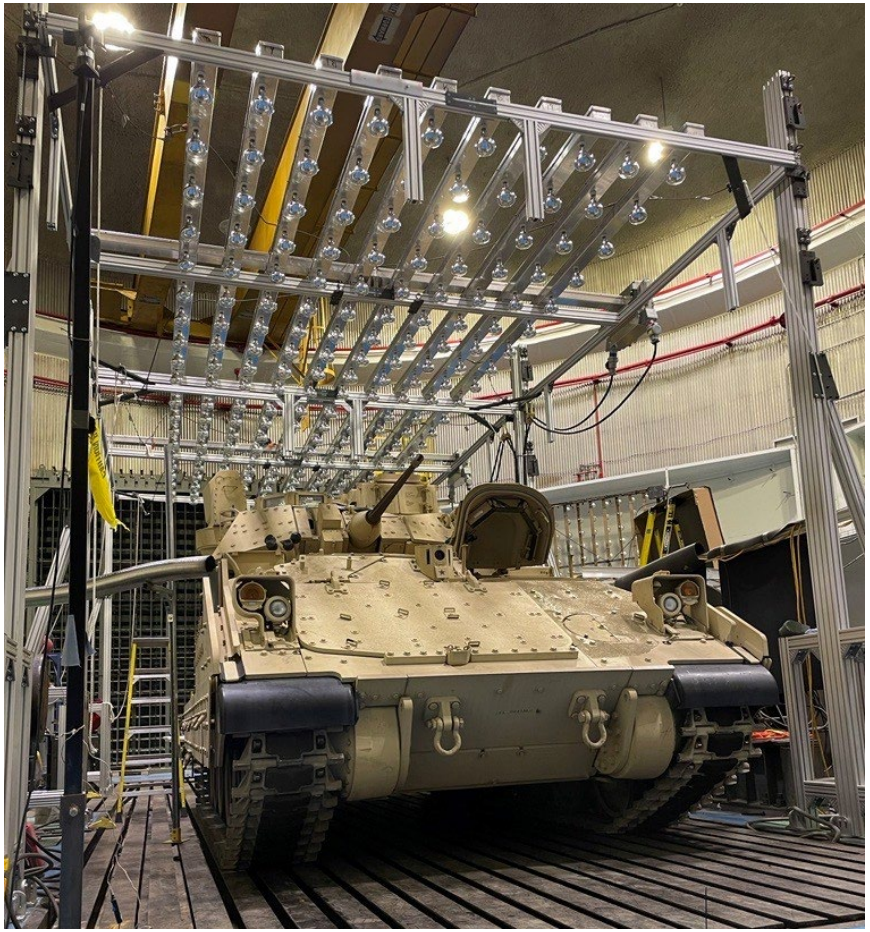
Propulsion Systems Laboratory

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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GSPEL Integration PSL

FOR FURTHER INFORMATION:

Dr. Igor Baseski, Division Chief T&E
e-Mail: igor.baseski.civ@army.mil
Phone: (586) 215-9327

Steven Beiter, GSPEL Branch Chief
e-Mail: steven.m.beiter2.civ@army.mil
Phone: (586) 571-5247

Dean McGrew, Integration Branch Chief
e-Mail: dean.z.mcgrew.civ@army.mil
Phone: (586) 306-6126

John Hubble, PSL Branch Chief
e-Mail: john.e.hubble.civ@army.mil
Phone: (586) 306-2031

CCDC - Ground Vehicle Systems Center
6501 E. 11 Mile Road
Bldg 212 (FCDD-GVR-TI), MS-121
Warren, MI 48397-5000

GVPM Testing and Integration Website:
https://gvsc.devcom.army.mil/gvpm/

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