

# SGS TESTING SERVICES

ENGINE & VEHICLE TESTING | COMPONENT TESTING | SERVICES & SUPPORT



WHEN YOU NEED TO BE SURE



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Aurora, CO

Columbus, IN

Empire, CO

Jackson, MI

Lapeer, MI

Taylor, MI

Troy, MI

# SGS GLOBAL & LOCAL

95,000 EMPLOYEES | 2,400 OFFICES & LABORATORIES AROUND THE WORLD



## GLOBAL SERVICE LOCAL EXPERTISE

### SGS TRANSPORTATION

- Automotive
- Aerospace & Defense
- Military
- Marine
- Off-road
- Non-road
- Small Engine
- Power Sports
- Agriculture
- Portable Fuel Containers
- Industry Groups
- Government & Regulatory Agencies

### CONTACT US

**VARIABLE ALTITUDE ENGINE & VEHICLE TESTING**  
Aurora, CO

**TEST CELL SOLUTIONS, SOFTWARE & VARIABLE HORSEPOWER ENGINE & VEHICLE TESTING**  
Columbus, IN

**ROCKY MOUNTAIN HIGH ALTITUDE TEST CENTER**  
Empire, CO

**MILEAGE ACCUMULATION CENTER**  
Jackson, MI

**FUEL & COMPONENT SYSTEMS TESTING**  
Lapeer, MI

**CATALYST AGING & COMPONENT TESTING SERVICES**  
Taylor, MI

**COMPONENT TESTING & ENGINEERING SERVICES**  
Troy, MI

**CALL** +01 844 730 4175  
**EMAIL** [us.transportation@sgs.com](mailto:us.transportation@sgs.com)

The SGS logo consists of the letters 'SGS' in a bold, sans-serif font. A vertical line is positioned to the right of the letters, and a horizontal line is positioned below the letters, forming an L-shaped frame around the text.

# SGS VEHICLE & ENGINE TESTING



AVAILABLE IN:

AURORA, CO

COLUMBUS, IN

EMPIRE, CO

JACKSON, MI

HIGH FEATURE TEST CELLS

ENGINE AND AWD / 2WD CHASSIS DYNAMOMETERS

DETROIT-BASED DRIVERLESS MILEAGE ACCUMULATION FACILITY

GASOLINE, DIESEL, CNG, SPECIALTY FUELS & EV/HEV CAPABILITIES

EXTREME ALTITUDE SIMULATION

VARIABLE ENVIRONMENTAL TEMPERATURES

EXHAUST & EVAPORATIVE EMISSIONS

PORTABLE EMISSIONS MEASUREMENT SYSTEM (PEMS)

CERTIFICATION & REGULATORY TESTING

IUVP & VEHICLE PROCUREMENT

DEVELOPMENT, DURABILITY & VALIDATION

**SGS**

# SGS VEHICLE & ENGINE TESTING

## RESEARCH, DEVELOPMENT AND CERTIFICATION TESTING WITH ENVIRONMENTAL CONDITIONS

SGS is equipped with a comprehensive array of laboratories capable of testing under extreme environmental conditions, at sea level, at altitude and even at simulated altitudes through its patented technology. Our experts can help you with anything from your most basic testing needs for small engines all the way to custom designed complex tests for larger engines and vehicles. Let our independent lab complement your current testing program.



### EXHAUST EMISSIONS CERTIFICATION

- Chassis dynamometer emissions laboratories compliant with EPA standards
- Federal and supplemental vehicle emissions certification testing
- EPA CAP2000 and In-Use Verification Program (IUVP)
- Motorcycle and ATV chassis dyno

### VEHICLE DEVELOPMENT

- Emissions labs to meet customer needs, including environmental testing, catalyst efficiency determination, custom drive cycles and test procedures as well as exhaust specification
- Vehicle instrumentation, including exhaust sample ports, thermocouples, pressure transducers and data logging
- Large cold soak room for cold start and sub-zero evaluation of products to -22°F (-30°C)
- Certification and specialty fuels in bulk tanks and drums

### EVAPORATIVE EMISSIONS

- Variable temperature SHEDs
- EPA and CARB procedures performed
- Point source running loss and fuel tank temp profile control
- On-board Refueling Vapor Recovery
- Canister loading and breakthrough

### EXTREME TESTING LABS AT SEA LEVEL, ALTITUDE AND EVERYTHING IN BETWEEN

- Patented altitude simulation capable of testing 0 to more than 12000' (3660 m) above sea level for both steady state and transient engine operating conditions
- Combustion air temperatures may be set from 14° to 130°F (-10° to 54°C)
- Vehicle and engine testing labs available at both sea level and altitude

### TYPICAL ENGINE TEST CELL USES

- Exhaust emissions certification tests, compliant with 40CFR Part 1065 and ISO8178 standards
- "Not-to-Exceed" performance and emissions testing at extreme environmental conditions
- Engine mapping and emission control system development
- Prototype engine development
- Electronic control system calibration
- Engine and aftertreatment component evaluations
- Verification of retrofit systems for state programs
- Fuel blends and additive studies
- Competitive benchmarking

### CONTACT US

To request a quote or discuss your testing needs in detail, please call +01 844 730 4175 or email [us.transportation@sgs.com](mailto:us.transportation@sgs.com).



# SGS VEHICLE & ENGINE TESTING

## SPECIFICATIONS FOR VEHICLE AND ENGINE TESTING WITH ENVIRONMENTAL CONDITIONS

SGS's network of transportation industry testing facilities are equipped with an array of test cells that allow our experts to test under extreme environmental conditions. With test cells at sea level, at altitude and even at simulated altitudes through its patented technology, we can test anything from small engines all the way to larger engines and vehicles. Let our independent lab complement your current testing program.

### ENGINE TEST CELL SPECIFICATIONS

DYNAMOMETER TYPE	MAX SPEED (RPM)	PEAK ABSORBING TORQUE (CONTINUOUS)	RATED ABSORBING POWER (CONTINUOUS)	SEA LEVEL OR ALTITUDE
AC Electric Motoring/Absorbing	4500	2668 lb-ft / 3617 Nm @ 0-1450 rpm	736 hp / 549 kW @ 1450-4500 rpm	Variable Altitude*
AC Electric Motoring/Absorbing High Speed Low Inertia	9000	570 lb-ft / 772 Nm @ 0-4000 rpm	430 hp / 320 kW @ 4000-7000 rpm	Variable Altitude*
AC Electric Motoring/Absorbing High Speed Low Inertia	6700	412 lb-ft / 560 Nm @ 0-2000 rpm	156 hp / 117 kW @ 2000-4400 rpm	Variable Altitude*
AC Electric Motoring/Absorbing	3600	2000 lb-ft / 2711 Nm @ 0-1500 rpm	600 hp / 447 kW @ 1500-3600 rpm	Sea Level
Eddy Current Absorbing Only	6000	805 lb-ft / 1092 Nm @ 1000-1500 rpm	230 hp / 172 kW @ 1500-5000 rpm	Variable Altitude*
Eddy Current Absorbing Only	4000	> 3000 lb-ft / 4067 Nm @ 500-1600 rpm	1200 hp / 895 kW @ 1600-4000 rpm	Sea Level

### VEHICLE TEST SITE SPECIFICATIONS

DYNAMOMETER	ABSORBING POWER (HP/KW)	AIR TEMPERATURE RANGE (°F / °C)	EMISSION SAMPLING	SEA LEVEL OR ALTITUDE
AC Electric Single 48" Roll	200 / 149	-20 to 110° F -29 to 43° C	5 Streams + Bag Gas & Diesel CVS	Variable Altitude*
AC Electric All-Wheel Drive Two Independent 48" Rolls	350 / 261 Front 450 / 336 Rear	0 to 110° F -18 to 43° C	5 Streams + Bag Gas & Diesel CVS	Variable Altitude*
AC Electric Single 48" Roll	200 / 149	50 to 110° F 10 to 43° C	4 Streams + Bag Gas CVS	Variable Altitude*
AC Electric Single 48" Roll	200 / 149	0 to 110° F -18 to 43° C	3 Streams + Bag Gas CVS Running Loss	Variable Altitude*
AC Electric Single 48" Roll	200 / 149	-10 to 110° F -23 to 43° C	3 Streams + Bag Gas CVS	Sea Level

\* SGS's patented Balancing Altitude Simulation Equipment (BASE) offers static and dynamic simulation of altitudes from sea level to 14,000 ft or 4,270 M

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## SEA LEVEL VEHICLE MILEAGE ACCUMULATION DYNAMOMETER SPECIFICATIONS

FEATURES	TYPICAL USES
<ul style="list-style-type: none"><li>Eddy current absorbing, single 40" roll</li></ul>	<ul style="list-style-type: none"><li>Rapid non-road mileage accumulation</li></ul>
<ul style="list-style-type: none"><li>Driverless, automated throttle and braking</li></ul>	<ul style="list-style-type: none"><li>Catalyst, transmission and driveline aging</li></ul>
<ul style="list-style-type: none"><li>Road load model, programmable drive cycles and OBD interface</li></ul>	<ul style="list-style-type: none"><li>Exhaust emissions deterioration</li></ul>
<ul style="list-style-type: none"><li>Road speed modulated frontal cooling fans</li></ul>	<ul style="list-style-type: none"><li>Fuel effects and lube evaluations</li></ul>
<ul style="list-style-type: none"><li>Data acquisition, comprehensive alarms and safeties</li></ul>	<ul style="list-style-type: none"><li>Diesel particulate filter regeneration studies</li></ul>
<ul style="list-style-type: none"><li>OBD Individual video recording of vehicles interface</li></ul>	<ul style="list-style-type: none"><li>Front wheel drive and rear wheel drive</li></ul>
<ul style="list-style-type: none"><li>Secured facility</li></ul>	<ul style="list-style-type: none"><li>Cost effective, low risk alternative to drivers</li></ul>

# SGS REAL WORLD PEMS EMISSIONS TESTING

## SGS PROVIDES A COMPREHENSIVE SUITE OF PORTABLE EMISSIONS TESTING SYSTEM (PEMS) SERVICES

The team at SGS has extensive experience providing engine, vehicle, emissions and performance testing services and is able to take that experience on the road. We offer a complete range of Portable Emissions Measurement System (PEMS) services to complement emissions testing in-use or in the laboratory. SGS's team of industry experts will provide comprehensive program solutions by working to understand your objectives, providing insight into industry trends, and developing a plan incorporating PEMS technology into your upcoming project.

### EMISSIONS ISSUES IN THE NEWS

The Real Driving Emissions (RDE) legislation (EU582/2011, EU6c (future)) in Europe and the heavy-duty diesel engine in-use compliance regulations in the US (per 40 CFR 1065) have driven advancements in portable emissions equipment and measurement methods. SGS recognizes the need for our customers to overcome these current and pending challenges for the purpose of compliance, regulation, and decision-making for engine development in both the traditional laboratory and real-world driving environments.

SGS continues to make significant investments in gas and PM instruments and measurement techniques for the development of next-generation vehicle and engine testing. Our customers now have the ability to fully test their vehicles on the road as well as correlate the recorded results within the test cell.

### CONTACT US

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### CAPABILITIES

- In-vehicle or in-lab use
- GPS tracking
- Advanced data acquisition technology
- Photo-acoustic real time soot measurement & gravimetric PM sampling capability
- Compliance with 40 CFR 1065, EU582/2011 & pending EU6c
- Measurement of THC, NO, NO<sub>2</sub>, CO, CO<sub>2</sub> & O<sub>2</sub>
- Operating temperatures from -30°C to +45°C
- Sensors for ambient temperature, humidity & atmospheric pressure
- OBD/CAN interface
- Exhaust flow measurement
- Can test anything from vehicles, trucks, boats, and aircraft to generators and power plants

### INSTALLATION

- No vehicle modifications required
- Compatible with a wide range of vehicle types
- Small size & minimal weight
- In-vehicle, trailer hitch or custom mount

### SERVICES

- Installation & set-up
- Unit calibration & maintenance
- Vehicle procurement & certified driver
- Route planning & drive cycle
- Data collection, download & validation
- Engineering support & evaluation
- Part procurement & fabrication
- Field service & technical support

### REAL WORLD OR TEST CELL APPLICATIONS

SGS's PEMS can be used for in-use testing of new and older vehicles or machines including: validating engine or after-treatment control and on-board diagnostic (OBD) strategies, compliance against NTE limits, detecting "emission defeat" strategies, and capturing real-world driving cycles for playback in the laboratory.



# SGS EMISSIONS ANALYTICS SUPPORT

Extracting full value from in-use test data can be elusive due to the control system complexity and the massive amount of information that is logged at high frequency. Data analysis is made even more difficult by the real-world nature of in-use testing. The weather, drive route, road grade, traffic and driver tendencies can all have a profound impact on emissions. Interpretation of test data is far more challenging outside of the dynamometer laboratory because in-use tests are not reproducible. SGS has tested prototype and production launch vehicles using PEMS to provide our customers with real-world information that supports the vehicle development process.



## LET SGS ASSIST YOU WITH ANALYZING YOUR PEMS DATA

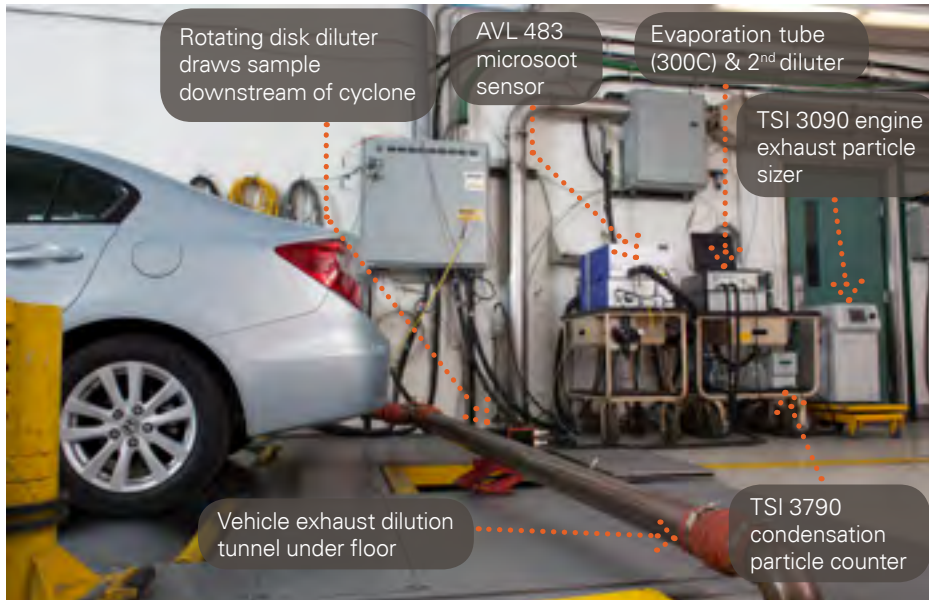
SGS has developed data analytics software and services to help engineers discover hidden relationships between emissions, fuel consumption and control system behavior.

- Test data are segregated into different modes of operation to provide statistics-based visualizations for an individual test or for the entire test campaign
- Pre-configured dashboards allow visualization of test data by subsystem and by event to provide insight for deeper data exploration
- SGS has developed clustering and association algorithms to explore low temperature operation, engine and catalyst control tradeoffs and emissions implications, as well as causation analysis for malfunctions and anomalies
- Machine learning is employed to isolate control system differences in situations where good and poor performance have been observed
- SGS provides a hierarchy of analytics solutions ranging from ad hoc data exploration to big data computing on a production scale

# SGS PARTICULATE MATTER CHARACTERIZATION

## SGS IS EQUIPPED TO HELP YOU UNDERSTAND PARTICULATE MATTER EMISSIONS

SGS has made a significant investment in particulate matter (PM) instruments and measurement techniques for the development of next-generation engines. Offering an array of instruments to characterize particulate emissions, the instruments are used in SGS engine and vehicle chassis dyno emissions labs to develop new products and to perform certification tests. SGS engine and vehicle labs, located in Aurora, CO, are compliant with US and European emissions certification testing standards.



### AVAILABLE INSTRUMENTS

- Particle counters
- Particle size spectrometer
- Research grade diluters
- Thermodenuders
- Microsoot sensors
- Part 1065/1066 PM samplers
- EC/OC/sulfate fractionation
- Available in SGS engine & vehicle emissions labs

### UNDERSTANDING PM

Our engineers can use instruments to understand the make-up and variability of PM emissions, the source of the emissions, and pathways to emissions reduction.

- Diesel Particulate Filter (DPF) filtration efficiency
- Soot slip past particulate filters on cold start & during active DPF regenerations
- DPF materials/porosity evaluation
- Filter damage assessment on filtration efficiency (missing plugs, cracks, segmentation, & matting defects)
- Contribution of unburned fuel & oil to PM
- Catalyst sulfate-make & sulfur purge effects
- Strategies to meet PM regulations without a particulate filter

### MEETING GOVERNMENT STANDARDS

Further evolution of powertrain technology will be required to meet stringent government standards for PM emissions.

- EPA Tier 3 has reduced light-duty PM emissions limits by 70% to 3 mg/mile
- CARB LEVIII has reduced light duty vehicle PM emissions to 3 mg/mile starting in 2017, & to 1 mg/mile starting in 2025
- Stage V for non-road engine applications will force DPFs & require particle number certification starting in 2019
- European light-duty vehicles & on road heavy-duty engines must be certified within a Euro 6 particle number limit

### CONTACT US

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# SGS HIGH ALTITUDE TESTING

## OUR ROCKY MOUNTAIN TEST CENTER OFFERS VARIABLE TEMPERATURES FOR HIGH ALTITUDE TESTING

SGS operates a secure facility for your cold start, drive away and high altitude development testing. Located at nearly 9000 feet above sea level in Empire, CO, the facility offers three private bays that can reach temperatures as cold as -22°F, or -30°C as well as a shop bay equipped with a lift.



### CONTACT US

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### PRIVATE & SECURE BAYS

Because we know confidentiality is important to our customers, our bays each have their own office with both hard line and wireless Internet, a restroom and are individually keyed.

- Each bay is 50' by 20'
- 12' W by 14' H doors can accommodate class 8 trucks and construction equipment
- Vehicle exhaust ventilation
- Vehicle shop with hoist on-site
- On-site refueling
- 700' off-highway drive-away
- Ability to set and monitor bay temperatures remotely

### TYPICAL USES FOR OUR HIGH ALTITUDE COLD CHAMBERS

- Passenger car and trucks
- On-road Class 1 to 8 heavy-duty trucks
- Construction equipment
- Agriculture equipment
- Skid-mounted engines
- Generator sets
- Transmissions
- Hydraulic systems

### WHY CHOOSE SGS?

- Newly constructed 4800 sq ft user facility
- Our facility can independently test products at a range of controlled temperatures as low as -30°C (-22°F)
- Use the test facility as a staging area to support test campaigns taking place around the I-70 corridor
- Centrally located near popular vehicle development venues including Berthoud Pass, Hoosier Pass, Vail Pass, Loveland Pass, Dillon and Mount Evans
- Less than an hour from our Aurora, CO facility for cold start testing and driveability assessments

### ADDITIONAL TESTING CAPABILITIES IN AURORA, CO

- Vehicle and engine emissions, particulate matter characterization and dynamometer testing services
- Cold testing including a large cold soak room and trailers
- Altitude simulation available



# SGS LARGE FORMAT COLD TESTING

## SGS PROVIDES CONVENIENTLY BAD WEATHER ALL YEAR LONG FOR YOUR COLD TESTING NEEDS

Rapid product development cycles depend on plannable work. Waiting for the weather to diagnose or validate a product feature adds months of schedule and uncertainty to development programs, and working in weather can be inconvenient and dangerous. SGS's expansive climate center in Columbus, IN offers a controlled environment that removes technical, cost, and measurement uncertainty from your development program.



### CONTACT US

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### TESTING CAPABILITIES

- Two 40' x 60' x 20' test chambers can handle large vehicles, engines and other test components
- Temperatures can range from -30°F to 150°F
- Capable of continuous running rated conditions on 2000 BHP engines at -20°F
- When chambers are combined, we are capable of running rated conditions on 4000 BHP engines at -20°F

### SUPPORT SERVICES

- Fueling
- Load management
- Test instrumentation and controls
- Emissions measurement
- Installation and setup
- Test operations, measurement and analysis
- Maintenance

### APPLICATIONS

- Vehicles
- Generator sets
- Battery and start systems
- Machinery
- HVAC systems

### TEST TYPES AVAILABLE

- Cold start for engines and vehicles
- Cold performance
- Thermal performance profiling
- Cold mechanical development
- Thermal modeling verification
- Current product troubleshooting
- Cold procedure verification
- Thermal protection and enhancement testing

### BENEFITS TO USING OUR CLIMATE CENTER

- Faster time to market when cold testing is needed
- Convenient central location reduces travel time and cost
- Quantifiable and repeatable test conditions
- ISO 9001:2008 weather
- Data quality measurement is built-in
- Controlled test sequencing
- About an hour to Indianapolis, Cincinnati and Louisville



# SGS EV & HEV VEHICLE TESTING SERVICES

SGS NORTH AMERICA CONSISTS OF A **COMPREHENSIVE NETWORK** OF TESTING LABORATORIES SERVING THE RESEARCH, DEVELOPMENT AND CERTIFICATION NEEDS FOR OUR CUSTOMERS

SGS can provide full vehicle, component level and system level testing on your electric vehicles (EV) and hybrid vehicles (HEV) and is accredited under ISO 17025. Our labs operate advanced chassis dynamometers with AWD and 2WD capabilities that simulate driving conditions for custom driving patterns or standard road cycles. SGS can also perform vehicle and component level testing in a multitude of simulated environments including road, temperature and altitude.



## CONTACT US

To request a quote or discuss your testing needs in detail, please call +01 844 730 4175 or email [us.transportation@sgs.com](mailto:us.transportation@sgs.com).

## VEHICLE TESTING CAPABILITIES

Our lab offers options for driveability with available certified technical drivers or the use of automated robot drivers for precise repeatability that is crucial to vehicle and battery manufacturers in obtaining accurate range and SOC measurement. Additionally we offer related vehicle and component testing services:

- Custom or standard cycles can be executed as a single test (state test) or continuously repeated (range test) in any combination
- Portable Emissions Measurement System (PEMS) testing services
- Vehicle procurement

## COMPONENT TESTING CAPABILITIES

- Cold soak and environmental testing of assemblies and components
- Evaporative emissions measurement
- Vibration and in-use simulation
- Servo-hydraulic testing
- Exhaust testing
- Electro-dynamic shaker testing
- Durability, fatigue and ultimate strength testing
- Product development
- Impact, static torsion and bending

## TEST SPECIFICATIONS

- SAE J1634, SAE J1711 and SAE J2951 test procedures
- ISO, TC 22Sc 21 and WG 2 test standard PHEV

## FACILITIES & EQUIPMENT

- AWD/RWD/FWD Chassis dynamometer and suspension
- Motorcycle/ATV/side-by-side chassis dynamometer
- PHEV charge stations
- Multi-range SOC analyzer
- Altitude simulation
- Vehicle environmental testing from -20°F to 110°F, sea level to high altitude
- Cold soak room and staging area
- CAN data recording
- Evaporative emissions testing SHEDs
- Dedicated office space for local and visiting staff
- Mechanic shop with private wash bay and vehicle lifts
- Systems for driveline, motors, gear boxes, couplings, BIW, structure, electrical and battery

## TESTING PROCEDURES

- Vehicle types supported include PHEV, EV, ZEV, PEV and BEV
- Range, SOC plotting and SOC measurement
- Range depletion mode
- Battery heat and cooling control
- Vehicle thermal management
- Depletion cycle at steady-state speed
- Vehicle hot and cold charge depleting mode
- Standard cycles including UDDS, HWY, US06, FTP and WLTP
- Custom cycles can be set up for any configuration
- Vehicle auxiliary testing AC on/off and BTM
- Charge recovery
- Power, speed and torque testing
- Continuous test run time up to 10 hours

# SGS MILEAGE ACCUMULATION

## OUR HIGH CAPACITY MAD FACILITY CAN ELIMINATE THE RISK TO ON-ROAD ACCUMULATION

SGS offers a mileage accumulation dynamometer (MAD) facility less than two hours from Detroit in Jackson, MI. We are able to age passenger cars, trucks and light-duty commercial vehicles for engine catalyst control system aging, exhaust emissions deterioration, vehicle load acceptance, vehicle calibration development, lube evaluations, and transmission aging, as well as diesel particulate filter regeneration studies.



### CONTACT US

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### DRIVERLESS AGING ON EDDY CURRENT DYNOS

Our Jackson, MI facility offers seven eddy current absorbing, single 40" roll dynamometers as well as a flexible automation system for data acquisition, customized drive cycles and alarming.

- Determine the engine and catalyst emissions deterioration performance at full useful life
- Driverless, automated throttle and braking
- Road load model
- Sensors and customized alarms may be added for vehicle protection
- Programmable drive cycles
- Road speed modulated frontal cooling fans
- OBD interface
- Video surveillance and recording for each vehicle
- 24/7 operation

### ADVANTAGES OF MAD TESTING OVER ON-ROAD AGING

- Eliminate risk to the on-road driver
- Your tests will be uninterrupted testing in inclement weather
- Eliminate the potential for on-road accidents
- Using the EPA's Standard Road Cycle, vehicles can be aged in 120,000 in four months
- Closed loop control systems ensure accurate and repeatable drives on the dynamometer
- MAD testing is more cost effective than on-road aging

# SGS

# SGS COLD TESTING CAPABILITIES

## SGS PROVIDES CONVENIENTLY BAD WEATHER ALL YEAR LONG FOR YOUR TESTING NEEDS

Rapid product development cycles depend on plannable work. Waiting for the weather to diagnose or validate a product feature adds months of schedule and uncertainty to development programs, while working in extreme weather can be inconvenient and dangerous. SGS's network of testing services laboratories offers controlled environments across the US that remove technical, cost and measurement uncertainty from your development program with quantifiable and repeatable testing conditions.



### CONTACT US

To request a quote or discuss your testing needs in detail, please call [+01 844 730 4175](tel:+018447304175) or email [us.transportation@sgs.com](mailto:us.transportation@sgs.com).

### TESTING CAPABILITIES

- Small components up to large vehicles in extreme conditions
- Temperatures can range from -65° C to 165° C in chambers both small to large depending on location
- 40' x 60' x 20' test chambers capable of continuous running rated conditions on 2000 BHP engines at -28° C
- 50' x 20' high altitude cold chambers
- 30' x 30' x 16' cold room with altitude simulation that makes it possible to test from sea level to extreme altitude
- 53' cold trailers
- Chassis dynamometer cold test cells with emissions testing capabilities
- 96" x 96" x 88" test chambers for component testing

### TEST TYPES AVAILABLE

- Emissions testing
- Cold start for engines and vehicles
- Cold performance
- Thermal performance profiling
- Cold mechanical development
- Thermal modeling verification
- Current product troubleshooting
- Cold procedure verification
- Thermal protection and enhancement testing
- Durability testing

### SUPPORT SERVICES

- Fueling
- Load management
- Test instrumentation and controls
- Emissions measurement
- Installation and setup
- Test operations, measurement and analysis
- Maintenance

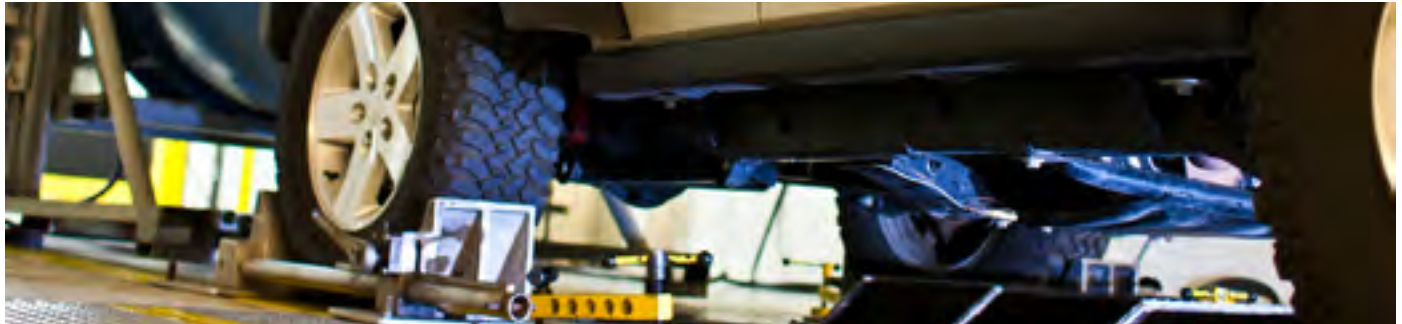
### APPLICATIONS

- Light, medium and heavy duty vehicles
- Off-highway, agriculture and construction equipment
- Off-road vehicles and power sports
- Generator sets
- Battery and start systems
- Machinery
- HVAC systems
- Small engines and hand-helds
- Components
- Locomotive
- Marine

# SGS IN-USE VERIFICATION PROGRAM

## SGS IS YOUR GLOBAL EXPERT IN TURNKEY VEHICLE PROCUREMENT & TESTING SERVICES

All of SGS's provided services, including procurement and chassis dynamometer testing, are performed in full compliance with the US EPA, CARB, and CAP 2000 emissions requirements.



### IN-USE PROCUREMENT

- Complete services for obtaining in-use vehicles for compliance testing
- All tasks related to your customer mailings
- Arranging pick-up and drop-off of vehicles
- Qualified drivers pick up the participants' vehicles, inspect the vehicles, and handle all the necessary paperwork
- Participant rental vehicles delivered with a full tank of fuel
- Test vehicles are driven or transported to designated test facilities
- Vehicles can be tested at one of our vehicle test labs or at your designated facility
- We will initiate payment to the participants after the testing is completed
- All logs and forms are completed as necessary in a professional and timely manner
- All vehicles are returned cleaned insuring the participants and your satisfaction

### TESTING SERVICES AVAILABLE

- In-use testing is performed in our labs on our advanced chassis dynamometers
- You'll receive detailed data and reports indicating the current performance characteristics of the legacy vehicles after being used in real world driving conditions for extended periods of time
- We will help you develop a clear understanding of the owner's driving patterns along with providing valuable information for developing future accelerated aging cycles for new model vehicles and various levels of powertrain components

### CONTACT US

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### EXPANDED INSIGHT & DATA FOR ENHANCED ANALYSIS

SGS offers our customers a complete range of Portable Emissions Measurement System (PEMS) services to complement emissions testing in-use or in the lab. Our team of industry experts will work to understand your objectives, provide insight into industry trends, develop a plan and provide comprehensive program solutions for incorporating PEMS technology into your upcoming IUVP project.



# SGS COMPONENT TESTING



AVAILABLE IN:

AURORA, CO

COLUMBUS, IN

LAPEER, MI

TAYLOR, MI

TROY, MI

HIGH FLOW SERVO-HYDRAULIC

LOW AND HIGH-LOAD ELECTRODYNAMIC VIBRATION

BURNER-BASED THERMAL EXHAUST EXPOSURE

ENVIRONMENTAL CONDITIONING, SIMULATION & THERMAL SHOCK

HOT, COLD AND HUMIDITY CAPABLE CHAMBERS

CATALYST AGING WITH GASOLINE, DIESEL OR NATURAL GAS

FUEL SYSTEM & COMPONENT EVAPORATIVE EMISSIONS

CERTIFICATION & REGULATORY TESTING

FUEL PUMP & MODULE DURABILITY

CANISTER LOADING & CONDITIONING

GASOLINE, DIESEL & DEF FILL TESTS

TANK SLOSH & NOISE TESTING

# SGS EVAPORATIVE EMISSIONS TESTING

Offering more than 1500 different testing services to clients in automotive, marine, small engine, agriculture, and portable fuel container markets, our lab in Lapeer, MI is equipped to help you with your testing needs. From simple tensile measurements to complex engineering evaluations requiring simultaneous measurement and control of vibration, temperature, flow, and altitude, we deliver quality results, unparalleled service, and fast turnaround times.

Just north of suburban Detroit, our ISO 17025 accredited facilities include more than 40,000 square feet of lab space. We assist clients with certification compliance testing and submission as well as develop and perform custom tests for individual companies and industry groups.



## SHED & WEIGHT LOSS METHODS

### SEALED HOUSING EVAPORATIVE DETERMINATION (SHED)

- Four (4) mini SHEDs
- Twelve (12) micro SHEDs
- Standard EPA and CARB protocols as well as customizable diurnals and isothermals
- Identify HC 'hot spots' with TSG Multi-Point® analysis
- Innova analyzer for alcohol measurement

### GRAVIMETRIC EVAPORATIVE EMISSIONS MEASUREMENT (WEIGHT LOSS)

- SAE J1737, J1527 and J30
- Up to 54,000 grams with 0.1 grams resolution
- Low end resolution on lighter samples to 0.001 grams
- Environmentally controlled scale room
- CARB and EPA certification compliance service
- Fuel recirculation testing at elevated temperatures



### APPLICATIONS

- Automotive fuel storage and delivery systems
- Small Off-road Engine (SORE) systems
- Portable fuel container systems
- Marine systems

### CONTACT US

To request a quote or discuss your testing needs in detail, please call +01 844 730 4175 or email [us.transportation@sgs.com](mailto:us.transportation@sgs.com).



The SGS logo, consisting of the letters "SGS" in a bold, sans-serif font, with a vertical line to the right and a horizontal line below.

# SGS COMPONENT ENVIRONMENTAL TESTING

Offering more than 1500 different testing services to clients in automotive, marine, small engine, agriculture, and portable fuel container markets, our lab in Lapeer, MI is equipped to help you with your testing needs. From simple tensile measurements to complex engineering evaluations requiring simultaneous measurement and control of vibration, temperature, flow, and altitude, we deliver quality results, unparalleled service, and fast turnaround times.

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## ROBOT & VIBRATION BASED TESTING

### COMPONENT TESTING WITH ENVIRONMENTAL CONDITIONING

- Chamber temperatures can range from -65°C to +165°C
- The interior dimensions of the chamber are 96" x 96" x 88"
- Three axis motion
- Displacement measured with laser system
- Can handle payloads up to 270 kg

### MEASUREMENT PARAMETERS

- Motion/displacement
- Temperature
- Pressure/vacuum
- Flow

### APPLICATIONS

- Hose testing
- Cold rolls
- Durability
- Thermal cycling



### CONTACT US

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# SGS COMPONENT LATERAL SLOSH TESTING

Offering more than 1500 different testing services to clients in automotive, marine, small engine, agriculture, and portable fuel container markets, our lab in Lapeer, MI is equipped to help you with your testing needs. From simple tensile measurements to complex engineering evaluations requiring simultaneous measurement and control of vibration, temperature, flow, and altitude, we deliver quality results, unparalleled service, and fast turnaround times.

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## DURABILITY & NOISE SYSTEMS

### SLOSH NOISE TESTING FOR FUEL TANKS

- Third octave, octave and narrow band analysis plus four digital video signals
- Noise floor of 28 dB(A) in semi-anechoic termination cell
- Acceleration/deceleration rates up to 4.9 m/s<sup>2</sup>
- Payloads up to 200kg

### SLOSH DURABILITY TESTING

- Fuel pump module durability
- Multiple OEM protocols available
- Cold slosh cycle for DEF components

### MEASUREMENT PARAMETERS

- Temperature
- Pressure
- Flow
- Resistance

### APPLICATIONS

- Fuel tank pump/module durability
- Fuel tank baffle system durability
- DEF tank freeze and thaw durability



## CONTACT US

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# SGS REFUELING & FILL TESTING

Offering more than 1500 different testing services to clients in automotive, marine, small engine, agriculture, and portable fuel container markets, our lab in Lapeer, MI is equipped to help you with your testing needs. From simple tensile measurements to complex engineering evaluations requiring simultaneous measurement and control of vibration, temperature, flow, and altitude, we deliver quality results, unparalleled service, and fast turnaround times.

Just north of suburban Detroit, our ISO 17025 accredited facilities include more than 40,000 square feet of lab space. We assist clients with certification compliance testing and submission as well as develop and perform custom tests for individual companies and industry groups.



## GASOLINE, DIESEL & DEF/UREA

### FILL CARTS

- Gas and diesel fill cart
- DEF/Urea fill cart
- Capable of dispensing fuel at flow rates from less than 4 gpm to over 25 gpm
- No excessive back pressure

### WIDE RANGE OF NOZZLES

- Over 50 nozzles available for use in fill testing
- Replicate fueling scenarios for most gas stations in the US
- Vapor/vacuum assist and balanced nozzle capabilities

### APPLICATIONS

- Automotive
- Marine
- Off-road
- Hand-held
- Portable fuel storage



### CONTACT US

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# SGS

# SGS VIBRATION TESTING SERVICES

Located minutes from the Detroit Metro Airport, our ISO 17025 accredited, 17,000 square foot facility in Taylor, MI is equipped with high-frequency vibration equipment and state-of-the-art high-performance natural gas and diesel burners. A leader within the industry for testing and engineering services, SGS serves customers in a wide range of industries including: automotive, off-road, heavy truck, aerospace, power sport, marine and military. Through investments in technology, the use of flexible equipment, and collaboration with our network of SGS labs, we work hand-in-hand with our customers to create accelerated lab-based testing methods that support shorter product life-cycles in order to bring products to market quickly and efficiently.



## AMBIENT, HIGH TEMPERATURE & VIBRATION TESTING

### TESTING CAPABILITIES

- Electro-dynamic shaker systems are utilized extensively to evaluate components over a wide range of acceleration levels and high-frequency ranges
- Our lab has 13 electro-dynamic shaker systems with slip tables offering 3 axis vibration with force ratings up to 20,000 lbs, frequencies of 5 to 2,500 Hz and 2 inch stroke
  - Performing sine, random, sine on random, and random on random testing
  - Capable of supporting custom inputs as required
- 48 inch by 48 inch slip tables, 47 inch by 47 inch head expanders of 20 foot overhead clearance allows the testing of large and tall items with high overturning movements
- Electro-dynamic test systems can be integrated with environmental chamber capabilities allowing components to be simultaneously exposed to vibration and extreme temperature cycling
- Instrumentation and data collection using Vibration View software, PDAQ and GAQ technology is utilized

### APPLICATIONS

- Exhaust
- Fuel Components
- HVAC
- Cooling Modules
- Interior Cockpit
- Electrical
- Battery
- Driveline

### EQUIPMENT

- 13 electro-dynamic shaker systems with slip tables
- 19 high performance burner systems
- Environmental simulation including hot, cold and humidity
- Automated water submersion, spray and dunk-tank systems
- Lead detection systems

### CONTACT US

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### SGS ADVANTAGE

- We have extensive experience testing to the most complex vibration requirements on products that are used within many industries and business segments
- Our 19 high-performance burners can be combined with vibration systems to create a unique test system to support extreme component or system level testing



# SGS SERVO-HYDRAULIC TESTING

Located just north of Detroit, our ISO 17025 accredited, 33,000+ square foot facility on almost 2.5 acres in Troy, MI is capable of performing servo-hydraulic, shock and vibration testing. A leader within the industry for testing and engineering services, SGS serves customers in a wide range of industries including; automotive, off-road, heavy truck, aerospace, power sports, marine and military. Through investments in technology, the use of flexible equipment, and collaboration with our network of SGS labs, we work hand-in-hand with our customers to create accelerated lab-based testing methods that support shorter product life-cycles in order to bring products to market quickly and efficiently.



## CONTACT US

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Certificate #1901.01

## FATIGUE, DURABILITY & LIFE CYCLE TESTING

### SERVO-HYDRAULIC TESTING CAPABILITIES

- Fatigue
- Durability
- Block cycle
- Tensile and compression
- Impact
- Rotary
- Static bending and torsion
- Testing combined with thermal cycling

### EQUIPMENT

- Over 100 servo-hydraulic linear actuators with a capacity in excess of 100,000 lbs and up to 200 Hz
- Rotary actuators with a capacity up to 100,000 in/lb and a +/- 50 degree rotation
- Custom designed heavy duty shock absorber test stands
- MTS 4-post road simulator with 11-kip actuators
- Environmental simulation including hot, cold and humidity
- MTS and Shore Western hydraulics controllers

### APPLICATIONS

- Shock absorbers and dampers
- Chassis and suspension
- Steering
- BIW and body structures
- Powertrain
- Seating systems
- Interior cockpit
- Exterior

# SGS SHOCK ABSORBER TESTING

Located just north of Detroit, our ISO 17025 accredited facility in Troy, MI is capable of performing servo-hydraulic, shock and vibration testing. A leader within the industry for testing and engineering services, SGS serves customers in a wide range of industries including; automotive, off-road, heavy truck, aerospace, power sports, marine and military. Through investments in technology, the use of flexible equipment, and collaboration with our network of SGS labs, we work hand-in-hand with our customers to create accelerated lab-based testing methods that support shorter product life-cycles in order to bring products to market quickly and efficiently.



## AVAILABLE EQUIPMENT & SUPPORT

- Three dedicated shock absorber test stands capable of testing sample sizes of six simultaneously
- Two purpose built shock absorber test stands designed to support large vehicles, heavy trucks, off-road vehicles and military applications
- Multiple high performance test rigs with speeds in excess of 5.0 m/s
- Anechoic chamber for noise evaluations
- Control systems that support damper software and real-time testing
- 1000 GPM hydraulic pumping system
- All tests can include cooling jackets, side loading, data collection and data acquisition
- Dedicated technical staff support is available seven days a week, 24 hours a day



## TESTING CAPABILITIES

- High speed valve durability
- High and low speed cycling
- High speed impact
- Damping force characteristics
- Temperature cycling
- Noise evaluations
- Tube static strength
- High speed piston endurance
- Piston rod fatigue
- Static bending strength
- Mounting pin static and dynamic load
- Dust durability
- Oil seal durability
- Muddy water endurance
- Friction testing
- Rebound bumper testing
- Biaxial life cycle
- Gas repulsion
- Impact drop
- Piston rod bending fatigue
- Clevis bracket to cylinder durability

## HEAVY DUTY SHOCK ABSORBER TESTING CAPABILITIES

- Heavy duty shock absorber test systems to support military, aerospace, heavy duty, off-road, bus, rail and industrial applications
- Ridged two and four post test frames with 45 kip actuators, +/- 5 inch stroke, and high response servo valves
- Optional hydraulic or pneumatic side loading capability
- Custom enclosures for high and low temperature environmental conditions
- All tests can include water cooling jackets, data collection and data acquisition
- Custom fixture design, build and fabrication capabilities
- Test frames mounted to in-ground bed plates with reaction mass

## CONTACT US

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Certificate #1901.01



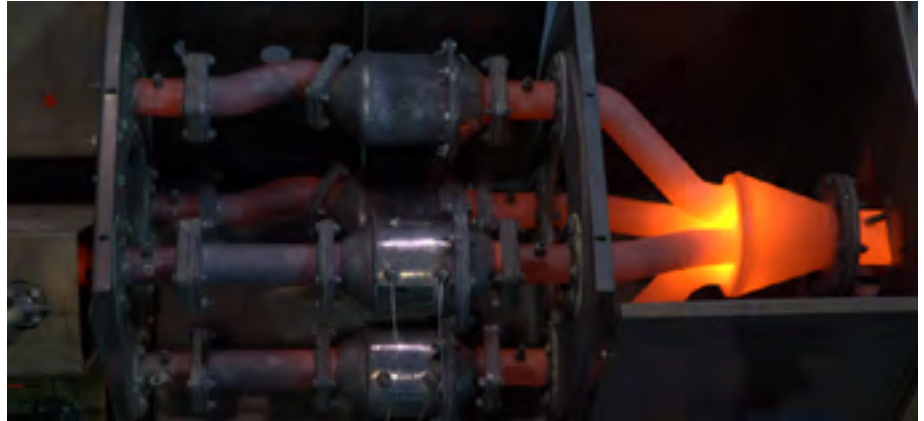


# SGS CATALYST AGING

Located within minutes of the Detroit Metro Airport, SGS provides catalyst aging services to clients around the world at its Taylor, MI location. Utilizing patented C-FOCAS<sup>®</sup> and natural gas burner technology, we successfully reduce aging cost for OEMs and suppliers alike while also providing burner manufacturing, engineering services, and support.

## WHAT IS C-FOCAS<sup>®</sup> BURNER-BASED CATALYST AGING?

- C-FOCAS<sup>®</sup> is a computer controlled, gasoline-fueled burner-based exhaust catalyst aging system developed to provide accelerated aging in order to shorten test time requirements and reduce costs through fuel savings.
- The system realistically simulates the flow of exhaust gas from an engine under a variety of load conditions allowing full-sized automotive catalyst systems to be rapidly and precisely aged. Unlike an engine, the multi-catalyst burner easily operates at temperatures exceeding 1200°C.
- Stoichiometric combustion systems are available for aging three-way catalysts using gasoline, natural gas, and propane fuels. The system can accurately inject oil or metered poison to simulate engine oil consumption.
- Four-up aging, with full size catalysts, reduces the carbon footprint correlated to multiple OEM specifications, SBC/Rat-A, independent control of A/F, flow, and temperature.
- The system has been demonstrated to accurately age catalysts using gasoline, natural gas or propane.



## ADVANTAGES OF C-FOCAS<sup>®</sup> BURNER-BASED CATALYST AGING OVER ENGINE DYNAMOMETER

- Burner-based catalyst aging allows independent control of thermal effects and the effects caused by lubrication oil poisoning. Unlike engine-based aging, where oil consumption is inherent to engine operation and changes with engine wear, the system consumes no oil during fuel-air combustion. Lube oil may be injected into the hot combustion products with a metering and measurement system. This process allows the user to age catalysts with or without oil poisoning effects.
- Catalyst aging temperature is precisely controlled with less variation and to higher extremes than can be obtained from an engine based system. The burner based system is not susceptible to engine related failure modes that can cause misfires and uncontrolled catalyst exotherms. This translates to fewer failures of expensive prototype catalysts. The system easily stays within  $\pm 5^{\circ}\text{C}$  at temperatures exceeding 1150°C.
- The C-FOCAS<sup>®</sup> aging system has been correlated to numerous aging specifications including RAT-A, ZDAKW, SBC, four-mode aging, and several proprietary OEM cycles. The result is significant reduction in both overall cycle time and fuel consumption with improved quality.

### CONTACT US

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# SGS

# SGS DIESEL CATALYST AGING

Using an economy natural gas burner for temperature and IEFI (In Exhaust diesel Fuel Injection) for diesel injection, the system offers a low-cost approach to diesel catalyst aging. SGS also offers economy NG1 natural gas fired burners, which can be coupled with an IEFI system, for thermal aging and cycling of diesel exhaust components.

- The IEFI system consists of a water cooled injection system, including numerous safeties, flexible TC and analog I/O, as well as closed loop control on temperature. This system is an economical approach to component validation and testing compared to standard dynamometer operating burden and costs.
- These economy burners feature a programmable controller allowing the development of thermal cycling protocols and tests.
- Applications include validation and testing of DPFs, catalytic converters, O2 sensors as well as other exhaust components.



# SGS SERVICES, SUPPORT & TEST CELL SOLUTIONS



AVAILABLE IN:

**AURORA, CO**

**COLUMBUS, IN**

**LAPEER, MI**

**TAYLOR, MI**

**TROY, MI**

**PROJECT MANAGEMENT &  
CONSULTING**

**RESEARCH & DEVELOPMENT**

**TEST PROCEDURE DEVELOPMENT**

**US & EUROPEAN CERTIFICATION  
PROGRAM SUPPORT**

**HOMOLOGATION**

**CONTROL SYSTEM CALIBRATION &  
DEVELOPMENT**

**DESIGN OF EXPERIMENTS**

**DATA & STATISTICAL ANALYSIS**

**COMPETITIVE BENCHMARKING**

**DEDICATED LAB OPERATIONS &  
STAFFING**

**COMPLETE FACILITY PLANNING &  
MANAGEMENT**

**MODULAR & FIXED TEST CELLS**

**SPECIFICATION & DESIGN  
DEVELOPMENT**

**VENDOR QUALIFICATION & SELECTION  
SUPPORT**

**EQUIPMENT SELECTION, DESIGN &  
FABRICATION**

**CUSTOMIZED TEST EQUIPMENT**

**CONSTRUCTION ADMINISTRATION &  
OWNERS' REPRESENTATIVE**

**COMMISSIONING & PERFORMANCE  
VALIDATION**

**BURNER MANUFACTURING**

**TEST CELL ALTITUDE SIMULATION  
SYSTEM**

**TEST CELL SOFTWARE**

**DRIVER AID & TEST EVENT SCHEDULE**

**EMISSIONS CELL CONTROL SYSTEM**

**DATA ACQUISITION & CONTROL**

**POST TEST ANALYSIS**

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**SGS**

# SGS TEST AUTOMATION TECHNOLOGY

## CYFLEX SUPPORTS MANY TEST AND MEASUREMENT APPLICATIONS

CyFlex Test Automation Software offers effective and versatile data acquisition, control and test automation. The software manages test articles and environments in engine development and production, integrated power trains, components and rigs, power generation, and emissions equipment – all in test regimes as simple or complex as required.



### TEST AUTOMATION FUNCTIONS AVAILABLE

- Measurement hardware monitoring and control
- Intelligent sub-system supervisory control
- Test article control
- Test sequencing both script and table driven
- Real-time displays and trends
- Data logging
- Limit checking
- User-defined calculations and channels
- Units aware math, displays and logging
- Communications drives for most popular test cell instruments

### CONTACT US

To request a quote or discuss your testing needs in detail, please call [+01 844 730 4175](tel:+018447304175) or email [us.transportation@sgs.com](mailto:us.transportation@sgs.com).



### WHY CHOOSE CYFLEX BY SGS?

- Our powerful software suite was created by a team that has extensive experience in developing, delivering, supporting and operating hundreds of automated test cells and rigs
- Its design focuses on modularity and flexibility, tailored to a range of applications from general-purpose data acquisition to customized test environments with unique hardware and test sequences
- CyFlex test systems are particularly well-suited for multiple installations per test facility; they deliver the benefits of a common standard for test systems worldwide:
  - Full range of test applications, from rig to transient emissions testing
  - Ease of data capture, display, analysis, and network transfer
  - Consistent measurement quality and accuracy
  - Uniform and familiar user experience
  - Common data formats and analysis tools
  - Common use of CyFlex enables development of best practices and sharing between lab operations groups at different sites and between business units
  - Our skilled development team is continuously making improvements and new technology available and is also available to address specific customer needs
  - Integration of increasingly complex instrumentation and test environments
- We also offer site and enterprise licenses, instrumentation, installation, setup, commissioning, maintenance and tailoring

### APPLICATIONS

- Engine-dyno testing for performance, durability, emissions development, emissions certification, and component aging
- Power systems testing for generators and transmissions
- Component testing for turbochargers, heat exchangers, fuel pumps, fuel injectors and after-treatment components
- Advanced test methods including HIL simulation, mapping and calibration

# SGS PROGRAM MANAGEMENT SERVICES

## NEW AND RENOVATED TESTING FACILITY AND SYSTEMS PROJECTS LED BY TESTING EXPERTS

We believe that managing a successful project requires a team that understands testing technology as well as the process of project delivery. Backed by the world's leading certification, inspection, testing and verification company, our program management team is focused exclusively on testing related projects. We are test cell experts who design, equip and operate test cells, and our team has executed thousands of testing technology, systems and facility projects.



### WHY CHOOSE SGS?

- Our approach is to understand and adapt to our clients' needs and constraints whether they be technical, financial, or schedule-based
- Adhering to ISO 9001 processes, we consistently provide high quality and efficient results
- The program management team includes: project managers, planners, test facility and system designers, instrumentation and controls experts, construction administrators and facility commissioning staff

### CONTACT US

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### OUR PROCESS

- We listen to your testing requirements
  - Understand and document the objectives
  - Define test capabilities, data and test articles
  - Identify and engage stakeholders early
  - Record constraints: budget, schedule, or infrastructure
- We define the testing technology
  - Develop a realistic project scope
  - Evaluate options against objectives
  - Identify short and long term objectives as well as phasing
  - Align scope and budget avoiding the 'funding loop'
- We manage the team and deliver the project
  - Evaluate alternative delivery models
  - Assemble and manage the right team of suppliers and contractors
  - Balance cost, schedule and risk
  - Manage change as well as control scope, schedule and budget
  - Schedule for phasing, cash flow, funding and decision making
- We verify the outcome
  - Define what done means and manage the final acceptance plan
  - Establish responsibilities and hold all accountable
  - Plan for handover, training and long term support
  - Meet the objectives and satisfy the stakeholders



# SGS TESTING EQUIPMENT & SYSTEMS

We believe in using technology, experience, creativity, and a global supplier network to help our clients define and solve their most troublesome testing equipment problems. Backed by the world's leading certification, inspection, testing and verification company, our Columbus, IN team is focused exclusively on testing. We are test cell experts who design, equip and operate test cells, and our team has executed thousands of testing technology, systems and equipment projects.



## CONTACT US

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## SERVICES OFFERED

- Analysis and solutions for complex problems
- Evaluation and modification of existing systems
- Analysis and selection of commercially available options
- Mechanical engineering and design of equipment
- Fabrication of custom equipment
- On-site troubleshooting and repair
- On-site commissioning
- Controls engineering
- In-house testing for proof of concept
- In-house testing of equipment functionality
- Project management to control scope, schedule and budget

## FLUID SYSTEMS

- Fuel measurement and conditioning
- Gaseous and liquid fuel blending
- Jacket water conditioning
- Intercooler and charged air systems
- Thermal cycling

## MECHANICAL SYSTEMS

- Bedplates and testbeds
- Dynamometers
- Driveline and guarding
- Engine carts and docking systems
- Transfer mechanisms
- Test article connections
- Component test stands
- Complete containerized test cells

## TOOLS

- AutoCAD
- Creo
- Cyflex control software

# SGS VEHICLE & ENGINE SERVICES

## VARIABLE HORSEPOWER, HIGH FLEXIBILITY AND EXTREME TEMPERATURE TESTING AT SEA LEVEL

The instrumentation professionals and testing experts at SGS's expansive Columbus, IN sea level testing center are equipped to handle anything from chassis dynamometer testing, extreme temperature testing of oversized vehicles, engines and other test components to full project management. With repeatable conditions, high quality measurements, and controlled test sequencing, you'll get results you can trust. SGS also offers modern, flexible test automation software, test cell solutions and a wide array of professional services.



### SEA LEVEL FACILITIES

- 100,000 SF of modern testing space
- Extreme temperature capabilities from -40° F all the way to 150° F that can support continuous loaded running
- Two large variable temperature chambers measuring 22' x 60' x 20' with 12,000 CFM cold combustion air
- 1200 hp engine dynamometer
- 150 hp vehicle chassis dynamometer
- Specialized DEF system validation test bed
- Variable temperature SHEDs

### TEST PROGRAMS

- Cold start/continuous loaded running
- Thermal performance profiling
- Engine testing for emissions, performance, durability and aging
- Generator set testing
- Emissions component testing
- Controls and diagnostics verification
- High pressure alternative fuels: liquid and gaseous
- Diesel testing and development

### APPLICATIONS

- On highway trucks and buses
- Off highway equipment
- Off road vehicle and power sports
- Power generation
- Locomotive and marine

### SERVICES AVAILABLE

- Instrumentation
- Installation and setup
- Test operations
- Maintenance
- Analysis
- EPA and CARB procedures performed

### SOFTWARE

- Data acquisition and control software
- Post test analysis software
- Cost effective, real-time
- Flexible, third party integration
- Scalable for a range of testing environments

### PROFESSIONAL SERVICES

- Available services include anything from program management and planning to complete facility design
- Can help you define, manage, deliver and verify your testing projects
- Specification and design development
- Vendor qualification and selection support
- Equipment selection, design and fabrication
- Construction administration, owners' representative, commissioning and performance validation

### CONTACT US

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# SGS TRANSPORTATION ANALYTICS

## ANALYTICS EXPERTISE FROM A TRANSPORTATION INDUSTRY SERVICE LEADER

SGS Testcom is recognized as a leader in building and managing data-intensive vehicle safety and emissions inspection programs. Fast emerging intelligent transportation systems (ITS) are compelling agencies to look at new approaches for leveraging constantly increasing volumes of transportation-related data.



### ITS RELATED SERVICES

- Design and implementation of customized data management systems
- Big data analytics, including data mining, machine learning, predictive modeling and root cause analysis
- Development of flexible visualization and reporting tools
- Rapid project execution and problem-solving applications development

### TURN-KEY SERVICES FOR ENGINE AND VEHICLE TESTING

- Data logger, telematics hardware selection and configuration, field instrumentation, database configuration, data analysis and reporting
- Advanced testing methods requiring the power of smart transportation data analytics, such as connected vehicle and autonomous vehicle quality assurance

### PREPARE YOURSELF FOR THE NEW AGE OF TRANSPORTATION DATA

Current vehicles require increasingly complex control system management, with over 80 microcontrollers, more than 100 types of sensors, and 5 types of networks. Telematics in future vehicles and infrastructure will enable "Internet of Things" connectivity and short range communication to ITS elements. The deployment of these technologies will move us towards this new age of transportation data.

At SGS Testcom, we develop approaches with our agency partners, in a consultative way, that allow them to contend with and create added value from the coming volumes of connected vehicle and traveler data. We enable a wide range of new smart data strategies that will enhance safety, mobility, and environmental benefits. We offer consulting, engineering, testing services and customized data mining applications that leverage our vast industry knowledge to allow for rapid demonstration of the value data analytics can provide.

### SGS TRANSPORTATION ANALYTICS SOLUTIONS ENABLE:

- Program verification and validation
- Measurably enhanced safety programs
- Environmental initiative reporting and analysis
- Compliance auditing, detecting and reporting

### CONTACT US

To request a quote or discuss your needs in detail, please call (518) 580-0555 or email [us.transportation@sgs.com](mailto:us.transportation@sgs.com). Visit us online at [www.sgs.com/testcom](http://www.sgs.com/testcom).



# SGS TRANSPORTATION DATA SOLUTIONS

## ANALYTICS AND DATA SOLUTIONS INFORMED BY DEEP TRANSPORTATION DOMAIN EXPERTISE

We deliver effective solutions for transportation agencies across the country, helping you leverage the increasing amounts of available data into actionable results. Our experienced and multi-disciplined project team will work with you to build a custom solution around your needs. Let us help you find value in your data by uncovering unique insights with statistical certainty.



### SGS BY THE NUMBERS

**15** Customer database programs managed

**19K** Interconnected workstations

**22K** Hot-line calls

**25 TB** Data hosted

**99.9%** Operational up-time

### CONTACT US

To request a quote or discuss your needs in detail, please call [\(518\) 580-0555](tel:5185800555) or email [us.transportation@sgs.com](mailto:us.transportation@sgs.com). Visit us online at [www.sgs.com/testcom](http://www.sgs.com/testcom).

### COMPLIANCE ANALYTICS

- Joint creation of hypotheses and testing against different data sets to detect anomalies that could indicate evidence of fraud or non-compliance
- Cloud-based, intuitive dashboard interface makes analysis easy for users
- Powerful drill-down features and ad-hoc reporting for expert analysis
- Secure data handling with role-based access controls, audit ability and assurance of data integrity
- Ability to easily export data extracts from analysis sessions and produce reports as needed

### SUPPORT & TRAINING

- Team of data scientists and transportation experts collaborate to design studies, perform analysis, revise statistical models as required
- Our experts will help you draw conclusions from the resulting data
- Extract and combine data from disparate sources when needed for causation analysis
- Proven track record for delivering insightful analytics solutions for transportation stakeholders
- Provide insight and recommendations for further customization utilizing structured and unstructured data from both internal and external sources
- Deliver customized, solution-specific training

The logo for SGS, featuring the letters 'SGS' in a bold, sans-serif font. A vertical line is positioned to the right of the letters, and a horizontal line is positioned below the letters, forming an L-shape that frames the logo.

# SGS ON-ROAD VEHICLE TESTING ANALYTICS

While on-road testing is critical to quality, it is also becoming an increasingly complex and costly endeavor. SGS's team of data science and engineering experts have deep transportation industry knowledge and can provide analytics to improve the effectiveness of vehicle test campaigns. You will be able to extract more value from your test data while maximizing your return on investment.

## UTILIZE DATA ANALYTICS TO NAVIGATE THE CHANGING TRANSPORTATION LANDSCAPE



Research and development for advanced vehicle technologies is accelerating as automakers contemplate a new wave of fuel economy, emissions and safety requirements. Light-duty vehicles will increasingly employ downsized and turbo charged engines, advanced combustion and after-treatment controls with more sensors, sophisticated transmissions, electrification features, and V2x connectivity. The complexity of these systems and the pace of their introduction will radically change the vehicle testing paradigm. The design of test programs warrants more scrutiny to ensure these new technologies and their countless system interactions are thoroughly evaluated.

- Our data scientists are collaborating with test engineers to develop new transportation analytics software and services to support the testing and development of these next generation vehicles
- Focus areas include drive route analytics, test plan design, detection of hidden defects and malfunctions, and integration with customer enterprise processes
- Our applications ingest data from loggers, telematics devices and other instruments
- Batch, live-connection and stream analytics processing are available
- SGS provides a hierarchy of analytics solutions ranging from ad hoc data exploration to big data computing on a production scale

## CONTACT US

For more information on our transportation data analytics services, email [us.transportation@sgs.com](mailto:us.transportation@sgs.com).

## ON-ROAD TESTING CHALLENGES

On-road testing lacks the repeatability of dynamometer lab testing. The drive route, road grade, weather, traffic and driver tendencies can all have a profound impact on test results. SGS uses statistical methods to quantify on-road test variation, account for confounding factors, isolate dependencies and make statistically valid conclusions to support the development process.

## DEEPER DATA DISCOVERY

- Event-based analysis of powertrain subsystems such as stop-start, canister purge, catalyst light-off, DPF regeneration, charge depletion, OBD monitors and more
- Clustering and association algorithms using time domain data to explore low temperature operation, engine and catalyst control behavior
- Causation analysis for malfunctions and anomalies
- Machine learning to isolate control system differences in situations where good and poor performance have been observed
- Inferential statistics to design test plans with the right amount of coverage within the operational space, enabling the discovery of quality problems and the prediction of outcomes for larger vehicle populations

# SGS DATA ANALYTICS CASE STUDIES

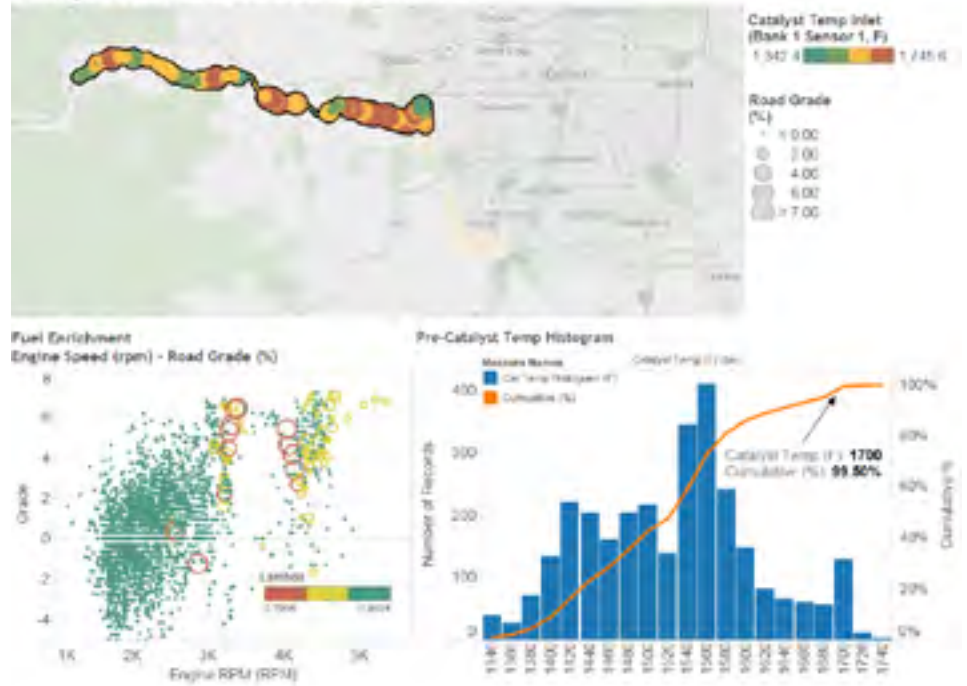
## CATALYST THERMAL PROTECTION

SGS analytics and interactive visualization tools are designed for specific vehicle subsystems, enabling engineers to evaluate performance quickly.

In this example, a 2016 vehicle was tested while ascending the Rocky Mountains on a drive route up I-70 westbound from Golden to Georgetown, Colorado. The drive route included extreme road grade and speed combinations suitable for validating the catalyst thermal protection strategy.

At a glance, engineers have evidence that the catalyst briefly reached a very high temperature, 950°C (1740°F). The analysis verified that fuel enrichment was used on multiple occasions, typically on high road grades. It was also effective at limiting catalyst temperatures below 1000°C.

Catalyst Thermal Protection Dashboard



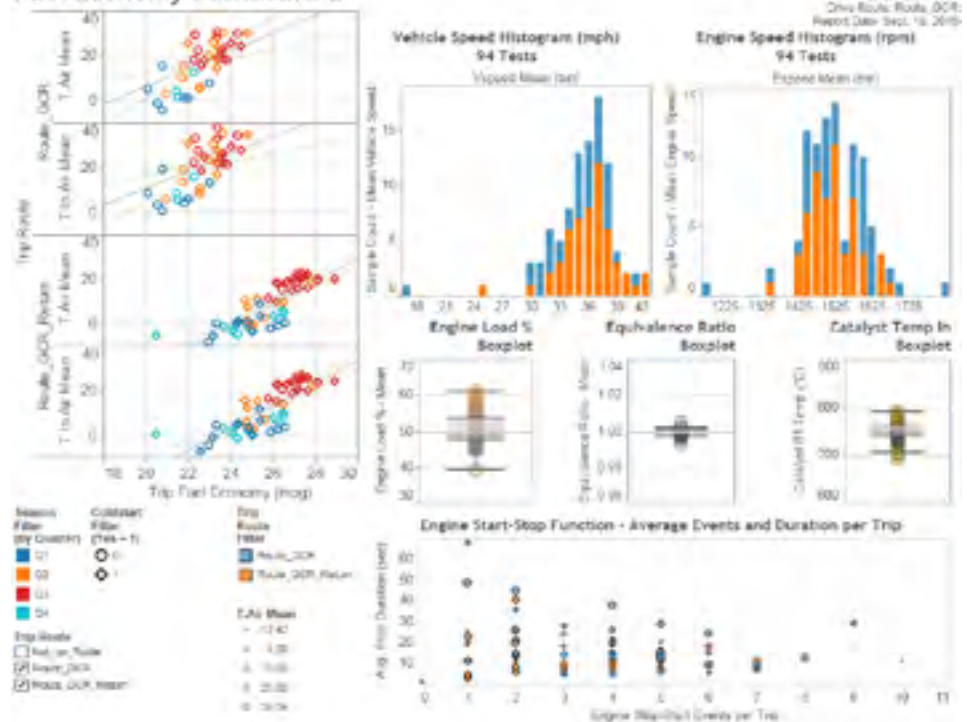
## SEASONAL EFFECTS ON FUEL ECONOMY

Data logs are easily aggregated for temporal analysis and test fleet studies. Variation in fuel economy was of interest for this long term test vehicle that was primarily driven along two different routes for a year.

The intake air temperature was found to be the primary variable impacting fuel economy, accounting for about 8% lower fuel economy (about 2 mpg difference) in cold seasons with  $\geq 95\%$  confidence.

Whereas vehicle fuel economy is known to be impacted by cold temperatures, the dependency was also observed between moderate and hot ambient temperatures.

Fuel Economy Dashboard 2



WHEN YOU NEED TO BE SURE

# SGS HOMOLOGATION & FUNCTIONAL SAFETY

SGS TÜV Saar offers homologation and functional safety services around the globe, with offices in North America, Europe and Asia. With accreditation based on ISO 17020 and 17025 and designations from various other authorities, SGS is equipped to help you get your product certified or approved no matter where you are. We can help you plan an effective certification plan that will maximize your testing efforts and get you to market quickly and efficiently.



## HOMOLOGATION CHALLENGES

- Autonomous driving is not yet legalized in Europe
- Legal requirements for autonomous driving are still in the development phase
- Testing of autonomous driving functions in public traffic is possible under certain boundary conditions

## WORLDWIDE EU & ECE HOMOLOGATION SERVICES FOR ALL VEHICLE CATEGORIES

SGS, an industry leader in certification, inspection, testing and verification services, is active in several expert committees and supports manufacturers as they explore the development of autonomous vehicle technology. We use our expertise to help our customers in all aspects of homologation and functional safety.

- Our team will investigate certification requirements and provide an initial assessment
- You'll receive an information folder with everything you need to know regarding your certification process
- We can evaluate your testing program whether you are utilizing our network of testing facilities, your own or another third party
- SGS supports virtual testing
- We can provide consultation and training services relating to a number of topics
  - Test standards for EU, ECE and StVZO as well as interpretations
  - Test standards for Non-EC including FMVSS, China and Brazil
  - Laboratory standards for ISO/IEC 17025
  - Homologation training, both in-house or public training services are available

## CONTACT US

To speak to someone about our homologation and functional safety services, send an email to [us.transportation@sgs.com](mailto:us.transportation@sgs.com).

## FUNCTIONAL SAFETY & CYBER SECURITY

SGS is a world leading accredited body for automotive functional safety with a global network of functional safety experts ready to assist you.

- We are a member of a number of standardization committees, including ISO 26262
- SGS is an accredited body for functional safety and IT security according to ISO/IEC 17025 and 17020
- Our team of experts can support you in the selection and use of new technologies and components for autonomous driving concepts
- SGS is a development member of AUTOSAR

# UNDERSTANDING FUNCTIONAL SAFETY

SGS is member of national and international working groups focused on the development and improvement of ISO 26262, the standard for functional safety of automotive electronics that delivers a guide in safe development processes as well as a safe design of technical solutions. With a deep understanding of these regulations and many others, SGS provides combined expertise for IT security and functional safety. Let us support you in the selection and use of new technologies and components for autonomous driving concepts.

## FUNCTIONAL SAFETY & CYBER SECURITY CHALLENGES

- Availability becomes a safety concern with failure-tolerant in-vehicle systems and the driving behavior of the vehicle
- Security becomes a safety concern as external open vehicle communication is introduced
- The role of humans in automated driving will remain a safety concern
- Legal basics have to be adapted
- These challenges will create a need for safe and secure technical solutions, validation and assessment of safety and security as well as common criteria for acceptability



## THE ROLE OF FUNCTIONAL SAFETY & CYBER SECURITY

- Hazards caused by malfunctioning behavior, or the loss of functional safety, of driving systems have to be avoided or controlled in any case
- Forced malfunctions may have a big impact on autonomous driving systems, due drivers who may attempt to employ countermeasures
- IT security also has to be considered in the context of functional safety
- SAE J3061 is the first automotive-specific standard for IT security, serving as a starting point within the automotive industry

## AVAILABLE FUNCTIONAL SAFETY & CYBER SECURITY SERVICES

- Training and personal qualification programs
- Evaluation and certification regarding SAE J3061 relating to automotive cyber security
- Auditing and certification regarding ISO 27001, covering information security management systems
- Evaluation and certification according to the standard series IEC 62443 for industrial communication networks as well as network and system security
- Planning of assessment activities with respect to functional safety requirements
- Functional safety assessments covering vehicle and system concepts for autonomous driving
- Certification of components used in autonomous driving architectures
- Review of safety assessment reports delivered by suppliers of systems and components
- Final functional safety assessment reports covering all safety relevant items

# SGS NETWORK OF TESTING FACILITIES

## AURORA, CO

### RESEARCH, DEVELOPMENT AND EMISSIONS CERTIFICATION TESTING

- High-feature test cells with extreme environmental conditions
- Variable altitude engine and chassis dynamometer testing
- Motorcycle and ATV chassis dynamometer
- Diesel and spark ignited engine capabilities
- AWD/FWD/RWD vehicle capabilities
- EPA and CARB compliant cells
- Particulate matter characterization
- PEMS and RDE real world emissions testing
- Variable temperature SHEDs for evaporative emissions testing
- Ideal for catalyst conversion efficiency determination, light-off, drive cycle effects, and complete system performance testing
- On-road program design, consulting and data analytics



## COLUMBUS, IN

### TEST CELL SOLUTIONS, SOFTWARE AND VARIABLE HORSEPOWER ENGINE AND VEHICLE TESTING

- Test programs
- Engine and vehicle testing
- Extreme temperature capabilities from small components to our 40'x60'x20' variable temperature chambers
- Cold start and thermal shock testing
- Emissions, performance and durability testing
- Controls and diagnostics verification
- Test automation, post test analysis, data acquisition and control software
- Professional services, facility engineering, management and project delivery
- From program management and planning to complete facility design
- Equipment selection, design and fabrication



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## EMPIRE, CO

### MODERN & ACCESSIBLE 4,800 SQ FT HIGH ALTITUDE COLD TESTING FACILITY

- Newly commissioned user facility located 8900' (2710m) above sea level
- Centrally located near popular vehicle development venues including Berthoud Pass, Hoosier Pass, Vail Pass, Loveland Pass, Dillon and Mount Evans
- Four large 50' x 20' bays with 12' wide by 14' high doors including three cold bays and one workshop equipped with a lift/hoist
- Each bay features independently controlled refrigeration with temperatures as low as -22°F (-30°C)
- Vehicle exhaust ventilation and on-site fuel storage
- Accommodates multiple customer applications from individual components, lawn equipment and power sports to light duty vehicles, Class 8 trucks and construction equipment
- Secure access with individually keyed bays, guest Wi-Fi, office areas and private restrooms
- Cost-effective short and long-term rental solutions
- Local engineering and calibration services available



## JACKSON, MI

### MILEAGE ACCUMULATION CENTER OUTSIDE OF DETROIT, MICHIGAN

- Eddy current absorbing, single 40" roll dynamometers for driverless aging
- Flexible automation system for data acquisition, customized drive cycles and alarming
- Determine the engine and catalyst emissions deterioration performance at full useful life
- Driverless, automated throttle and braking
- Road load model
- Sensors and customized alarms may be added for vehicle protection
- Programmable drive cycles
- Road speed modulated frontal cooling fans
- OBD interface
- Video surveillance and recording for each vehicle
- 24/7 operation



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## LAPEER, MI

### COMPREHENSIVE FUEL SYSTEM TESTING

- Class I, Division I infrastructure for testing in fuel with over 1,000 different fuel system tests available including diesel exhaust fluid (DEF/Urea) system testing and detection
- Alcohols, diesel/bio-diesel capabilities
- Component environmental testing and robot based systems
- Evaporative emissions testing
- Physical tests (pressure vacuum, drop, burst)
- Fire resistance testing
- Slosh noise and durability
- Long term aging, material compatibility with fuels
- Government and regulatory agency procedures
- Product validation and development support for automotive, marine, off-road, recreational, agricultural, small engine and portable fuel containers
- A variety of equipment including: tensile/compression/force measurement, E/D shakers with Agree chamber and slip table, thermal chambers (ovens, reach-ins, walk-ins and class I), fuel fill carts with variable flow, temperatures and nozzles, fuel pump/fuel module durability stations, hydraulic slosh tables (lateral and tilt methods), mini and micro-SHEDs, SHED and SAE J1737



## TAYLOR, MI

### CATALYST AGING AND VIBRATION TESTING SERVICES

- Catalyst useful life aging
- Catalyst OBD aging
- OSC characterization
- High temperature thermal cycling
- H<sub>2</sub>O immersion exhaust components
- Diesel component aging
- High temperature oven aging
- Burner manufacturing and support
- Sine, random, sine on random, sine on sine, shock
- Maximum two-inch stroke
- Resonant searches and dwells
- Custom fixture design and fabrication
- Fixture resonance evaluation
- Testing combined with thermal cycling
- Equipment includes: C-FOCAS®, IEFI (in exhaust fuel injection) system, electro-dynamic shaker systems with slip tables, high performance burner systems, environmental simulation capabilities including cold, hot and humidity, automated water submersion, spray, and dunk tank systems, leak detection systems
- Testing is done for exhaust systems, fuel components, HVAC, cooling modules, interior cockpits, electrical, batteries and driveline



### Table of Contents

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## TROY, MI

### SERVO-HYDRAULIC TESTING

- Fatigue testing
- Durability testing
- Block cycle testing
- Tensile & compression testing
- Impact
- Rotary
- Static bending and torsion
- Testing combined with thermal cycling
- Equipment includes: over 100 servo-hydraulic linear actuators with capacity in excess of 100,000 lbs and up to 200 Hz, rotary actuators with capacity up to 100,000 in-lbs + / - 50 degree rotation, custom designed heavy duty shock absorber test stands, MTS four post road simulator (11-Kip actuators), environmental simulation capabilities including hot, cold and humidity and MTS / Shore Western hydraulics controllers
- Testing is done for shock absorbers, dampers, chassis, suspension, steering, BIW, body structures, powertrain, seating systems, interior cockpit and exterior components

