MILLBROOK

Overview

www.millbrook.co.uk

2498 10121 10121

T236 (EN ISO/IEC 17025)

Information on the activities and locations within the scopes of UKAS and FINAS accreditations is available on the websites www.ukas.com and www.finas.fi

Welcome to Millbrook

At Millbrook, we serve the best Companies in the World. We help them to develop the engines, vehicles, tyres, fuels and lubricants of the future. We are independent and impartial in everything that we do.

In this brochure, you will find an overview of the broad range of services and test facilities that we offer to our customers. We put safety at the heart of our operations and we are passionate about providing outstanding customer service at all times. We invest in our people and our facilities and strive to be the best service provider in the markets that we serve.

Our 700 employees take pride in delivering exactly what our customers want, whether that is a vehicle test, driveline test stand, engineered solution or smooth-running event. The quality of our work is reflected in our ISO management system certifications.

Please do not hesitate to contact us if we can be of service.

Alex Burns

President

Contents

Millbrook at a Glance

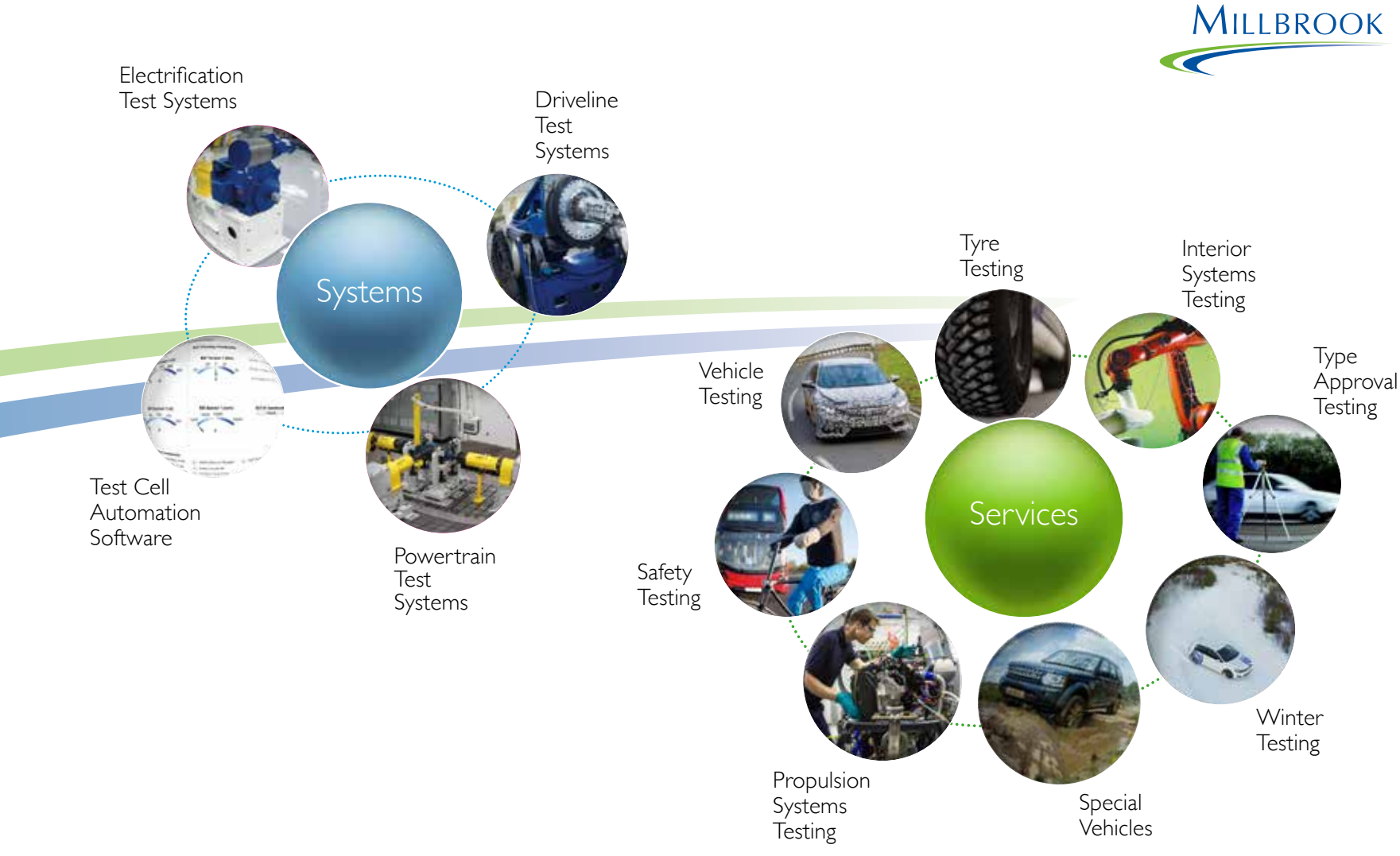
spectris

Millbrook is part of the Test and Measurement business segment of Spectris plc

Spectris is a leading supplier of productivity-enhancing instrumentation and controls.

Millbrook is best known for its test tracks where it performs repeatable tests in a safe and secure environment. Millbrook also has a range of test facilities for full vehicles, tyres and components, including engine dynamometers, e-motor and e-axle test cells, structural test laboratories, crash laboratories, interior systems laboratories, advanced emissions chassis dynamometers, battery test facilities and innovative indoor winter test tracks.

Millbrook supports its customers with the supply and service of dynamometer based test systems, specialist vehicle conversions, workshops in its Technology Park and vehicle-related events.


Electrification
Test Systems
Driveline
Test
Systems
Systems
Test Cell
Automation
Software
Powertrain
Test
Systems
Tyre
Testing
Interior
Systems
Testing
Vehicle
Testing
Type
Approval
Testing
Services
Safety
Testing
Winter
Testing
Propulsion
Systems
Testing
Special
Vehicles

Services

Millbrook offers its customers a range of test, validation and support services:

Propulsion Systems Testing
Safety Testing
Vehicle Testing
Interior Systems Testing
Vehicle Winter Testing
Tyre Testing
Type Approval Testing
Special Vehicles

Propulsion Systems Testing

Millbrook provides premier independent propulsion systems test services. It performs a range of CEC fuels, vehicle emissions, engine, battery and electric machine tests.

Millbrook offers propulsion systems test services to a global automotive and petrochemical customer base. It works with high performance and heavy duty engines, hybrid and electric propulsion systems, commercial vehicles and passenger cars.

Millbrook supports engine and vehicle development, calibration and testing for emissions, fuel consumption, energy and range. It designs test programmes to meet customers' objectives and conducts regulatory tests and customer-specific tests.

Millbrook offers a complete range of test solutions for electric driveline components and systems for various applications.

Emissions and Fuel Economy Testing capabilities include:

- 4WD climatic emissions chassis dynamometer
- Road Load Simulation including full gradient
- Heavy duty climatic emissions chassis dynamometer
- Portable Emissions and Measurement Systems for Real Driving Emissions, correlation to 4WD dynamometer
- Evaporative Emissions VTSHED
- Canister loading and purging rig
- On-vehicle fuel flow meters
- Particle size distribution measurement
- FTIRs for NOx, ammonia and other pollutant speciation
- Electric vehicle range and energy consumption measurement

Engine Testing capabilities include:

- 28 engine test cells covering a diverse range of capabilities
- Latest test cell automation software and hardware
- Up to 2.1MW dynamometers
- Cold climatic capability, down to -30°C
- Road Load Simulation
- Vehicle model simulation on engine test bed
- Driveline durability with speeds up to 2,900rpm (300km/hr)
- Complete driveline testing for full electric, range-extender
- Full CVS emissions system cell
- Extensive emissions measurement capability
- Gigabit Combustion measurement
- Full DOE capability with real time controllers and online optimisation
- CEC fuels testing
- NVH
- Fuel blending up to 1,000L
- Bulk and special fuels capability, bio fuel and E100
- Component strip and rate for post-test inspection

Drivetrain Testing capabilities include versatile laboratories with:

- 15kW to 900kW power range
- 0 to 17,000rpm speed range
- 0 to 40,000Nm, up to 80,000 TOT (for axles) and full torque at 0rpm
- 0 to 400kW power
- 0 to 700V DC DC voltage
- 0 to 900A DC current
- 60°C to 180°C environmental chamber temperature range

Full Driveline Testing capabilities include a fired 2E driveline rig:

- Hybrid vehicle architecture test capability
- Ultra high dynamic road speed AC machines
- AVL Fuel Exact fuel measurement
- System nominal power absorption 700kW
- 300kW Battery Simulator (1,000V/600A)
- Engine coolant control to +/- 1°C
- Measurement of 70 temperatures and 32 pressures

Vehicle and Driveline Testing capabilities include a fired powertrain rig with:

- 1,000kW system nominal power absorption
- Optimisation of chassis control systems, such as ABS, TC and ESP
- Hybrid system control algorithm integration and optimisation
- 4 off ultra-dynamic synchronous motors; 350kW, 3,500Nm (+20% overload). Maximum speed 3,000rpm
- Dynamic torque changes performed at minimum 0.13ms
- 350kW Battery Simulator (1,000V/1,000A)
- ETAS Inca ECU calibration tools with iLinkRT real-time interface
- Modelling and Simulation realised through Mathworks and dSPACE software integration
- Rig and engine intake air control between 18°C and 25°C +/- 1°C

Development Support Testing capabilities include:

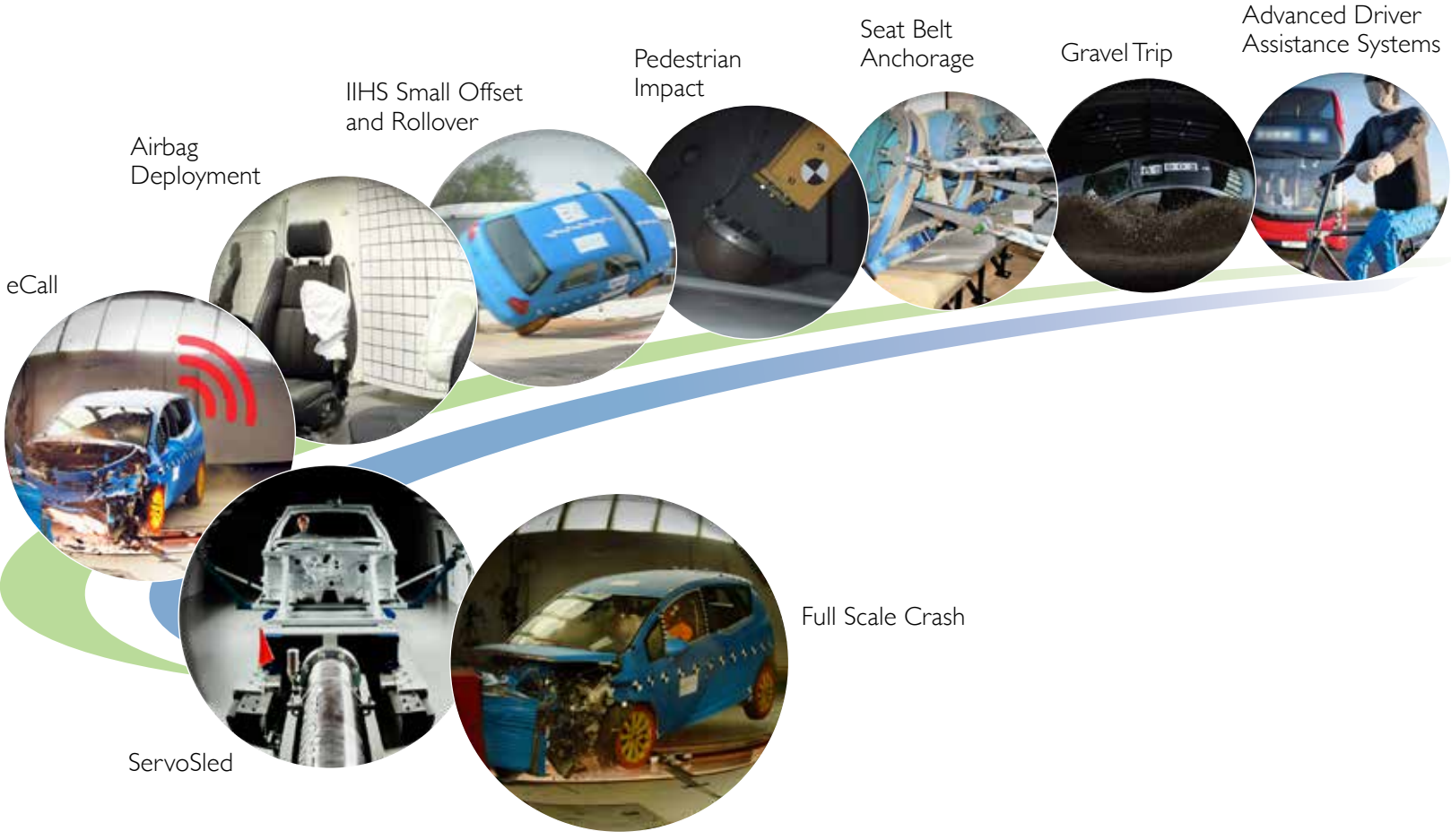
- Engine and transmission strip and rate
- Test tracks in the UK and Finland including indoor snow, ice and wet and dry asphalt, with integrated cold boxes to -40°C

Battery and Electric Machine Testing capabilities include:

- 12 climatic cycling cells for complete automotive battery packs
  - 1,100V
  - Up to 750kW per cell
  - -40°C to +90°C
- Integrated systems or individual subsystems, including energy storage and power electronics and interconnections
- Performance and characterisation of electric machines, cells, modules and packs
- Electrical stress testing:
  - Hi-Pot
  - Surge
  - Insulation resistance
- Back-to-back endurance testing with environmental loading
- Environmental testing and ingress protection
- Noise testing, shock and vibration (NVH)
- 128kW/800V/700A cycling
- UN 38.3 and Reg 100
- ServoSled impact testing of live modules and packs
- Battery abuse testing

Millbrook's vehicle electrification test facilities in the US are equipped with AC dynamometers that incorporate the latest inverter and control technology. This facilitates precise control and allows Millbrook to conduct the full range of tests from steady state to highly dynamic trace profiles.

Safety Testing



Millbrook has a range of vehicle, system and component safety laboratories for testing and validating both active and passive safety.

Skilled and experienced engineers, consultants and project managers work with the latest equipment to deliver high complexity tests to global legislative and vehicle development scenarios.

Millbrook is experienced in crash testing high voltage BEVs and HEVs.

Millbrook offers electric system and component safety tests including motors to UL 1004. It offers sled testing for batteries at cell level, module level and pack level allowing voltages to be monitored and structural integrity of fixings and mounting points to be checked.

Passive Safety facilities include:

- Secure preparation bays
- Crash Laboratory: 8km/h to 90km/h; +/-0.5km/h, track length 220m
- IIHS Small Offset Facility
- Rollover Facility
- ServoSled Laboratory to FMVSS, ECE and NCAP Safety Standards
- NAC Memrecam and IDT HD digital high speed colour video system, up to 1920 x 1080 pixel at 1,000fps, recording up to 20,000fps
- DTS G5 On-board Data Acquisition Units conforming to SAE J211 specifications; over 400 data channels per test, up to 100kHz sampling rate
- Comprehensive fleet of test dummies including WorldSID, Q6 and Q10, on-site dummy calibration
- Environmental Static Airbag Deployment Facility
- Airbag Deployment, Abuse and Misuse: laboratory and track-based testing
- Bumper Pendulum System
- Headform Pendulum Impact Rig
- Pedestrian Test Facility
- Seat Belt Anchorage Rig
- Gravity Drop Tower

Active Safety facilities and capabilities include:

- Tow targets
- OxTS RT3003 inertial & GPS measurements with 1 cm accuracy
- OxTS RT base station
- Data acquisition capabilities
- ABD Torus steering robot with torque measurement
- Autonomous Emergency Braking
  - Static and mobile vehicle to vehicle shunt collisions
  - Pedestrian and cyclist crossing in front of a vehicle
  - Vehicle turning across the path of pedestrians and cyclists
  - EuroNCAP specification soft car with towing rig
  - Articulated adult and child pedestrian dummies
  - Bicycle and cyclist dummy

Advanced Driver Assistance Systems tested include:

- Active Cruise Control
- Lane Departure Warning
- Lane Keep Assist
- Blind Spot Detection
- Autonomous Parking
- Autonomous Emergency Braking

Vehicle Testing

Millbrook provides subjective and objective measurement, robustness and durability tests.

Full Vehicle Testing

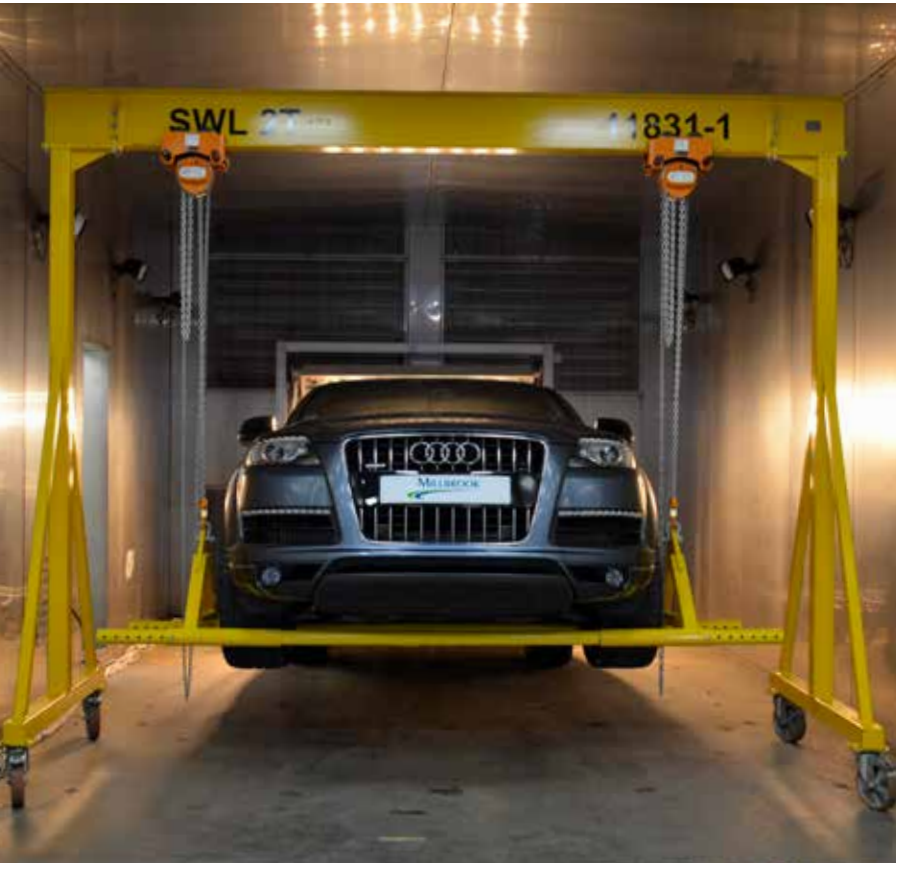
Millbrook offers a comprehensive range of tests on full vehicles using its proving ground and laboratory facilities. These are designed to support effective and efficient development and validation of vehicle attributes.

Facilities include:

- Proving grounds with high speed circuits, hill route including gradients up to 26%, accelerated durability surfaces and features, together with ride and handling tracks and ISO drive-by noise track
- Corrosion chambers up to 12m x 7m x 3.5m, 50°C and 20% to 100% RH
- Climatic chambers up to 13.7m x 5.7m x 6m, -60°C to +150°C and up to 98% RH
- Full vehicle chassis dynamometers including specialist facilities for emissions and fuel consumption, acoustics, cooling and HVAC
- 4-poster full vehicle durability test facility covering cars through to heavy trucks and buses
- 4E powertrain rig with 350kW battery simulator for IC and EV vehicles

Capabilities include:

- Durability schedule development with specialist correlation team
- Structural durability testing of full vehicles on the proving grounds and in the laboratories
- Driveline durability testing on the proving grounds and in the laboratories
- Whole vehicle quality assessment, corrosion and structural durability
- Refinement (NVH) and drive-by noise assessment and development
- Vehicle robustness validation



Systems and Components Testing

Millbrook provides full support for validation testing of systems and components. It delivers a range of tests covering environmental, durability and performance assessment of body and chassis systems from passenger cars through to heavy trucks and buses.

- 800m² structural test laboratory including electro-hydraulic ring mains, a reinforced concrete floor grid and a dynamic modular beam system
- Hydraulic actuators up to 500kN
- Single and multi axis
- Road Load Simulation
- 600°C diesel burners
- Exhaust durability
- Stress and strain analysis
- Vibration testing
- Multi-axis shake tables
- MTS RPC drive signal generation
- nCode Glyphworks durability data processing and analysis
- Environmental chambers
- Confidential structural test laboratory for style sensitive BIW testing
- 4E powertrain rig with 350kW battery simulator for IC and EV vehicles

Vehicle Measurement

Millbrook provides data collection on public roads and proving ground tracks combined with fast and accurate data analysis. It turns data into information to support attribute validation, development and problem investigation.

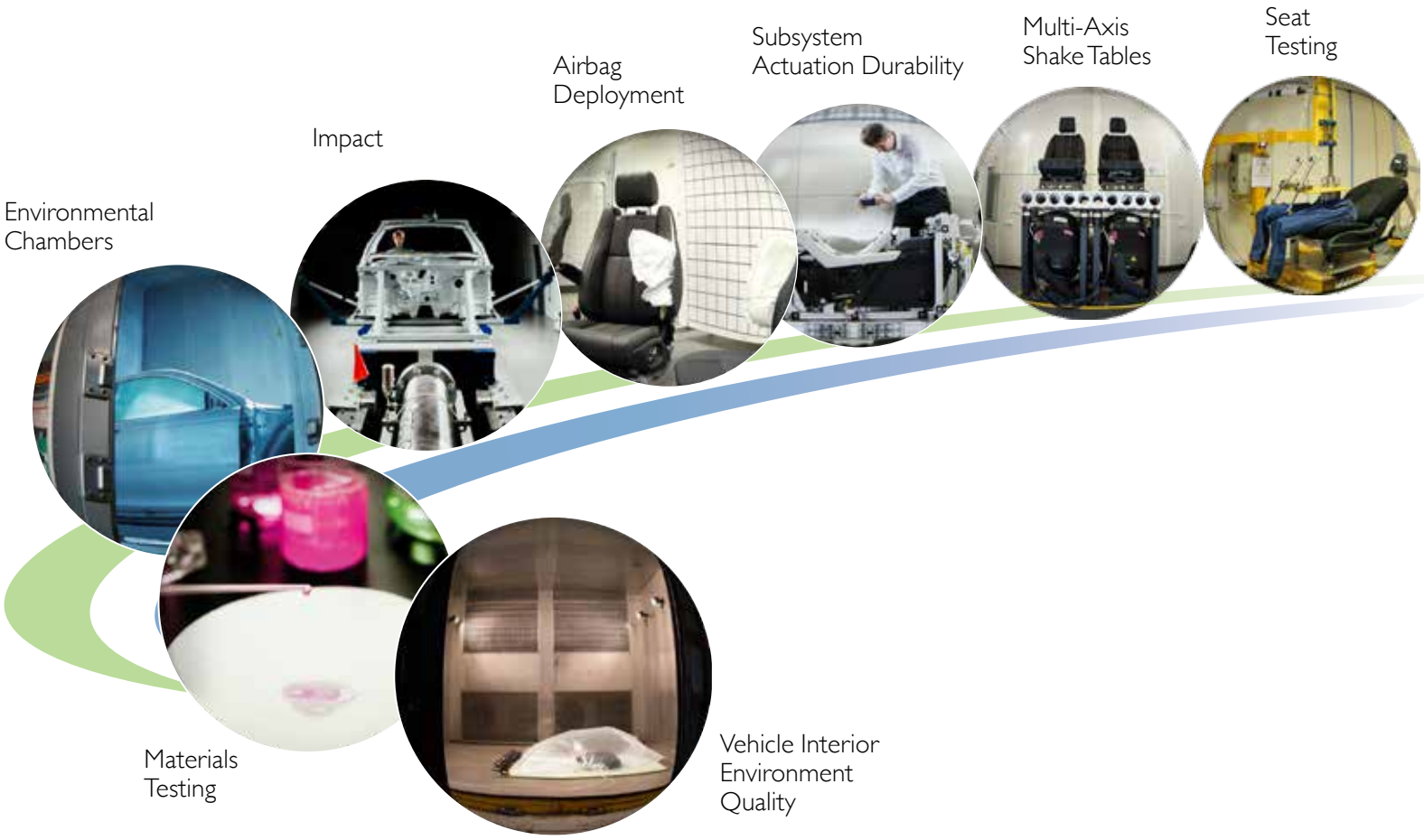
- ISO 10844:2014 compliant drive-by noise surface
- Tilt platform 9m long x 3.3m wide, 42,000kg, platform angle 45°
- Full range of attribute measurement with GPS data collection and high sampling frequency data loggers
- Semi-anechoic chamber 19m x 9m x 5m, down to 40dB linear
- CAE model correlation using defined proving ground surfaces or precisely controlled inputs using electro-hydraulic test rigs

Connected and Autonomous Vehicles

Millbrook provides a safe, confidential and controlled environment to validate the dynamic performance of connected and autonomous vehicle systems and data collection to capture operating parameters.

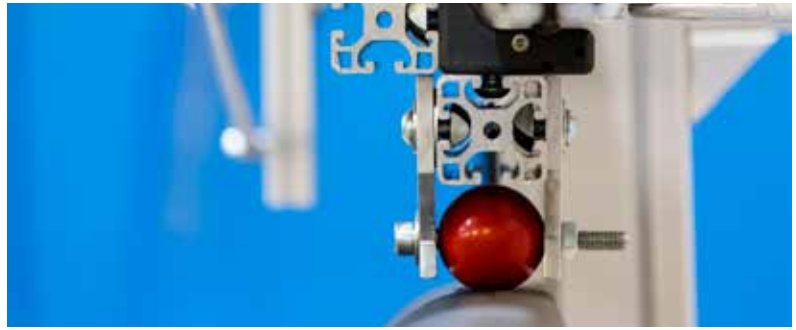
- Full range of real world driving scenarios and soft targets
- Individual tests available on demand

Interior Systems Testing



Millbrook delivers complex multi-sample, multi-test validation programmes to support engineering and production sign-off of interiors, systems and components from seats to instrument panels.

Millbrook helps customers to ensure that the products they produce are reliable, durable and refined. Its highly experienced teams provide support throughout test programmes on the latest technologies associated with lightweight vehicle structures, premium interiors and connected vehicles.



Environmental Testing capabilities include:

- Climatic chambers up to 13.7m x 5.7m x 6m, -60°C to +150°C and up to 98% RH
- EM Shakers / Slip Tables (up to 32kN)
- GOM / FARO Arm measurement and analysis

Materials Testing capabilities include:

- Full suite of materials tests from flammability and odour to taber abrasion and crocking

Interior Testing capabilities include:

- Kuka robots for ingress and egress testing
- Seat pressure mapping
- Key Life Testing (including climatic)
- Multi-axis shake tables
- Squeak and rattle assessment
- Subsystem actuation durability
- ServoSled laboratory
- Airbag and seatbelt testing
- Servo-controlled closures rigs
- Stiffness and deflection testing

Vehicle Winter Testing

Millbrook's winter proving ground, Test World in Northern Finland, offers a long winter season and range of safe and secure test facilities to challenge all types of on- and off-highway vehicles.

Test World boasts 1,250 hectares of proving ground, split over two sites. Its specially-designed and maintained tracks are suitable for anything from sports cars to the biggest on-highway vehicles.

Test tracks developed specifically for vehicle testing include a high speed circuit, a vehicle dynamics area and a snow handling track. These shared access tracks, offering faster speeds with increased run off for safety, are based on compressed snow.

Their construction method avoids the negative 'polishing' effect typical of lake-based test tracks. The expertly prepared snow tracks are inherently safer, do not suffer from unwanted surface depression, and have a longer operational season.

Customers benefit from the availability of service buildings nearby, from a wide range of accommodation and hospitality options, and from Test World's legendary customer service.

Tyre Testing

Test World in Finland is the premier test facility for winter tyres. Innovative indoor facilities allow testing on natural snow throughout the year.

The teams in Finland and the UK can undertake the full suite of tests necessary during tyre development and tyre certification. With two locations and the indoor facilities at Test World, Millbrook is a one-stop-shop for all tyre tests.

The team in Finland is expert at preparing snow and ice tracks. Customers report very high levels of repeatability throughout the testing season.

Tyre Testing and Track Rental

- Indoor snow platform
- Indoor ice lane
- Indoor snow handling
- Snow braking
- Ice braking
- Snow handling
- Ice handling
- Constant radius snow
- Constant radius ice
- Wear and durability tests
- Aquaplaning
- Wet braking
  - High μ
  - Low μ
  - Split μ
- Dry braking
- Dry handling
- External rolling noise

Studded Tyre Road Wear Certification

Tyre Certification to UN/ECE Regulation 117

- Wet grip
- Snow grip
- Pass by noise
- Rolling resistance

Year-round testing of vehicles and tyres in winter conditions

Indoor facilities enable year-round testing in winter conditions on natural snow and ice. The surfaces are carefully managed to give excellent test results. From 2018 three new indoor areas are available. They increase the capacity for testing on natural snow and ice and introduce wet and dry braking and aquaplaning. The adjustable temperature and humidity give an advantage to development, certification and labelling testing by allowing greater environmental control.

Testing on snow and ice

For subjective testing, Test World offers a closed-circuit snow handling track measuring 350m x 9m. For objective acceleration and braking work, it offers two snow and ice platforms with a maximum combined length of 410m.

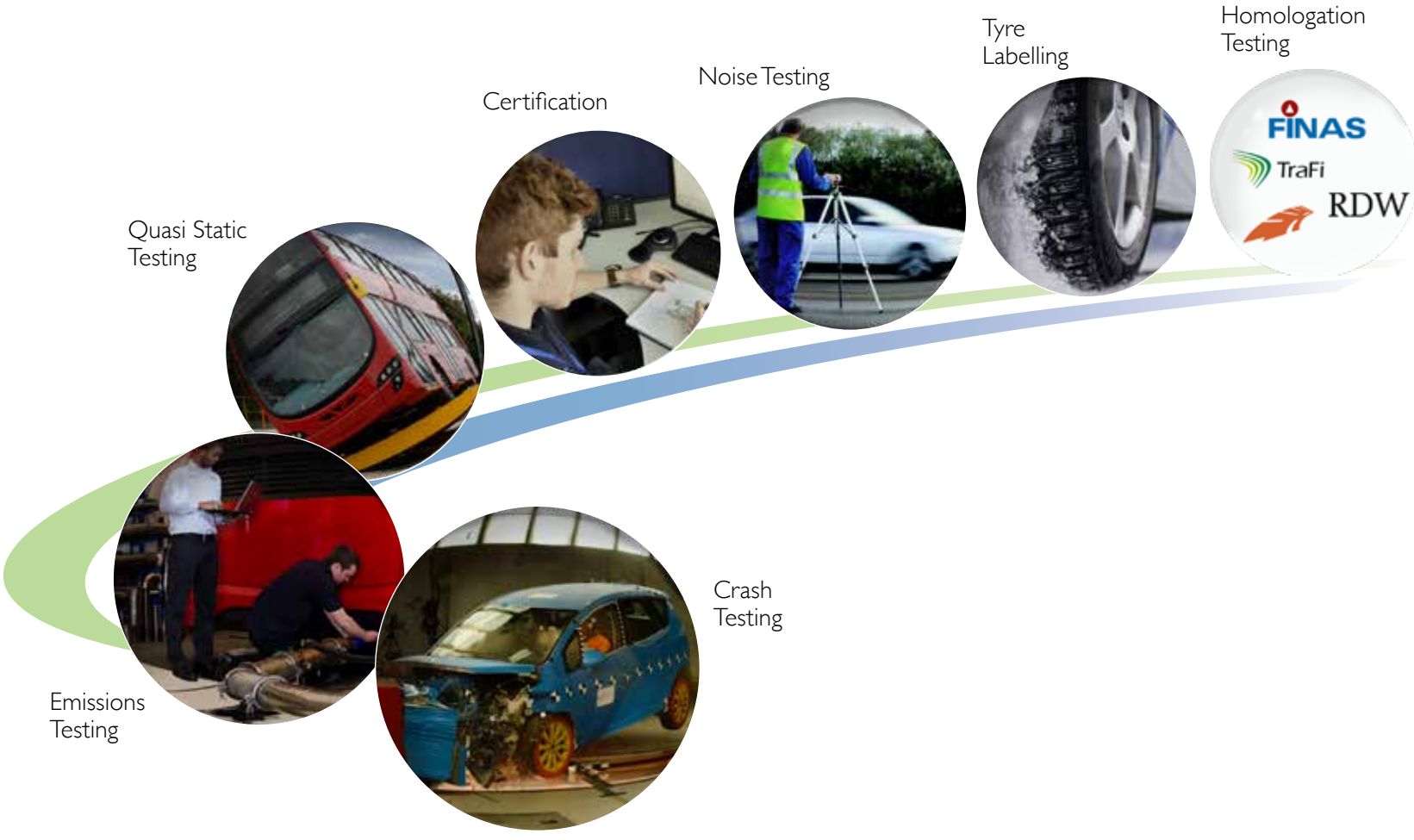
Test World has extended the existing indoor snow and ice platform by adding a second area. They are sufficient to test the largest tyres (C3) used on trucks and buses, as well as to test brakes on passenger cars at higher speeds than were possible in the original facility.

Wet and dry braking and aquaplaning

Two new asphalted facilities are situated alongside the snow and ice platforms for performing wet and dry braking and longitudinal aquaplaning tests. They can be operated separately or together with a combined length of 410m.

These new facilities mean that the site now provides the majority of objective tests required by tyre manufacturers on one site, year-round.

Type Approval Testing



Vehicle, system and component certification and homologation services in the UK and Finland.

Millbrook's type approval expertise covers all types of vehicles and tyres for existing and proposed legislation for the UK, EU and other regions.

Millbrook offers a one-stop-shop for expert legislative advice, negotiation with authorities, test programme development, project management and production of technical drawings and formal documentation.

It has all the knowledge and equipment required to test and verify that a vehicle conforms to the relevant regulations anywhere in the World.

Millbrook assists its customers with the interpretation and application of legal provisions, specific legislative and regulatory requirements and approval processes.

The Vehicle Certification Agency (VCA) maintains an office at Millbrook's proving ground in the UK. The resident VCA engineers can witness customer test work conducted in the laboratories.

Millbrook provides technical services for:

- Vehicle Certification Agency
- RDW
- VSCC Authorised Laboratory for Taiwan
- RVCS Test Facility for Australia
- TRIAS Accreditation Laboratories for Japan

Special Vehicles

Millbrook Special Vehicles uses its automotive engineering knowledge and Millbrook's test facilities to produce vehicles with enhanced capabilities or major modifications.

The team has extensive skills in systems integration, ballistic protection, propulsion modifications and vehicle dynamics.

Powertrain Changes

Millbrook Special Vehicles can convert existing vehicles to have the latest emissions standard ICE, or replace with a hybrid or full electric drive to reduce CO_2 and pollutant emissions. Projects can include:

- Technology assessment and selection
- Vehicle integration design and prototyping
- Low volume production

Engineering Programmes

Projects typically include the following:

- Base vehicle assessment and selection
- Design and systems integration
- Verification and validation
- Production
- Through life support and ILS
- Driver training

Protection

Millbrook Special Vehicles offers a range of discreet protected vehicles, with ballistic and blast protection to various certification levels. These vehicles include vehicle upgrades to ensure the dynamic performance of the base vehicle is not compromised.

Systems and Software

Millbrook Revolutionary Engineering specialises in test system integration. It designs, builds, installs and services dynamometer test systems and an associated test cell automation system, REPS.

It is based in the US with presence in Germany, China and the UK.

Driveline and Powertrain Test Systems

Millbrook Revolutionary Engineering offers turnkey dynamometer-based test systems, enabling its customers to perform a full range of testing scenarios in-house - from the simplest to the most demanding.

Designed for durability, long life, high performance and safety, customers use these systems to test a broad spectrum of mechanical products, including:

- Engines
- Transmissions
- Axles
- Chassis
- Clutches
- Torque converters
- Transfer cases
- Shafts

Millbrook Revolutionary Engineering provides customisable test systems to fit each customer's unique specifications.

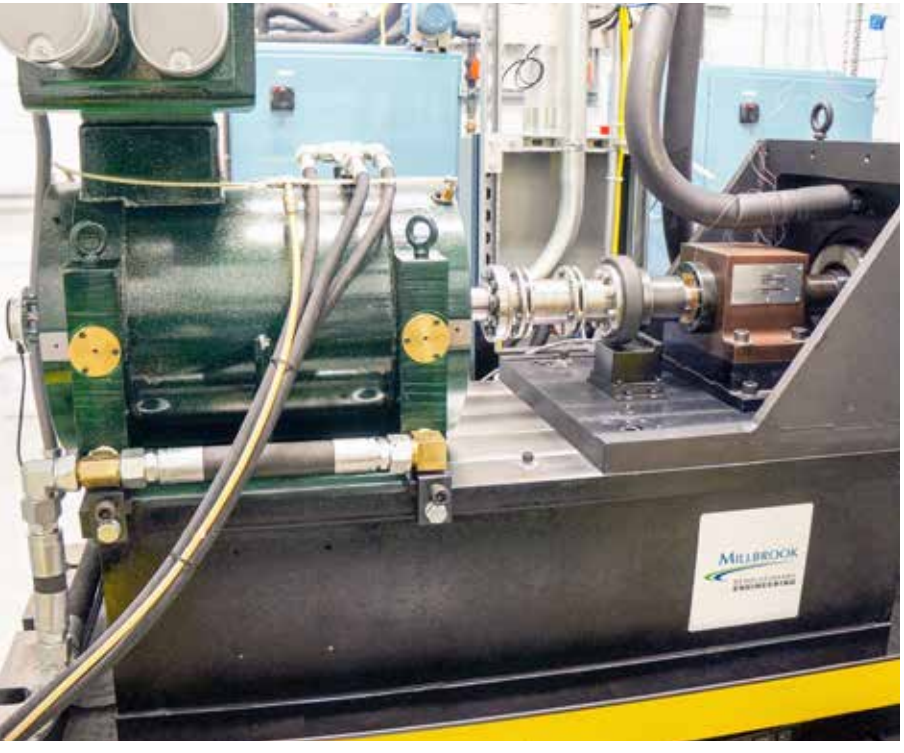
Millbrook Revolutionary Engineering provides innovative mechanical fixtures with their systems. They offer a multitude of adjustments that can be easily made by the operator based on the types of test articles being tested.

Some of these fixtures include:

- Adjustable motor bases that can be moved in the x, y, and z directions with the push of a button
- Adjustable axle stands that can be raised up and down and have angular adjustments to set the desired pinion angles
- Tilt and roll transmission test fixtures that allow for +/-50° of tilt or 360° of roll at a rate of 10° per second to the transmission during testing. The angular changes are automated and can be adjusted while a test is running
- Telescopic and height adjustable shafting guards that can be fully adjusted with basic hand tools
- Custom thermal enclosures that bolt to the test article fixtures to allow for remote air conditioning

Electrification Test Systems

Millbrook Revolutionary Engineering provides leading edge test systems for development and test for a variety of electric vehicle systems and components such as electric motors, inverters, batteries, belt integrated starter and generator testers, and electric motor driven transaxles.



Turnkey Inverter Test Systems

- Testing multiple inverters with synchronous control of all inverters using high frequency transformers on the output of the test articles
- Can use one common cooling system for all test articles to save the need for independent environmental chambers and sub ambient coolant conditioning systems
- Between the output and input of the DC converter and AC inverter the customer will be able to install their test articles in series with a 3 phase transformer and inductors that are selected to mimic the inductive loading of the customer's motor
- Include all power analysing equipment and instrumentation based on testing needs

Turnkey Electric Motor Test Systems

- Installed on a common system base to mount the AC dynamometer motor and customer-provided electric motor
- Designed to maintain accurate driveline alignments during test article change outs by the use of high precision machine slides and high precision machined test article mounting pilots and locating dowels
- Include a battery simulator to provide the customer's inverter with a DC power source
- Designed to operate at speeds of 25,000rpm with provisions to run up to speeds of 75,000rpm
- Custom environmental chambers and sub ambient cooling systems allow for ambient temperature control around the test articles of -70°C to +180°C as well as coolant circulation from -40°C to +140°C depending on the coolant type

Electric Motor Driven Transaxle Test Systems

- Designed to mount the customer's electric motor/transaxle assemblies so that they can be tested together as they would be installed in a vehicle
- A battery simulator is included with the dynamometer inverter system as well as two AC inverters to power the output motors
- Include all power analysing and temperature controlling equipment based on test system requirements

Test Cell Automation Software

Millbrook Revolutionary Engineering's automation system, REPS, is highly configurable and easy to use. It provides customers with complete control over every aspect of their test system.

REPS runs and automates different types of tests, including part failures, efficiency, speeds, torques and impacts. It also allows the user to create reports and logs in digital and printable formats.

REPS uses a desktop PC with a user interface, a RT for data acquisition and control, and an EtherCAT input/output chassis for system interfacing. The RT accommodates multiple industrial communication protocols allowing the user to attach a variety of measuring instruments and devices.

Core capabilities:

- Fully configurable control modes
- Configurable displays, buttons, and indicators
- Master Setup which links individual setup files for convenient saving and loading
- HIL simulation
- Customer add-ons through the LabVIEW Plug-in (LVP)
- Road load simulation
- Powerful test profiler
- Playback for importing and replacing field-measured data
- PID control n Authentication for managing user and access rights
- Web based and VNC based remote access

Channels:

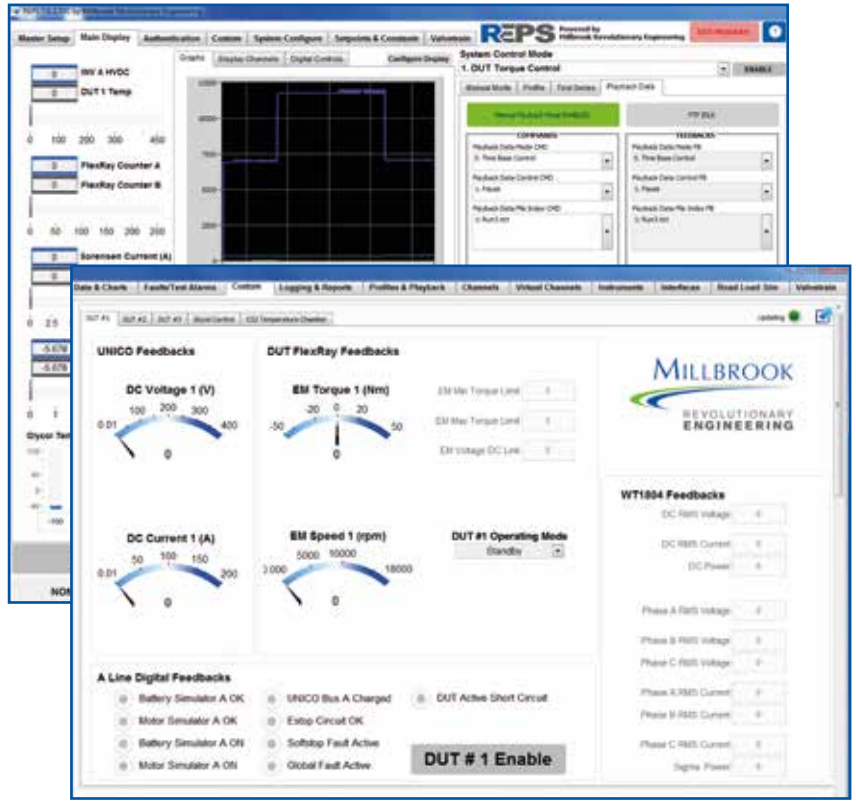
- 8,000 standard channels that can be user modified
- Built-in channel calibration utility
- User defined PID parameters
- Constant or variable alarm limit
- Configurable low pass filter channels
- Virtual channels
  - Waveform
  - Ramp
  - Integration
  - Differentiation
  - Formula
  - Trigger

Communication protocols:

- CAN, CAN FD
- FlexRay, ASAP3, CCP, XCP
- Existing drivers for external instruments
  - AVL smoke meter and micro soot sensor
  - Yokogawa power meters
  - Throttle and shift controllers
  - CAS drivers
  - Opdax water-cooled chillers/heaters
  - Sorenson power supplies
  - Revolutions counters

Reporting:

- Real time data logging
- Post mortem logging
- Multiple data report formats (TDMS, Text, MS Excel)



Further Information

Venues

Millbrook has a number of event venues around its proving grounds in the UK and in Finland, each with its own atmosphere.

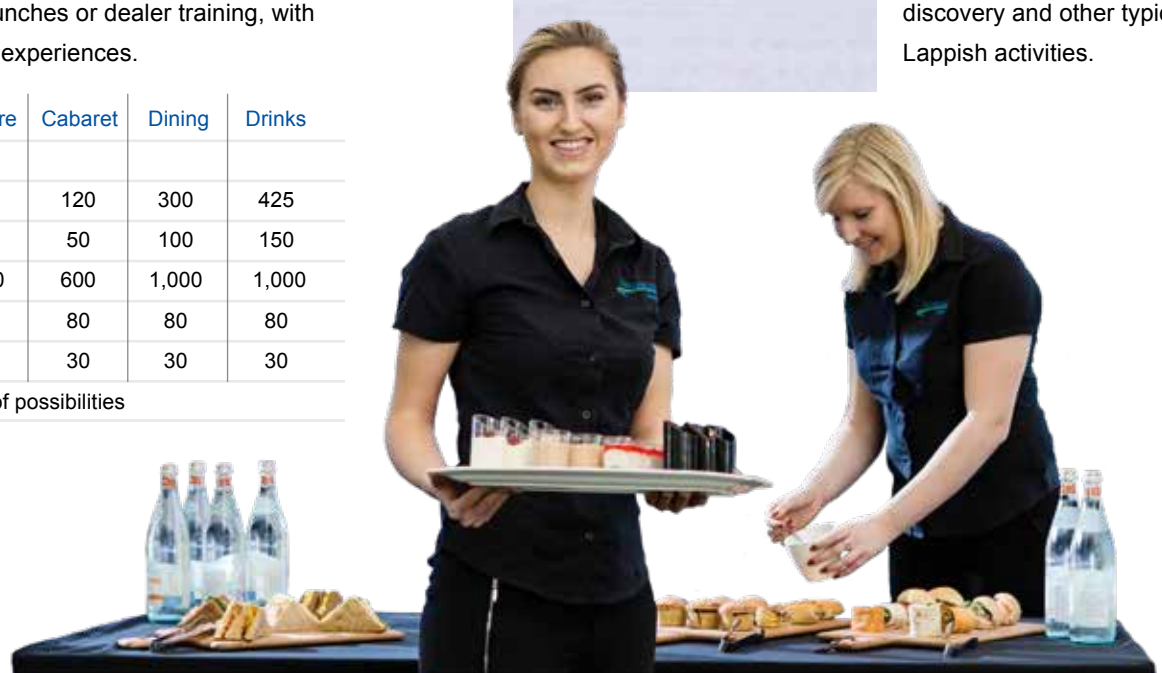
Millbrook's events team give customers complete flexibility for event design, with each venue being available on an exclusive basis. They are located in a secure environment, allowing for total confidentiality.

Millbrook offers customers the opportunity to combine top-grade hospitality and catering with access to private test tracks. This makes the facilities ideally suited to product launches or dealer training, with classroom sessions followed by driving experiences.

Venue	Area	Theatre	Cabaret	Dining	Drinks
Concept 1					
per wing	388m²	350	120	300	425
per dome	160m²	150	50	100	150
Concept 2	1,250m²	1,000	600	1,000	1,000
Pod	375m²	80	80	80	80
Cubo	120m²	30	30	30	30
Test World	1,250 hectares of possibilities				

Test World

In Finland, Millbrook is able to offer tailored events, combining driving on snow and ice with skiing, husky dog sledging, Northern Lights discovery and other typical Lappish activities.



Concept 2

1,250m^2 of open space for large events for up to 1,000 people.

Concept 1

A flexible space that can be configured for 50 to 500 people, overlooking the steering pad.

Pod

A discreet, medium-sized venue close to the tracks with parking for vehicles.

Cubo

An intimate venue for up to 30 guests in the heart of the proving ground.

Track Testing – UK

Millbrook Proving Ground in the UK contains an unrivalled combination of tracks suitable for virtually every vehicle test.

Millbrook Proving Ground was purpose-built as a test facility for passenger cars and heavy duty vehicles. The on-road tracks include the famous Millbrook Hill Route, which simulates challenging European roads, the high speed circuit and numerous special surfaces.

The off-road tracks contain a large number of obstacles that test the capabilities of the finest civilian and defence vehicles.

On-Road Tracks and Features

1. Hill Route
2. Hill Route Loop 1
3. Hill Route Loop 2
4. Hill Route Loop 3
5. High/Constant Speed Circuit
6. City/Handling Circuit
7. Outer Handling Circuit
8. Steering Pad
9. Dynamics Pad
10. Mile Straight/Mile Straight Apron
11. Driveway Ramps
12. Truck Slopes
13. Sine Waves
14. Random Waves
15. Noise Generating
16. Belgian Pavé
17. ABS and Traction Control
18. Drive-by External Noise
19. Twist Humps
20. Troughs
21. Rough Tracks, Kerbs and Features

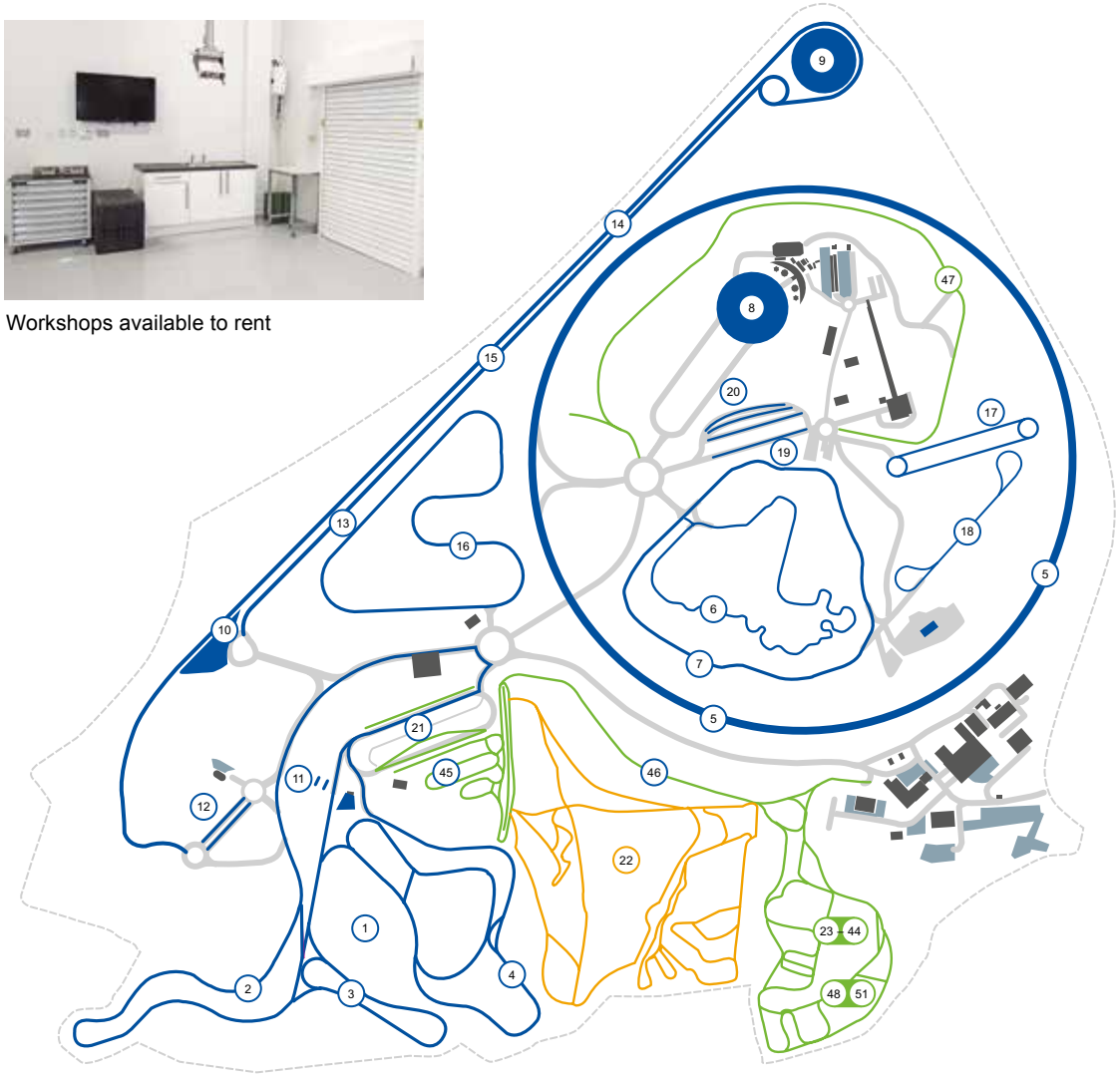
Off-Road Tracks

22. Off-Road and Severe Off-Road

Off-Road Technical Features

23. Wading Pond
24. Semi Axle Bumps
25. Axle Bumps
26. Severe Vehicle Twist
27. Rock Run
28. Wading Trough
29. Concrete Ditches
30. Concrete Kerbs
31. Ditch Run
32. Mortar Holes
33. Log Roll
34. Log Run
35. Steps
36. One in One
37. 25° Traverse
38. Gravel Hills
39. 35% Gravel Hill and 155° Breakover
40. Snake Climb

Workshops available to rent



41. Sand Hills
42. Deep Ditches
43. Twist Climb
44. Offset Sinusoidals
45. Structural Test Features
46. Berm Road
47. Gravel Road
48. 60% Hill Slope
49. Severe Articulation/Hummer Hollows
50. Recovery Vehicle Winch
    Anchor Points
51. Gravel Pits

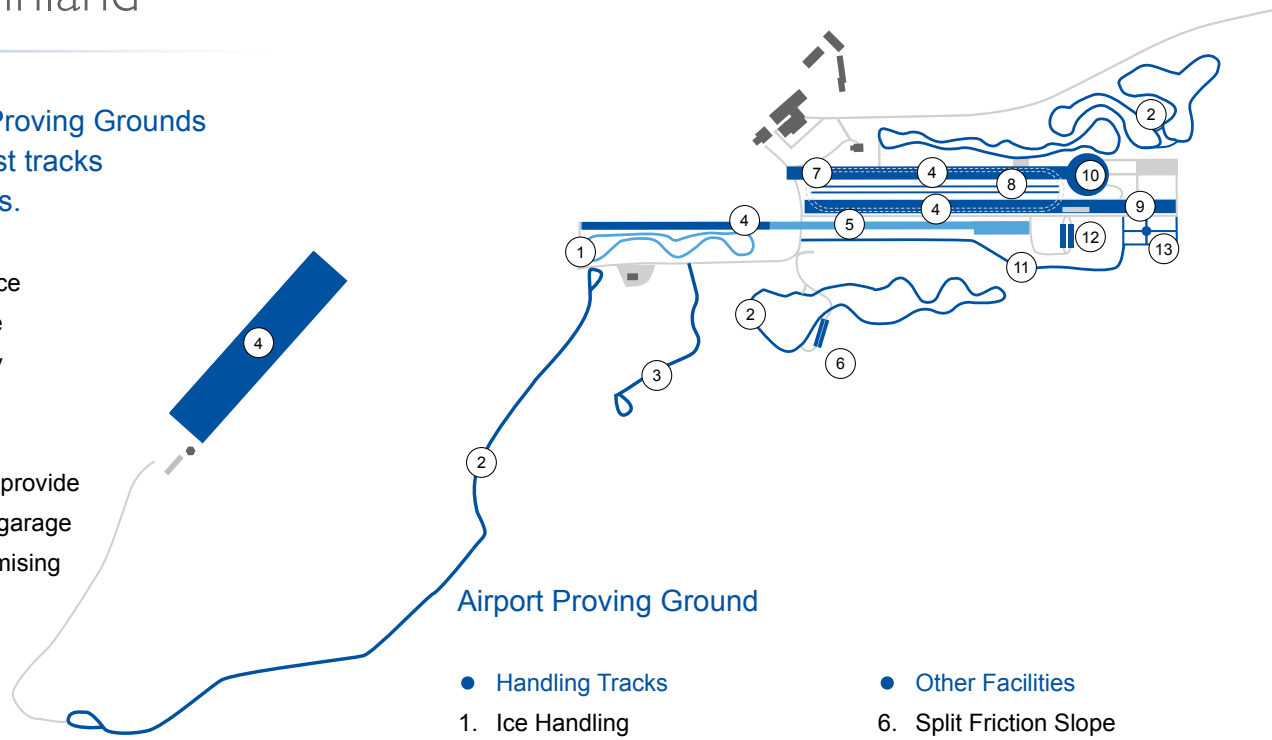
Track Testing – Finland

The Mellatracks and Airport Proving Grounds are home to superb winter test tracks and innovative Indoor facilities.

Test World prepares the snow and ice tracks to give consistent, repeatable test results that are highly valued by tyre and passenger car test teams.

The proving grounds are laid out to provide each visiting test team with its own garage and set of handling tracks, so maximising test efficiency and confidentiality.

The location 300km North of the Arctic Circle provides an exceptionally long winter test season, with outdoor tracks often open from October to April and indoor tracks open year round.



Airport Proving Ground

- Handling Tracks

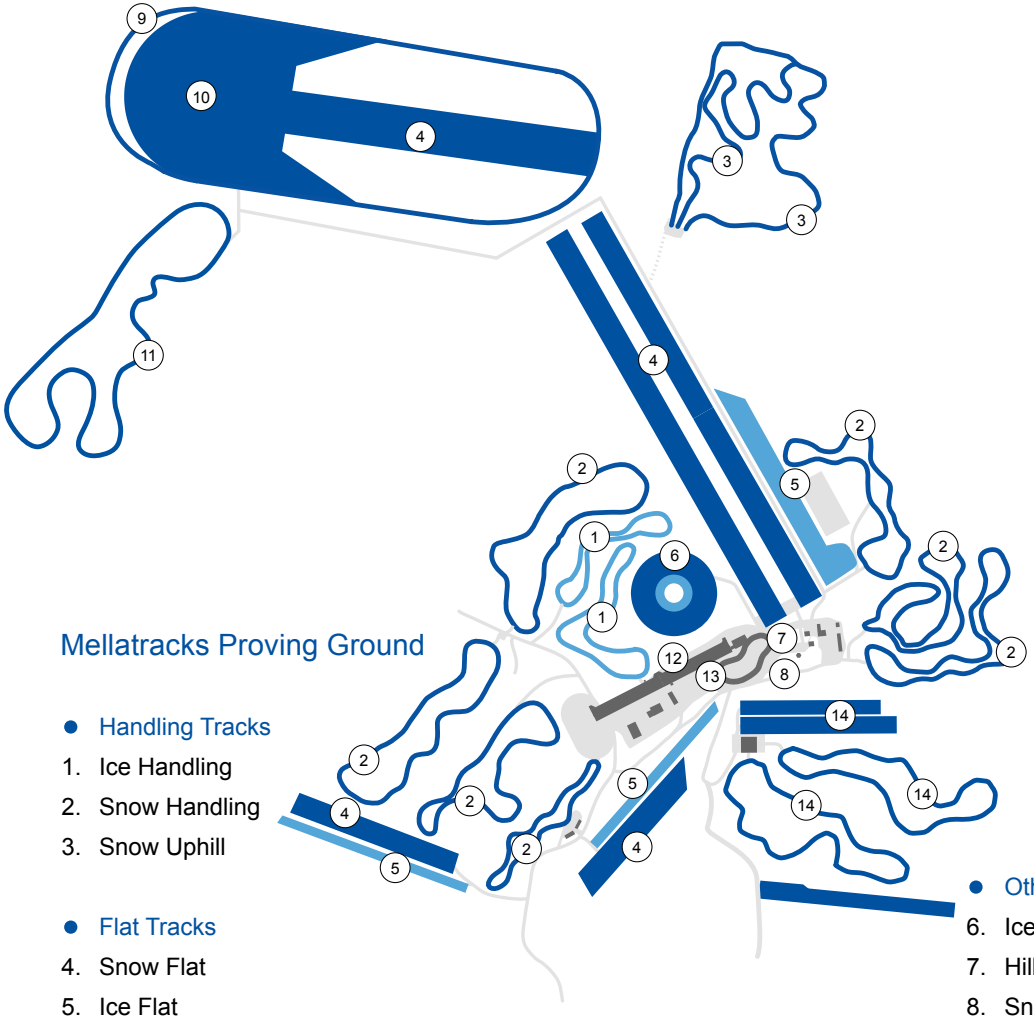
1. Ice Handling
2. Snow Handling
3. Snow Uphill

- Flat Tracks

4. Snow Flat
5. Ice Flat

- Other Facilities

6. Split Friction Slope
7. Oval Track
8. Soft Snow Tracks
9. Split Friction Track
10. Ice and Snow Circle
11. Comfort Road
12. Hill Slope
13. City Block



Mellatracks Proving Ground

- Handling Tracks

1. Ice Handling
2. Snow Handling
3. Snow Uphill

- Flat Tracks

4. Snow Flat
5. Ice Flat

- Other Tracks

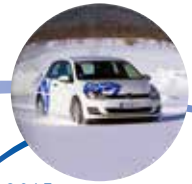
6. Ice and Snow Circle
7. Hill Climb
8. Snowhill
9. High Speed Snow Circuit
10. Snow Vehicle Dynamics Area
11. Snow Vehicle Handling Track
12. Indoor 1, 3, 4, 5
13. Indoor 2
14. Customer Specific Areas

History

1970
General Motors opens Millbrook Proving Ground

1988
Millbrook starts to serve third party customers

1999
Engine test centre opens



2015
Millbrook acquires Test World

2012
World's first indoor winter test facility opens

1991
Test World founded

1980
Leyland Technical Centre opens

2011
First comprehensive electric motor testing established at Leyland

spectris

2016
Millbrook joins Spectris plc

2017
Millbrook acquires test facility in Leyland

2018
Major investment in battery and e-propulsion testing

2017
Office established in Germany

2011
Office established in China

2002
First E-Motor Auxiliary Test System shipped

2001
Revolutionary Engineering, Inc. established

MILLBROOK

2018
Millbrook acquires Revolutionary Engineering

Locations and Contacts

Millbrook operates facilities across the globe.

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Representatives in other countries offer local support, for more information, please visit the website.

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