# High Performance Tools to Speed Up Your R&D

## DSI Product Range:

1. **Modern Test Centre** for Engines & Lubricants
   - Engine test centre based in Belgium

2. **Lubricant Aeration**
   - Air-X equipment for on-line measurement of gas content in oil

3. **Engine Oil Consumption**
   - C-Lube equipment for real-time measurement of oil consumption on I.C. engines and turbochargers

4. **Fuel Dilution**
   - D-Lube equipment for on-line measurement of fuel dilution

5. **On-Line Wear Measurement**
   - Thin Layer Activation (TLA) services and equipment for real-time wear measurement

6. **AFTER TREATMENT SYSTEMS**
   - Special tools for monitoring poisoning & clogging of ATS during engine operation
   - X-ray imaging
   - Development of ATS cleaning / recycling procedures

7. **Test Rigs and Ancillary Equipment**
   - TC-Lube for separate lubrication of turbochargers
   - AIR-MIX to generate controlled aeration lubricants
   - Development and manufacturing of dedicated water/oil conditioning systems

8. **Tribology & Aeronautics**
   - Innovative tools to speed-up the development of new materials, new coatings, and ancillary systems for jet engines
DSi offers complete services for research, development and evaluation of engines and lubricants.

A 1,300 sqm test facility based in Belgium, with modern test cells equipped with radiotracing tools.

YOUR BENEFITS

• A fully independent contract service center
• Modern engine test equipment associated to innovative radiotracing tools
• Real-time results
• A significant reduction of your development time & associated testing costs
• Our highly qualified and experienced technical staff
• Customer oriented solutions and high flexibility

STANDARD TOOLS

• Low inertia “tandem” dynamometers
• Data acquisition @ 100Hz
• ECU diagnostics (INCA, DDT, etc.)
• Standard fuels and biofuels
• Fuel flow meters
• Blow-by meters
• Regulated oil/water heating systems (up to 150°C)
• Combustion analysis system
• Oil/fuel analysis services
• Measurement of friction losses
• 400V power supply unit for hybrid engines

DSI CUSTOMER REFERENCES

• PSA
• Renault SAS
• Renault Sport F1
• Jaguar / Land Rover
• Bentley
• Daimler
• Toyota (TME)
• TOTAL France
• BP Castrol
• SK Corp
• Lubrizol
• Ricardo
• Tickford
• Volvo Trucks
• DAF Trucks
• Perkins Engines
• Cummins Engines
• Cosworth (UK)
• Promevo (UK)
• Magna Powertrains
• I.F.P. (Institut Français du Pétrole)
• Le Moteur Moderne (AVL Group)
• Schrick (AVL Group)
• Codemo Racing
• Case New Holland

SPECIAL TOOLS [RADIOTRACERS]

• On-line wear measurement
• On-line fuel dilution measurement
• On-line gas content (aeration) measurement
• On-line oil consumption measurement (engine, turbocharger and oil separator)
• External engine / turbocharger lubrication system
• Monitoring equipment for ATS

• Federal Mogul
• HMC [KIA-Hyundai]
• Maruti • Suzuki Group
• Massachussets Institute of Technology (MIT)
• GM
• John Deere
• Ford
• …
Air-X, the right tool for monitoring lubricant aeration

- The reference tool in the automotive industry for gas content measurement
- Based on X-ray transmission: range from 0% to 100% gas content
- Real-time results: response time selectable from 1 sec to 1 min.
- Continuous oil sampling, at regulated flow (selectable)
- Allows measuring both dissolved and non-dissolved fractions
- Accuracy: 0.1% in terms of gas content
- Automatic temperature compensation
- Easy to calibrate and user-friendly interface
- Visualisation of oil flow in the measuring chamber (video signal)
- 4 versions available, from low to high flows
- In-board model available
- Single USB connection

DSI EXPERTISE
DSI team has acquired a strong expertise in assisting our customers to understand and solve aeration problems.

- Service measurement with AirX equipment, at your company
- Service measurement at DSI including rent of engine test tools
- Solving aeration problems by adapting the oil circuit and lubricant properties
- Training on the aeration process (theoretical and practical)
- Design and manufacturing of dedicated test rigs for aeration measurement
- Development of special configuration in the hydraulic and mechanical industries

USER’S INTERFACE

All measurement data (oil temperature, oil pressure, and gas content) are recorded and can be visualized on a graphic during operation of Air-X. A dedicated routine is also provided, which allows converting the results to a .csv format.
DSi offers a patented methodology for on-line measurement of oil consumption on I.C. engines. The method is based on lubricant labelling using radiotracers that are representative of the distillation interval. It allows distinguishing between various sources of oil consumption: engine block, turbocharger (turbine side and compressor side), and oil separator (blow-by) circuit.

The methodology offers the following benefits:

- Real-time results
- High sensitivity (<1 mg)
- Separate monitoring of oil consumption sources
- Fast results (21-points oil consumption map within 8 hours)
- No special fuel or lubricant required
- No change in oil properties associated to the presence of the radiotracer
- Selectable chain length to be labelled, from very light to heavy oil fractions
- Burned and unburned oil fractions are taken into account
- The method is not affected by fuel dilution

### CONTRIBUTION OF TURBOCHARGERS AND OIL SEPARATOR SYSTEMS

Reducing oil consumption of turbochargers and increasing efficiency of oil separators are important issues for reducing emissions and for increasing lifetime of ATS.

### CONTRIBUTION OF OIL SEPARATOR SYSTEMS

Our radiotracer method allows measuring on-line oil consumption issuing from the engine ventilation system. An absolute filter is installed downstream the oil separator to collect residual oil. It offers negligible pressure losses and it is equipped with a probe that monitors accumulation of oil with a sensitivity of less than 1 milligram.

### CONTRIBUTION OF TURBOCHARGERS

A separate lubrication system (“TC-Lube” see details page 13) containing labelled oil (radiotracer) is used to feed the turbocharger independently from the rest of the engine. Oil leaks issuing from the turbine bearing are monitored in the exhaust line where an absolute filter is installed. Leaks from the compressor stage are trapped in another filter installed between the compressor and the intercooler. As a consequence, oil consumption from both stages are measured independently.
Fuel dilution measurement is of particular interest in light of new environmental regulations imposed on today’s passenger car and heavy duty engines. Our innovative methodology offers on-line and accurate results. It is based on lubricant labelling using a new radiotracer compound, which is representative of the lubricant.

**MEASUREMENT PRINCIPLE**

As first step, a radiotracer compound is mixed to the lubricant. During engine operation oil is circulated continuously into a measuring chamber where the signal (gamma-rays) emitted by the radiotracer is monitored. This signal is representative of the dilution process. Temperature / density effects are corrected automatically.

- **No change in oil properties**:
  Less than 100 µl of tracer is added to the engine oil pan. It does not interact chemically with oil and additives.
- **Equipment is easy to install**:
  Oil is sampled directly from the sump at a rate of ~1 litre per min. 2 hoses are easily connected between the engine and D-Lube equipment.
- **Applicable on test beds and on vehicles**:
  Our standard equipment is dedicated to test bench applications. A compact version is available for in-board installation on passenger cars and HD vehicles. It includes a data logger for acquisition during road tests.

The methodology applies to gasoline, diesel and bio-fuel engines for optimisation of cold start procedures, for the development of post-injection strategies and of evaporation cycles.

D-Lube offers significant advantages over other methods, including:
- **On-line / Real-time results**:
  Oil dilution is monitored continuously during engine operation, at a rate of 1 measurement per minute.
- **Short Test Durations**:
  Dilution rates are accurately measured within short runs from <1 hour to 4 hours, depending on dilution rates.
- **High sensitivity**:
  Sensitivity is of 0.05% per hour (in terms of dilution rate).

The graph hereunder shows typical results obtained during successive dilution and evaporation phases performed on a passenger car diesel engine. Oil temperature is shown (red signal) and fuel content in oil (volumic, in %) is displayed on-line.

D-Lube equipment reduces significantly the time needed for optimizing fuel injection strategies on I.C. engines.
WEAR MEASUREMENT (TLA/RNT)

For more than 15 years, DSi has applied radiotracer techniques to offer accurate and real-time wear measurements.

TLA (Thin Layer Activation) is our key product. The method allows performing on-line wear measurements on running engines without dismantling parts (i.e. camshafts, cylinder sleeves, piston rings, valves & seats, bearings, turbocharger bearings, etc.). TLA is also convenient for studying the impact of lubricant formulation, fuel dilution and soot content on wear.

DSi provides TLA-RNT measurement services as a full package that includes activation services, equipment sales & renting and qualified manpower. Wear measurements services can be performed either at your site or at our engine test centre in Belgium.

THE METHODOLOGY IS APPLIED IN 2 STEPS:

STEP 1

Labelling of wear parts:
A particle accelerator is used to produce a thin layer of radiotracers at the surface of wear parts.

STEP 2

On-line measurement during engine operation: “direct” and “flow-through” methods.

DIRECT MEASUREMENT
A probe is installed externally to the engine for monitoring of the gamma-ray signal emitted by the labelled area. Any loss of signal is automatically converted in material loss.

“FLOW THROUGH” METHOD
It consists in monitoring the increase of gamma-ray signal in the lubricant where worn particles are released. A probe is installed in a measuring chamber where the fluid is circulated. A particle trap (a filter or a magnet) can also be installed in the chamber to collect worn particles.

YOUR BENEFITS
• On-line results
• Significant reduction of test duration
• Extremely high sensitivity: 1 nanometer
• Real-operating conditions without dismantling parts
• Non-destructive measurement
• Full package service measurement at DSi or at your test facility
**INNOVATIVE TOOLS FOR THE DEVELOPMENT OF AFTER-TREATMENT DEVICES (ATS)**

Poisoning and clogging of ATS by soot and by ash residues affects their performances. DSi has developed a non-destructive technique based on radiotracer labelling of additive compounds contained in the fuel or in the lubricant (e.g. zinc, calcium, molybdenum...). The methodology allows monitoring ash deposits during engine operation.

DSi has acquired a strong expertise in the development, manufacturing and installation of dedicated test tools for engines and lubricants. Amongst several of our recent projects:

- Development, manufacturing and installation of wear and aeration test rigs
- Development and manufacturing of oil and water conditioners for test beds with very accurate flow and temperature control (engine test facility)
- Development of test rigs for friction losses measurement
- Development of test procedures to compare the impact of lubricant formulation and oil aging on engine wear

Tc-lube is a separate lubrication system for turboschargers. It provides very fast response and includes programmable and accurate control of oil temperature and oil pressure.

**RANGE OF APPLICATIONS**:

- Investigation of lubrication limits
- Study of the impact of oil aging (soot content, wear particles, dilution)
- On-line measurement of oil consumption of the TC only
- On-line wear measurement (axial and radial wear of bearings)
DSI contributes to the development of new materials and new coatings that are more extensively used to reduce wear and friction losses in modern powertrains. Our contribution in this field includes the development of on-line wear monitoring tools dedicated to tribology machines and the development of new radiotracer techniques for labelling thin coatings such as chromium and bismuth-based coatings, tin-aluminium coatings, DLCs, etc.

INNOVATIVE TOOLS PROPOSED BY DSI ALLOW SPEEDING-UP THE DEVELOPMENT OF JET ENGINES AND ANCILLARY SYSTEMS.

Our services in this field include the development of oil/fuel de-aeration systems; on-line wear measurement of critical parts (bearings, gears, carbon seals,…); and optimisation of oil separator systems to reduce oil releases in the environment.

R&D partnerships exist between DSI and local (Liège, Namur and Louvain-la-Neuve) and foreign universities (University of Birmingham). In the industry, DSI cooperates closely with R&D centres of major oil and car companies. A partnership exists for more than 12 years between DSI and a major Formula 1 engine supplier. The reason for this long-lasting cooperation is that radiotracer techniques combine real-time results with unequalled sensitivity. This is the reason why we can also speed-up your R&D programs!
WHY SELECTING DSI

FLEXIBILITY

MOTIVATION

TECHNOLOGY

CUSTOMER ORIENTED SERVICES

INNOVATION

EXPERTISE

SAE Award for DSi

Our methodology for oil consumption measurement is the fruit of a cooperative research program between DSi and TOTAL. It is described in SAE paper 2005-01-2178, which received a “SAE Award for Research on Automotive Lubricants”. This paper is entitled “An Innovative On-Line Measurement Method for Studying the Impact of Lubricant Formulations on Poisoning and Clogging of After-Treatment Devices.”

DSI offers industrial products for engine and lubricant testing

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