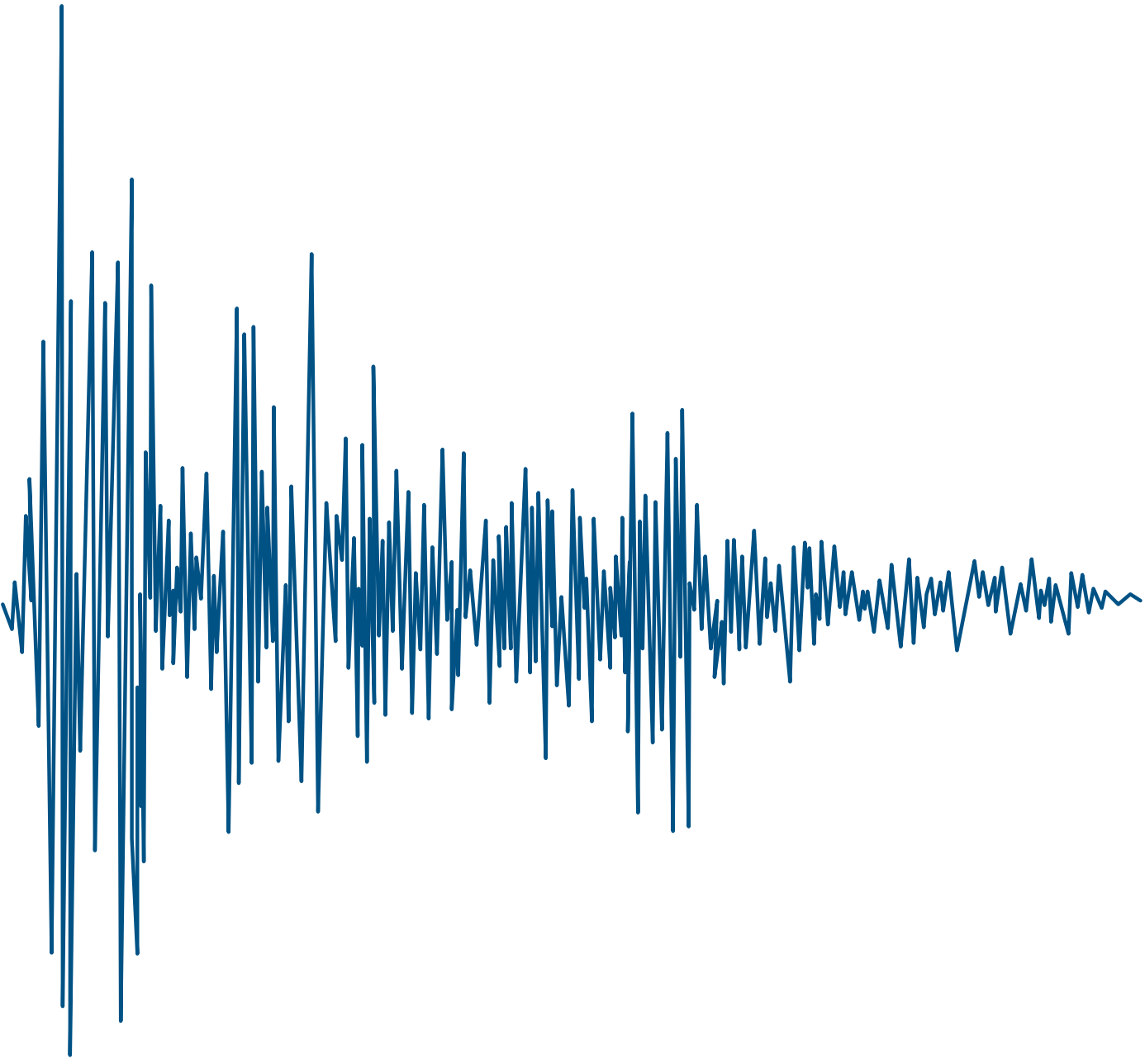
PEI VM
VIBRATION
MONITORING



Advanced vibrational diagnostic systems

About PEI VM

Our company has more than 20 years of experience in the **NVH sector (Noise, Vibration & Harshness)** providing consulting services and measurement systems for many applications, such as **power transmissions, automotive, motorcycle, powertools and packaging**.

One of the keypoints of **PEI VM** is to develop experimental **vibrational diagnostic systems** (hardware and software).

The software is based on advanced algorithms, internally developed by the company, in order to investigate various types of rotating machinery: an easy and user-friendly interface enables the operator, even an inexperienced one, to detect if inside the measured machines there are defective/damaged components.

The consultancy is carried out directly by the customer or in our headquarter (in Zola Predosa, Bologna). Furthermore, in our facility we have a **semi-anechoic chamber** suitable for acoustic characterization and for vibration and acoustic correlation.

We are also an ideal partner to develop customized **software interfaces** for measurement procedures and commissioning tests.

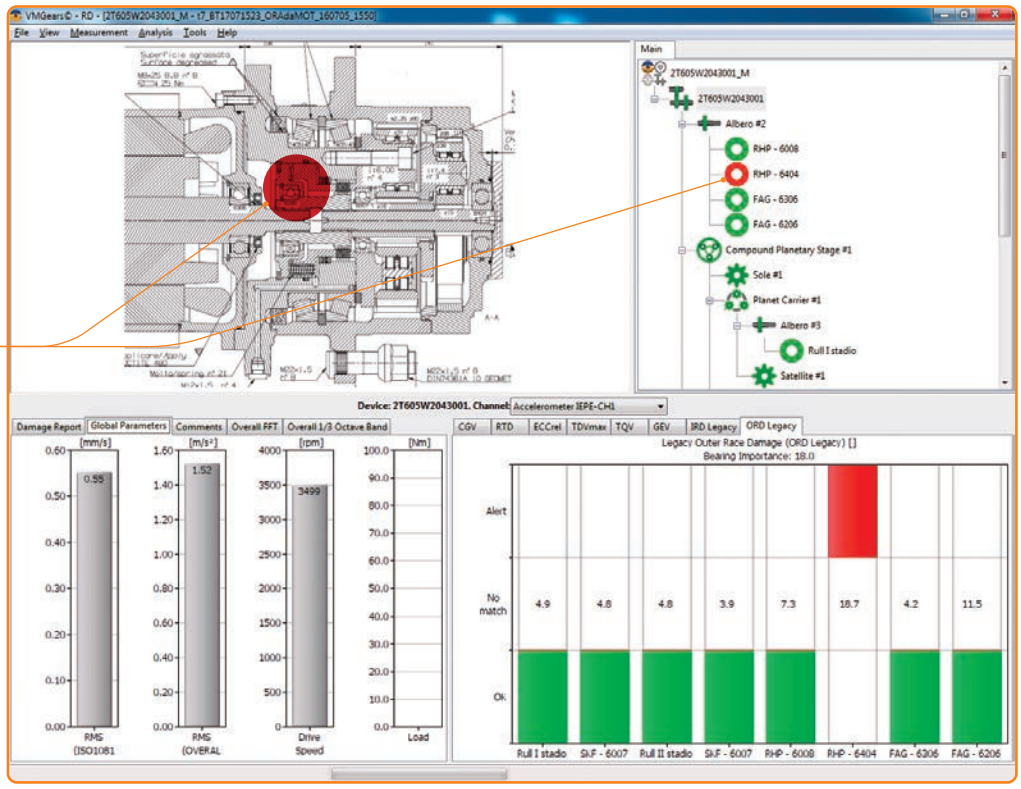
Since 2018 **PEI VM** is a part of **P.E.I. Srl**, a leading manufacturer in Italy and Europe of protective covers for machine tools on the market for more than 40 years, for which we carry out design and calculation activities aimed at product development and innovation.

Research & Development

VMGears **RD**

VMGears RD has innovative algorithms for vibration-based diagnostic of each component inside the machine: gears, bearings, pistons, valves, pumping elements, etc..

DETECTION OF DEFECTIVE COMPONENT AND TYPE OF DAMAGE, **IT ALLOWS YOU TO INTERVENE BEFORE BEGINNING PRODUCTION**

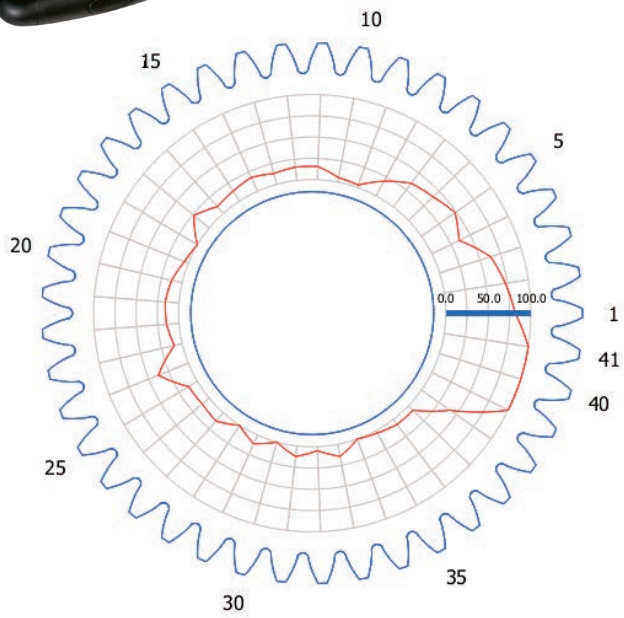


- **VMGears RD** is a portable system for vibro-acoustic analysis of rotating machinery, such as gear motors, gearboxes and electric motors.
- **VMGears RD** allows vibrational benchmark in comparison to products from competitors, helping the development phase of new products.
- **VMGears RD** shows in an easy and quick way events like dented teeth, abnormal meshing, pitch errors, eccentricity, damaged bearings, unbalanced rotors, worn pumping elements and valve impacts.
- **VMGears RD** is a complete system, composed by a dedicated easy-to-use software, an electronic control unit, sensors and wires.

Research & Development

VMGears **RD**

Diagnostic of internal components
of the assembled machine.

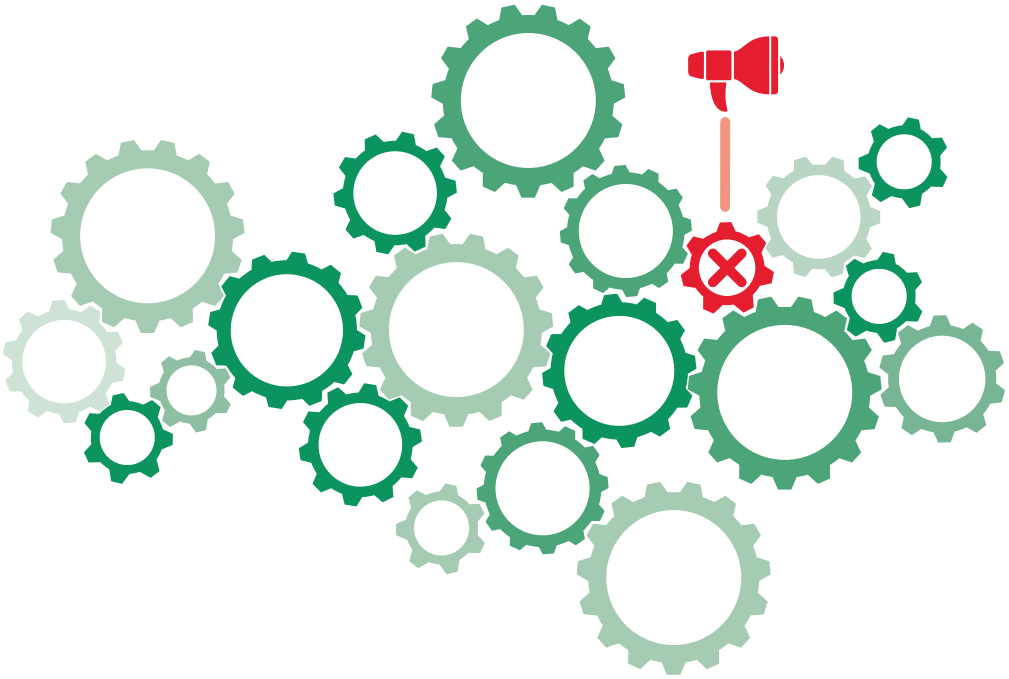


- **VMGears RD:** performs a vibrational characterization of the product, allowing the identification of critical components during the development phase and giving key inputs for the design of the end-of-line test rig.
- **VMGears RD** has a modular hardware, configurable from three to thirtytwo analogue input channels.

Quality Control

VMGears **QC**

VMGears QC carries out a quality check of the product as well as of the assembly process, running a targeted analysis of the vibrations measured on machine housing surface in the end-of-line or during the product commissioning test.
It has a user-friendly interface which provides a prompt visualization of the results.



Quality Control on the assembly line

End -Of-Line Monitoring

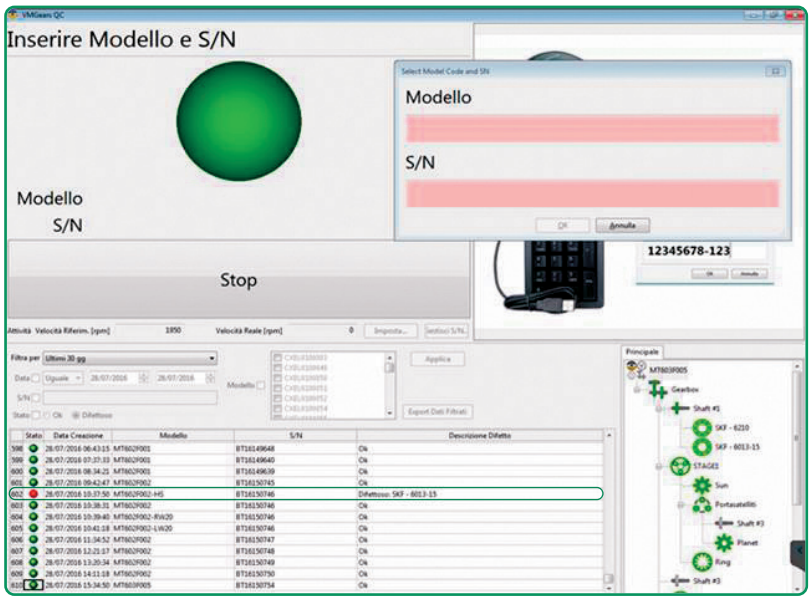
Dedicated indexes for each component

- **VMGears QC** is a Quality Control system installed on the assembly line or integrated into the End-Of-Line test rig.
- **VMGears QC** carries out the end-of-line vibration-based check of gearboxes, transmissions, axles, electric motors, pumps and combustion engines.
- **VMGears QC** software has a dedicated analysis module and a dedicated set of algorithms for each type of rotating machine.
- **VMGears QC** elaborates dedicated indexes for each rotating component inside the machine and each type of defect: these indexes are compared with the respective acceptability thresholds (generally defined by statistical method) to determine if the tested product is **OK** or **NOT OK**.

Quality Control

VMGears QC

Quality control in the production End-Of-Line.



- **VMGears QC** could be easily integrated in any line or test bench, and can work stand-alone or interfaced with a supervisor for data exchange (codes, machine parameters, analysis results).

- **VMGears QC** is a complete system, composed by a dedicated software, an electronic unit control, sensors and wires.
  The software manages a SQL database easily accessible and exportable.

Testing & Quality Control

VMGears **VH**

VMGears VH is dedicated to vibrational and acoustic analysis of the drivelines mounted on vehicles.

- Drivelines of lifters, dumpers, scrapers and wheeled vehicles are composed by several rotating machines like electric or hydraulic motors, i.c. engines, pumps, axles, gearboxes. **VMGears VH** performs a dedicated analysis of each single machine of the driveline during the vehicle testing, identifying which of them is responsible for abnormal behaviours.

- Wheeled vehicles are tested as soon as they exit from production line.
  The user drives each vehicle following a specific procedure: during this test the vibrations are collected and analyzed by **VMGears VH**.

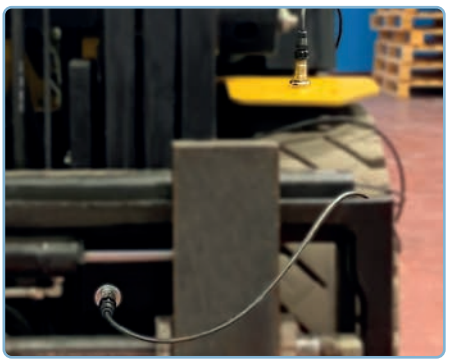
- **VMGears VH**, performs a correlation analysis between sound pressure measured inside the driver cabin and the vibrations measured on the vehicle frame in order to diagnose the complete driveline.

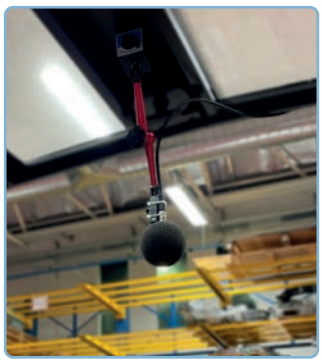
Testing & Quality Control

VMGears **VH**

VMGears VH is a hand-held equipment, easy-to-use on the vehicles.

VMGears VH allows a quick hardware set-up, thanks to a compact, lightweight control unit operated by an industrial tablet, and accelerometers with magnets for fast connection.



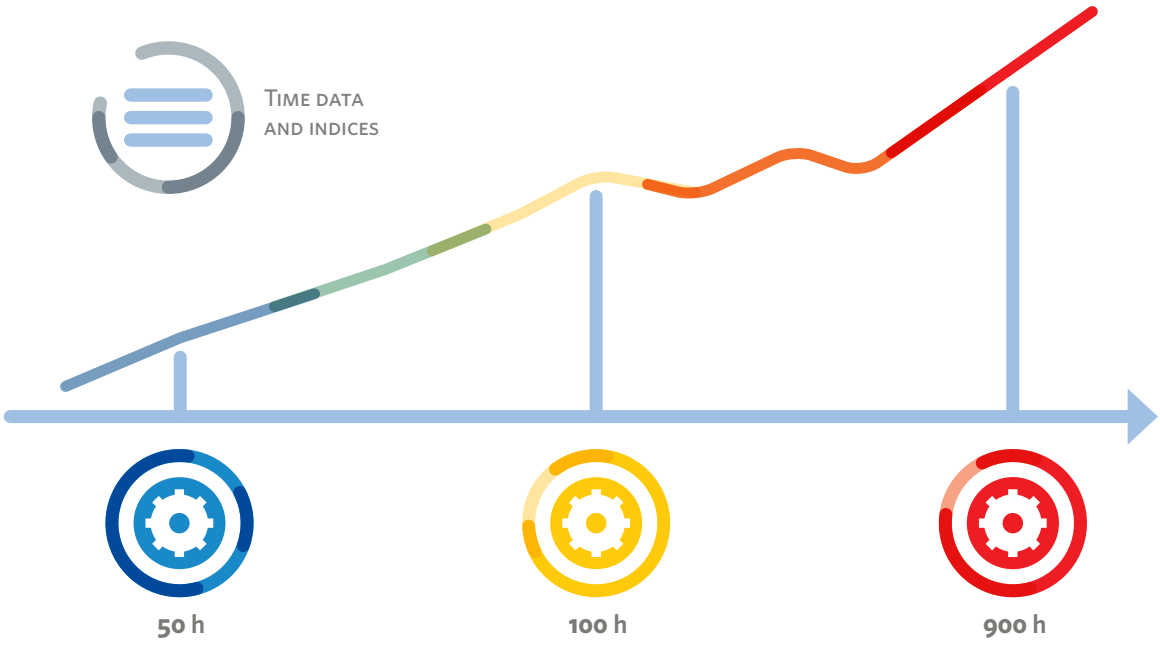


VMGears VH displays the vehicle health status as soon as the test is over, indicating the defective component by a red light.

Monitoring

VMGears **DM**

VMGears DM is used in endurance tests of rotating machines with the purpose of monitoring over time the defects and their evolution, i.e. dent teeth, pitting, pitch errors, eccentricity, impacts, piston slap, unbalanced rotors, etc..

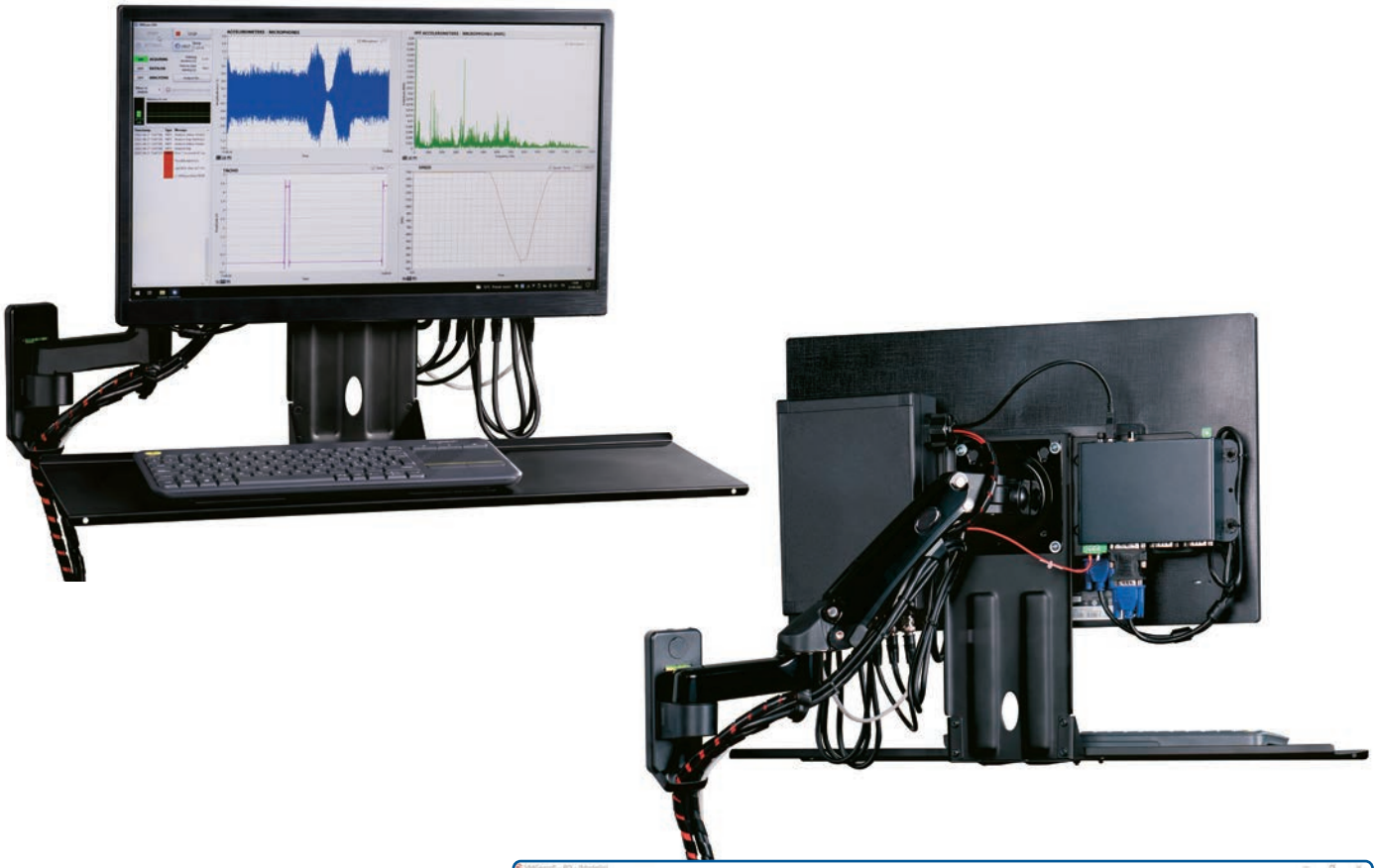


- **VMGears DM** is a complete system, composed by a dedicated software, an electronic unit control, sensors and wires. The system is built to measure and analyze vibrational data continuously, managing a database, which can be connected to the company network.
- **VMGears DM** is a remote monitoring system of rotating machines, i.e. gearboxes, electric motors, pumps and i.c. engines.
- **VMGears DM** is programmed to execute measurement and analysis in function of a predefined endurance test cycle. The system outputs analysis results and monitors their trend over time, giving a warning if a threshold is exceeded.
- **VMGears DM** hardware set-up can be customized accordingly to customer requirements.

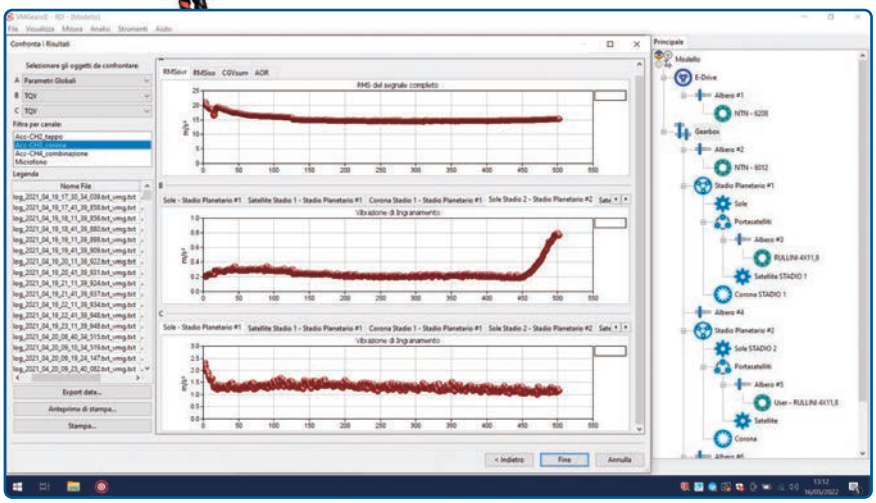
Monitoring

VMGears **DM**

Rotating machines diagnostic during endurance test.



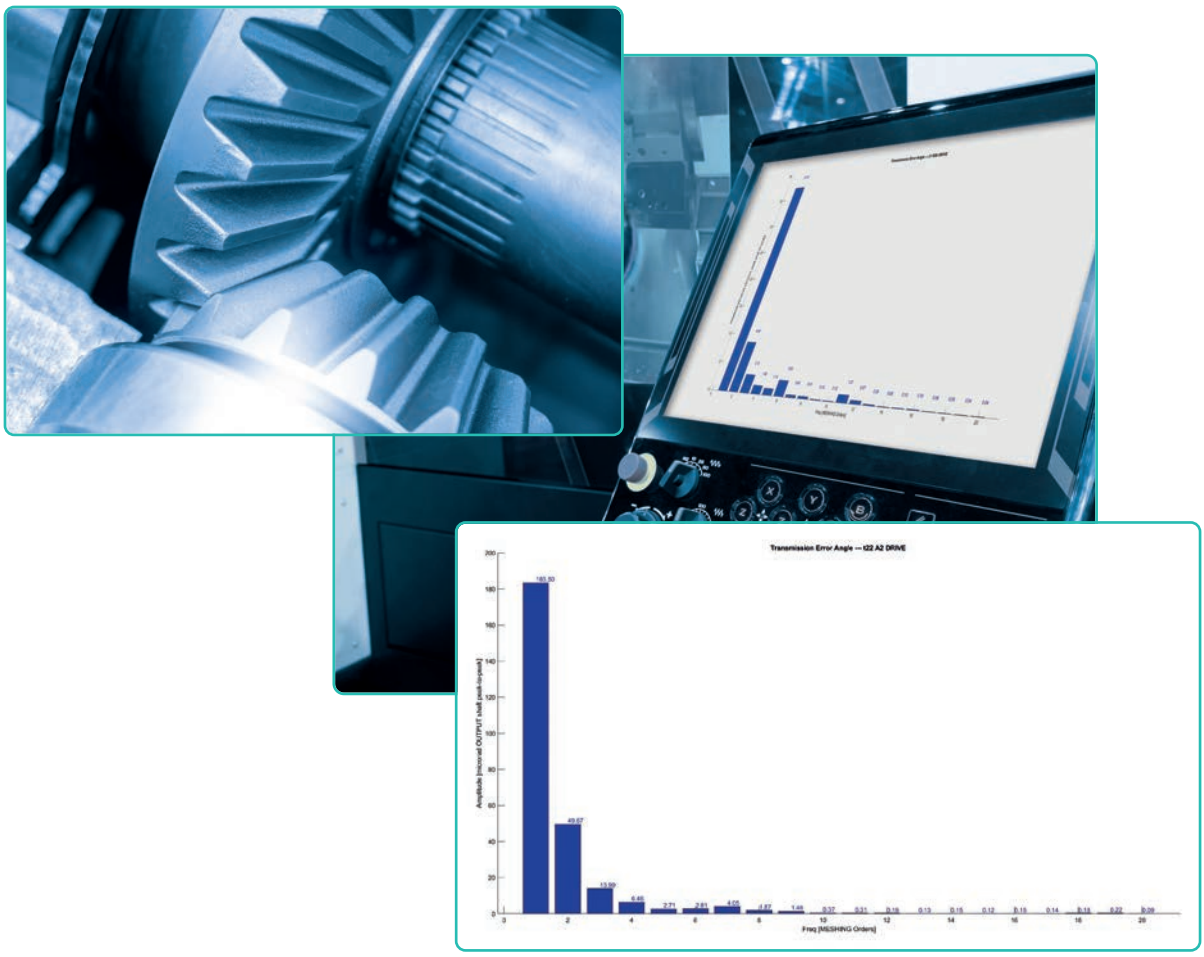
VMGears DM works continuously and automatically during the endurance test. Differently from a simple datalogger, which saves raw signal data which must be processed afterward, **VMGears DM** performs the analysis on-board and outputs the trend curve of each vibrational indicator.



End-of-line

TRGears

TRGears performs the Transmission Error measurement of gearboxes / gear pairs, by means of high-resolution encoders.

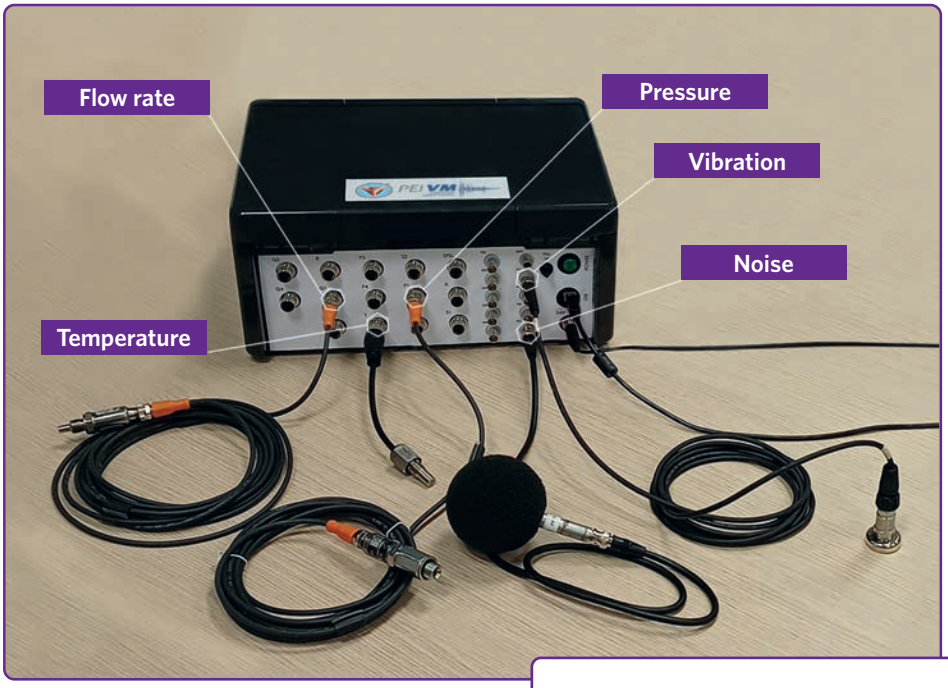


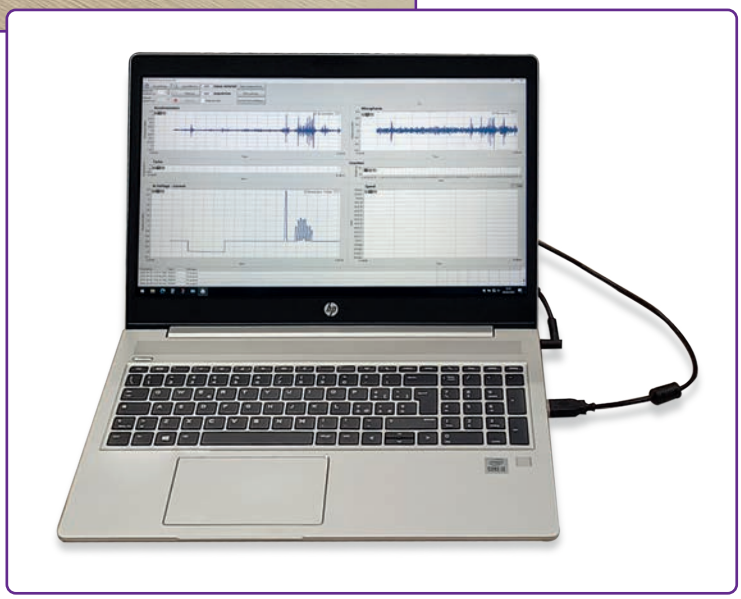
- Bevel gears represent one of the main sources of vibration in the gear transmissions: **TRGears** system can identify defects caused by the manufacturing process, before the gears are mounted inside the gearbox.
- **TRGears** processes synchronously the signals from two high-resolution encoders, mounted on input and output shaft of tester for gearboxes / gear pairs, and extracts the so-called "Transmission Error" (TE in brief).
- Malfunctions in teething processes like face milling or face hobbing result in the amplification of TE amplitudes in specific frequencies.
- **TRGears** system can be installed regardless of **VMGears** system. Bevel gears testers can be equipped with both systems in order to perform a complete product characterization.

Measurement & Testing

VM**Lab**

VMLab is a general-purpose data logger, with easy-to-use interface and compatible with SVT and VMGears.





- In order to measure physical variables such as temperatures, pressures, flow rates and correlate them to vibrations and noise, **PEI VM** has developed **VMLab** system.
- **VMLab** is a flexible and general-purpose data logger: hardware modules and software set-up can be configured by the user in function of the sensors required for each measurement.
- **VMLab** is the right tool for managing measurements on-site or in the Testing Room. Datafiles generated by **VMLab** can be analyzed by **PEI VM** software like **SVT** and **VMGears RD**.

Measurement & Testing

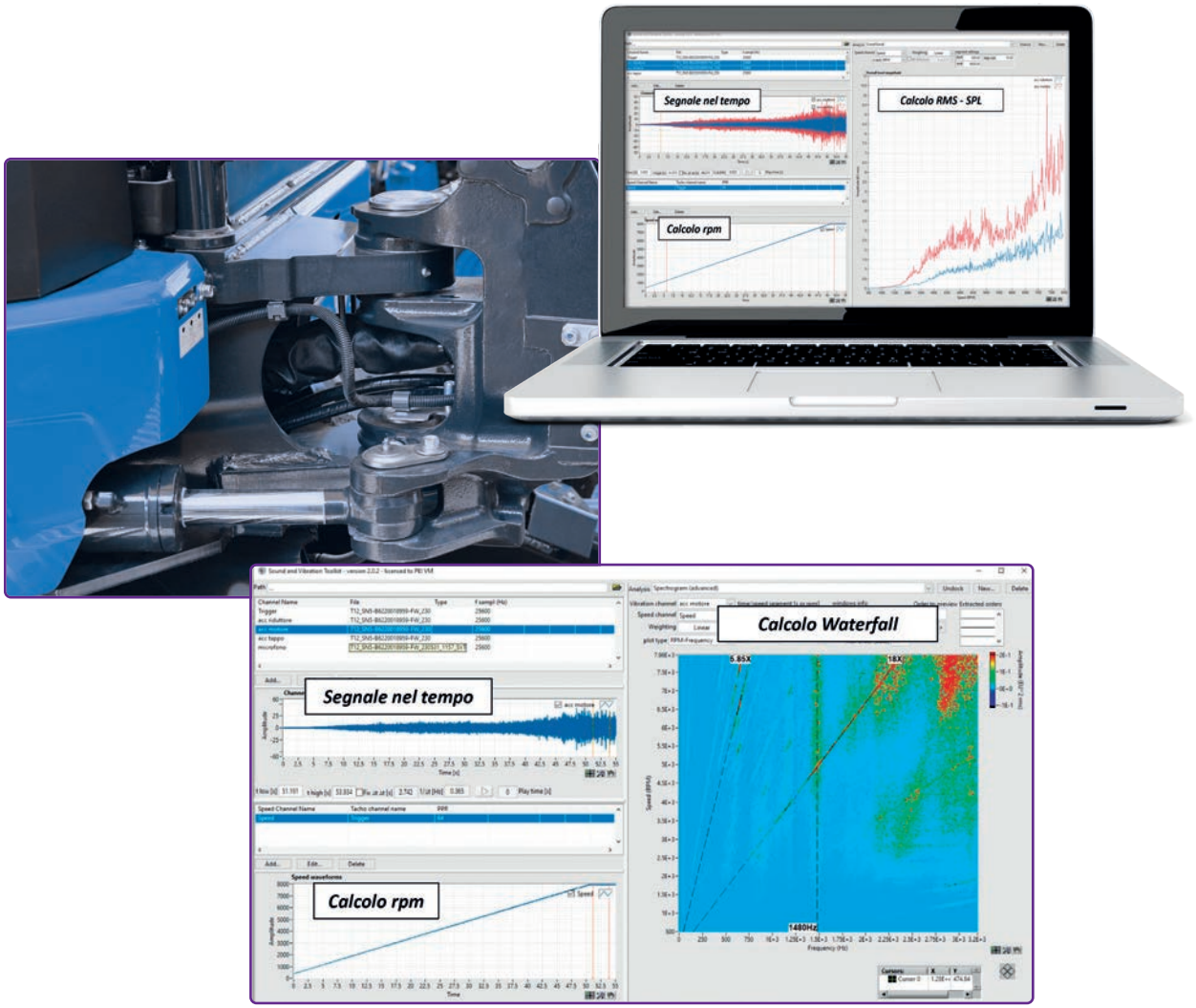
SVT

Sound & Vibration Toolkit

SVT is a general-purpose analyzer for dynamic signals.

- **SVT** is a general-purpose analyzer: measurements done by **VMLAB** or **VMGears** can be analyzed by **SVT**, regardless of signals type (pressures, temperatures, flows, vibrations, torques, sound pressures).

- Main functions: rms-dynamic analysis, octave band, envelope, FFT (on time-windowed signal), Waterfall/ Campbell analysis with different formats (rpm/frequency, time/frequency, order/frequency), Order-Cuts Extraction, simple setting / display of excitation orders, results export the results in text format, possibility to compare more measurements.



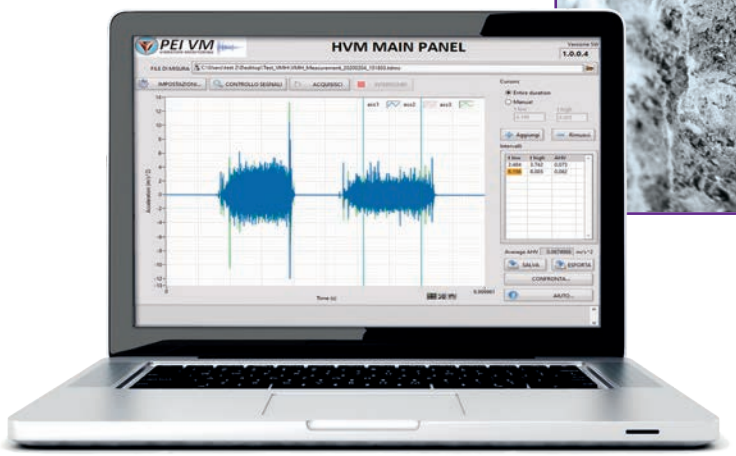
Measurement & Testing

HVM

Hand-Transmitted **V**ibration **M**onitoring

HVM is a system designed to homologate hand-held tools, by checking vibration level transmitted to human body.

- Tools as drills, screwdrivers and pressure washers, for example, transfer potentially harmful vibrations to the human body and therefore they must be necessarily homologated through a vibration measurement procedure regulated by ISO 5349 and ISO 2631.



Measurement & Testing

SPM

Sound **P**ower **M**odule

SPM is a system allowing Sound Power measurement according to ISO 3744 and ISO 3746 standards.

- Measurement configuration with 9 microphones (parallelepiped) or 20 microphones (hemisphere), accordingly to ISO methods. In addition, possibility to work with one microphone, moving it from point to point.

Measurement & Testing

ATB

ATB (Acoustic Test Bench) performs the measurement of Trasmission Loss and Backpressure of intake and exhaust systems for 2 or 4-wheels vehicles.

- The TL is an intrinsic feature of a muffler that describes how much the muffler can attenuate the Sound Power input from the engine. Depending on the design of the muffler, the attenuation of the noise is a function of frequency, therefore the TL is a key indicator for the correct design of the muffler.
- **ATB** software contains a feature to estimate the level of noise that a specific muffler would generate if installed on an engine with known excitations from experimental test analysis or models.
- The test bench can be equipped with additional modules to carry out other measurements, to achieve a complete characterization of the product:
  - PTB module, dedicated to Backpressure measurement
  - LTB module, dedicated to Leakage measurement.
- The **ATB** is a strategic tool for saving time and costs in R&D phase, because the tests for prototypes optimization can be done with plastic parts and without the need to mount the muffler on the vehicle.

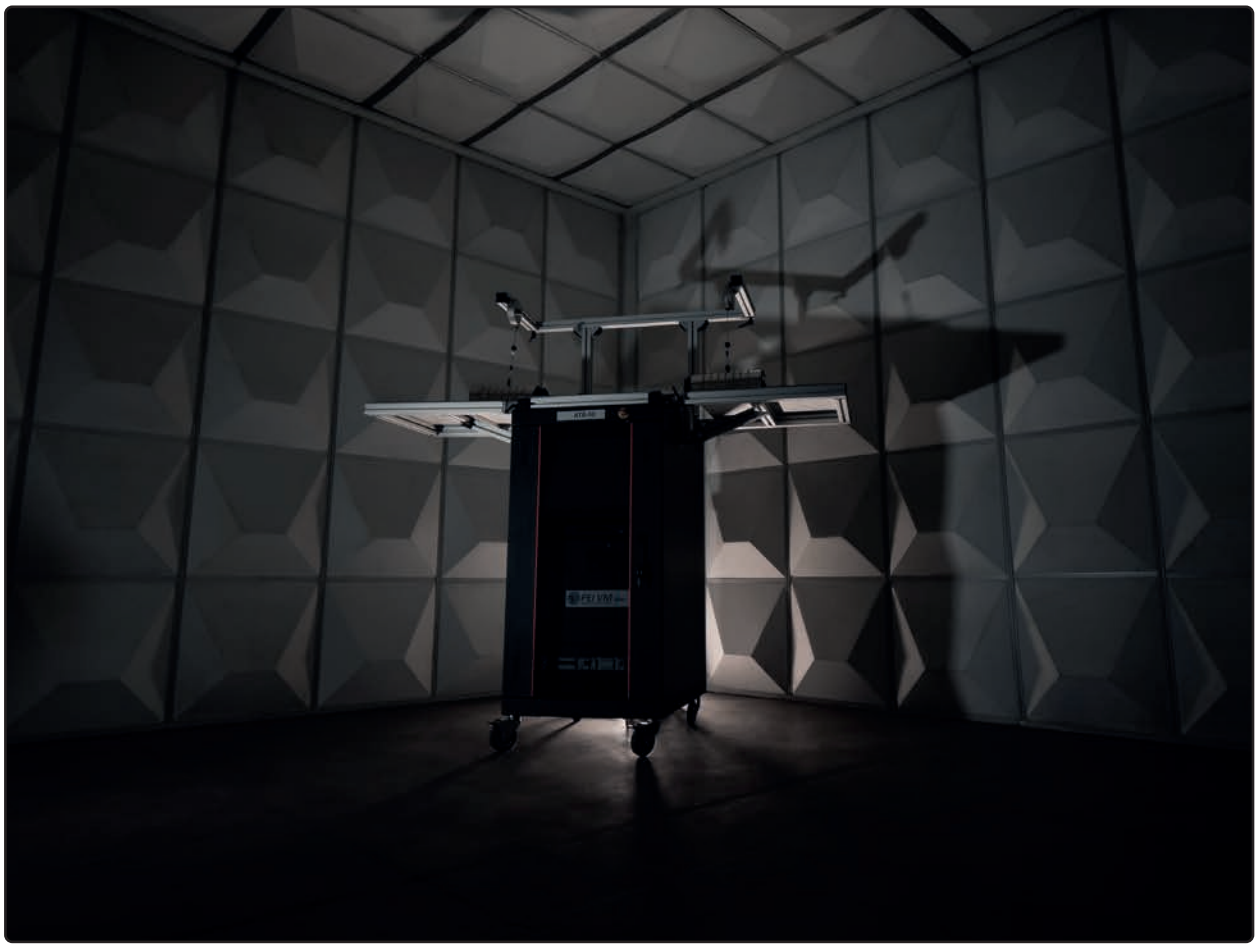
Measurement & Testing

TTB

TTB (Throttle-body Test Bench) is a dedicated throttle body flow meter for motorcycle and automotive applications.

- The **TTB** software automatically regulates the rotation frequency of the internal compressor to reach the required target of backpressure across the throttle, measuring the corresponding airflow, and checking if it's compliant with the expected target values.
- The results of each test are stored into a PostgreSQL database together with product code and serial number of the tested part. The Production Engineering dept can access to the database in order to run a statistical analysis of production.

Semi-Anechoic
chamber



PEI VM has a semi-anechoic chamber suitable for various types of test, in particular:

- Sound power measurements according to ISO 3744 / ISO 3746 standards.
- Measurements of correlation between vibration and noise (for problem solving).
- Measurements of correlation between combustion pressure and noise (for combustion engines).
- Measurements of prototypes comparison.
- Sound Attenuation measurements.

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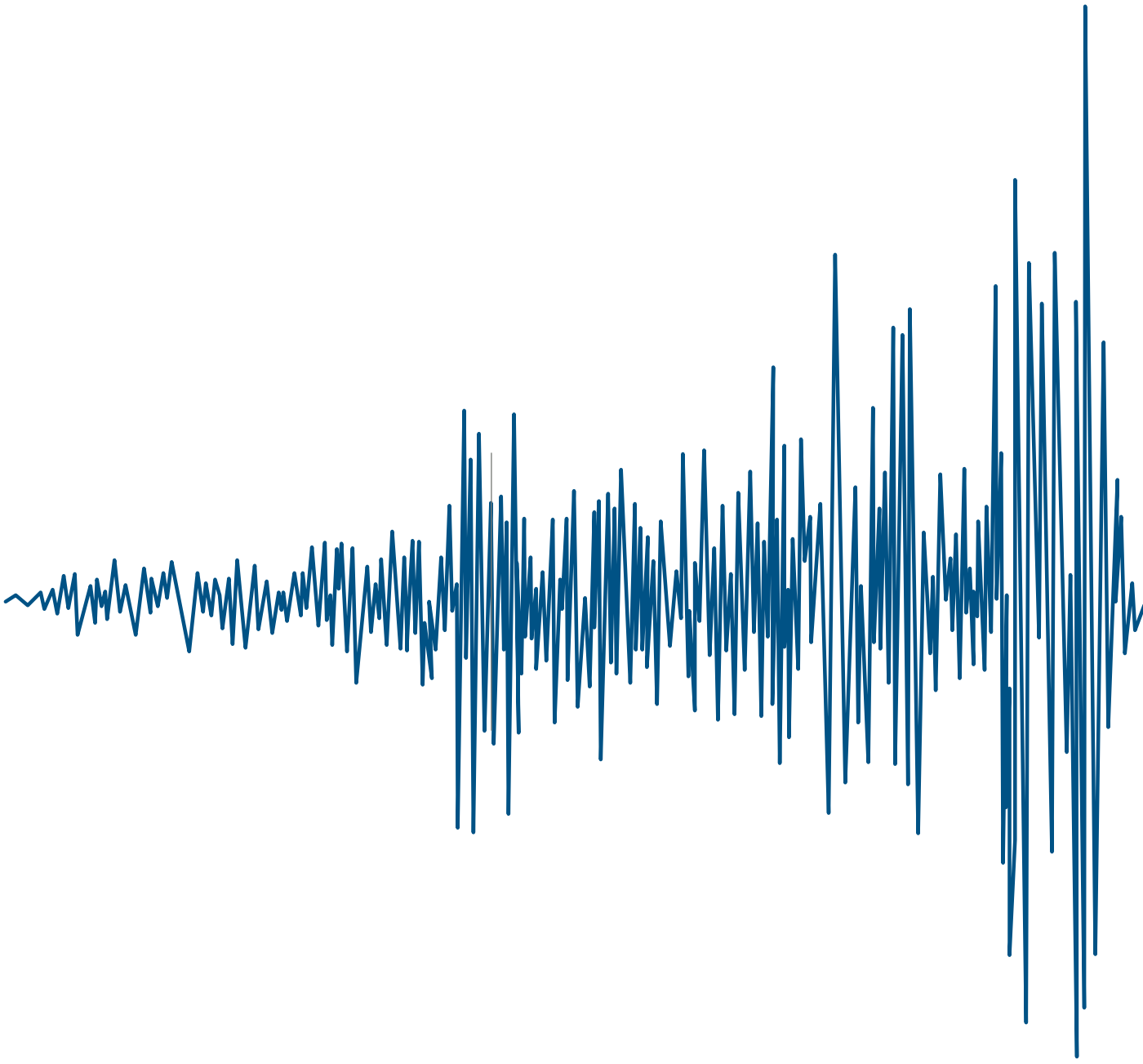

PEI VM srl
Via Fratelli Rosselli 11 - 40069 Zola Predosa (BOLOGNA) – Italy
Ph + 39 051 411 34 42 - Fax +39 051 411 74 31
info@peivm.it
www.peivm.it

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