NVHG-EAR

THE LEADING-EDGE TECHNOLOGY FOR GEAR NVH ANALYSIS

MARPOSS

Marposs NVH G-EAR tester offers what today gear manufacturers really need to complete their internal production quality inspection. With its solid and robust structure, the machine is capable to test gears under **high speed** and **torque** conditions to evaluate surface defects, machining distortions and noise behavior on the individual component prior to the assembly into the gearbox.
In general terms, the **Noise Vibration Harshness (NVH)** issue is identified as the method of investigating the vibro-acoustical behavior of mechanical components, either **individual** or **sub-assemblies**. This method of analysis is used to objectify the assessment of the vibrational behavior of mechanical groups, especially due to mechanical power transmission.
A combination of international regulations and consumer expectations is already driving since years the demand for reduced noise on all drivetrain components.
Further demand is driven by the growing trend towards electrification.
As a result, the drivetrains of hybrid (HEV) and full electric vehicles (EV) are facing many challenges, like increased requirements for NVH in high speed e-Drives and the need for performance improvements to deal with recuperation requirements.

In EVs and HEVs noise from ICE is intermittent or no longer present, and the contribution of transmission noise to overall vehicle noise becomes dominant. Noise has thus become not only a **mechanical issue** for the performance of the transmission, but also a **comfort issue** for the driver.

What is true is that the number of gear wheels is significantly reduced in electric vehicles due to the use of **one** or **two-speed reducers** instead of the classic manual, automatic or twin-clutch gearboxes. In return, these are loaded with **torque** and **rpm** not previously found in high-volume production.

SINGLE FLANK/NOISE TESTING OF INDIVIDUAL GEARS

Marposs NVH G-EAR tester, that works on the **Single Flank** testing principle of one master gear meshing with the component under inspection, is able to detect **macro-geometry** (nicks, runout etc.) and **micro-geometry** (gear mesh excitation, ghost orders) defects that are responsible of **gear whine** and **noise** phenomena.
The ability of achieving **high values** of **torque** and **rotational speed** and the possibility to adjust them at will during testing, is one of the major benefits of the application, which allows testing the gears at operating conditions almost comparable to those found in the final e-Drive.
A robust **granite** base frame to become non-sensitive to external interferences and disturbances and a highly configurable software make Marposs NVH gear tester at the forefront of technology in the sector, capable of correlating data with the **End Of Line** test rig.

WHY TESTING GEARS AT COMPONENT LEVEL?

Why evaluating NVH on component level could represent a benefit than making the analysis directly on the final assembly only?
Because identifying defects (like tooth micro-geometry errors) on the single component could avoid issues hard to solve at the assembly stage, when it might be too late to recover the whole assembly unit.
This represent an invaluable benefit in terms of time and money saved for our customers.

Moreover, the NVH test allows to identify defects on the gear flanks that are normally not detectable with the traditional production quality tests (Double Flank roll checkers, DOB/MdK measurements).

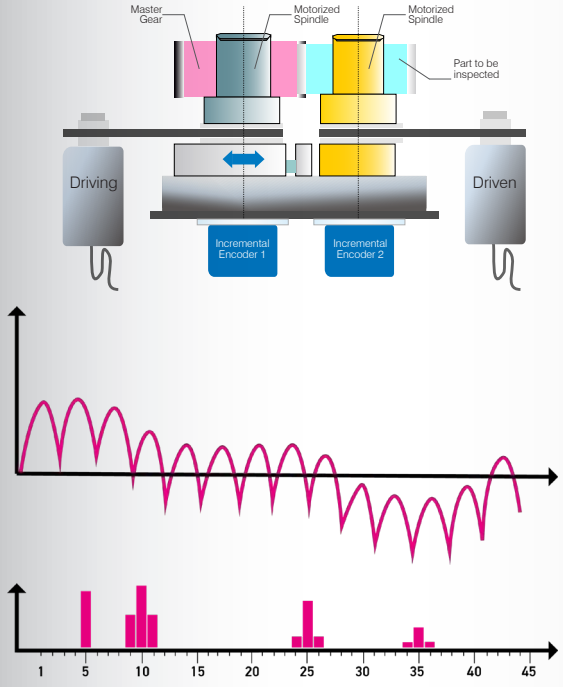
For instance, a gear that is machined inside the manufacturing tolerances and that passes the traditional measurements checks, may equally produce noise at certain frequencies in the gearbox. This event is also known as the **ripple** phenomenon, responsible of frequency orders whose amplitude exceeds the expected threshold (**ghost orders**). The ghost orders are due to micro-surface issues in the profile and lead directions of the gear flanks.

GENERAL MACHINE SPECIFICATIONS

PARAMETER	VALUE
Power Consumption	10 kW
Power Supply	50 Hz – 400 V (3+N)
Installed Power	50 kVA
Nominal Power	32 kVA
Nominal Current	50 A
Control Voltage	24 V (=)
Machine Footprint	3600 mm (L) x 2500 mm (W) x 2800 mm (H)
Loading Height	1127 mm
Measuring Sensors	1 Torsiometer 2 Incremental Encoders 1 Torsional Accelerometer (TAC)
Driving Torque	0 – 40 Nm
Part Rotating Speed	0 – 3000 rpm
Part Diameter Range	40 – 250 mm
Part Length Range	40 – 350 mm
Max Gear Width	70 mm
Center Distance Adjustable Range	100 – 200 mm
Master Gear Spindle - Adjustable Horizontal Position Range	80 mm
Part Load	Manual and/or Automatic

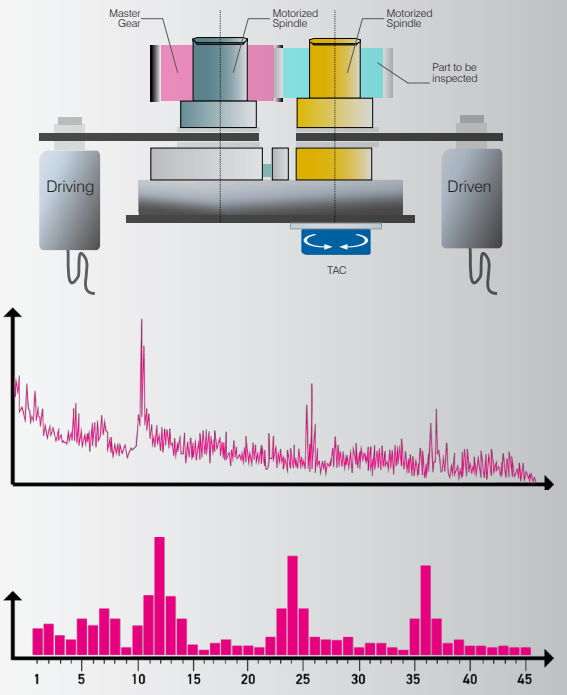
TESTING CONDITIONS

SINGLE FLANK TEST



Measurement at **low** speed (30 rpm)

TORSIONAL ACCELERATION TEST



Measurement at **high** speed (500 – 3000 rpm)
Measurement at constant speed – constant torque
Measurement at constant speed – ramp torque
Measurement at ramp speed – constant torque

The output parameter is the **angular acceleration** (rad/s^2) evaluated instantaneously and in the long run.

The signal of the sensor is elaborated to obtain the FFT spectrum to show the amplitude of the frequencies of vibrations.
The spectrum normally shows a range of frequencies related to the **gear meshing frequencies** and relevant **sidebands**, whose amplitude is usually related to the transmitted load. Unexpected high amplitude are related to ripple.

This type of peaks detected over the FFT spectrum of the gear may have different origins, but all of them are related to the manufacturing process.

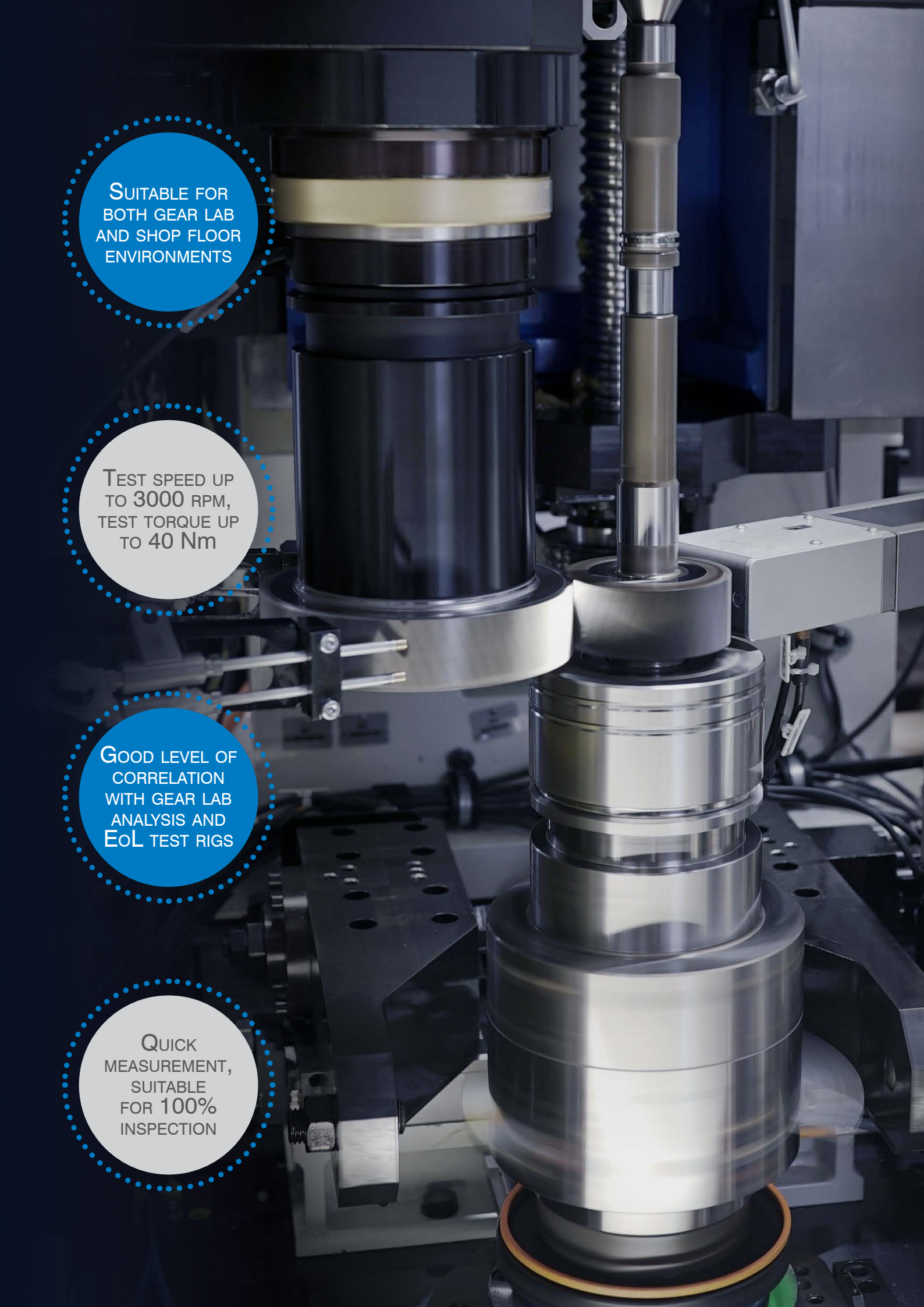
For example, there are different factors that can affect the correct execution of the grinding operation of the gear teeth, such as:

- Non good alignment of the spindle;
- Wear or damage of the spindle bearings;
- Non proper balancing of the grinding wheel;

contributing to increase some frequence amplitudes leading to noise and gear whine.

All of the above mentioned failures have a direct consequence on the gear surface finishing and can be detected by Marposs NVH G-EAR.


MARPOSS


Suitable for both gear lab and shop floor environments
Test speed up to 3000 rpm, test torque up to 40 Nm
Good level of correlation with gear lab analysis and EoL test rigs
Quick measurement, suitable for 100% inspection

QUICK CHANGEOVER

- Interchangeable expanding arbors (mechanic or hydraulic) for part clamping
- Interchangeable master gears
- Master gear position adjustable by NC slide
- New setting configuration selectable from the HMI

PROVEN ACCURACY

- High-precision hydraulic slides to ensure great mechanical precision
- High-precision expanding arbors with minimum level of eccentricity
- Granite base frame to ensure no influence from external disturbances
- Flywheels and elastic joints to decouple the measuring portion from the rest of the structure
- Standard deviation less than 1.2 dB over 30 measurement cycles

MODULAR DESIGN

- Base design suitable for both gear and shaft measurement
- Upper tailstock can be included as option upon request
- Design protect for automatic loading by robot/portal
- Integration of DMC reader, marking unit, conveyors, G/NG chutes can be added as options upon request

For a full list of address locations, please consult the Marposs official website

Marposs has an integrated system to manage the Company quality, the environment and safety, attested by ISO 9001, ISO 14001 and OHSAS 18001 certifications. Marposs has further been qualified EAQF 94 and has obtained the Q1-Award.