Quality assurance for engines and transmissions
Why engine / transmission end of line test?

- Quality control of production
- Quality proof for all manufactured test items
- Visualization of defects in assembly and production as well as error trends
- Cost reduction through targeted rework
- 100% objective final test according to DIN/ISO 9000 following

Finding noisy engines / transmissions through acoustical analysis is particularly important. The eol-ANALYSER developed by Reilhofer KG represents an all encompassing solution for quality assurance. Through statistical evaluation even errors are found that no one has yet thought of.

Function Principle:

The eol-ANALYSER determines automatically from the test items of a running production a structure-borne noise reference. Through the comparison with the actual test item it creates a deviation pattern. Using this changed pattern the eol-ANALYSER determines if the test item is OK or NOK. The Pattern recognition finally assigns the defective component and sends out a repair notice in clear text.
Quality Control with the eol-ANALYSER

- 100% reliable NOK detection
- short test times
- clear diagnostics
- objective, archive building
- self learning, self adjusting, patented
- transferable, reproducible
- user friendly
- no anechoic chamber necessary
- no obstruction to regular production
- low test torque
- pattern recognition
- gear shift verification

Field of application:

Transmissions:
Manual, automatic, double clutch and CVT. Transfer case and rear-axle transmission

Engines:
Inline, horizontally opposed, V, W, gasoline, natural gas, Diesel and hybrid engines

Components:
Hydraulic pumps, hydraulic motors, small transmissions, actuators and compressors

The eol-ANALYSER allows cost effective and precise Quality Control with small investment
Short test times

Current productions require very short test bench cycle times and not to increase by the eol-ANALYSER. With the eol-ANALYSER Reilhofer KG has developed a measuring system that delivers precise results in a very short time. The average test time is only 1,5 seconds and the measuring and evaluation of a complete transmission takes less than 21 seconds (without shifting and clamping times).

Clear diagnostics

The eol-ANALYSER produces a clear analysis with a result of OK or NOK. The measuring results from the test bench do not have to be evaluated by specialized personnel.

100% reliable NOK detection

Many years of commitment to well-known automobile manufacturers confirm that the acoustical measurements of the eol-ANALYSER detect all damaged test items precisely. Even faults not audible by ear, such as a missing pin in an idler gear bearing, are revealed by the eol-ANALYSER.

User friendly

The graphic user interface of the eol-ANALYSER shows all relevant data at a glance. Every gear and load step is clearly illustrated with its particular analysis as well as the NOK rate of the running production. Further details can be called up with a simple click. The context sensitive online help menu allows for easy information search. The menu is available in several languages.

Transferable, reproducible

The sensor of the eol-ANALYSER for the recording of structure-borne noise is permanently fixed on the test bench clamping plate and is directly in the sound path like in the car. The acoustic LASER is used if non contact measurements are necessary. The results obtained from the test bench are directly transferable to the situation in the vehicle.

Objective, archive building

Contrary to subjective testing, the eol-ANALYSER is completely objective and unaffected by any human “frame of mind”. Unlike selective testing, all produced items are tested. The established data of all test items are evaluated and archived in a database. Production processes are visualized and the quality is assured.

Graphic user interface at the test bench
Self learning, self adjusting, patented

No specializ trained personnel is necessary for the adjustment and operation of an eol-ANALYSER after its installation. The difference between OK and NOK test items is automatically found by the system. For new test items the test program creation is also carried out automatically. The number of different test item types for a test bench is arbitrary. The eol-ANALYSER automatically adjusts the tolerances to the running production, but also recognizes any gradual deviation. An algorithm developed at REILHOFER KG allows measurements of continually high quality over the years.

Low test torque

Noise measurement can be effected with very low input test torque. Test benches can be built smaller resulting in additional savings.

Pattern recognition

The integrated pattern recognition allows for fast quality improvement with its clear text display at the test bench. Previous tests can also be viewed.

No interference with the running production

The commissioning of the eol-ANALYSER can be carried out during a running production. It does not require a costly testphase with selected good and NOK test items. The running production is adequate.

Gear shift verification

The integrated GEAR SHIFT CHECK of the eol-ANALYSER allows the monitoring of the shift quality and detection of flawed shifts during the regular analysis of the structure-borne noise.

Non-contact vibration measurement with the acoustic LASER at the valve cover

Acoustical isolation of the test bench is not necessary

The eol-ANALYSER measures structure-borne noise meaning that third party machines and interference noise carried through air can not influence the measuring results.
How do engines / transmissions stand out acoustically?

- Gear defects (whine, whistle, knock)
- Faulty grinding
- Mixed up components
- Unbalance
- Design problems
- Overstepping component tolerances
- Transport, mounting and handling errors
- Variances in geometry
- Faulty parts
- Quality variations from part suppliers

What is the eol-ANALYSER capable of?

- Detects acoustically deviating and faulty test items
- Keeps records of the acoustical behaviour of each test item
- Recognizes the cause of faults
- Order and frequency analysis
- Save raw signals
- Time signal classification
- Absolute reference
- Pattern recognition
- Gear shift verification
- Automatic report generation
- Fixed boundaries
For which test is the eol-ANALYSER used?
The eol-ANALYSER is used in hot and cold tests for the verification of engines as well as in end-of-line tests for transmissions. With transmissions it has been proven advantageous to test both flanks of the teeth by measuring drive and coast conditions. The measuring of each flank takes only 1.5 seconds.

Ramp or constant velocity test, what is better?
Ramps can obtain very good results detecting periodic and non-periodic faults as well as revealing resonance effects. Constant condition tests detect periodic faults. Both tests are possible with the eol-ANALYSER.

What sensors are used with the eol-ANALYSER?
An accelerometer delivers well reproducible results with clamped test items. When the test item sits on a pallet or hangs from a transport carrier, then it is required to measure contact-free. The common laser vibrometer is not adequate as the surface roughness is too huge (see the prospectus of the acoustic LASER). For this reason REILHOFER KG has developed the acoustic LASER to measure contact-free.

Do threshold limits have to be set?
NO! If a test item type arrives at 3 a.m. nothing needs to be adjusted. The system is absolutely self learning.

Are there special system characteristics?
Self learning, self adjusting, patented Hunting Wavelet, pattern recognition Non-contact measurements with the acoustic LASER Web application (not an extra program) Integration of gear shift check Simply expandable (to customer specs)

Do errors have to be learned?
NO! The system is based on noticeable acoustical problems compared to the population, therefore it is not necessary to provide faulty samples.

Are YOU the first one to use the system?
NO! Worldwide there are hundreds of systems working 7 days a week and 24 hours a day.
Web based menu prompting

The eol-ANALYSER rests on the four pillars
- eol-config.NET,
- eol-CodeDefiniton.NET
- eol-Repair.NET
- eol-Evaluation.NET
All applications are operated via Internet Explorer. Over the company intranet the user can work and operate from the office.

Adjustments of data and all processes

• Only necessary with the first installation
• Simple language selection
• Data sheet generation for all settings
• Settings and changes from one test bench to all test benches simultaneously
• Logging of all settings and changes
• Simple and clearly structured: Explanations and help available for all settings
**Pattern recognition**

- Component group classification
- Fault recognition with pictures
- Repair orders with exact instruction to solve the problem

**Repair**

- User administration
- Direct access to measuring results with barcode scanner or input of serial number
- Exact repair instructions as per eol-CodeDefinition.NET

Input screen for pattern recognition

Screen for repair and login screen
Filter

- Implement particular filters for repeating runs
- Expand filters, generate new ones, or erase

Results

- Clear results
- Test bench / type / serial number / test time
- Number of tested items
- Overview OK / NOK
- Overview of loadsteps
- Quality index of individual processes
- Add comments
- Pattern recognition
- History of repair orders
- Individual test item analysis
- Report generation (pdf, xls, rtf, xps, jpg)
- Data export
Quality distribution statistics

Statistic

- OK / NOK distribution
- Distribution of quality
- Concentration diagram
- Waterfall
- Report generation (pdf, xls, rtf, xps, jpg)
- Data export

Configurable for:
- Total production
- Particular types
- Time duration
etc.

From the generation of the OK / NOK distribution to the report with only two clicks
Trend analysis for a loadstep of a type

Trend analysis / histogram

Type and loadstep for:
- Order
- Frequency
- Quality index
- Linesums

- Report generation (pdf, xls, rtf, xps, jpg)
- Data export

Production trend over 4 months
Network integration eol-ANALYSER / Server

The eol-ANALYSER can be used as stand alone system or as part of a network. It communicates with the test bench controller and sends data to the database. The quality of the production can thus be followed from the office desk.

Examples of faults: (Abridged)

- Balance shaft seized; mounted with offset
- Intake – exhaust valves crooked
- Chain tensioner spring shortened; broken
- Misfiring, engine cuts out
- Cylinder head noise (valve rattle)
- Hydraulic lifter empty / not able to push up
- Chain tensioner locking up; without oil feed
- Crankshaft unbalance
- Gear whine noise
- Gear wheel grind error
- Shaft bent, twisted
- Involute tooth error
- Bearing damage in transmission (twist, missing or damaged rolling elements, unbalance, spinning race)

- Air conditioning compressor, alternator, etc.
- Engine bearing damage (i.e. main and connecting rod bearing)
- Cam shaft bearing cover screw loose
- Contaminated oil passage
- Oil pump intake O-ring missing
- Scoring in cylinder bore
- Rocker arm misaligned
- Lifter bore too big
- Turbo charger defect
- Chain drive: defective sprocket
- Gear wheel damage; chain drive timing chain
- Cylinder head bearing support cracked
- Loose cam shaft; chatter marks; base circle, angle, bump (geometric failure)
- Difference between left hand drive and right hand drive engine
# Technical Specifications

## Measuring System:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal inputs</td>
<td>4 independent channels for acceleration and speed (8 optional)</td>
</tr>
<tr>
<td>Input sensitivity</td>
<td>± 1 mV - ±10 V</td>
</tr>
<tr>
<td>Input filtering</td>
<td>freely programmable active low pass filter; Bessel characteristics 8 pole; 48 dB / octave</td>
</tr>
<tr>
<td>Sensor voltage</td>
<td>5V / 15V / 24V DC und 24V / 4mA constant power for acceleration and rotation speed sensors</td>
</tr>
<tr>
<td>Digitalization</td>
<td>16 / 24 Bit</td>
</tr>
<tr>
<td>Sampling rate</td>
<td>freely programmable; max. 400 kHz</td>
</tr>
<tr>
<td>Main processor</td>
<td>Pariot 32 bit</td>
</tr>
<tr>
<td>Rotation sync. processor</td>
<td>PLD gate array; 204 Mhz, accepts 1 bis 4096 trigger pulses / rotation (max. 100 kHz / optional 200 kHz)</td>
</tr>
<tr>
<td>FFT processor</td>
<td>ADSP 32 / 40 bit</td>
</tr>
<tr>
<td>Dimensions</td>
<td>19&quot; slide-in module, 3RU, 110 / 230 Volt 50 / 60 Hz, 350 W</td>
</tr>
<tr>
<td></td>
<td>operating temp -10°C - + 55°C, IP 30, protection class I</td>
</tr>
</tbody>
</table>

## Signals / Data processing:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency and order analysis</td>
<td>512 – 262,144 lines freely programmable, realtime</td>
</tr>
<tr>
<td>Saving all data</td>
<td>SQL data base</td>
</tr>
</tbody>
</table>

## Visualization PC:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial PC</td>
<td>current tech., 19&quot; slide-in module, 4RU, 110 / 230V, 50 / 60 Hz, 350 W</td>
</tr>
<tr>
<td>PC software</td>
<td>WinXP Prof.</td>
</tr>
<tr>
<td>Communication</td>
<td>Link-up to test bench central computer, company network</td>
</tr>
</tbody>
</table>

## Controller / Communication:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>16 digital channels 24V / 5V DC</td>
</tr>
<tr>
<td></td>
<td>8 analog channels ±10V DC</td>
</tr>
<tr>
<td>Outputs</td>
<td>16 digital channels 24V / 5V DC</td>
</tr>
<tr>
<td></td>
<td>4 analog channels ±10V DC</td>
</tr>
<tr>
<td>Communication</td>
<td>Profibus DP, CAN, seriell</td>
</tr>
<tr>
<td>Ethernet</td>
<td>10 / 100 / 1000 Mbit/s</td>
</tr>
<tr>
<td>Optional</td>
<td>freely programmable mini PLC – controller</td>
</tr>
<tr>
<td></td>
<td>4 analog inputs 0 - 10V</td>
</tr>
<tr>
<td></td>
<td>8 digital inputs 24V DC</td>
</tr>
<tr>
<td></td>
<td>8 digital outputs 24V DC</td>
</tr>
<tr>
<td></td>
<td>arbitrary extension</td>
</tr>
</tbody>
</table>
References (Abridged):

ASTON MARTIN

AUDI

AMG

BMW

VOLKSWAGEN

WIA

TRANSFORMATION TECHNOLOGIES Corporation

HYUNDAI

FIAT

PORSCHE

SAAB

CHEVROLET

DYOMOS

YUCHAI

PSA PEUGEOT CITROEN

ZF

VISTEON

GETRAG

Mercedes-Benz

GETRAG FORD Transmissions

DETOUR DIESEL

OPEL

THIILEN Fein mechanik

Hightech for metal & plastic