



Overview

AS-Smart system is a flexible and customizable PC Based system for end-of-production quality control, based on dynamic (typically acoustics or vibrations) measurements.

High emitted noise - or high vibrations - very often means defective components; for this reason a careful measurement of vibrations or emitted noise can often identify defective components in a very effective and statistically accurate way.

This philosophy has been in the last years successfully applied on many different industrial products (electrical motors, valves, blades, fans, compressors, etc.), but it has been widely used especially for gearbox testing (reducers, axles, conic gears, complete automotive transmissions): in fact specific measurement techniques and algorithms have been developed in order to describe the gearbox structure and precisely identify bad gears.

The system - in a manual, semi-automated or completely automated process - is able to perform one or more multi-channel measurements on the tested component, analyze data, extract specific components, compare the current result with reference levels or masks, and provide a test result in terms of "Pass" or "Fail" (or "Warning" or "Out of Range", too).

The AS-Smart software environment is extremely flexible, in such a way that many different hardware solutions can be directly configured by the standard software interface.

Various type of transducers, like microphones, laser sensors, accelerometers, etc. can be directly conditioned.

An accurate RPM measurement (HW and software), allows very precise RPM-related analysis (i.e. synchronous acquisition for gearbox testing).

The system has a wide range of automation features, specifically developed in order to easily exchange informations with a PLC (digital lines, Ethernet, Profibus, serial, etc.) and to work with the maximum level of automation (i.e. bar code reading, semaphores, host communication, etc.): normally the system is intended to work without human intervention.

AS-Smart allows flexible configuration of a standard quality control test procedure, including automation process, tolerance management and database access.

The software has been carefully design in such a way that even unskilled people can interact with the system, easily select predefined test setup, run a test, check the test status, analyze data, extract relevant diagnostic informations, print test reports, etc., but - at the same time - the quality engineers and the R&D specialists, can access data in an advanced mode, and be able to configure different test procedures, tune the tolerance thresholds, make objective and subjective comparisons, make statistical analysis, analyze recordings with advances processing techniques.

The AS-Smart package is composed by four applications:

- **Utilities:** system configuration, test setup, data review and analysis, statistical processing, troubleshooting, RPM monitor, license management.
- **Test Execution:** standard test execution module, for measurement, tolerance check, data storage, etc. cycling in manual or automated mode, according with the system and test configurations.
- **Time History Processing (option):** comprehensive acquisition and analysis package for multichannel time history recording, real time processing, interactive data analysis in 2D and 3D format (spectrum vs time or RPM, order tracking, 1/3 octave analysis, Frequency Response Function, Coherence, etc.), playback to loudspeakers.
- **Playlist:** tool for comparing different recordings by listening (through loudspeakers), for an effective defect identification and subjective/objective correlation.

Test Execution is the only running application on the production line during normal operations: the other software modules are used for system configuration, data management, time history processing, listening, etc., and only skilled people will normally run them.

Hardware Specifications

AS-Smart can have a very large number of different configurations, depending on the specific test to be performed: in this paragraph only the most popular options are listed and described.

Please contact your local distributor or Aesse Misure srl directly, for technical details and for submitting specific request or needs.

System Components

- Transducers and Cables
- Analog&Digital Frontend
- Data Acquisition Board
- Personal Computer (standard or industrial)
- Accessories

Transducers

Many different type of transducers and accessories can be selected, on the basis of the specific test to be performed.

The most commonly used transducer is the accelerometer, which is very reliable and accurate. Mounting accessories are available on request.

Microphones are widely used as well: the need of some kind of acoustic insulation, very often limits the practical use of these sensors in quality control applications.

Other sensor can be connected as well: pressure sensors, laser vibrometers, load cells, torque sensors, etc.



- Example of installed quality control system (gearboxes) -

Acquisition Board

- PCI-447x: PCI 4 or 8 channels high performance dynamic acquisition board (24 bit, 120 dB dynamic range, 20 KHz bandwidth/channel, IEPE support)
- USB-923x: USB-2 , 4 channels dynamic acquisition board (portable) (24 bit, 100 dB dynamic range, 20 KHz bandwidth/channel, IEPE support).
- Cdaq modular platform (4-8 slots).
- Other hardware solutions and options are available for specific needs. Please contact Aesse Misure for details.

Hardware Options

- External Start Test Button (manual)
- External Semaphore (Result: Green=Good; Red= Fail)
- Bar Code Interface (Keyboard emulation or Serial)
- Profibus
- Ethernet communication.

Computer

- Desktop Computer (various models)
- Industrial Computer (various models)
- Notebook Computer.

Hardware (RAM, HD, graphic resolution, etc.) and software specification to be validated and confirmed by Aesse Misure, based on the application requirements.

Software Specifications

System Configuration

A dedicated utility allows setting up the system parameters, including all the hardware parameters, and the core SW parameters.

A secure access option (password protected), prevent unwanted modification of those parameters.

Main Parameters:

- Database Configuration (Local Station and remote Stations).
- System Parameters: HW Setting, digital lines, bar code configuration, Profibus, level and type of automation, automatic S/N Increment, Sound Card Config.
- Channel Table: HW Ch#, name, sensitivity, coupling, Voltage range, IEPE current supply, unit.
- Tachometer: hardware setting for RPM input: HW Ch#, trigger level, hysteresis, slope, pulse/rev, smoothing, spikes removal.
- Subjective Testing: a list of subjective judges can be created and activated here, in order to allow the operator to associate his own subjective judge (like "very good", "good", "fair", "bad", "very bad") to the objective measurements.
- Data logging configuration.
- S/N input mode (User prompt, autoincrement, bar code, serial, Profibus, TCP).
- Password protection.

Test Setup

The quality control process is typically made by a sequence of measurements - stages - (the simplest test is performed with just one measurement); each measurement is made while the component under test is operating at one specific stationary or transient condition: each measurement result will be compare with his own specific tolerances, and will produce one result like Pass/Fail; the final test result will be the combination of each stage result.

Many different tests can be created; usually one test identifies a certain "model" or lot.

For gearbox testing, the user configures the kinematic of the complete gearbox (number of tooth - Z_{in}/Z_{out} - of each gear pair, and how the gears are matched - pinion and crown - for each ratio): the system automatically calculates the speed of all the shafts, synchronizes the synchronous processing and automatically extract all the relevant order related results (order tracking and/or order spectrum) in a very accurate way.



Main settings:

- General parameters:
 - General Test identifiers
 - Number of Stages.
 - Test Start (manual, digital, etc.)
 - Frequency Response Function (Option)
 - Stage List:
 - Stage Name
 - Analysis: FFT Spectrum, 1/3 octave spectrum, Order analysis.
- Gearbox configuration: gear pair definition (name, Z_{in}/Z_{out})
- Specific Settings.
- Single Stage Configuration:
 - Processing Params (FFT resolution, Order Resolution, spectral windows, averaging type, triggering, time history preprocessing, etc.).
 - Max. measurement duration (sec.)
 - Stage Start (user prompt, digital, Profibus, etc.)
 - Measurement condition: stationary or transient; in case of transient the system calculate both order levels vs RPM, and order spectrum (avg or peak hold)

- Ramp mode: runpu or rundown.
- RPM range.
- Data storing options.
- Gear sets definition.
- Order Tracking setup (orders to extract + Overall)
- Tolerance Table.
- Graphic plots configuration.



- Tolerance Configuration Panel -

Standard Test Procedure

Following is a typical test procedure: however, many other combinations can be created.

- 1) Select current test or multiple test sequence (manually by operator or predefined and loaded at start)
- 2) Specify database header information's (by operator or automatically):
 - a) S/N detection:
 - i) automatic increment
 - ii) bar code
 - iii) profibus
 - b) Operator Code
 - c) Test Notes
 - d) Other database fields available.
- 3) Starting automatic test cycling (as specified in the Test Setup).
- 4) Start measurements:
 - a) Manual (Keyboard or Mouse)
 - b) From PLC (digital, Profibus, TCP, etc.)
 - c) On Condition (RPM, Level Trigger, etc.)
- 5) RPM Measurements:
 - a) Use nominal RPM
 - b) Measure current RPM (checking it against the nominal - expected - RPM).
- 6) Multichannel Dynamic Processing according to the Test Configuration: (FFT, Order Spectra, Order Levels, 3D spectrogram, 1/3 Octave Spectrum, etc.). Data display and storing.
- 7) Tolerance check according to the Tolerance Table configuration: the system automatically calculates several values (band Energy, Order Tracking component, gear defects, mask comparison, etc.). Each value is compared with one or more thresholds (Low, High, Warning and Fail) and generate one "single component result". One "stage result" is then generated as logical combination of all the "single tolerance" results.
- 8) Stage Result ("Pass", "Warning", "Fail", "Out of Range")
 - a) To Screen (Green, Yellow, Red, Purple indicator)
 - b) To Digital Line
 - c) To host (PLC)
- 9) Subjective Result: if activated, the operator is asked to associate to the current measurement, his subjective evaluation of the test item; the subjective result will be stored in the data Header, together with the test result (objective), for later statistical use.
- 10) Multiple graphic plots of the most relevant results (orders, spectra, etc.).
- 11) Data storing according to configuration.
- 12) Return to step 4, until the measurement sequence is completed.
- 13) Once the test sequence has been completed (or interrupted), a global "final" result is generated.



- Example of Test Exec user interface -

Additional Functions during test execution:

- HW or SW error detection.
- Single Step and Global Test result (logical AND)
- Show Single Component Tolerance Check
- Result Table: this table, reassuming all the test cycles (Test conditions, nominal and measured RPM, meas. RMS, test results), can be displayed, printed (also automatically) and/or stored at the end of the test.
- Messaging display and logging.
- Conditional data storing.

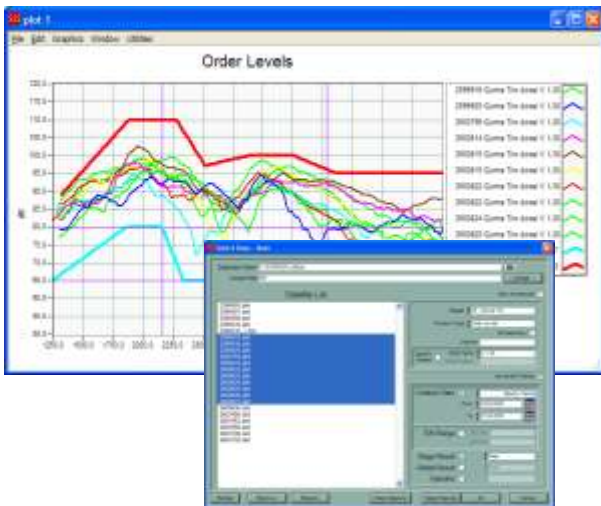
Data Review and Analysis

Single or multiple stored data can be recalled from the database and displayed in multiple graphic windows, for data analysis, statistics evaluation, mask and tolerance creation and modification, reporting, etc.

A structured database allows convenient and efficient data storing and retrieving.

Main functions:

- Database access: thanks to friendly user interface the user can easily select multiple data, based on test condition and filtering features (date, time, function type, stage number, test result, etc.).



- Graphic Plot and Data Selection form -

- Multiple graphic plots:
 - Multiple traces recall/overlay
 - Export to ASCII or EXCEL
- Extensive graphic features:
 - X and Y axis type and scaling with function specific default, user selectable.
 - Trace appearance settings (plot style - lines, steps, bars, plates -, color, width, default or custom legend)
 - Mask appearance settings
 - Multiple trace graph setting.

- Store and recall of complete graph configurations.
- Legend formatting
- Cursor
- Grid and background colors.
- Upper and lower mask creation and editing panel:
 - Mask creation (average, max, min +/- n-sigma or +/- %tol.)
 - Automatic adjustment (bandwidth, threshold)
 - Manual editing (set levels, interpolate, scale range, add offset)
 - Enter X, Y by table.
 - Store and recall masks.
 - Save mask as datafile.
 - Import from txt file.



Transducer Calibration and verification

A complete calibration utilities is available for calibrating accelerometers or microphones.

The calibration level is calculated based on a known signal (typically generated with a vibration or acoustic calibrator); the system checks stability and distortion of the calibration signal; the new EU/Volts calibration level - if accepted by the user - is automatically and permanently stored in the system configuration file (channel table)

Analyzer

This utility works like an oscilloscope, allowing the users to acquire and display dynamic input data.

Input voltage, frequency range and blocksize can be interactively adjusted.

The purpose of this utility is mainly for troubleshooting: the Time History Processing application is available if real time FFT features are requested.

RPM Monitor

A simple RPM display can be activated in order to display the current RPM value, mainly for troubleshooting.

The user can tune the triggering parameters and check immediately the effects on the RPM detection.

Oscilloscope mode or Chart Mode are available, together with the standard RPM display.



- RPM Monitor Panel -

Data Export

All data files can be exported in ASCII or EXCEL format.

Main functions:

- Multiple data selectin.
- Unique destination folder
- Multiple data export in a single table
- Choose export formats
- Export result table.

Tolerance Management

Tolerance Management is a very powerful tool specifically designed for the tolerance creation: once a certain tolerance has been configured, the user can apply such tolerance on a set of already acquired data (time history or analysis results), and statistically verify the level of correlation between the subjective judge - based on listening - and the calculated level.

The user can select different tolerance types:

- Spectrum mask

- Order tracking mask
- Spectrum component
- Order tracking component
- Frequency of Peak
- Amplitude modulation
- Frequency modulation
- Gear Defect
- Shock impulse

Each algorithm generates a value: such value is compared with user defined thresholds (lower, upper, between, outside) and the result is Pass or Fail. Of course multiple tolerances can be created and the Stage result is a logical OR of all the single tolerance results.

The Tolerance Management option provides various statistical tools:

- Tolerance check on time histories, analysis data, pre-stored tolerance tables.
- Pass/Fail Histogram
- Subjective result editing
- Subjective/objective statistics
- Tolerance trends
- Tolerance Import/Export
- Playback to Sound Card with filtering



- Component extraction report -

Plant Statistics

This utility allows the quality assurance engineers to keep under control the production quality in a multi-bench, multi test networked environment, analyzing large set of data (hundreds of thousands of tests) along time. Using this utility, for example, production drifts can be then early detected and corrected.

Playlist

This is a simple but effective utility which allows the user to listen - with loudspeakers or headphones - to different recordings, and quickly switch between them: this is very useful for an accurate subjective identification of the defects.

The output level to the sound card is controlled by the application for all the loaded recordings, so the listening is not affected by auto-adjustments of the output dynamics.

Filtering (Low-pass, high-pass, band-pass, band-stop) on playback is available as well.

Different Playlists can be saved or recalled.



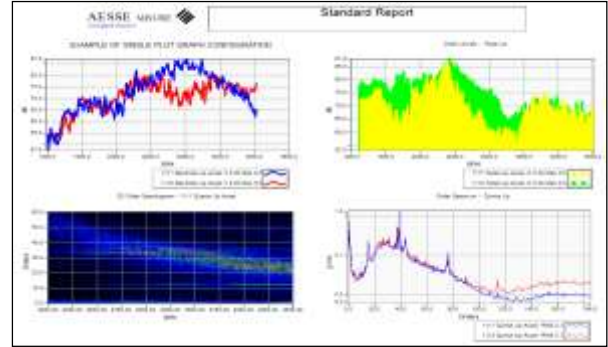
- Playlist Main Panel -

Reporting

A very flexible and powerful Reporting Utility allows the user to create multi-page and multi-plot/page reporting templates, in order to easily review, compare and print complex tests in standardized reporting formats.

Main features:

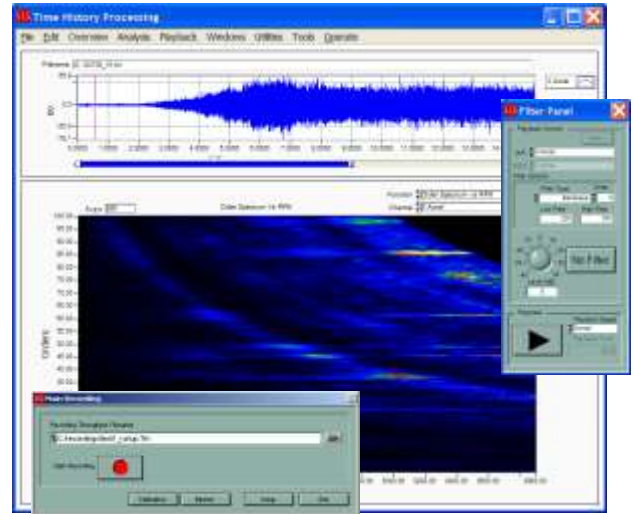
- Interactive or auto-print reporting multi-report processing.
- One Report/Test or Overlay Tests in a single report.
- Horizontal or vertical page orientation.
- 2, 4, 6, 8, 10 plot/page format, 2D or 3D fully customizable (size, positions, titles, etc.), with interactive and independent graphic setup, cursors, etc.



- Example of Report -

Time History Processing (Option)

This is a comprehensive application for data recording, real time FFT acquisition and time history postprocessing: it runs independently as a standalone software, but at the same time it's completely integrated - in terms of data exchange (time histories and analysis data) - with the AS Smart Quality Control software.



- Time History Processing - Playback and Recording Panels -

It's an extremely useful and convenient tool for deeper investigations about the noise and vibration emission, with extensive processing features (2D and 3D processing). Please read the specific data sheet for detailed information's.

Special customizations

Specific hardware and software solutions can be customized for special customer needs.

Please contact Aesse Misure s.r.l. for any information or for submitting specific QA inquires.

Aesse Misure s.r.l.

Via della Repubblica, 9 20090 Trezzano S/N (MI) Italy

Tel. +39-0245867186 - Fax +39-0245864091

Email: info@aessee-misure.it

Web: www.aessee-misure.it