Polytec

Silent Smooth Helpers

Vibro-acoustic Quality Control for Electric Engines

Application Note

Arçelik is a Turkish company manufacturing household equipment and entertainment electronics with a global sales network in more than 100 countries. To support their worldwide business, Arçelik has an impressive research and development department. Their production of electric motors requires acoustic tests and vibration measurements in order to cope with defined tolerances and to control the overall product quality, durability and functionality. Polytec vibrometers solve these measurement tasks with laser precision and high productivity, proving the advantages of this non-contact measurement technology.

1
Non-contact vibration measurement by laser light on electric motors for acoustic tests

High Throughput Production Testing of Electric Motors for Household Appliances

Maintenance-free Sensor System

The IVS Industrial Vibration Sensor by Polytec is particularly suitable for measuring in production environments. This optical sensor uses a laser beam (figure 1) as a measurement probe and has no external control elements. It is configured via the internal serial interface in order to avoid an accidental change of the settings during service and maintenance work.

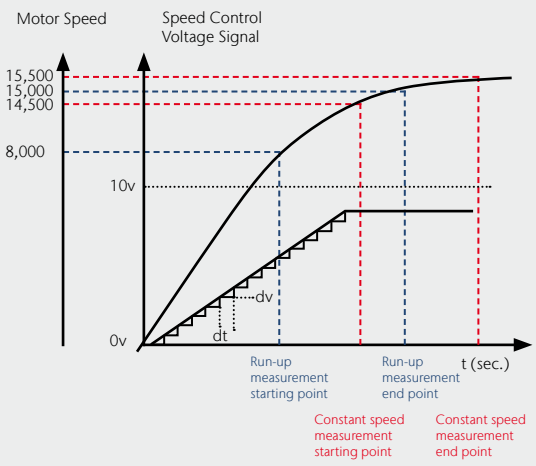
Other advantages of this optical measurement technology include:

- Simplified installation eliminates mechanical fixturing and direct contact with the test object
- Measurements in difficult to access regions thanks to a small laser spot
- Measure true vibration dynamics without additional mass-loading, unlike with accelerometers
- Laser immediately adapts to large and varying working-distances, e.g. for different test objects or different models

Customized Test Procedures

Two methods are predominantly used to test the motors: measuring during warm-up of the motor and/ or measuring at a constant RPM (figure 2). This means that a test bench must be designed to have flexible control of the motor speed, including acquisition and monitoring of the actual RPM on the motor under test. During the measurement, the structure-borne sound vibrations at the individual measurement points are recorded and then evaluated using software.

Depending on the test stand, the RPM is specified by setting a control voltage, for example by using a function generator without feedback, or by setting the motor speed directly and actively regulating it. In the first case, the actual motor speed must be measured using an encoder or an analog voltage which is proportional to the motor speed.



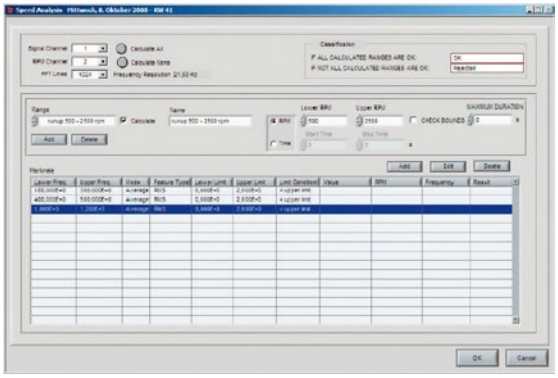
2
Time-speed diagram for the two different measurement procedures

The test procedure is controlled and evaluated using the Polytec test software QuickCheck. Its integrated function generator allows the setting of a trapeze shaped speed profile with an adjustable increase, an adjustable maximum voltage and a variable duration of the constant voltage. The measurement time is adjusted to correspond to the total duration of the measurement cycle. Alternatively, the measurement time is specified according to the production cycle and the motor speed profile is adjusted accordingly.

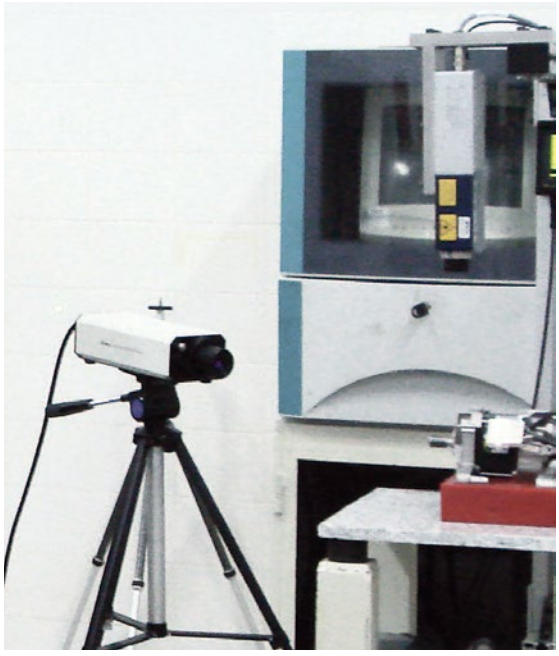
Together with the setting of the motor speed, the vibration signals are measured. The measurement data can be divided into sections on the basis of the motor speed specifications or the actual measured speed. A section can incorporate traversing the RPM range from 500 to 2,500 RPM or, as shown in figure 2, from 8,000 to 15,000 RPM. On the basis of the velocity signal, the software searches the relevant time domain and analyzes the vibration signals acquired in this range. This time signature can vary with every motor and arises out of its very own dynamic behavior.

When measuring at a constant speed, a specified time domain can be selected for the analysis. Setting and calculating characteristics can be done with the options described above. For off-line analyses, the measured time signals can be saved for subsequent order analysis.

All characteristics calculated in this way are shown in a table in the QuickCheck test software. For the tested motor to pass the test and move on to the next manufacturing step, all characteristics must be within their specified limits. The measurement values can easily be saved in a database with the time stamp of the measurement. QuickCheck also allows the serial number of every motor to be read by bar code or data-matrix code and the value can be saved with the corresponding measurement values. This is an extremely useful feature since it allows to trace the individual production and test results for each product at any given time.



3
Screenshot of the evaluation module in the QuickCheck test software



Efficient Evaluation

With QuickCheck, there is an evaluation model available for the test bench simplifying such tests and making them more user-friendly (figure 3). For this analysis, an RPM range is given initially. QuickCheck only analyzes the corresponding measurement data from the individual measurement channels in the relevant time section and then derives the spectrogram for this data using an adjustable block size. Various characteristics are calculated from this data and can be compared to specified limits (for example, the band energy or the peak value in the frequency range from 100 to 300 Hz). The software allows any number of characteristics to be calculated in an RPM range and any number of RPM ranges can be defined. These ranges can even overlap each other.

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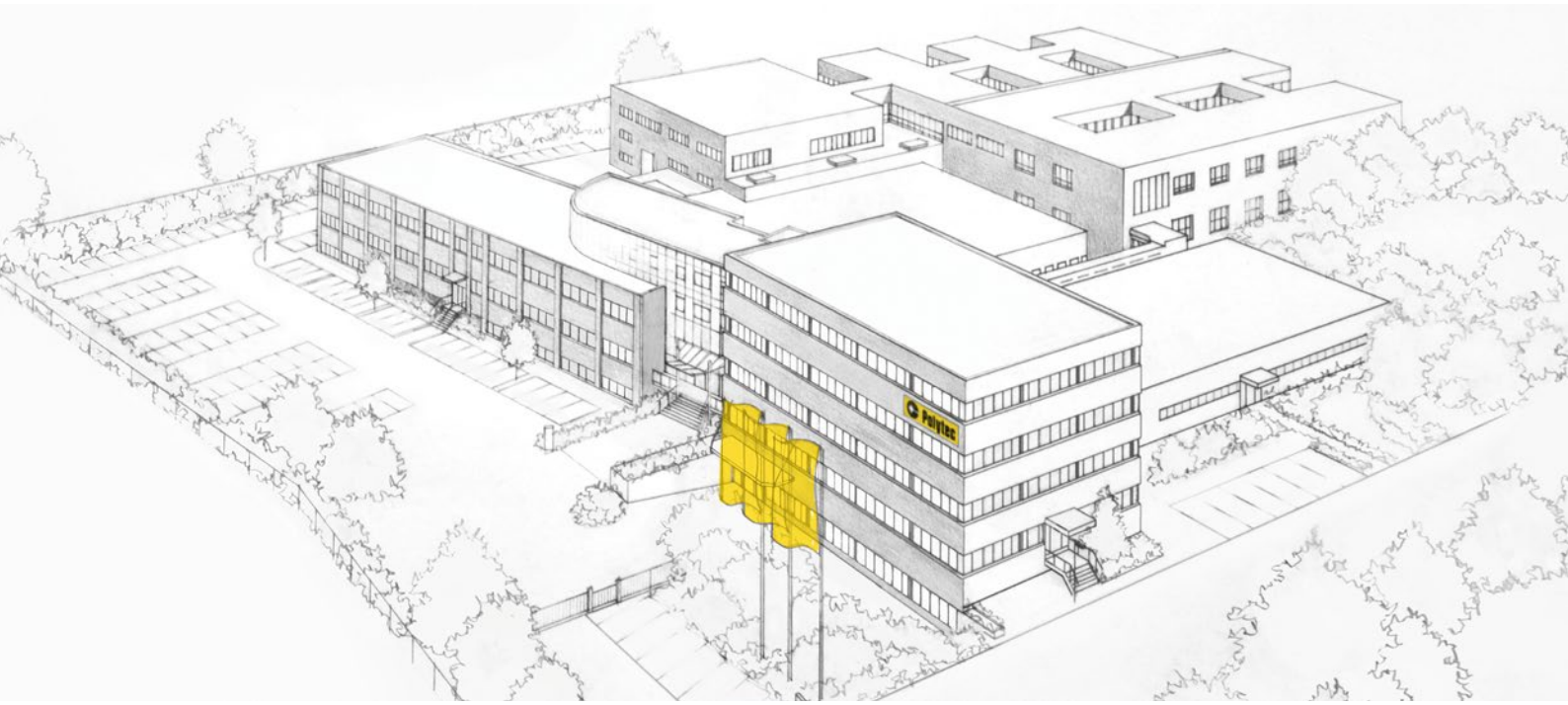
Source: Polytec InFocus



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