nanosystec
PRECISION AUTOMATION

NanoBalancer

Fine Balancing System with precise Laser Ablation

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Fine Balancing for New-Generation Workpieces

The fine balancing of miniature motors and impellers becomes more and more important. Several factors ask for this high precision, such as silent operation of the workpieces. In addition, imbalances lead to vibration and increase stress on the bearings which decreases the lifetime. Plus the miniaturization of the parts requires different processing methods which cannot be achieved with the traditional mechanical methods.

Non-Contact Processing with Laser Ablation

The NanoBalancer stations use industrial measurements systems to determine the imbalance of a rotor or impeller. This imbalance is measured regarding its mass and its angle to a reference mark. The NanoBalancer electronics acquires this information in order to generate the parameters for power and duration of the laser action at the correct position. The calculated mass is removed and the imbalance is corrected with high precision.

Typical work pieces include impellers for technical or medical equipment, air-driven turbines and small rotors of miniature motors.

The non-contact method avoids forces applied to the rotor. As the ablation takes place on the measurement set-up, there is no need to remove the workpiece for processing – a major improvement for the processing time. The ablated material is vaporized and extracted by a filter station. No particles impede the performance of the bearings compared to conventional drilling or milling methods.

The positioning of the laser beam is precise within a tolerance of 2 µm. As a result, the mass is ablated exactly at the correct position.

Interaction of Laser and Matter

Impellers and rotors consist of metal and/or plastics. These materials show different absorption characteristics for laser radiation. Therefore, NanoBalancer works with different laser sources.

For standard plastic parts, a CO_2 laser with a wavelength of 10.6 µm ablates the material with high reliability. The processing of impellers and rotors made of metals requires different lasers delivering pulses with high peak power. With such high peak power, the absorption becomes less important.

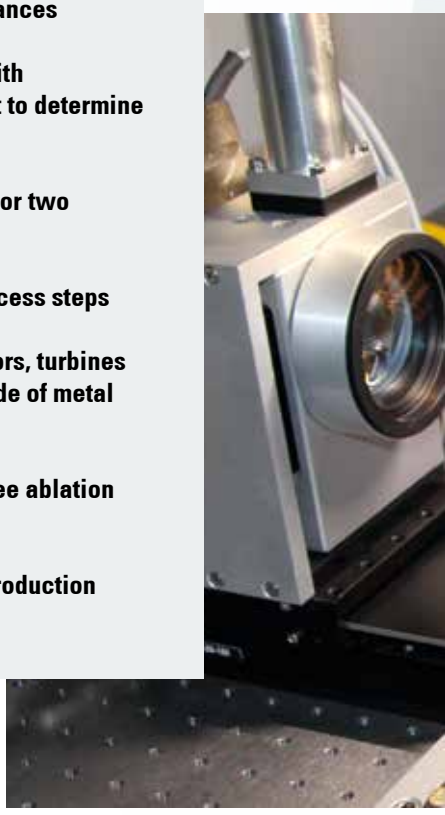
Typically, these laser emit at a wavelength around 1 µm, generate peak powers of 10 kW and higher with a pulse duration between 100 and 500 ns. Such lasers work with metals like aluminum, brass or steel.

Laser sources generating pulse durations in the picosecond or femtosecond regime reach even higher peak powers and work with every material as the absorption is no longer of importance.

The laser ablation process ensures high sensitivity. With the appropriate settings, masses in the range of sub micrograms will be removed.

Advantages of NanoBalancer

- **Precise ablation for correction of smallest imbalances**
- **Close coupling with measurement unit to determine imbalance**
- **Correction in one or two planes**
- **No additional process steps**
- **Processing of rotors, turbines and impellers made of metal and plastic**
- **Wear- and tear-free ablation process**
- **Integration into production lines**



Drives for the Rotor

The measurement speed during the balancing measurement should be close to the operational speed.

One method is a belt drive. However, attainable rotation speed is rather low and the belt touching the impeller generates a disturbing force.

An air jet as drive allows for substantially higher speed and increases the measurement sensitivity.

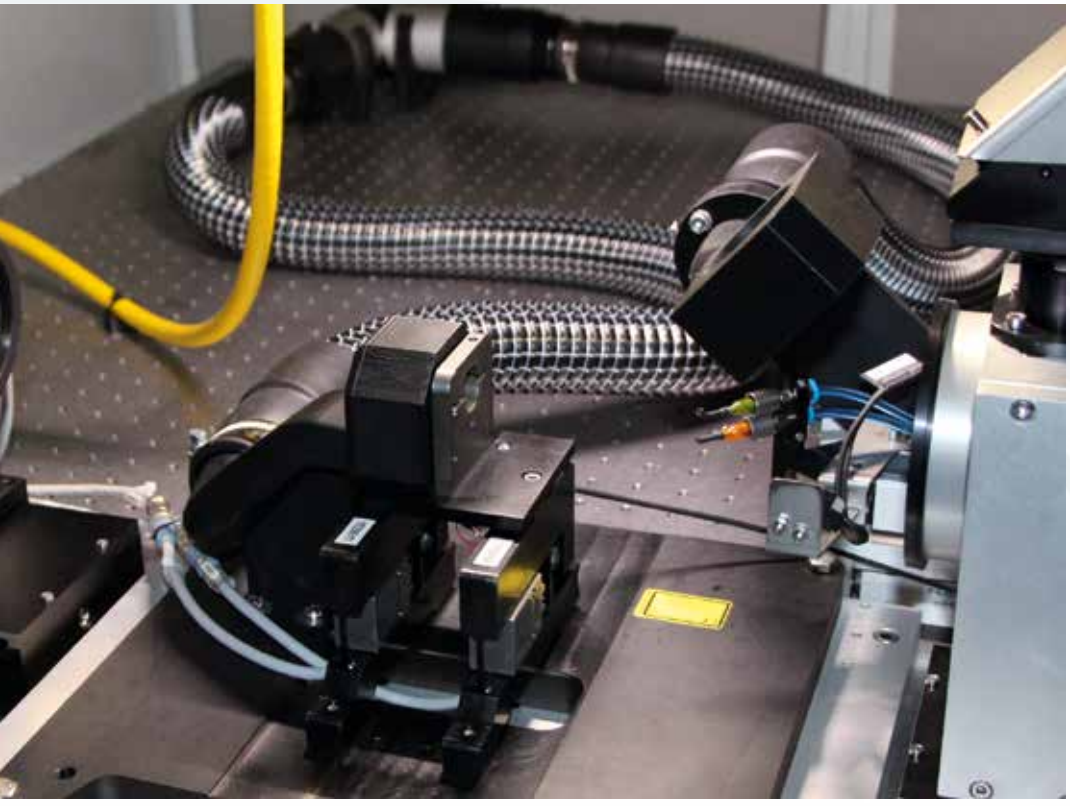
In many cases, the magnets of the rotor are already in place. In such applications, the stator with the coils is placed around or inside the rotor and the rotation follows the electrical field – ensuring fast start and stop ramps. In addition, the speed can be easily varied which is ideal during process development.

Balancing in one or two Planes

NanoBalancer corrects for imbalances in one or two planes. The measurement values are imported by the main electronics of NanoBalancer and the commands for the laser are generated.

Depending on the shape of the rotor, one or two laser sources are active. With two lasers, the simultaneous processing in the planes saves time.

Fixtures with quick loading mechanisms support the efficiency of NanoBalancer for manual loading processes.



NanoBalancer configuration with two different lasers for two plane balancing. Each laser beam is directed on the respective area of the impeller by a XY scanner with axial orientation of laser beams. The ablation in one plane impacts the imbalance in the other plane so that the amount of the ablated mass needs to be calculated carefully.

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Automation

NanoBalancer works as stand-alone system with manual or robot loading from device trays or it is integrated into automated production lines. For example, rotors can be transported by stop motion conveyor belts and NanoBalancer picks the devices from the belt and loads them into the measurement system. After balancing is finished, the workpieces are placed back onto the conveyor belt.

Alternatively, the rotors are presented on device trays, e. g. blister packs, an internal robot picks one rotor after the other and loads it onto the measurement station. After processing, it is loaded back to the tray.

NanoBalancer complies with the requirements for seamless integration. A large number of electrical and data interfaces facilitate the connection to higher hierarchy computer easily.

The production sequences and software generate all information for statistical process control.

NanoBalancer is a class 1 laser system and is built according to all relevant safety standards.

For higher volume operation, NanoBalancer uses a robot for loading and unloading of the parts. Depending on the system configuration, one robot supplies more than one balancing station. Parts are delivered with stop-motion belts or on device trays carrying multiple devices.

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