Optimum control of the grinding process thanks to reliable in-process measurement.
Your partner for measuring solutions

The Light & Production Division of Jenoptik is a global specialist in the optimization of manufacturing processes.

Our many years of experience and know-how in the field of industrial measurement technology and optical inspection, modern laser-based material processing and highly flexible robot-based automation enable us to develop tailor-made manufacturing solutions for our customers in automotive, aerospace, healthcare and other manufacturing industries.

As an experienced and reliable partner for high-precision, tactile and non-tactile production metrology, we support you with our global sales and services network. Depending on the requirements, our tactile, pneumatic and optical measuring systems take on a wide range of tasks for the inspection of surface and form as well as the determination of dimensions, throughout every phase of the production process including final inspection or in the metrology lab. Our systems provide you with precise measured data within the shortest time frames.

Movoline measuring solutions offer a wide field of applications for in-process measurement. Thanks to the continuous measurement of the workpieces during the actual grinding process in the working space of the machine, the grinding process can be controlled and optimized dependent on the measured parameters. Movoline solutions are also used in pre- and post-process measurements, for example for match grinding or for quality control.

Please scan for detailed Movoline information

<table>
<thead>
<tr>
<th>Parameters in-process</th>
<th>Parameters pre- or post-process</th>
<th>Successfully implemented worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Plain outer diameters</td>
<td>- Plain outer diameters</td>
<td>- Shafts</td>
</tr>
<tr>
<td>- Interrupted outer diameters</td>
<td>- Length</td>
<td>- Turbo chargers</td>
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<tr>
<td>- Inner diameters</td>
<td>- Concentricity</td>
<td>- Pistons</td>
</tr>
<tr>
<td>- Active and passive axial</td>
<td>- Interrupted outer diameters</td>
<td>- Injector components</td>
</tr>
<tr>
<td>positioning</td>
<td>- Radial run-out</td>
<td>- Hydraulic valves</td>
</tr>
<tr>
<td>- Length</td>
<td>- Conicity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Inner diameters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Roundness</td>
<td></td>
</tr>
</tbody>
</table>

Use for

- Cylindrical grinding
- Internal grinding
- Match grinding
- Flat grinding
Digital gauge heads with highest accuracy and large measuring ranges for diameters

Our standard gauge heads offer a wide measuring range for inner and outer diameters. With their compact design, high measuring precision and easy installation, the gauge heads are used for a wide range of applications. Measurement data is transmitted digitally and therefore fail-safe and independent of the cable length. We deliver accessories that are adapted to your measuring tasks, such as custom-designed gauge arms and gauge tips.

**Gauge heads for plain diameters**

- **DM200**
  - Workpiece diameter: 1 – 60\(^{11}\) mm
  - Measuring range: ±250 µm
  - Repeatability error: <0.1 µm
  - Gauging force: 1.3 N / ±10 %
  - Gauge arm lifting: yes
  - Crash protection: optional

- **DM400**
  - Workpiece diameter: 5 – 80\(^{11}\) mm
  - Measuring range: ±500 µm
  - Repeatability error: <0.2 µm
  - Gauging force: 1.5 N / ±20 %
  - Optional: yes

**Gauge heads for plain and interrupted diameters**

- **DM205**
  - Workpiece diameter: 1 – 60\(^{11}\) mm
  - Measuring range: ±500 µm
  - Repeatability error: <0.1 µm
  - Gauging force: 1.3 N / ±10 %
  - Gauge arm lifting: yes
  - Damping: yes
  - Crash protection: optional

- **DM405**
  - Workpiece diameter: 5 – 80\(^{11}\) mm
  - Measuring range: ±500 µm
  - Repeatability error: <0.2 µm
  - Gauging force: 1.5 N / ±20 %
  - Optional: yes

- **DU200**
  - Workpiece diameter: 4 – 80\(^{11}\) mm
  - Measuring range: ±500 µm
  - Repeatability error: <0.5 µm
  - Gauging force: 2 N / ±10 %
  - Crash protection: yes

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1) Larger measuring ranges available on request. – 2) Under standard conditions over 25 measurements. – 3) Limited measuring range for inner diameters.
Digital gauge heads

Gauge heads and slides for reliable and precise measurements

Gauge head for passive axial positioning and length measurements

Touch trigger probe for active positioning

<table>
<thead>
<tr>
<th>Feature</th>
<th>DP200</th>
<th>Sense directions</th>
<th>C25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>±2000 µm</td>
<td>±X, ±Y and -Z</td>
<td></td>
</tr>
<tr>
<td>Repeatability error 6s(^1)</td>
<td>&lt;0.3 µm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gauging force</td>
<td>1.5 N ±10 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gauge arm lifting(^2)</td>
<td>±2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damping</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crash protection</td>
<td>optional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reversion of probing direction</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Under standard conditions over 25 measurements. 2) Included in standard configuration.

Slides for optimal adaptation to your measuring task

High-precision slides with integrated damping guarantee secure movement of the gauge head to and from the workpiece. Depending on the requirements, slides are available in different versions and also with pneumatic technology on demand.

<table>
<thead>
<tr>
<th>Slides</th>
<th>Connection/supply</th>
<th>Stroke [in mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR260</td>
<td>hydraulic</td>
<td>5 – 100</td>
</tr>
<tr>
<td>DR275</td>
<td>hydraulic</td>
<td>110 – 157</td>
</tr>
</tbody>
</table>
Measurement control units for variable requirements

Movoline measurement control units offer a wide range of possible applications, in in-process as well as pre- or post-process measurements. The choice of the most suitable device depends on the measuring requirements and the machine.

ES124: the economy model for easy and reliable measurements
- 2 connectable gauge heads
- For diameter and length measurements
- Outputs:
  - 3-5 Relays
  - BCD signal
  - Optocoupler
  - RS232
- Models: table unit, rack-mounted ½ 19” or remote panel

ESZ400: integrated solution for highest demands
- 2 connectable gauge heads, extensible to 16
- For standard diameter and length measurements as well as custom-designed measuring tasks, for example cylinder correction
- Outputs:
  - Relays
  - BCD signal
  - Profibus
  - Optocoupler
  - RS232
- Models: rack-mounted ½ 19”

ES400: multifunctional control of demanding measurements
- 4 connectable gauge heads, extensible to 8
- For standard diameter and length measurements as well as custom-designed measuring tasks, for example cylinder correction
- Outputs:
  - Relays
  - BCD signal
  - Profibus
  - Optocoupler
  - RS232
- Models: table unit, rack-mounted 19” or remote panel
Integrated solution – operation via the machine control display

With the ESi140 and ESi440 measurement control units and the Windows based visualization software, operation and display of all measurement control functions are carried out directly via the graphical user interface of the grinding machine control – without additional displays or connecting cables.

Measurement control units ESi140 or ESi440
- For all digital Movoline gauge heads
- Maximum 8 (ESi140) or 16 (ESi440, depending on program) available measuring channels
- Software standard (ESi140) or custom-designed (ESi440)
- Integration into the machine control cabinet possible

Visualization software
- Allows operation and visualization of all measuring control functions via the display of the grinding machine control
- Configuration and display of measurement cycles as well as parametrization of digital gauge heads
- Windows based software for easy installation on the PC of the machine control
- Extensive diagnosis possibilities via Log files and system messages
- Assistance of service activities through import and export of software and configuration settings
- Simple operation via keyboard, softkeys, mouse or touchscreen in eleven languages
Process reliability even for complex measuring tasks

Measurement requirements

In-process measurement during grinding of a polygon workpiece holder according to ISO 26623-1:2008.

For example, the nominal value of the workpiece holder diameter is 32 – 100 mm with a polygon diameter of 22– 72 mm and a typical tolerance of 8 µm on the polygon diameter.

Movoline solution

- Active positioning of the workpiece after clamping in the grinding machine with the touch trigger probe C25 (not shown)
- Length positioning with the DP200 gauge head in order to identify the defined measurement position for determination of the diameter
- Measurement of the largest outer polygon diameter in reference to the face with a DM205 gauge head for interrupted outer diameters
- ES400 measurement control unit with custom-designed software

Optimum protection

The optional crash protection in form of a predetermined breaking point for the gauge arm offers effective protection against damages of gauge head, gauge arms or workpiece in case of collision, thus preventing machine shutdown times.
Increased productivity thanks to optimized measuring methods

Measurement requirements

Measurement of a pump gear with two diameters on the bearing surfaces and one diameter on the gear pinion as well as determination of the gear pinion width with a length measurement.

The admissible tolerance for diameters is typically 6 µm, for length 4 µm.

Movoline solution

- Measurement of plain outer diameters on the bearing surfaces with two DM200 gauge heads
- Measurement of the gear pinion with a DM205 gauge head for interrupted outer diameters
- Length measurement of the gear pinion with two gauge heads DP200 for passive axial positioning
- Integrated measurement control unit ESi140 for operation and visualization of the measurement process via the machine user interface

Smooth processes

The gauge arm lifting offers safe approach of the measurement position even with interrupted surfaces. Thanks to the electric motor operation, the gauge arm lifting can be controlled via the existing cable of the gauge head – further connections (e.g. pneumatic) are not necessary.
Fast adjustment to new workpieces for small batch series

Measurement requirements

In order to optimize the flexible production process for small batch series, different diameters from 18 to 44 mm have to be measured with one gauge head and low setup times. The tolerance allowed is 6 µm.

Movoline solution

- Two DU200 gauge heads with rotary knob for quick adjustment to new diameters, large measuring range as well as integrated crash protection
- Hydraulic slide, mounted on the machine table
- Measurement control as table unit or rack-mounted depending on the requirements

Flexible and quick adjustment

With the rotary knob you loosen the gauge arms of the DU200 gauge head in order to adjust them to new diameters. An additional mechanical zero adjustment is not necessary. This guarantees quick changes of workpieces, especially for small batch series.
Combined pre- and in-process measurements: match grinding

Measurement requirements

Match grinding of injector components: measurement of inner diameters of nozzle body and of outer diameters of nozzle needle with an admissible tolerance of 2 µm.

Movoline solution

Pre-process

– Pneumatic measurement of the inner diameter of the nozzle body on two levels with Jenoptik air tooling
– Tolerance range for inner diameter: 5 µm

In-process

– Determination of the corresponding outer diameter with two DM200 gauge heads
– The nozzle needle is grinded and controlled in-process according to the transmitted values from the pre-process measurement

Measurement control unit pre- and in-process

– ES400 for measurement control

According to the requirements: pneumatic or tactile pre-process measurements

Measurements in deep bores and on different levels are measured with pneumatic air tooling with typical measuring ranges from ±20 to ±60. Tactile gauge heads have a larger measuring range and offer economic solutions when measuring inner diameters on one level and whenever the roundness has to be determined.

Tactile gauge head for inner diameters and match grinding DI200

<table>
<thead>
<tr>
<th>Workpiece inner diameter</th>
<th>4 – 100 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>±100 µm</td>
</tr>
<tr>
<td>Repeatability error 6s¹</td>
<td>&lt; 0.2 µm</td>
</tr>
<tr>
<td>Gauging force</td>
<td>0.8 – 1.4 N</td>
</tr>
</tbody>
</table>

¹ Under standard conditions over 25 measurements.
Immediate control of the process step

Measurement requirements

Post-process measurement of turbo chargers in a loader operated measuring station with a cycle time of 8.5 seconds.

The admissible tolerance of for example two outer diameters is 3 µm, the one of the length is 50 µm.

Movoline solution

- Four DM200 gauge heads for outer diameters
- Creation of a reference axis for measurement of diameter and axial run-out with a tolerance of 30 µm on the wheel
- Length measurement with two DP200 gauge heads
- Gauge heads with pneumatic slide, as commonly used with loader operated measuring stations
- Optional crash protection DMprotect200 in order to reduce down times due to damages
- ESZ400 measurement control unit with custom-designed software
We support you worldwide.

Our qualified employees are available to assist you across the globe. We have subsidiaries and distribution partners in key industrial nations, meaning that we are always close by to offer you optimum support as a reliable partner.