Solutions for sensible balancing between dedicated and fully flexible gauge systems

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Brief Marposs presentation

- Marposs produces dimensional measuring systems for machine shop environment
- Two main application fields:
  - Measurements integrated in Machine Tool
  - Measurements off Machine Tool

Pre-process  |  Post-process  |  Final check, buy-off, Part grading
Marposs products

- Attribute gauges (go-no-go, masters etc.)
- Contact-electronic gauging
- Opto-electronic gauging
- Air-electronic gauging
- Non Destructive Testing
- Leak testing
- Sensors for Machine Tools
- Industrial PC & software for gauge applications, statistical process & quality control

Marposs provides complete systems and gauge components as well, to both End Users and Gauge Makers

At any automation level: manual, semi- or fully automatic systems
Marposs main facts

• Founded in 1952

• Consolidated turnover 240 M Euro

• Headquarters and main mfg. facility in Bentivoglio - Bologna Italy

• Worldwide presence with sales & service network plus local mfg. facilities - Nearly 1800 employees -

Close partnership with both end users and M/C Tool OEMs
The extreme basic models for gauging systems

Dedicated, single purpose multi-probe gauge

Single probe on CNC path - CMM -
### Pros & Cons

#### CMM’s
- **Pros**
  - Full flexibility
- **Cons**
  - Long cycle time
  - Skilled operator req’d
  - Limited ability to cope with harsh working surrounding
  - Limited ability to integrate into production automation
  - Higher cost

#### Dedicated gauges
- **Pros**
  - Short cycle time
  - Easy to use
  - Designed for harsh working surrounding
  - Easy integration into production automation with ancillary equipment (e.g. marking, sorting, additional quality checks)
  - Lower cost
- **Cons**
  - No flexibility
Examples of M/C shop environment effects

Part vibration on static measurements (e.g. basic dia check)
Marposs gauge systems always build a “closed” measurement chain on any transducer combination; potential vibrations do not affect the accuracy

Part vibration / displacement on dynamic cycles (e.g. runout check)
Marposs gauge systems acquire all transducers at the same time, hence no effect at all of potential vibrations / displacement or part shape errors
Examples of M/C shop gauge output & cycle times

6 cyl. In-line crankshaft

99 gauge transducers, 138 gauge parameters

25 sec. dynamic gauge cycle, plus laser marking for journal grading in 5 μm steps = total cycle 39 sec.
Examples of M/C shop gauge output & cycle times

Connecting Rod

23 gauge transducers, 28 gauge parameters (min. ID tolerance 12 \( \mu \text{m} \))

Additional weight measuring, opto-electronic surface check, part segregation in weight grades = floor-to-floor cycle time 5,4 sec.
Steps for re-tooling, re-configuration, adapted flexibility

1) Wide range gauge cell / 2) Ease of relocation

Basic gauge contact arrangement

1) Wide range gauge cell

Wide range configuration

Dovetail arrangement
for easy relocation / replacement of gauge calliper

Standard armset
for meas. range
~0.5 mm

Special armset
for meas. range
up to 5 mm
Typical wide range cell application for crankshaft

(Three gauge sections on the same main journal)

- Dovetail arrangement for easy relocation / replacement of the gauge calliper
- Special wide range armset to cover the full diameter variation, as required
- Small range armsets, aboard the wide range gauge system
- Roller for gauge contact / workpiece protection during gauge station introduction
Crankshaft M/C

Gauge structure main beam

Dovetail plate for pin follower support

Dovetail plate for main journal calliper support
Wide range calliper for main journal

Wide range calliper for pin journal, on pin follower mechanism

Wide range crankshaft M/C
3) Gauge plugs re-tooling within a given size range

Con-rod gauge plug with 8 gauge transducers

- Positive stop (plug nosepiece) for pivoting plate
- Transducer armset with finger and gauge contact, aboard pivoting plate

By replacing the nosepiece, the gauge cells are automatically re-located to the correct bore ID.
Gauge plugs re-tooling within a given size range (cont’d)

ID re-tooling range

Small End bore

Big End bore

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4) Full gauge station re-configuration within a given range of a component family - Disc brakes

- OD 178 - 400 mm
- ID 50 - 120 mm
- 7 - 40 mm
13 gauge transducers, 27 gauge parameters (min. tolerance 10 μm on Disc Thickness Variation)

25 sec. dynamic gauge cycle
Full gauge station re-configuration within a given range of a component family - disc brakes (cont’d)

- Gauge station ready for part loading
- Pivoting part drive ass’y
- Rear gauge assembly, retracted backwards
- Lower gauge assembly, stationary
- Adjustable drive finger for part rotation
- Rear gauge assembly advanced
- Gauge station ready to start gauge cycle
Full gauge station re-configuration within a given range of a component family - disc brakes (cont’d)

Lower gauge assembly

- Recombing tapered nosepiece for part centering (dedicated to a specific ID range)
- Interchangeable reference ring for location of “hat” inner bottom face
- Spacer for quick height change over
- Screw spindle for precise height adjustment
- Screw spindle for precise radial adjustment of ID gauge contacts
- Scales to visualize radial or height adjustment
5) Full protection for additional, still undefined, part types within a component family - Cylinder heads

Gauge station for determination of tappet thickness on engine assembly line

5-axis robot picks the gauge assembly and loads it to the engine cylinder head(s)

Palletized engine conveyor line

Free space for further gauge assemblies (future engine derivatives)

Engine is indexed in the gauge station

Gauge assembly in parking position

Gauge setting masters (min - max)
Gauge station for determination of tappet thickness on engine assembly line
6) 2-D flexibility for shaft-like parts - OPTO GAUGING

“Shadow casting principle”
Contact gauge assembly on NC pivot arm, to measure lateral runout and Z distances on specific points

Opto gauge head (200 mm range), aboard upper Z slide
Thank you very much for your kind attention