Automated monitoring of the welding process

Inline – during welding

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Process monitoring during welding

Fulfills different tasks:

- Measuring device
  - Generates measuring and process instructions
  - Controls parameters and detect tolerance exceedings
  - Assists during setting up the process
  - Accounting, calculation and review of welding tasks
  - Documentation of welding parameters during product lifetime
  - Verification of the compliance of parameter values limits
  - Automation, monitoring and sorting faulty welded parts
  - Analysis of the welding process
  - Development of new process variants
  - Calibration of sensors and welding machines

Specific requirements demand custom-tailored solutions
HKS-Products are:

✓ independent from the used welding equipment
✓ easy to operate
✓ robust for harsh industrial environments
✓ optimal tailored for different welding processes

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WELDQAS – Quality Assurance System

Documentation

Monitoring

Fault detection

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WELDQAS – What’s that?

automatic
- Welding observer
- Inspector
- Recorder

For arc welding processes MIG/MAG, TIG, SAW, Plasma

„inline“ weld data registration during welding

- without additional mountings to the welding torch
- excellent fault detection

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WELDQAS — Principle of Operation

Seam fault

Resulting difference in welding parameters

- Measuring welding parameters with 23 kHz (up to 234 kHz for stud welding)
- Signal processor based compression of measured values to welding parameters via intelligent algorithms
- Comparison with reference curves (time-sensitive reference values) during welding
- Calculating quality marks for each seam

➢ Instant notification when a bad welding occurs

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Data acquisition sensors

Welding current

Welding voltage
Data acquisition sensors

Wire feed

Gas flow

stationary

mobile

submerge

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Data acquisition sensors

various other physical values, for example

- Welding speed
- Temperature
- Distance
- Force

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WELDQAS – Versions

1. Compact version
   Standard device for monitoring up to two welding torches

2. Cabinet version
   Systems for complex plants
   - More than two welding torches
   - Multiple submerge arc torches
   - Endless profile mills

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Dynamic Process analysis
Detecting porosities by current and voltage

Monitoring by online-arc analysis

Dismantle in mass transfer phase
Phase accurate state analysis based on arc-welding model
Characteristic parameter

- Porosities
- Burn-through
- Wire jam
- Arc jam

Synchronised signals U, I
Current profile, short circuit
Dynamic Process analysis //
Detecting irregularities by current and voltage

detectable irregularities
- Porosities
- Seam length
- Seam interruption
- Burn-through

OK seam
- 5.54 mm

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Dynamic Process analysis
Detecting irregularities // Burn-trough

Process parameters over the time
Dynamic Process analysis
Detecting irregularities // Wire jam

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schweißstrom [A]</td>
<td></td>
</tr>
<tr>
<td>Schweißspannung [V]</td>
<td></td>
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<tr>
<td>LB-Fehler</td>
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<tr>
<td>Durchbrand</td>
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<tr>
<td>Drahtstörung</td>
<td></td>
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<tr>
<td>Porosität</td>
<td></td>
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</tbody>
</table>

Process parameters over the time
Dynamic Process analysis
Detecting irregularities // Porosities

Process parameters over the time
Arc ignition fault leads to timing differences. This differences exceed the respective tolerance band.

Arc ignition fault leads mostly to rework (approximately once per shift)

Arc ignition faults were always detected by the WeldQAS
Application – Monitoring MAG Welding – Track control arm

MAG Welding
Welding current: 270 A
Welding speed: 100 cm/min
3 mm in 0.18 sec.

180 ms to detect irregularities, a high dynamic resolution is mandatory

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Application laser soldering / Plasma welding

Monitored parameters

• Laser power
• Wire feed
• Heating current (hot wire)
• Heating voltage (hot wire)
• Joint position
• Focus position
• Welding current (Plasmatron)
• Welding voltage (Plasmatron)
• Gas flow (Plasmatron)
Application – Resistance welding

Monitored parameters:
- Current
- Voltage
- Force
- Energy
- Resistance
- Power
- Distance
Application – MAG welding - Torque converter

Porosity caused by oxygen containment

- Change in short circuit dynamic
- Current and voltage, averaged
Monitoring system detects lack of fusion
welding monitoring - automotive
monitoring during stud welding
some references

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Thank you for your attention

"Meine Schweißnaht scheint doch zu halten!"
(Epper, Halle-Saale)