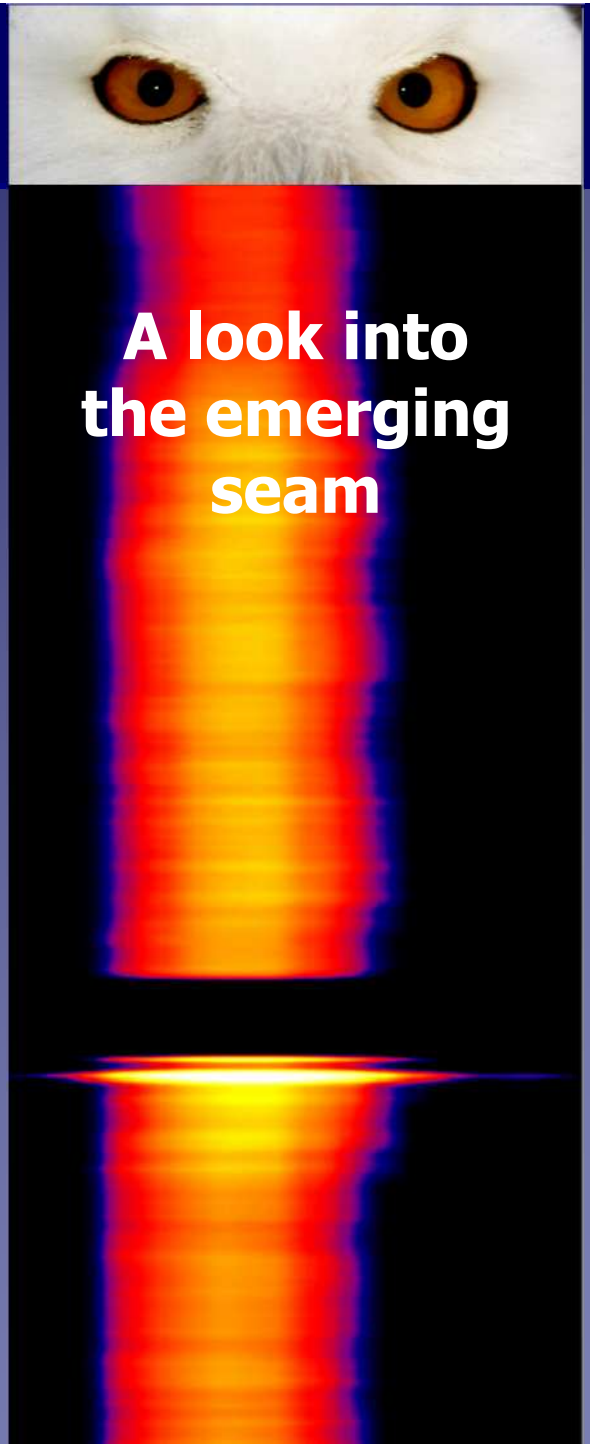
Thermo Profil Scanner



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The view *through the arc* into the heat signature

Local heat input is melting and is changing the structure of materials during brazing and welding processes.

The correct heat input and also the undisturbed heat distribution is an important attribute for the evaluation of welding seams.

The human eye can not see heat radiation. The glare of the visible part of an arc is so intense, it will cover up any heat information.

Herefor technology is required that can capture the heat information in spite of:
- Massive glare of the arc
- Fumes and spatter contaminated environment

permanently.

HKS is introducing a device , that fulfills these requirements

ThermoProfilScanner (TPS)

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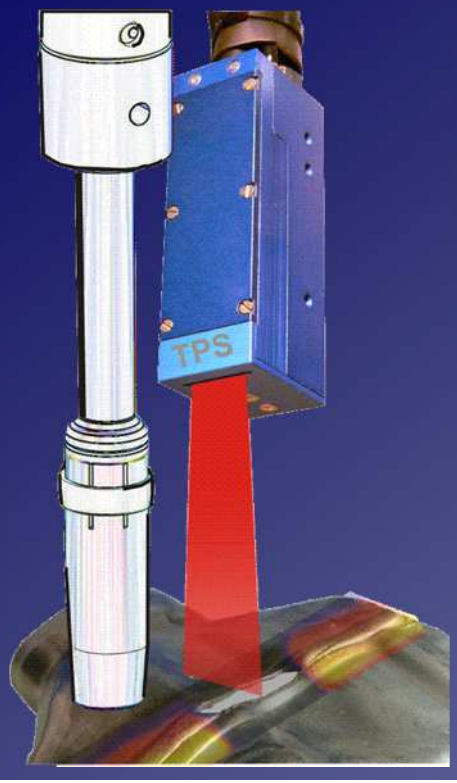
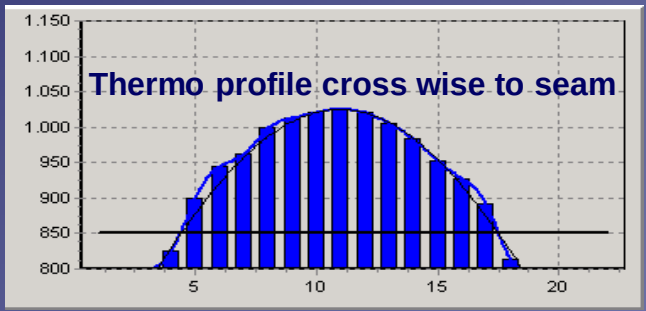
Principle of operation ThermoProfilScanner





The Thermoprofilscanner is constantly capturing a thermo profile **across the welding seam.**

Hereby it is able to fade out the visible light from the arc. A heat image of the welding seam is created by the continues movement of the welding torch.

Technical data:

- Work distance 15 to 120 mm
- Scan frequency < 400 Profiles/s allowing a resolution of better than 1 mm by speeds up to 20 m/min.
- Advanced design features allow
  Indefinite operation very close to torch:

  - ✓ Glass free design
  - ✓ Gas curtain
  - ✓ Anti spatter concept
  - ✓ Integrated water cooling

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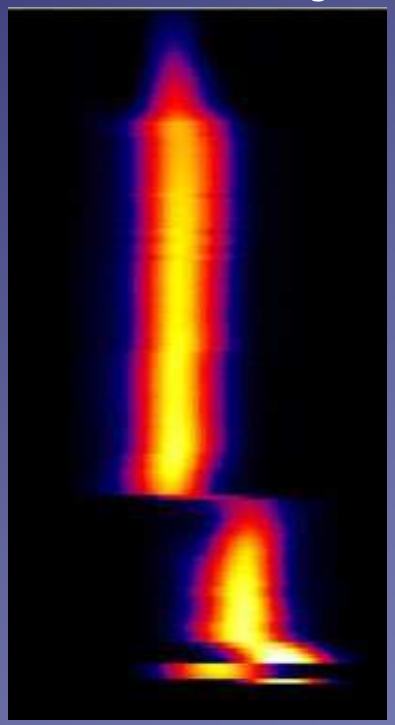
The view *into* the welding seam in creation

The thermo profile is captured after solidification of the welding seam,
before it is cooled down.
Depending on the application this happens 5 to 50 mm behind the torch.

brazing seam
with offset

affiliated heat image

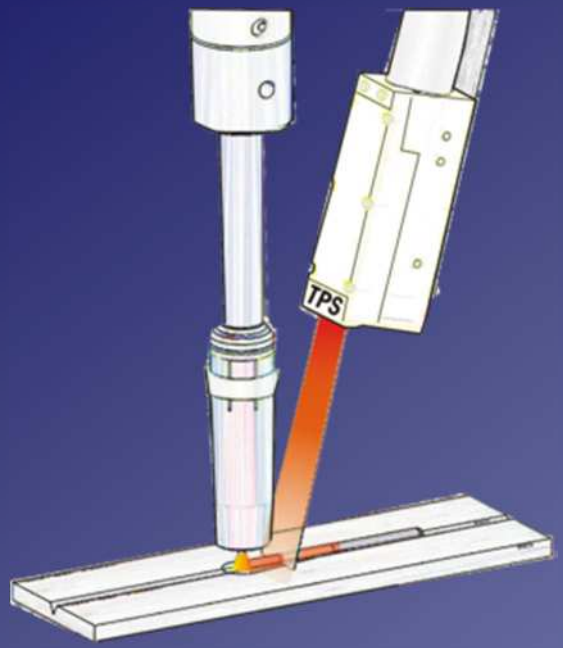


New possibilities of seam control

TPS =

Visual seam inspection
Recognition of seam position

+



Evaluation of metalurgic-thermal processes in the seam
to recognize penetration faults and insufficiant fusion along edges

The temperature profiles are processed in **real time,** width, position and symmetry e.t.c are analysed.

Welding inconsistancies compared to the OK-seam are recognized as deviations within the thermo profiles and will be flagged.

Attributes of the thermo profiles (width, postion..) are tought the same way as other parameters, and can be monitored via tresholds or envelopes.

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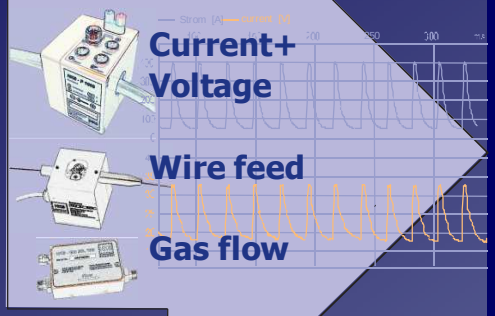
The ThermoProfilScanner as component for monitoring system WeldQAS

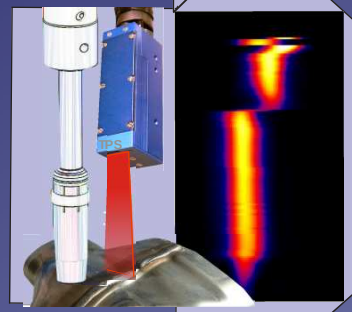
Measurement weld-parameter

SENSORS



Measurement Heat field

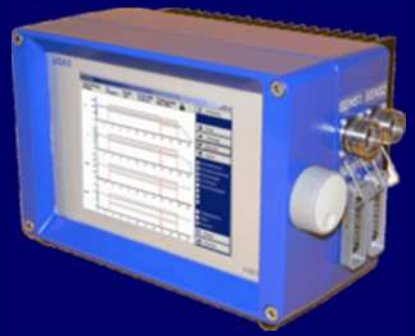
TPS



ThermoProfilScanner

WeldQAS

Weld monitoring system



Production documentation
Extensive representation and analysis functions

Welding process supervision
Thresholds for warnings and faults

Recognize faults reject
automatic recognition of faulty part and rejection in serial production

Fault output for part marking, ejection and alarm

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TPS advantages compared to other test methods

Optical offline-method (after welding)

(Automatic visualisation via
laser triangulation)

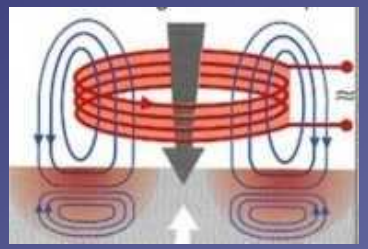
Principle: Laser is projecting a cut line onto seam, a camera system with image processing unit is evaluating patterns.

In comparison: Use of TPS

- **better fault detection** of
  - Pores
  - Pentration faults
  - Fusion faults below surface
- **substancially lower investment costs**
- **no tact time increase**

Eddy current method

Principle: Is inducting eddy currents into base material and is processing disturbances in current flow.



In comparison: Use of TPS

- **better fault detection** with
  - Seam offset
  - insufficient penetration
    (for example due to current deviation up to 50 %)
  - small holes
  - unsymmetrical edge penetration
- **lower Investment costs**

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Application examples

1. Plasmatron brazing in car body production
2. MAG-welding of exhaust systems
3. Spiral tube production TIG
4. Longitudinal pipe manufacturing TIG/Plasma
5. Research

Example 1

Robot guided brazing of car bodies with Plasmatron

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Example 1 Plasmatron brazing of car bodies

Task

Recognition of visible welding inconsistencies as fusion faults and pores larger than 1 mm.

ThermoProfilScanner
offset to the torch: **7 mm**
scan frequency: **140 Hz**
resolution: **0,9 mm**
work distance: **130 mm**
purging gas: **3 l/min**
welding speed: up to **3 m/min**
no water cooling

The immediate fault recognition is prevention the part being used for the total body assembly..The resulting cost savings amount to 1000 EUR per detected fault .

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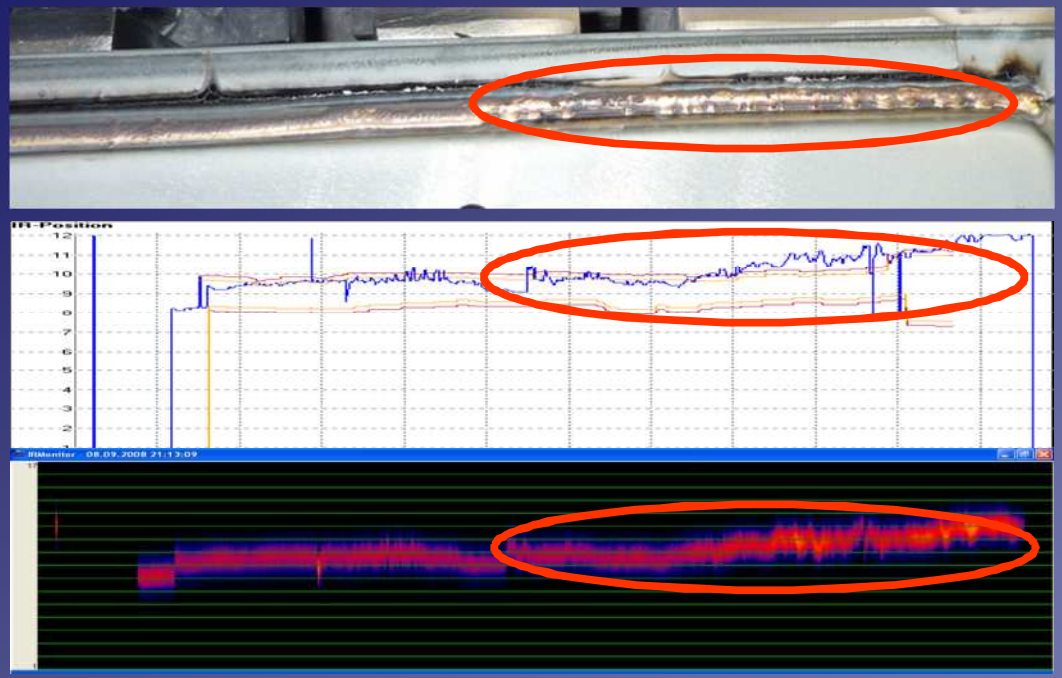
Example 1 Plasmatron brazing of car bodies

Fault image: large fusion fault



Right at the start, the seam is shifting towards the edge, than break up and fusion fault.

Example 1 Plasmatron brazing of car bodies

Fault image: small fusion faults

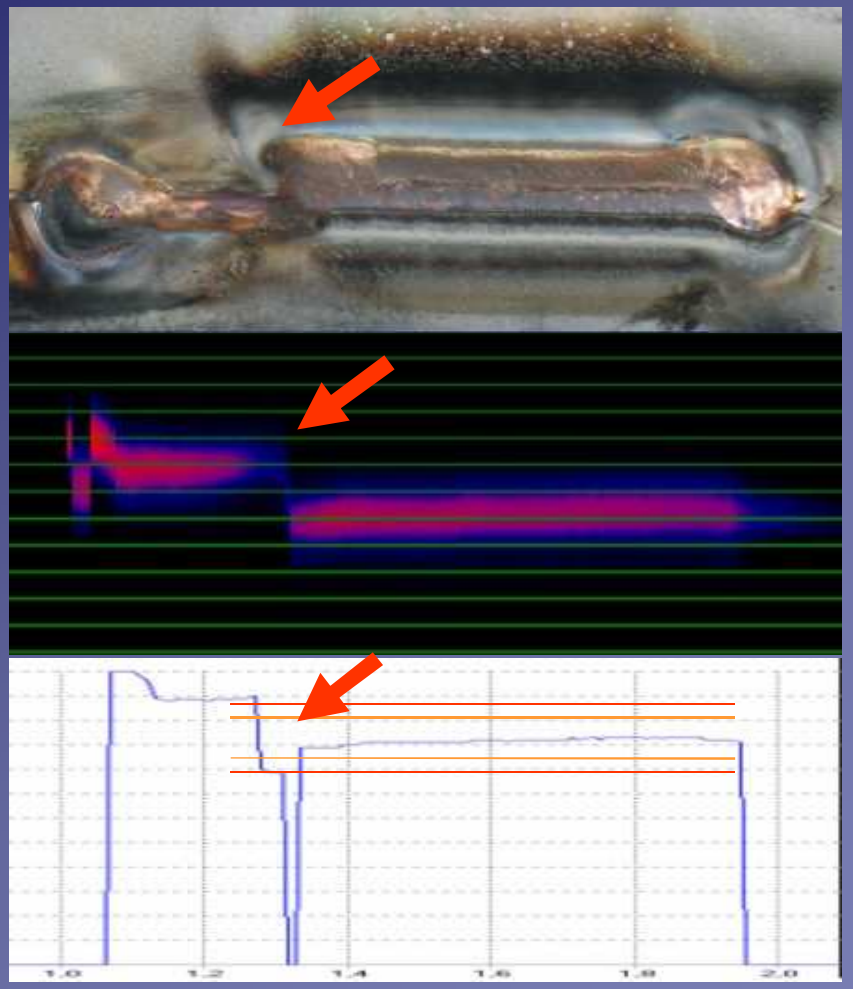
-Fusion fault
Caused by defective electrode

- Increasingly unstable seam progression towards the end of seam

Example 1 Plasmatron brazing of car bodies

Fault image:

No fusion during first 5 mm



Example 2 Robot guided MAG-welding of exhaust systems

Task:

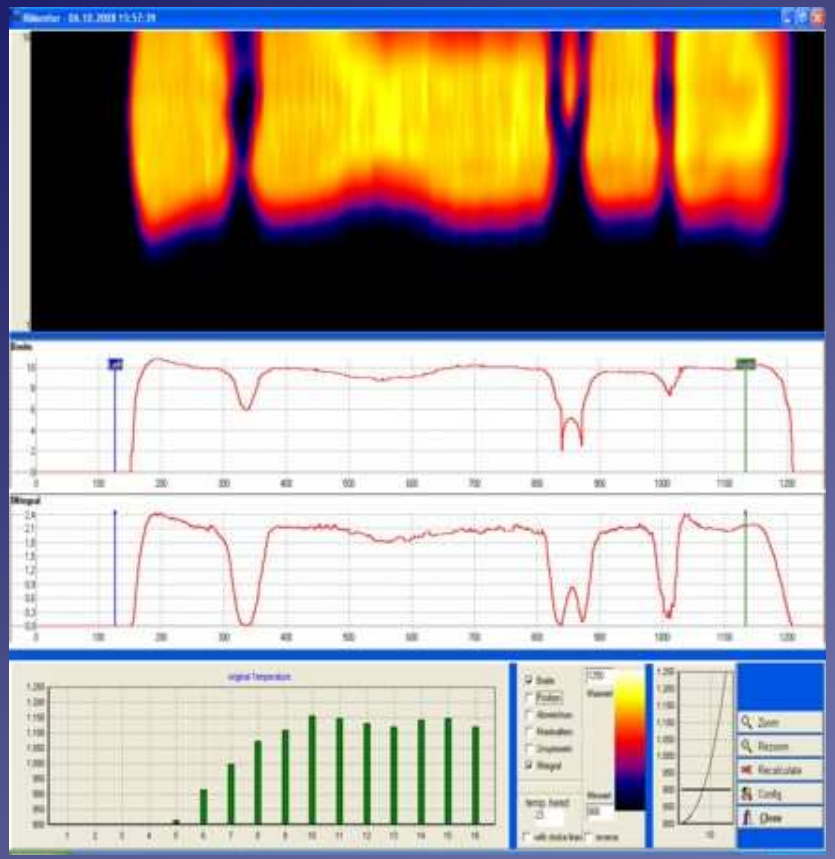
- Proof and recognition of visible welding inconsistencies during MAG-welding.
- Customer requested for a simpler and more robust handling as provided by an existing optical seam measuring system (after welding).
- Proof of visible burn through.

ThermoProfilScanner

offset to the torch: **40 mm**
scan frequency: **100 Hz**
resolution: **0,9 mm**
work distance: **60 mm**
purging gas: **3 l/min**
welding speed: **60 cm/min**
no water cooling

Example 2 MAG-welding exhaust systems

Fault image:
Multiple burn trough faults



Typical application for the TPS

- due the poor heat conductivity of the Cr-Ni-material, the burn trough happens app. 15 mm **behind** the arc.
- it is not possible to detect such burn through effects within the welding current and voltage.

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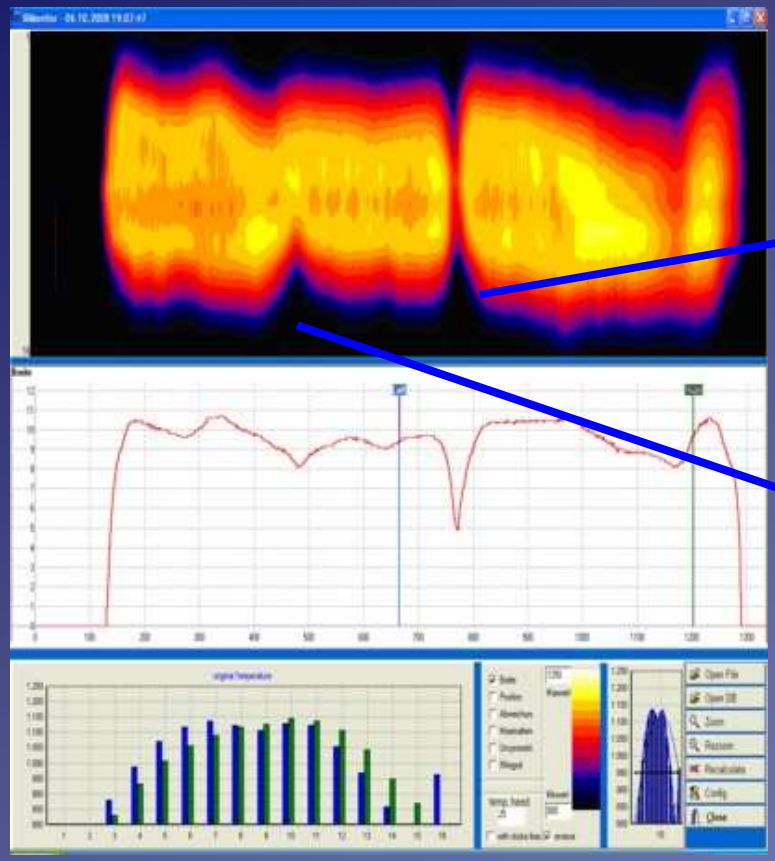
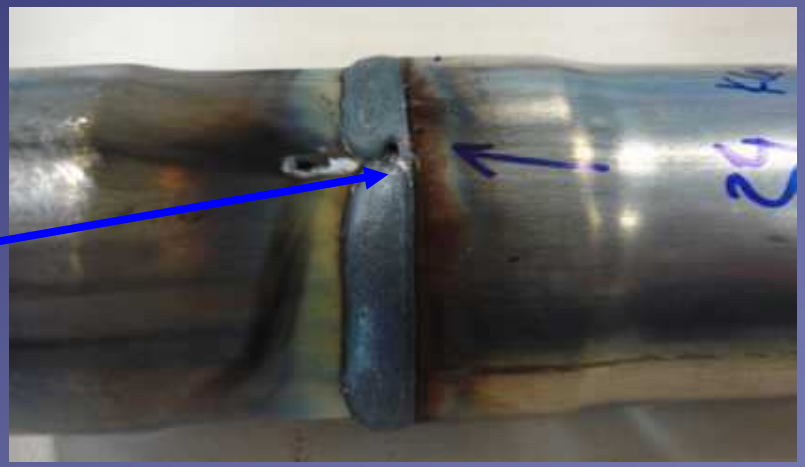
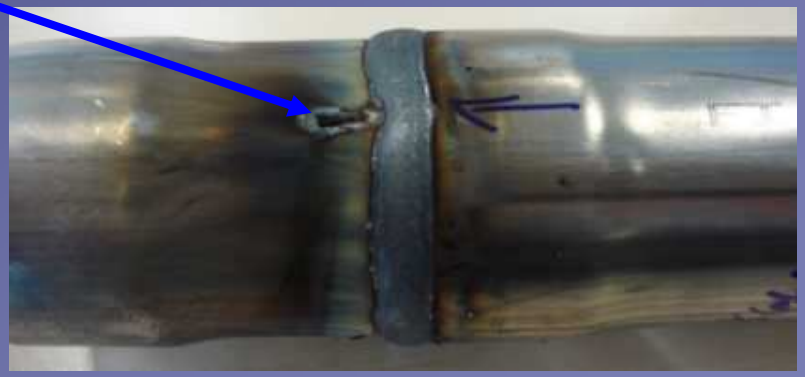
Example 2 MAG – welding exhaust systems

Fault image: geometric deviations and seam necking of 0,8 – 2 mm







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Example 3 Spiral tube production TIG

Task

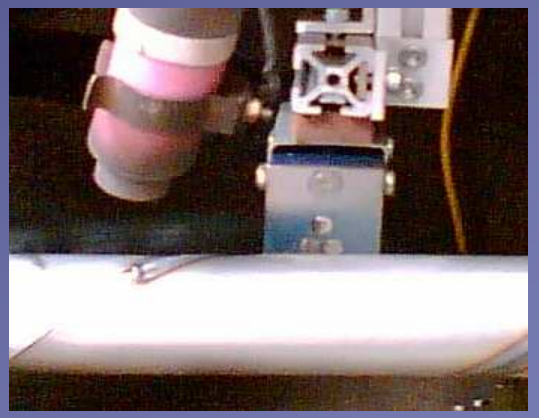
Recognition of visible and invisible welding inconsistencies
as holes, pores larger than 1 mm, edge fusion faults and penetration fluctuations.

Recognition of "weldability" problems with supplied materials.

The existing eddy current detection system does not fulfill requirements.

ThermoProfilScanner

offset to the torch: **40 mm**
scan frequency: **100 Hz**
resolution: **0,9 mm**
working distance: **20-60 mm**
purging gas: **3 l/min**
welding speed up to **3,5 m/min**
water cooling via power source



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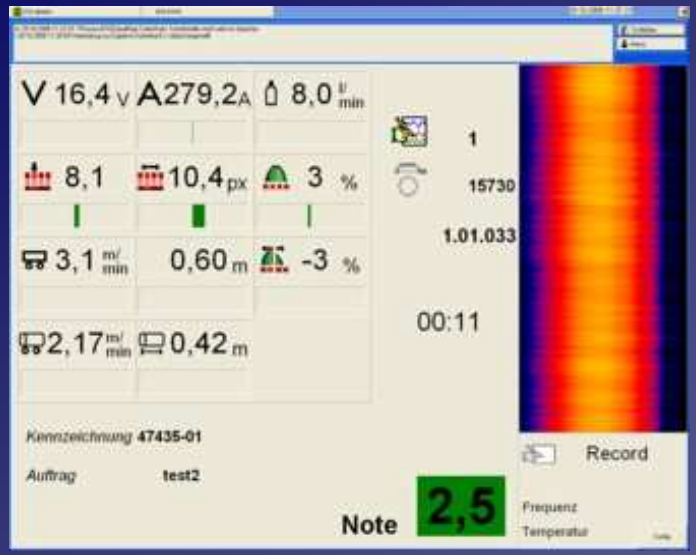
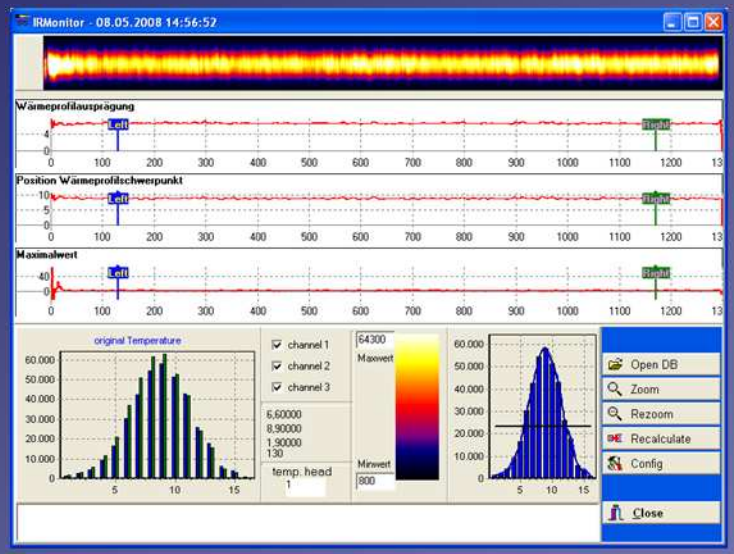
Example 3 Spiral tube production



Work monitor with actual seam evaluation and heat signature



Heat signature of a 6 m tube

Captured are:

- Welding current,
- Voltage,
- Shield gas amount,
- Band position and -speed

From the heat signature the following is calculated:

- Welding seam position
- Width of temperature zone
- Symmetry of heat field
- Cool down characteristic

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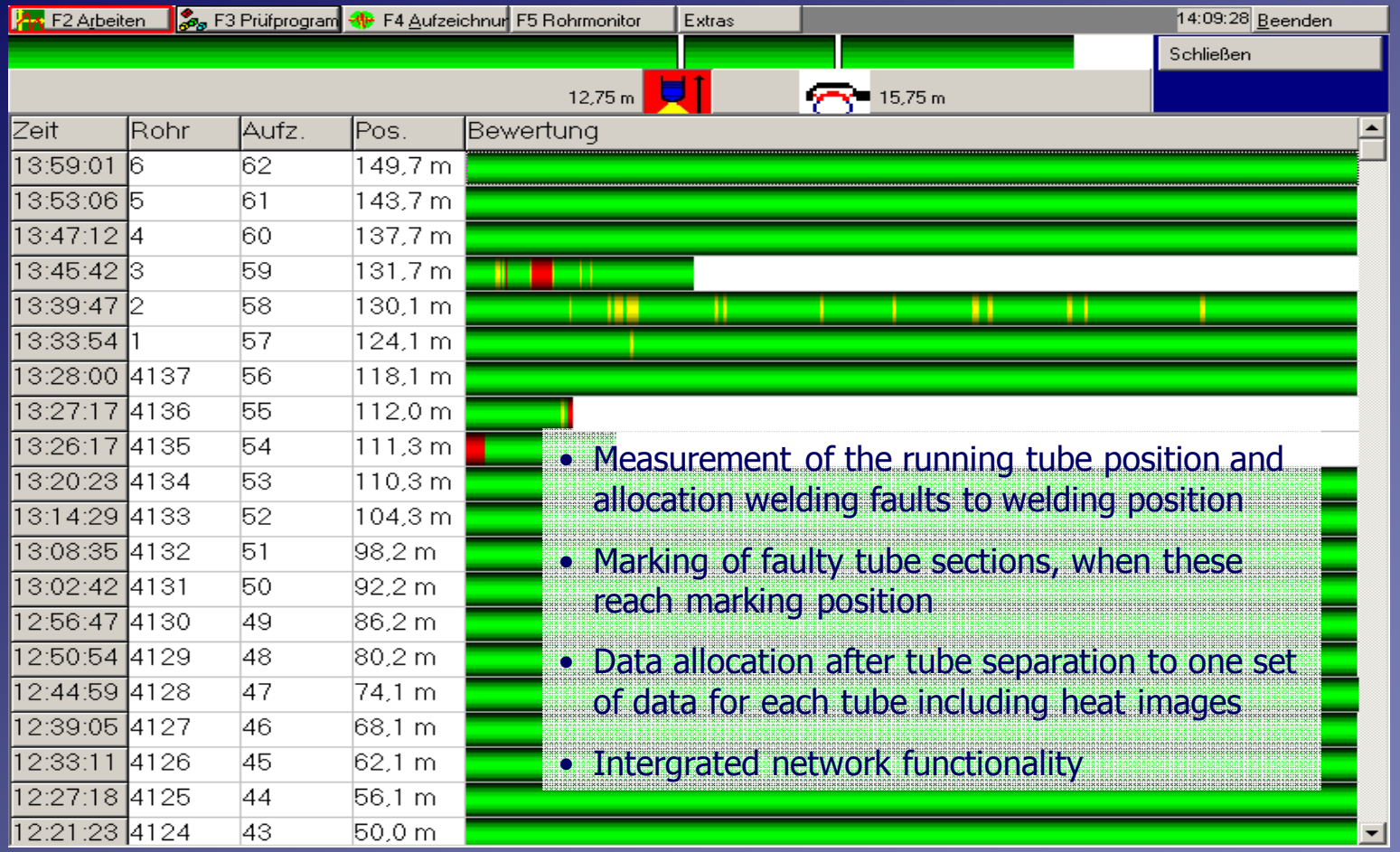
Example 3 Spiral tube production

Special features for seam pipe welding



Graphic display of the last 25 tubes in **tube monitor** application

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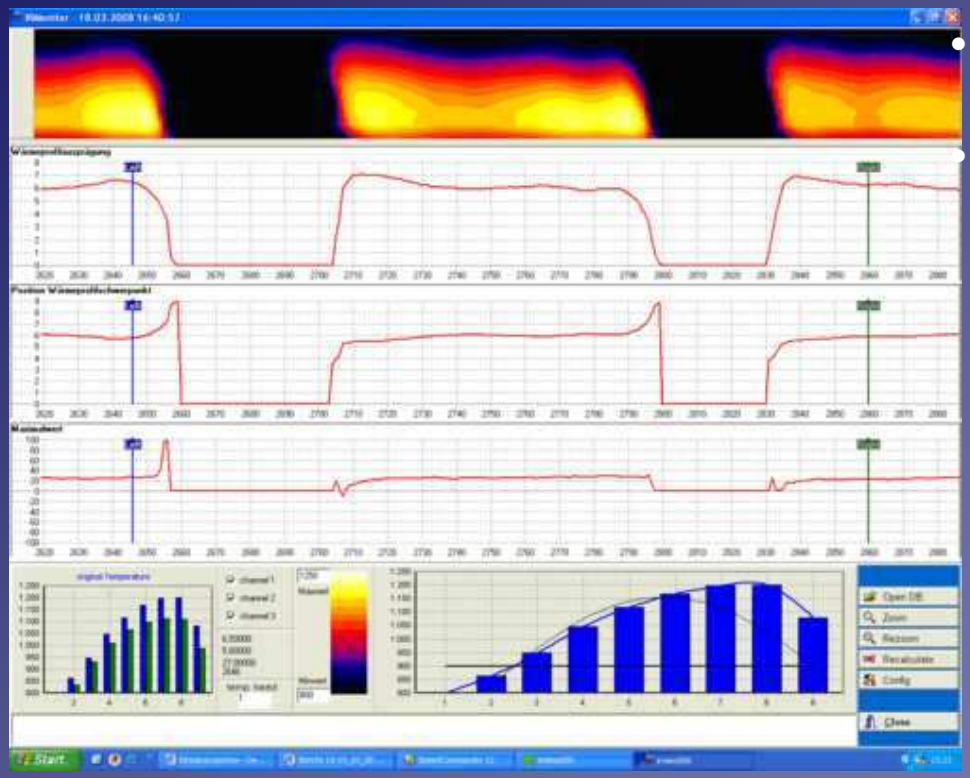
Example 3 Spiral tube production

Fault image: Burn trough

CrNi – Band 73*1,0 tube 32mm



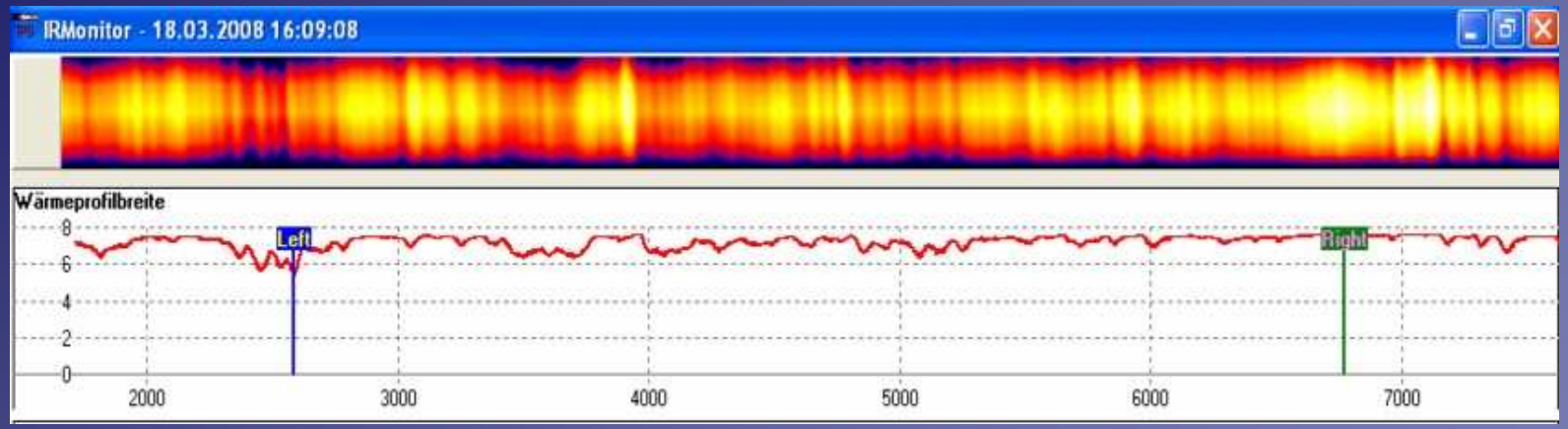
Burn through is causing heat jam

One scan is equivalent to scan width of 0,62 mm.

Example 3 Spiral tube production

Fault image:
Uneven heat distribution

Steel band 86*1,5 – tube 38 mm



Uneven heat input and penetration fluctuations due to defective band material
(Seam appearance – fish scaling)

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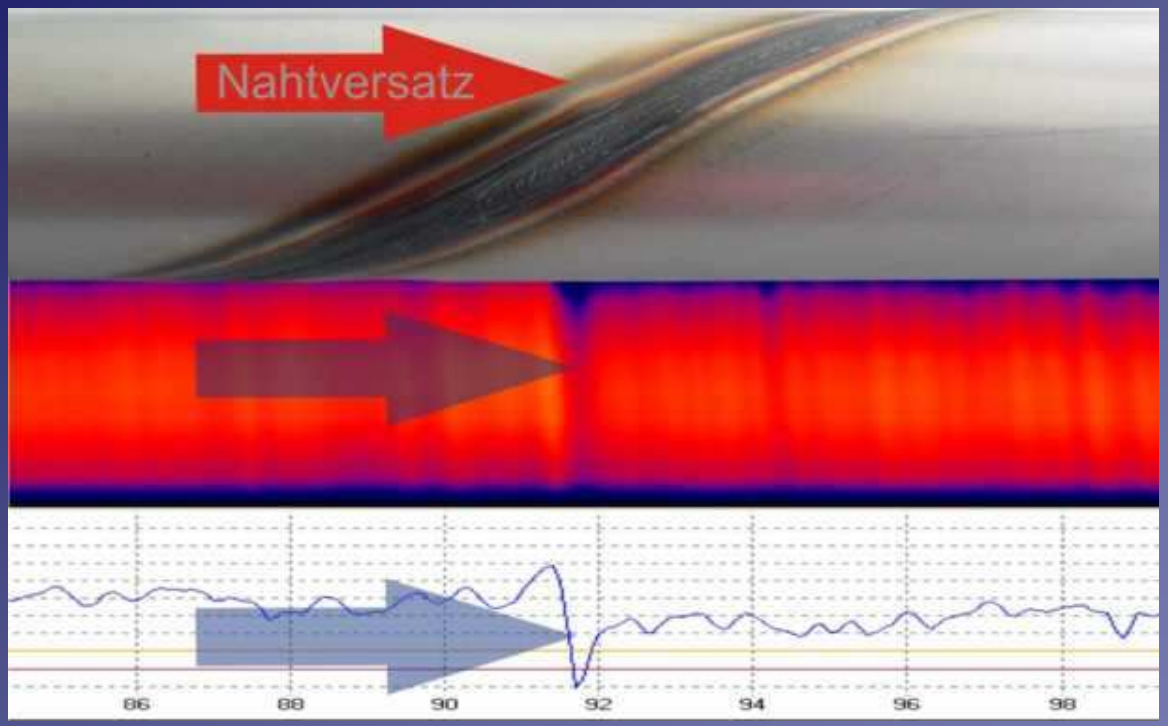
Example 3 Spiral tube production

Fault image:
Seam offset / seam position

CrNi - Band 73*1,0 tube 32mm



Such seam offsets causing welding seam to fail when the tube is pressurized.

Exemple 4 Longitudinal pipe manufacturing TIG/Plasma

Task

Detection of visible and invisible welding irregularities as pores, insufficient side-fusion, defect root penetration and the detection of torch misalignments.

ThermoProfilScanner

offset to the torch: 2**0 mm**
scan frequency: **100 Hz**
resolution: **0,9 mm**
working distance: **80 mm**
purging gas: **3 l/min**
welding speed up to **1,5 m/min**
water cooling

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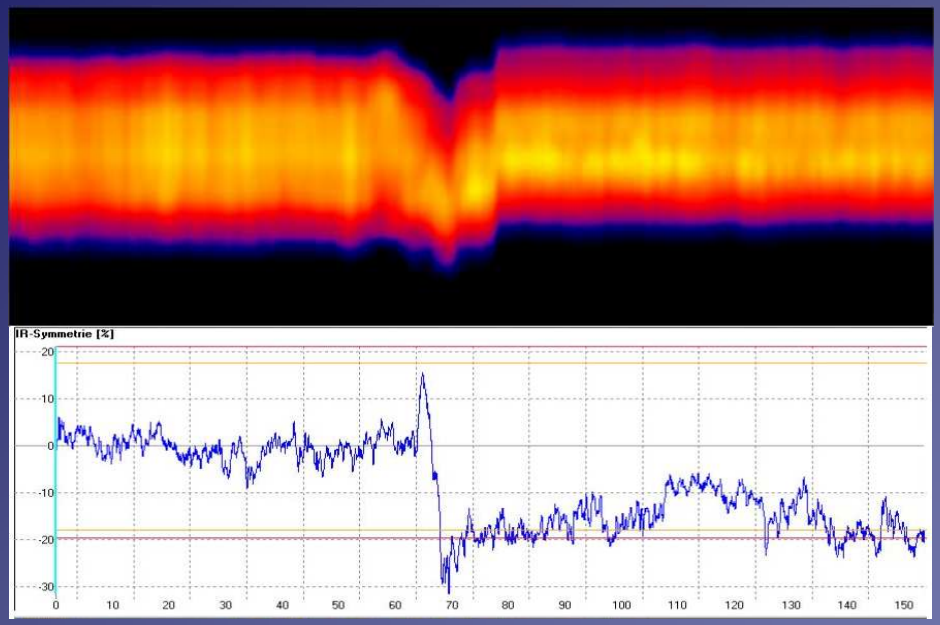
Example 4 - Longitudinal pipe manufacturing Plasma welding/TIG

Fault image: Torch is not in center line of the welding joint. (Seam symmetry)

CrNi - pipe 20*3 mm



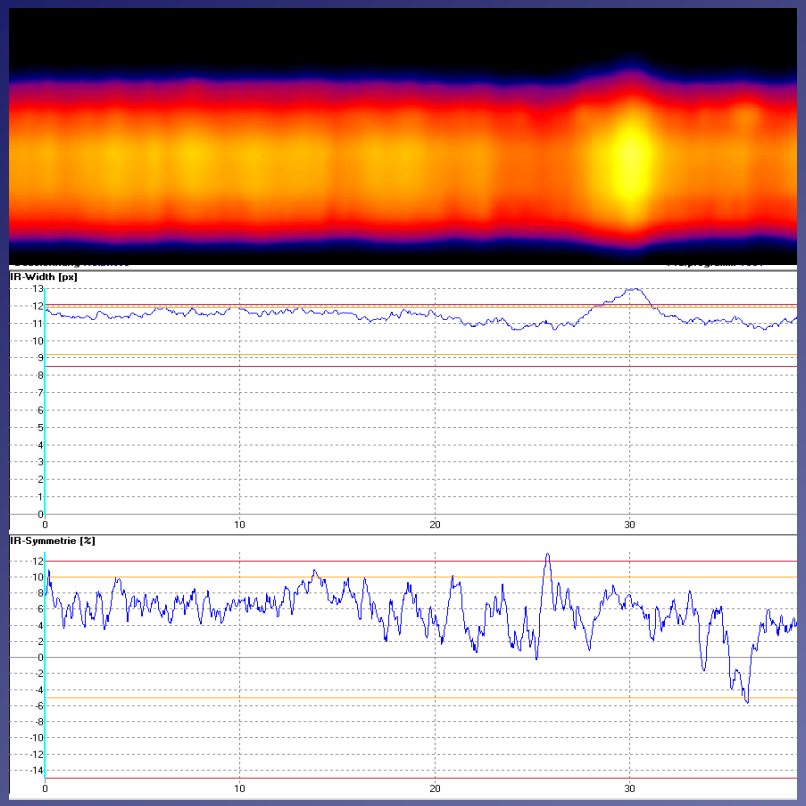
An off- center torch position is causing an asymmetric penetration. One fusion edge is melted more than another.

Optical hardly visible, but clearly visible in the heat signature.

Example 4 - Longitudinal pipe manufacturing Plasma welding/TIG

Fault image: pores

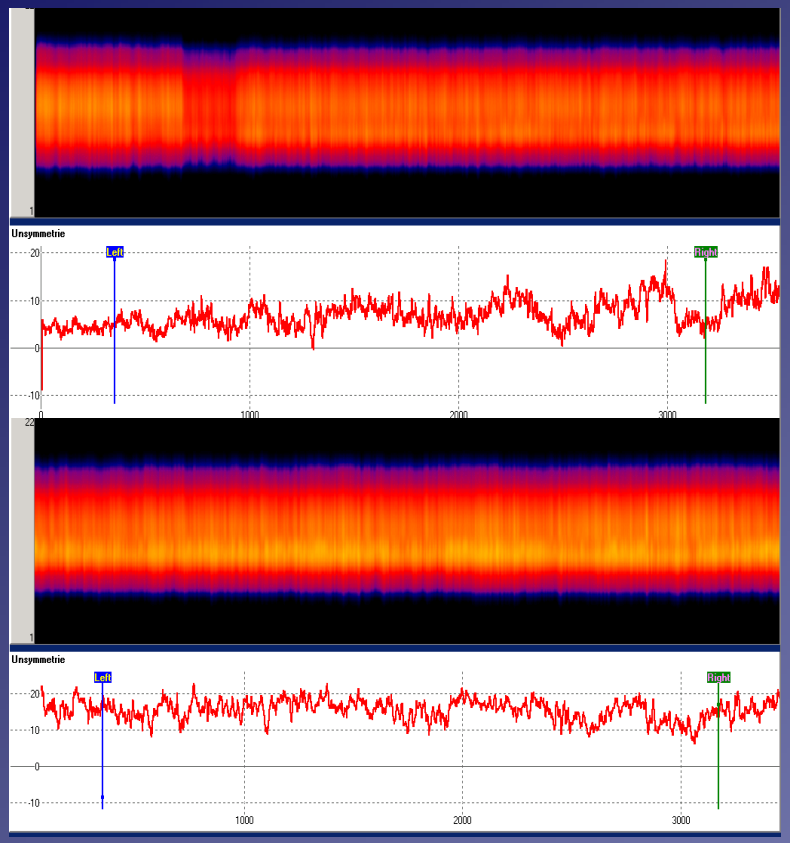
CrNi - tube 20*3 mm



Hot cracks and pores are represented as „Hotspots" in the heat image. Faults like these are causing a disturbance in the heat conduction and are therefore detectable.
These pipes are defective.

Example 4 - Longitudinal pipe manufacturing Plasma welding/TIG

Fault image: asymmetric penetration due to a misaligned coil feed.



Optical not visible, here the thermo profile is becoming more and more asymmetric, because of wear and tear or insufficient lubrication on a roller set.

CrNi - tube 20*3 mm

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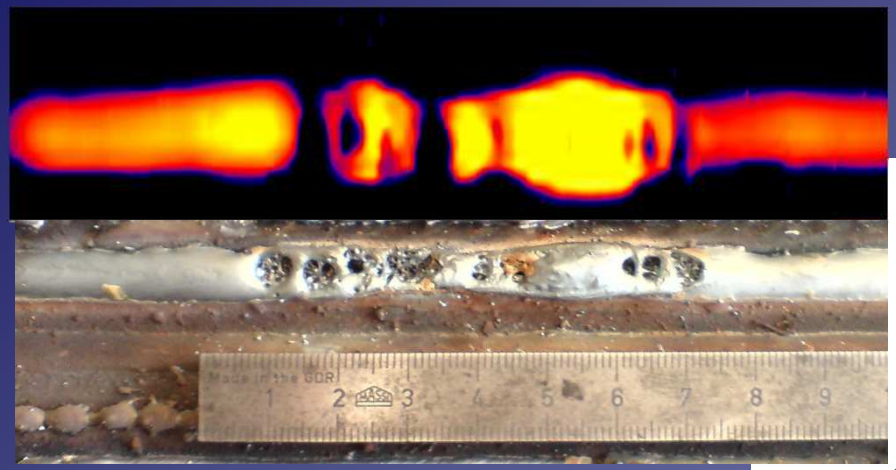
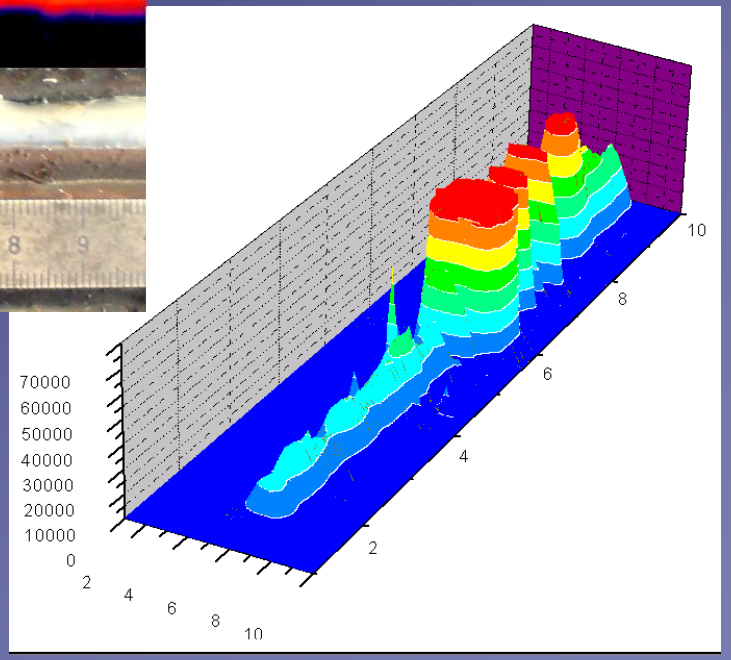
Example 5 Research

Task

TPS as an instrument of the thermography and in welding research





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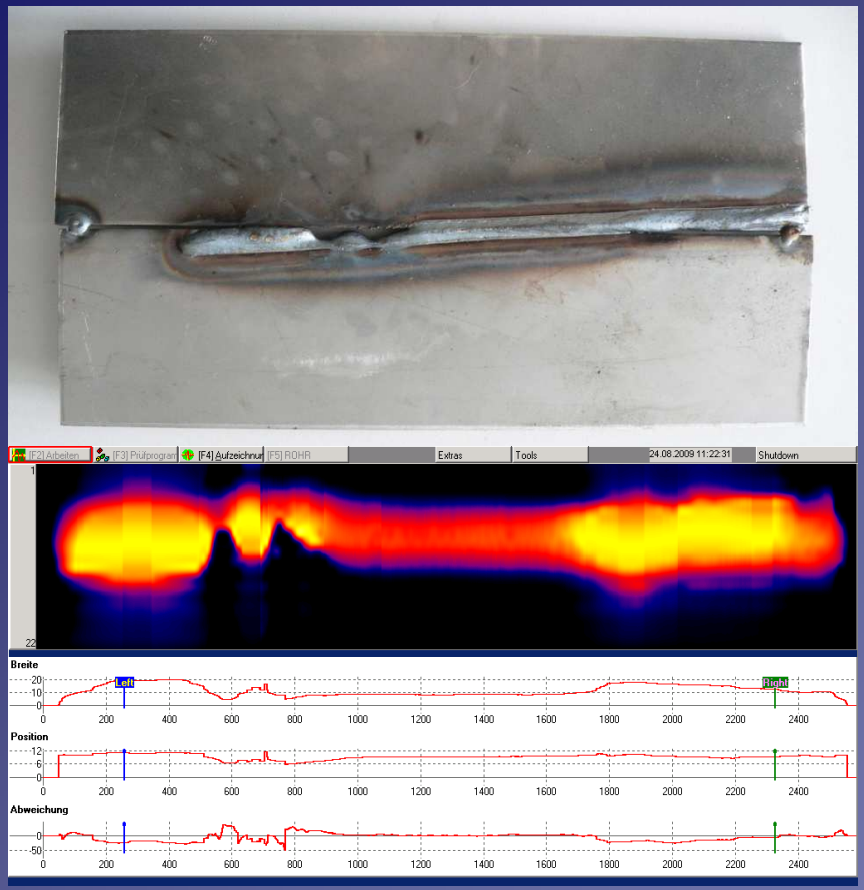
example 5 Research

fault image: root layer penetration, lack of side-fusion, holes (burn trough)



The TPS allows for the first time a thermographic evaluation of various welding seams.

With the **THERMOPROFILSCANNER** a simple and robust tool is now available for welding engineering and application research.
It opens up totally new possibilities evaluating weldments during the welding process.

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Thank you for your interest.

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email: sales@hks-prozesstechnik.de

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