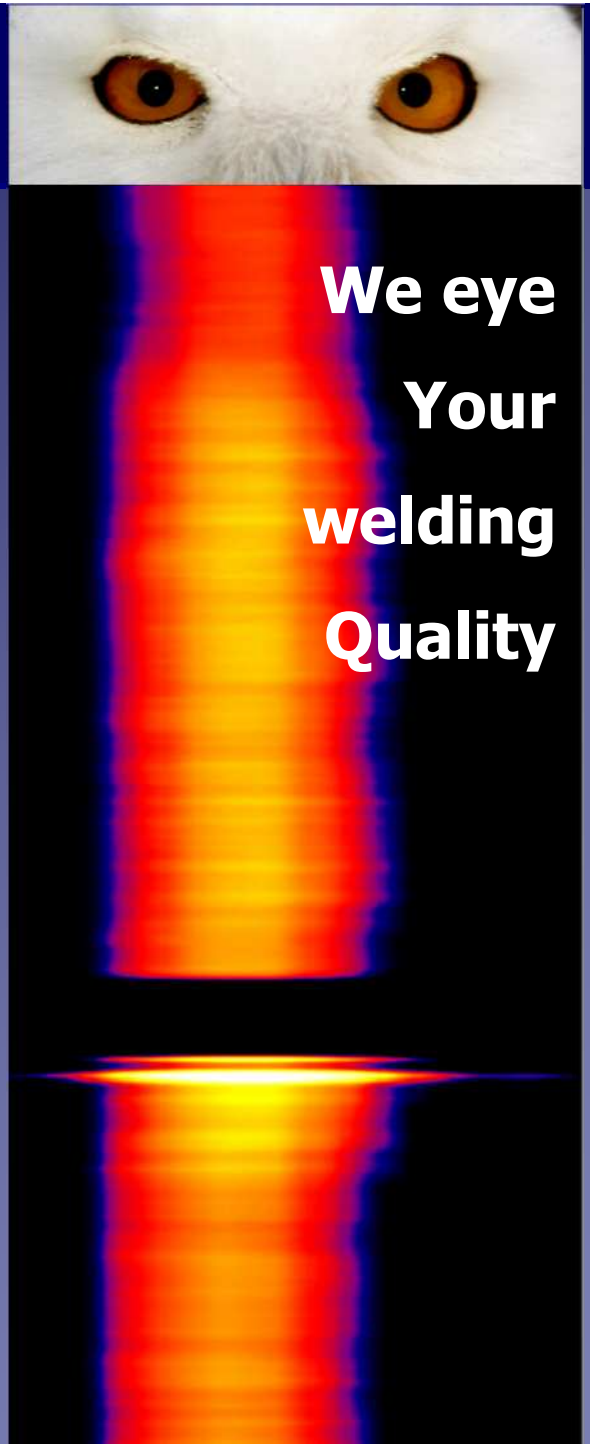
Thermo Profil Scanner

application for

HFI – tube welding



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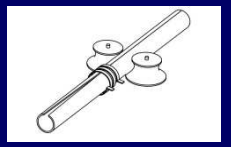
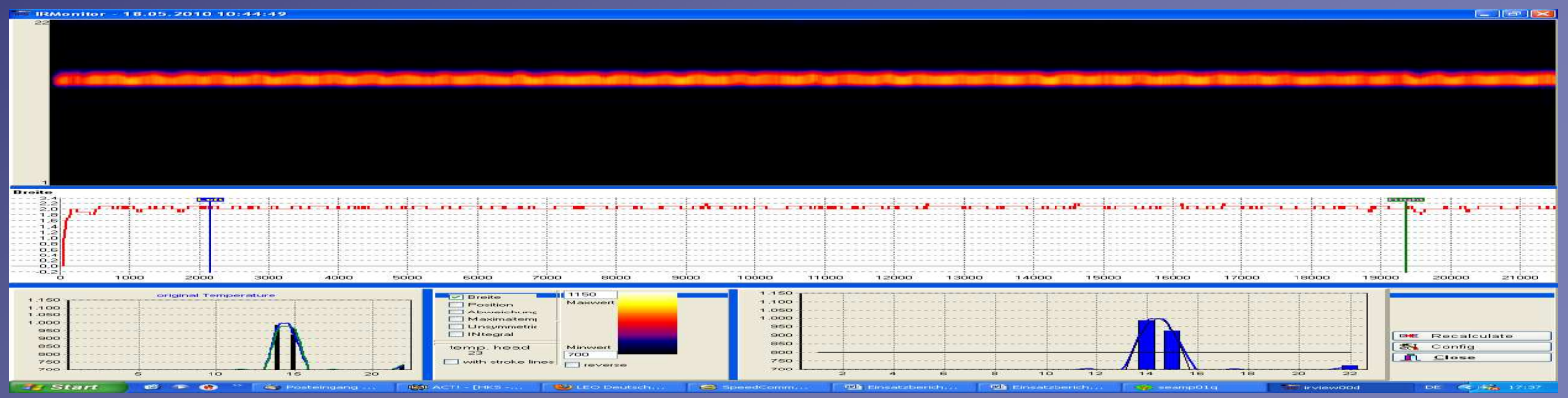
Initial situation for high frequency welding



- the usually used nondestructive testing methods for welded seam control as eddy current examination and ultrasonic examination fails at cold fusion points (bond seams).

- with the newly developed measuring of the heat field via ThermoProfilScanner, these and all other welding irregularities can also be recognized at welding speeds up to 180 m/min.

The visualization and parameterization of the heat field enabled a process control of the welding plant for an exact and reproducible welded seam quality.



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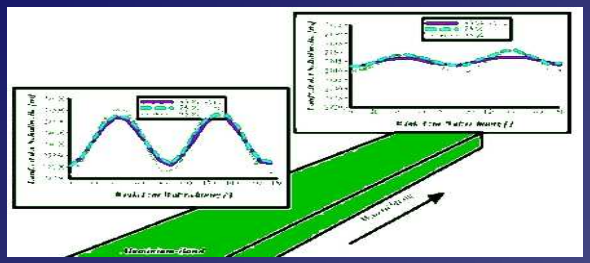
Disadvantages of common test methods

Ultrasonic system



- Cold fusion points are not recognized, because there is no edge, where an ultrasound signal can be reflected.
- **Not usable to control the process**

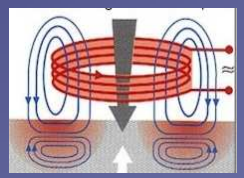
pyrometer

finds out the average Temperature in a measuring spot

- used for the process control, but the results partly are not reliable
- because there is no homogeneous thermal field, the measured temperature depends of the place and the temperature distribution in the welded seam
- **It is not used for the fault detection**

Eddy current system

induce eddy currents into the basic material and judges disturbances in the current course



- cold weldings are not recognized because there is no deflection of the magnetic field
- **Not usable to control the process**

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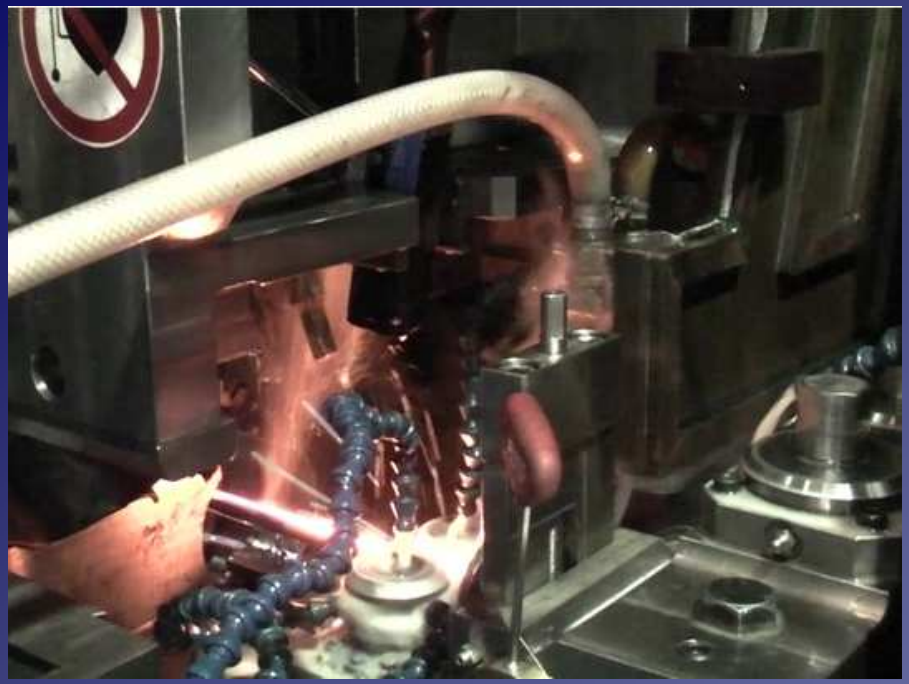
The view in the welded seam



While welding materials they are melted by a local application of energy and are changed in the structure.

The correct heat input as well as the undisturbed heat propagation are essential characteristics to judge the welded seams.

The human eye cannot register thermal radiation. The visible part of the glowing seam outshines the warmth information completely.

Therefore a technique is necessary, which can measure this temperature information durably, highly precise and reproducible under production conditions (pollution, smoke..).
The same temperature field guaranteed the same welding quality. For that reason and with 18 years experience the TPS was developed and patented.

ThermoProfilScanner

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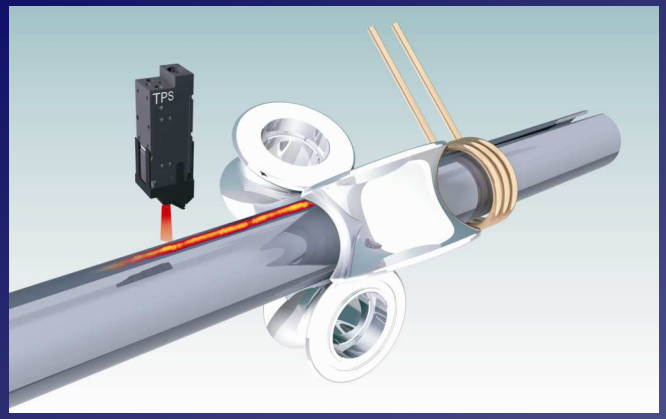
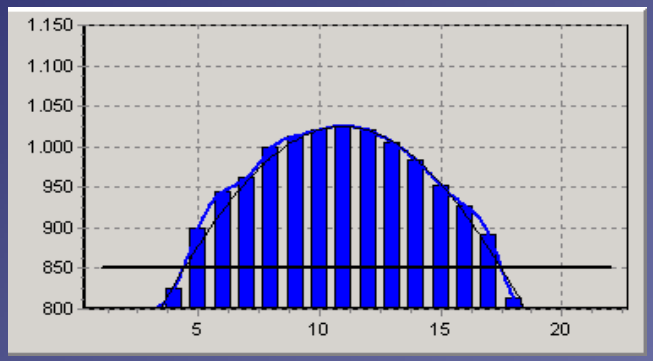
principle of operation - ThermoProfilScanner



The Thermoprofilscanner is constantly capturing a thermo profile

across the welding seam.

Because of the continuous movement of the pipe you get a thermal picture of the complete welded seam.



temperature profile across the seam

Technical data:

- Work distance 15 to 200 mm
- Scan frequency >= 400 Profile/s and shutter speeds of a single line of 50 µs allows a welding speed of 180 m/min.
- technical characteristics allows a long-term-work for HFI-welding (great heat, smoke, water vapor, water drops etc.):

  - ✓ glass free design
  - ✓ gas curtain
  - ✓ anti spatter concept
  - ✓ integrated water cooling
  - ✓ splash guard (optional)

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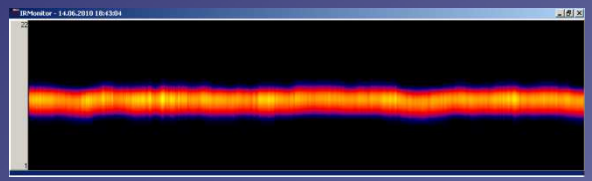
Extremely robust action directly on the welding point

The heat signature is captured after solidification of the welding seam, before the seam is cooled off.

In this phase disturbed areas in the temperature course are considerably recognizable.



Depending on the application this can be 5 mm to 300 mm behind the welding point.

The sensor can withstand most extreme working conditions and works reliable in great heat, dirt, welding spatters, water vapor, cooling liquid drops…

example conductive HF-welding

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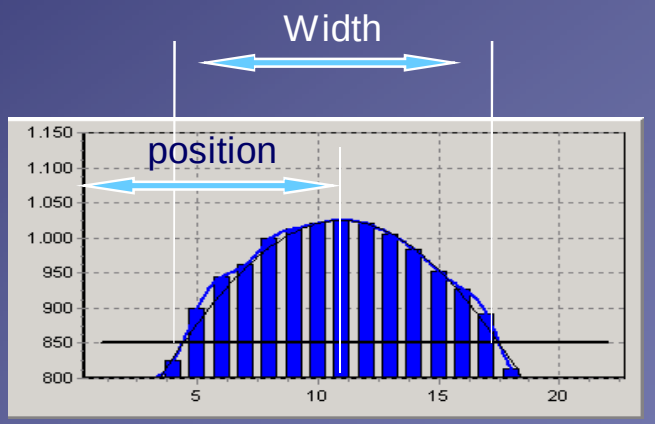
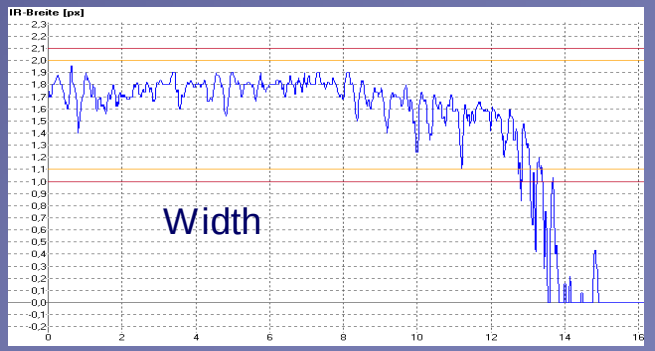
New possibilities to control the seam

The temperature profiles are processed and measured ***in real time.***

Some important parameters are:

- breadth of the thermal field above a specific temperature
- position of the center of the heat
- maximum temperature
- symmetry ...





Welding irregularities compared to an OK seam are recognized and signalized as deviations of the temperature profiles.
The features of the temperature profiles (width, position ..) can be taught and monitored by thresholds (envelopes) like other parameter.

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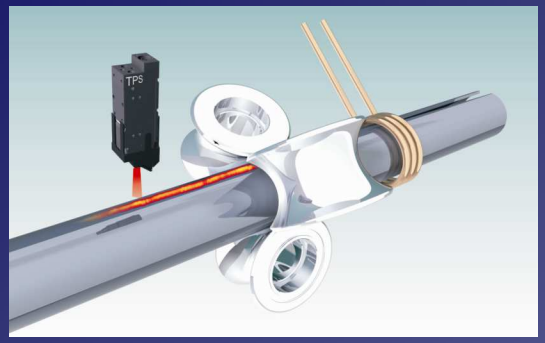
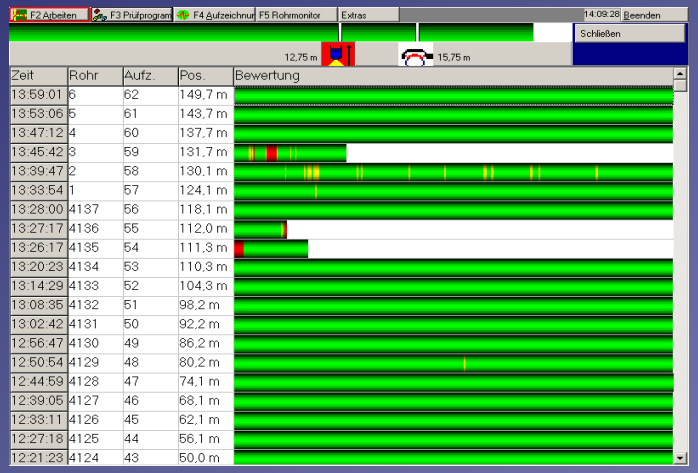
ThermoProfilScanner as a component of the monitoring system WeldQAS

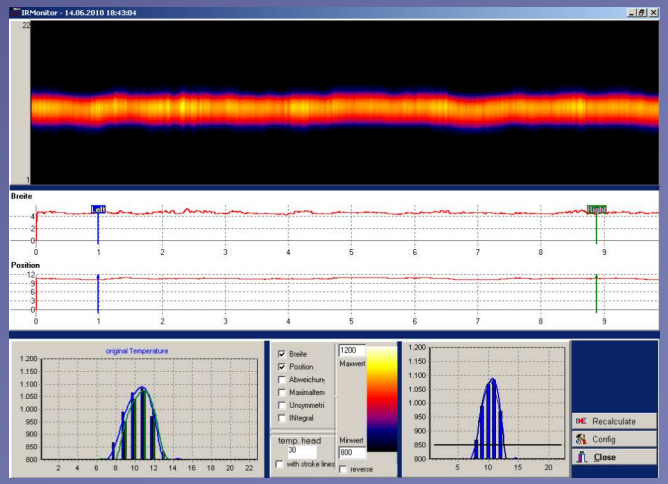
measurement of the thermal field



system of welding data monitoring



„tube“ - monitor



analysis of the heat field

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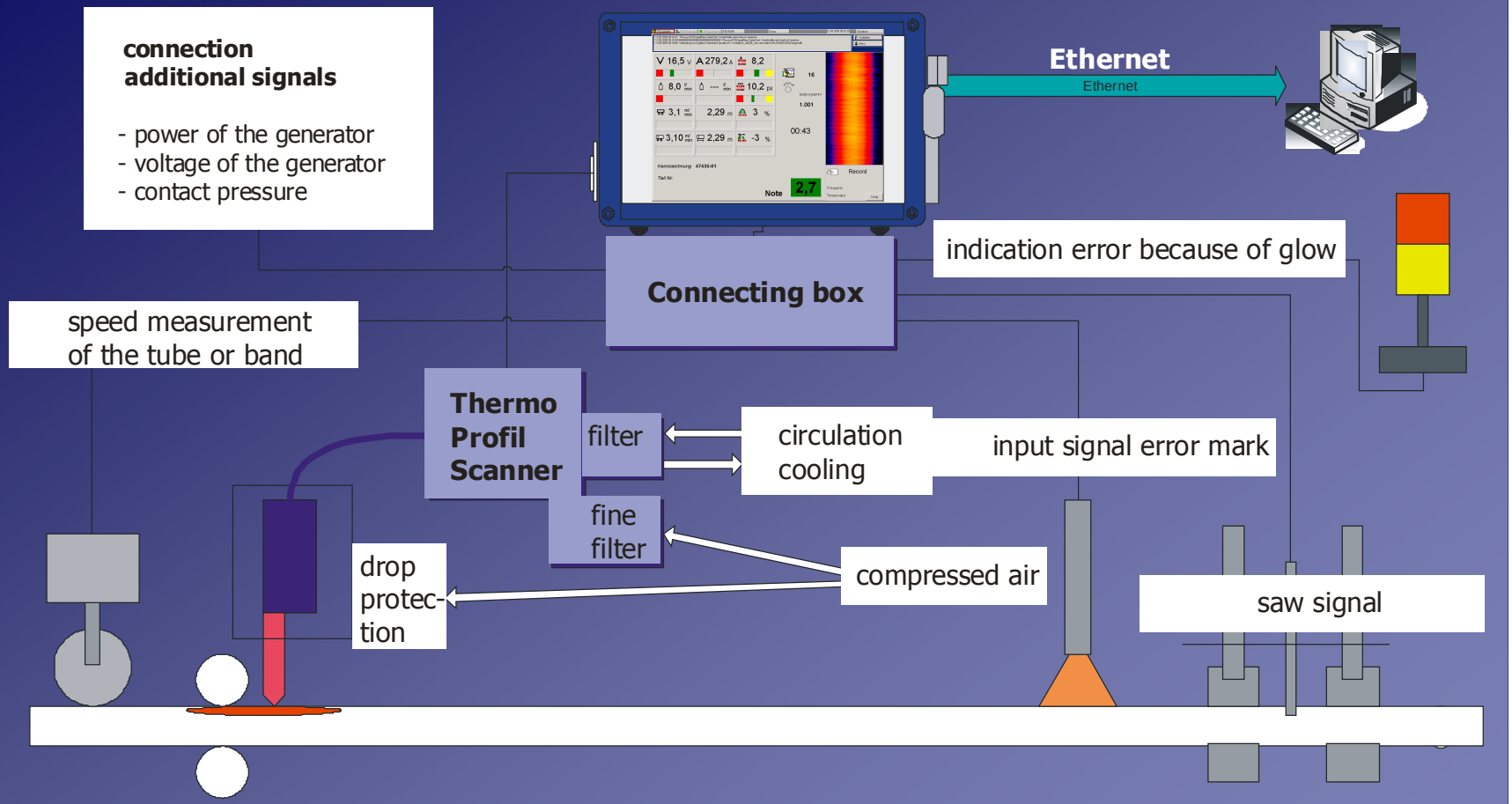
Connection schema in a high frequency welding plant



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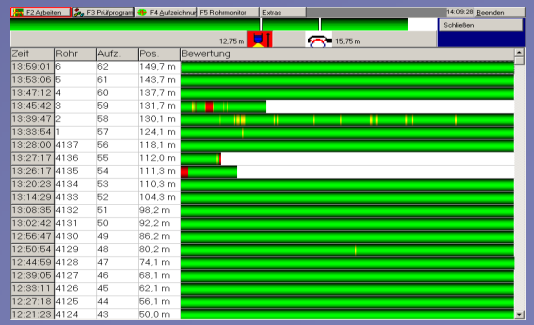
Method of operation of the TPS

1. The ThermoProfilScanner is capturing the temperature over the welding joint and is sending the data to the WeldQAS-device.
2. The WeldQAS-device is calculating for each line the attributes of the profile (width and position of the heat field, symmetry and max. temperature.)
3. The heat images are displayed simultaneous visually by the WeldQAS, stored and compared with programmed set values.
4. By recognizing violations of limit values the unit detects welding irregularities and their position within the pipe.
5. The error signal is generated immediately or can be buffered to mark the defective with a marking spray unit.
6. The WeldQAS-device is storing all data pertaining to the pipes, which will be numbered, and can be synchronized with a saw signal.
7. The data are stored in a data base and are displayed in a pipe monitor program.



„Tube“ monitor

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examples

1. **Conductive HF - tube – welding**

2. **High frequency induction tube Welding (HFI)**

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example 1 Conductive HF-welding

Application Data TPS

Distance to torch : **100 mm**
Working distance: **60 mm**
Gas purge Shield gas: **3 l/min**
Welding speed: **80 m/min**
Water cooling
Pipe dimensions: **13 x 2,5 mm**
HFI-Generator 250 kW **– conductive HF-welding**
Pipes are spooled to coil

Task

- Realizing a set up help for optimal welding parameters based on the heat signature
- Recogognition of visible and invisible welding faults, cold joints, and excessive root penetration.
- Color marking faults
- Re-place Eddy Current Detection Systems since these can not detect these faults

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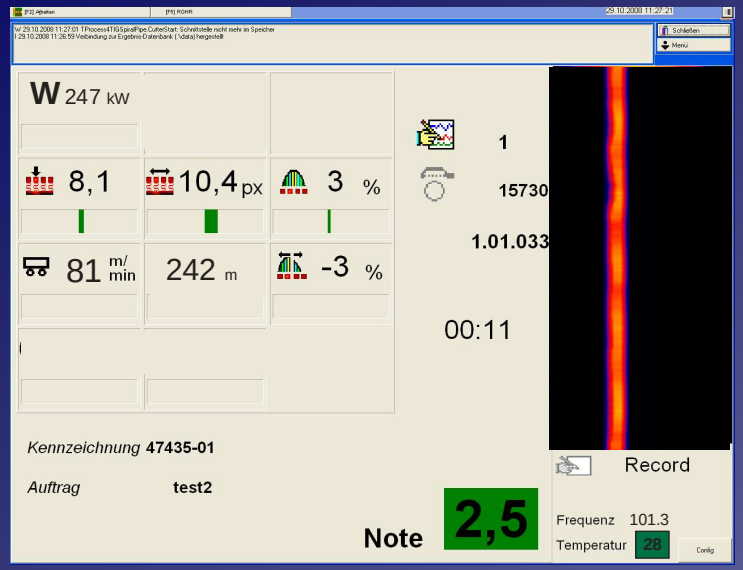
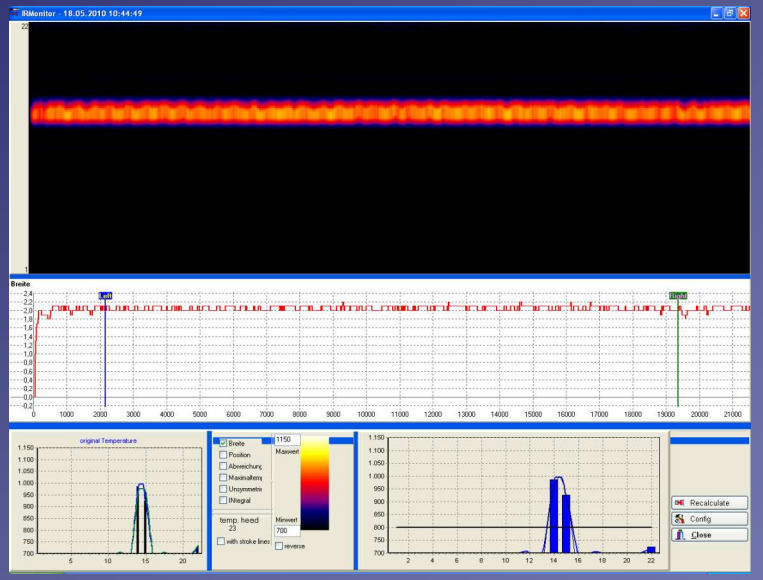
example 1 Conductive HF - tube - welding



Work monitor with actual seam evaluation and heat signature

Captured are:

- Generator output
- Band position and -speed



Heat signature of a 21 m tube

Using the thermal field are calculated:

- Welding seam position
- Width of temperature zone
- Symmetry of heat field

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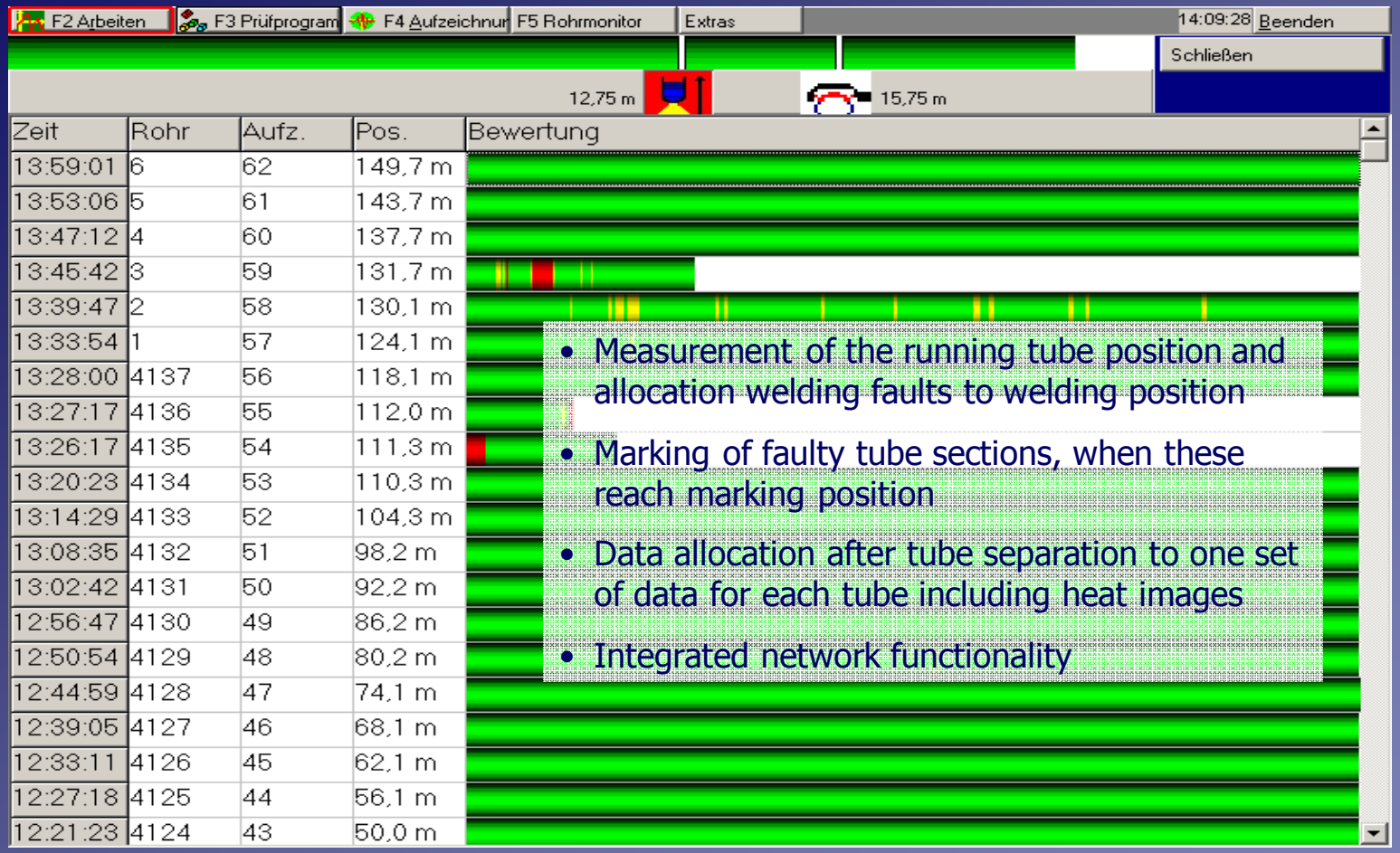
example 1 Conductive HF - tube - welding

Special features for seam pipe welding



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

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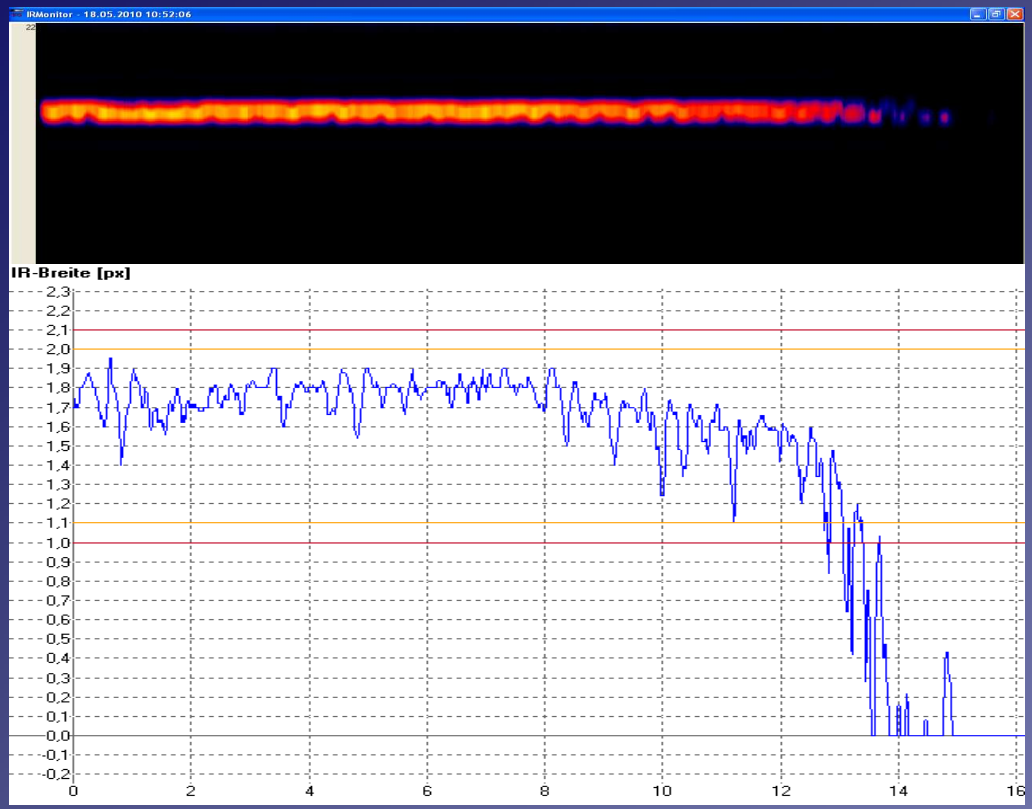
example 1 Conductive HF - tube - welding

Detecting cold fusion points



Width of heat filed and learned thresholds values.

Heat field when fault through cold fusion joint

When the melting temperature is not reached, the temperature is falling in the joining zones.

The sensor is calculating the heat field width via a set temperature threshold. Cold welding joints can be clearly seen in the diminishing heat field width.

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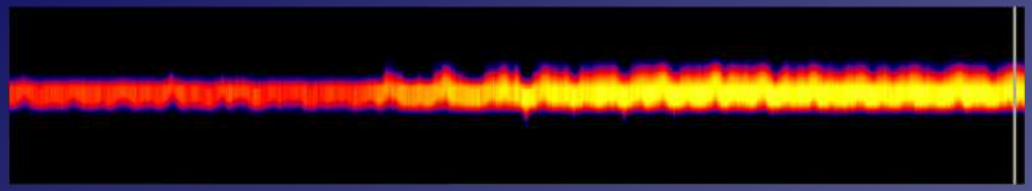
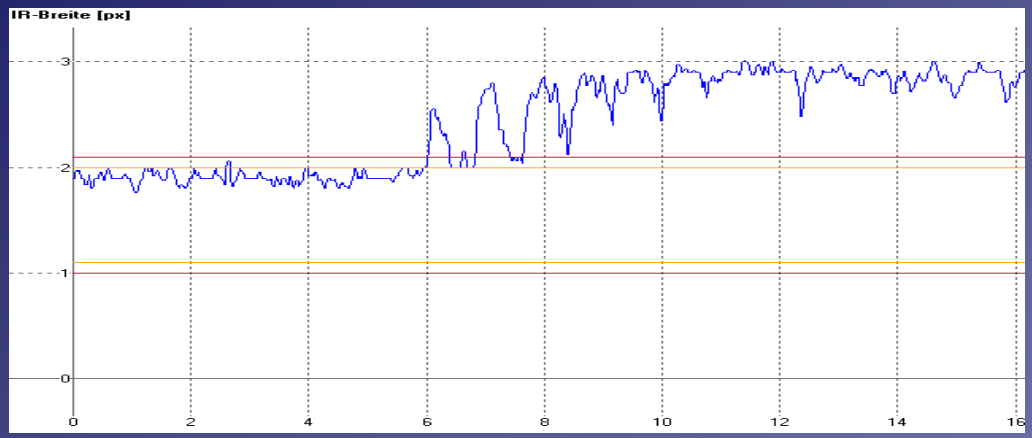
example 1 Conductive HF - tube - welding

Welding capacity adjusted wrongly





Thermal field at too highly adjusted welding capacity

A result of that are failures like big excess penetrations, spatters, burnings.

The breadth of the thermal field shows the heat input is too big.

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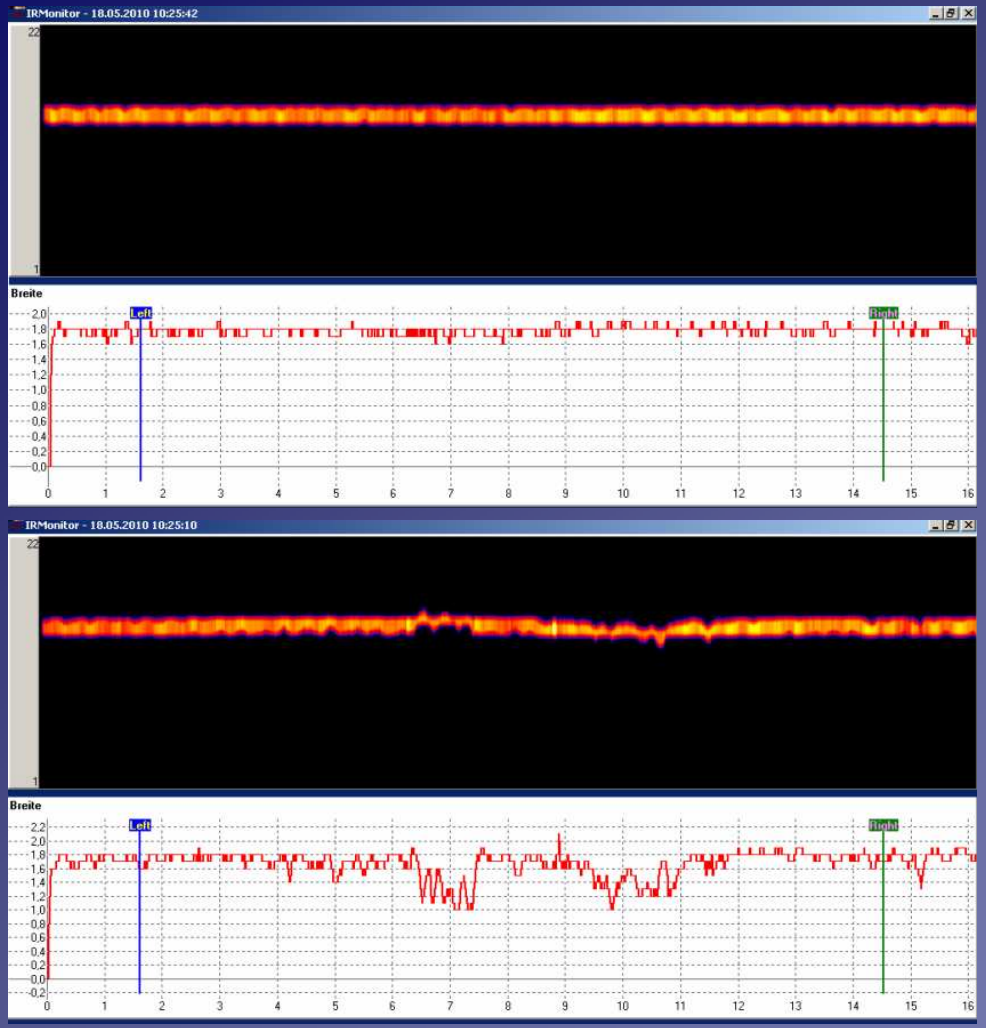
example 1 Conductive HF - tube - welding



Comparative representation

Thermal field of an i.O. - seam compared to a seam with irregular thermal field.

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exemple 2 High frequency-induction tube welding (HFI)

Tasks

- Detection of cold fusion points , (bond seams), which the integrated eddy current system and ultrasonic system could not recognize..
- Up till now only a destroying punctual testing of materials was possible. Pipes which got leaky later at the costumer could not be sorted out.
- Warranty of a constant quality based on the thermal field

Application Data TPS

Distance to torch : **50 mm**
Sampling rate: 2**00 Hz**
Working distance: : **120 mm**
Gas purge shield gas : **15 l/min**
Welding speed up to **60 m/min**
Water cooling

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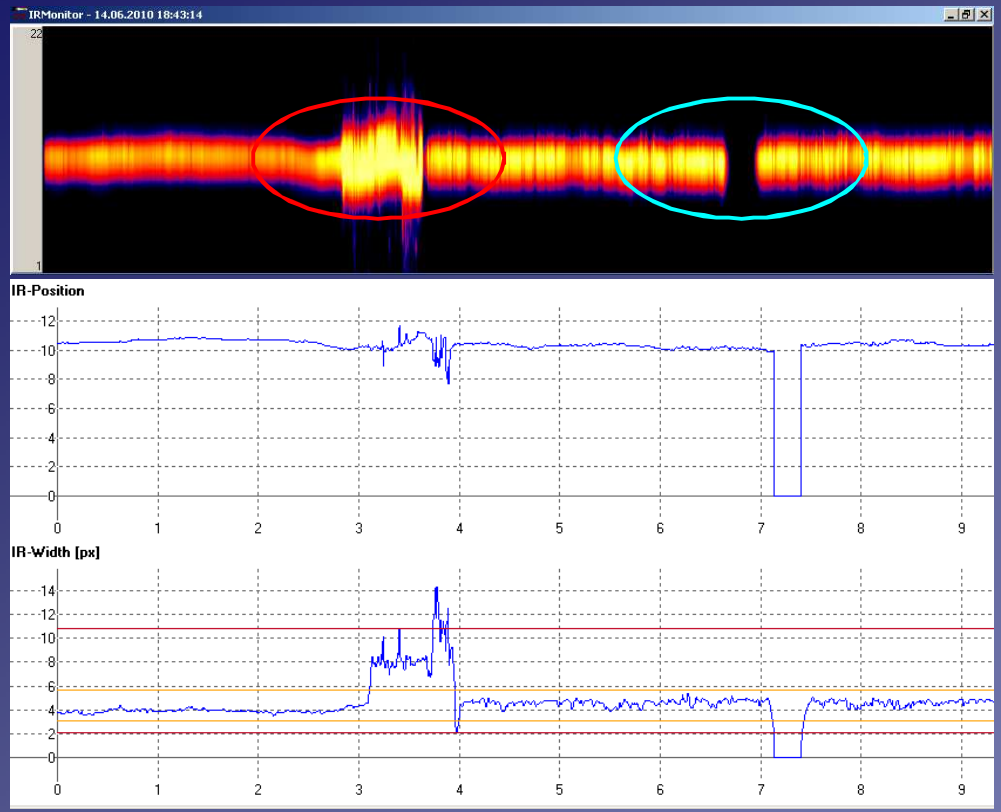
example 2 High frequency-induction tube welding (HFI)

failure in the adaption of energy power

steel - tube 13*2,2 mm, 5,6 m length



(red mark)
to high energy caused a very strong on-heating
(for the duration of 0,85 s.
The temperatures are higher and the heat field is considerably expanded.
(further zoom next page)

(blue mark)
cold fusion points (0,3s long)

These faulty sections are recognized and marked by the TPS and the additional monitoring system.

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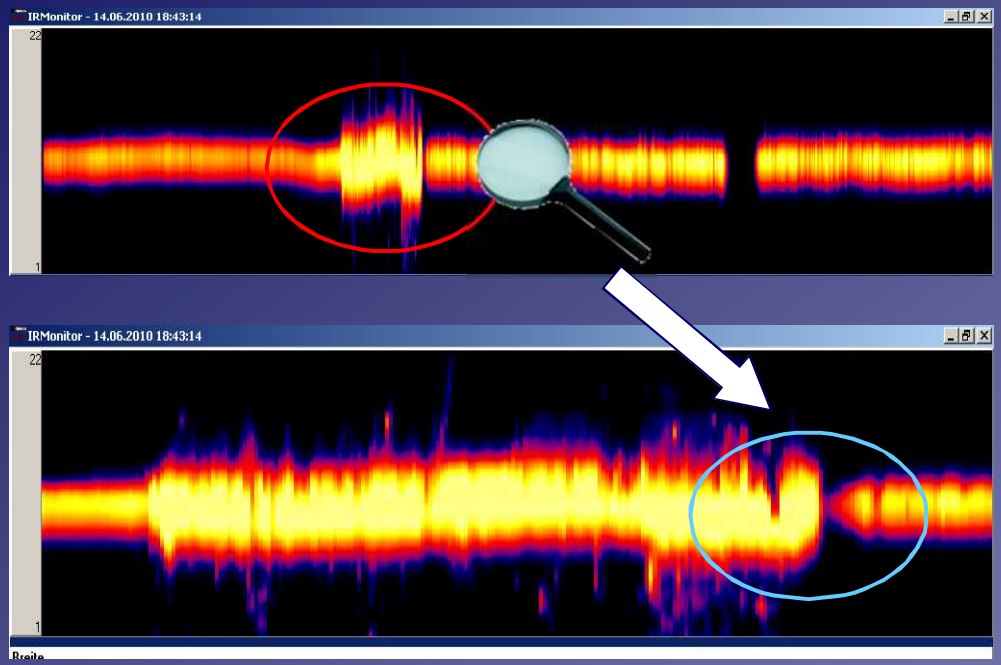
example 2 High frequency-induction tube welding (HFI)

Example for the sensibility of the thermal measuring at the seam



Red mark
The area zoomed with to high energy (from previous foil) has a cold point at the end

(blue mark)
Cold point (energy fall-off) for the duration of 40 ms .

These faulty sections are recognized and marked by the TPS and the additional monitoring system.

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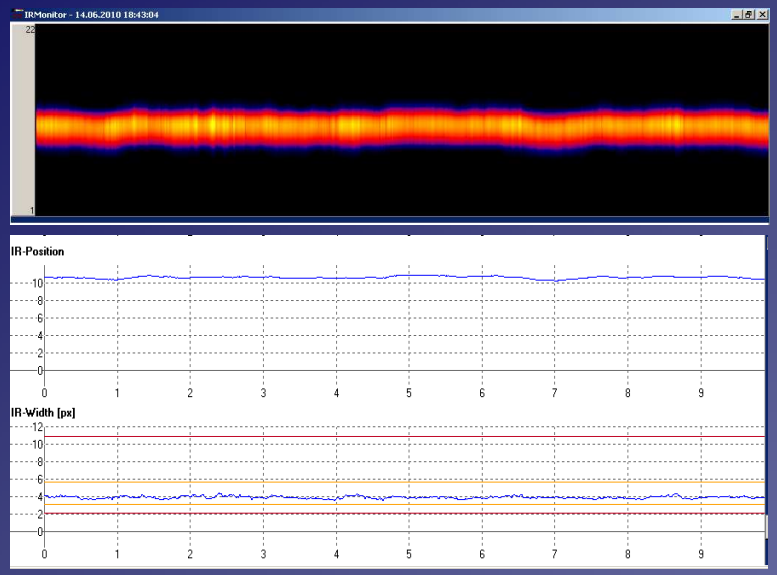
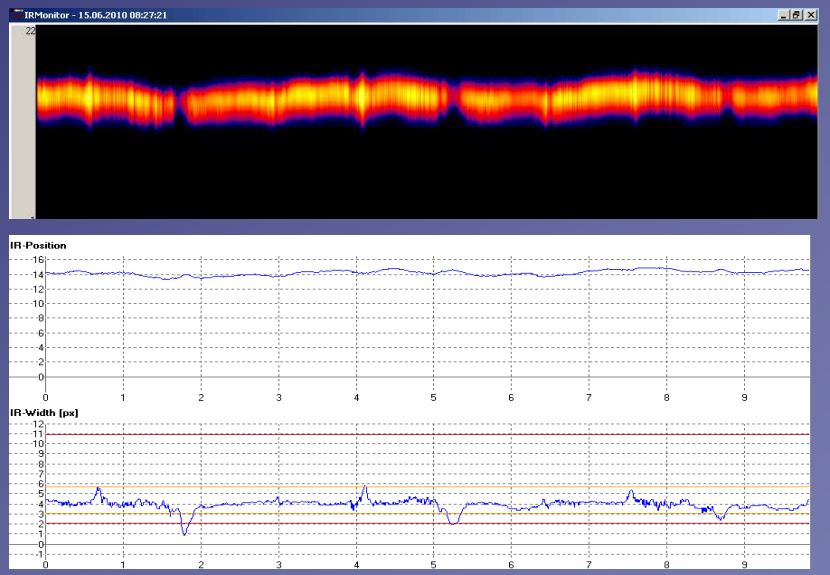
example 2 High frequency-induction tube welding (HFI)

Comparison of band qualities

steel - tube 13*2,2 mm



Regular thermal field



Irregular thermal field because of up- and downturns (fluctuations?) of the band material

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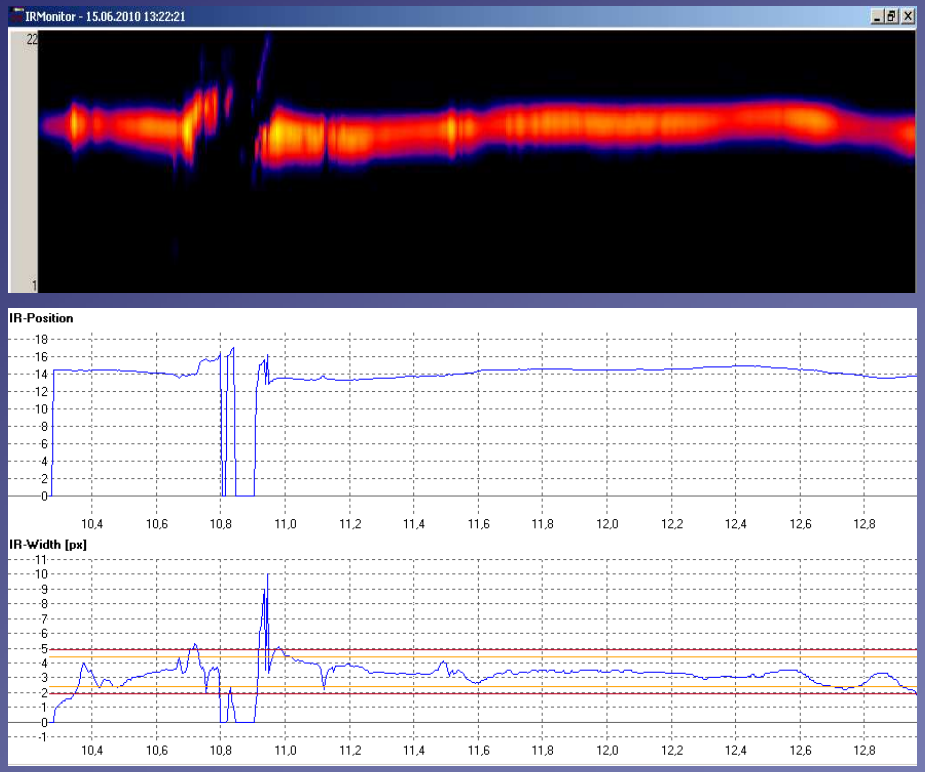
example 2 High frequency-induction tube welding (HFI)

Thermal field while burst open at the junction of two coils

steel - tube 13*2,2 mm



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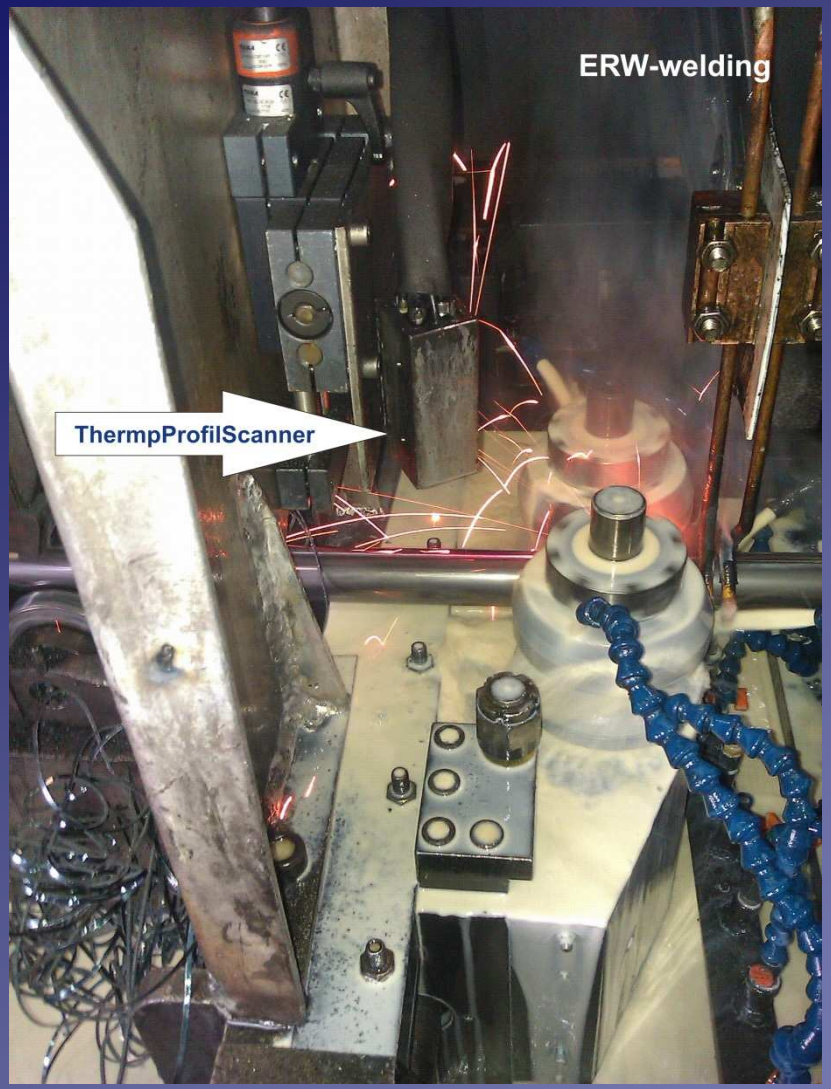
Examples for mounting of the TPS



HFI – process

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HFI – process 105 x 3 mm / 30 m/min

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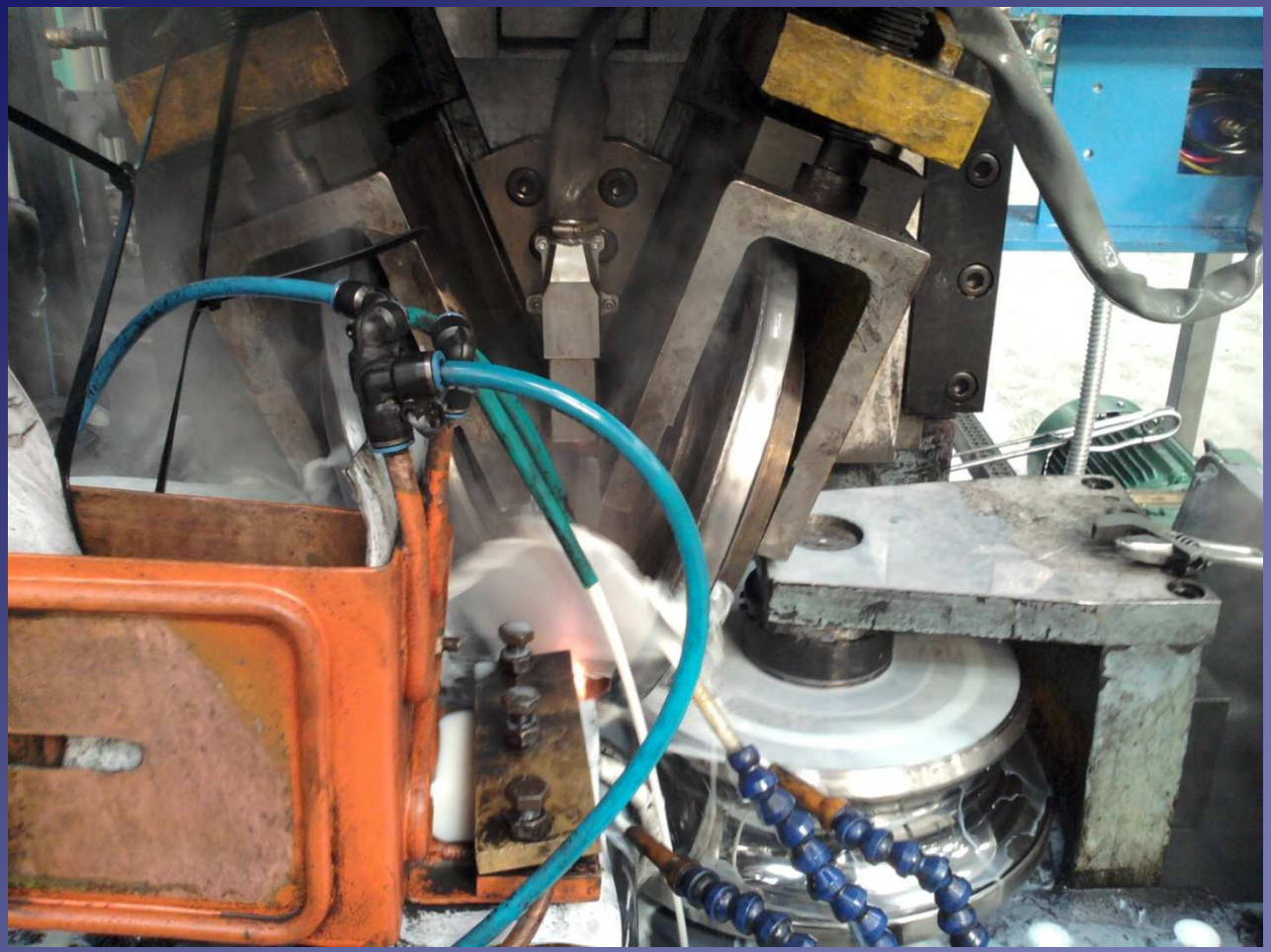
HFI – process 80 x 3 mm 40 m/min



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HFI – process 90 x 2 mm / 79 m/min

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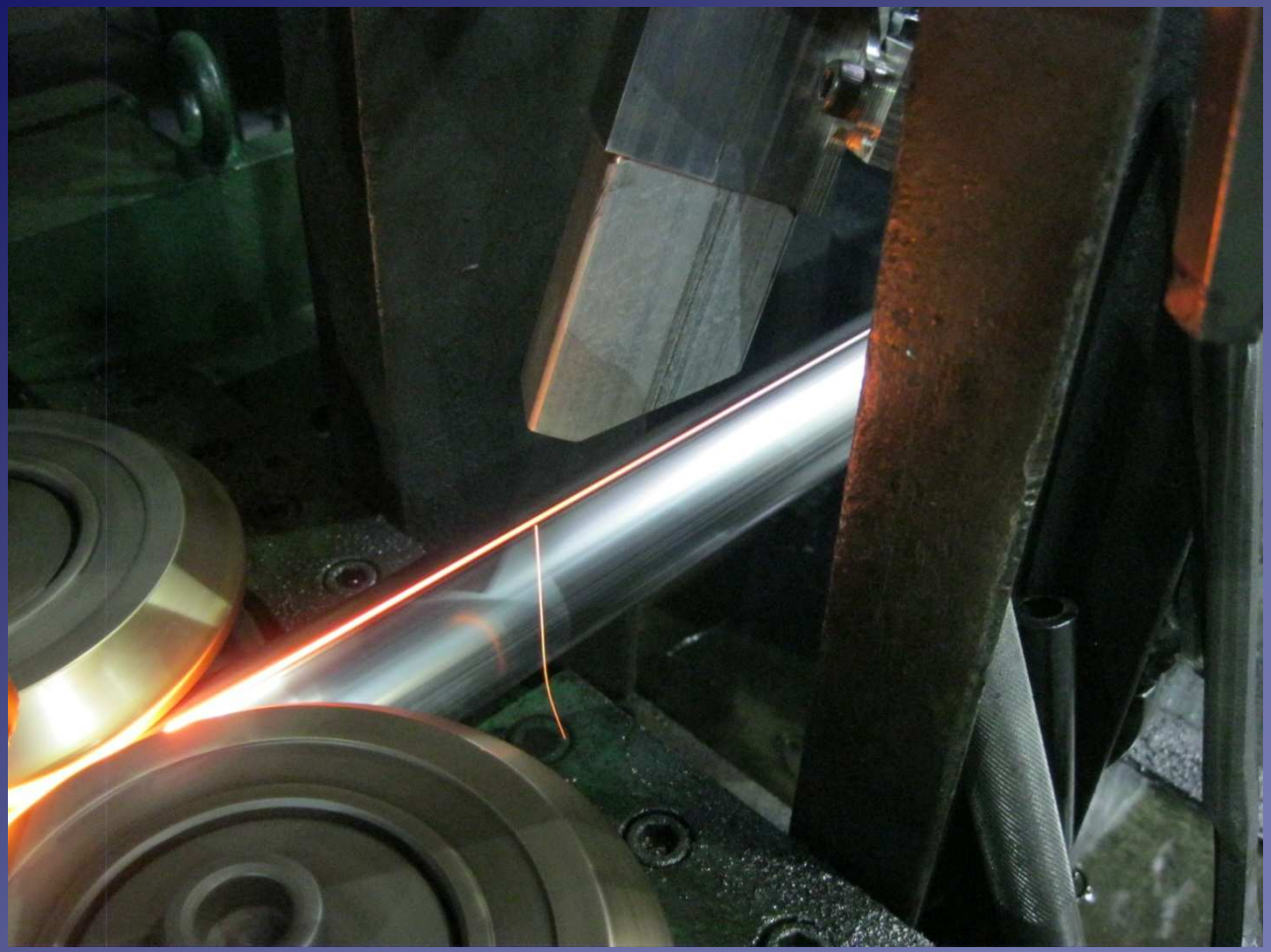
HFI – process 120 x 4.5 mm / 45 m/min



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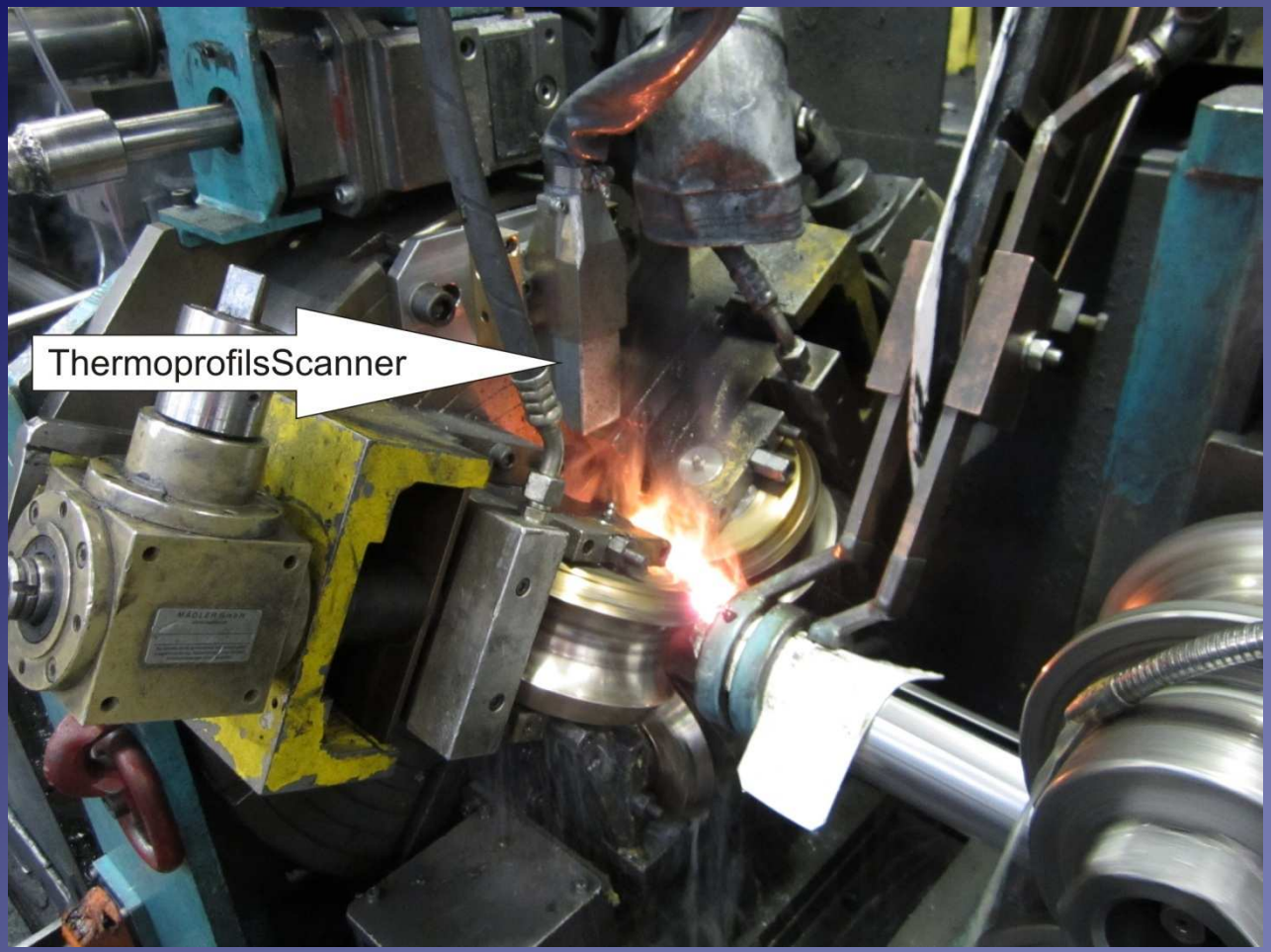
HFI - welding



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Many thanks for your interest

For further questions please
do not hesitate to contact us:

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