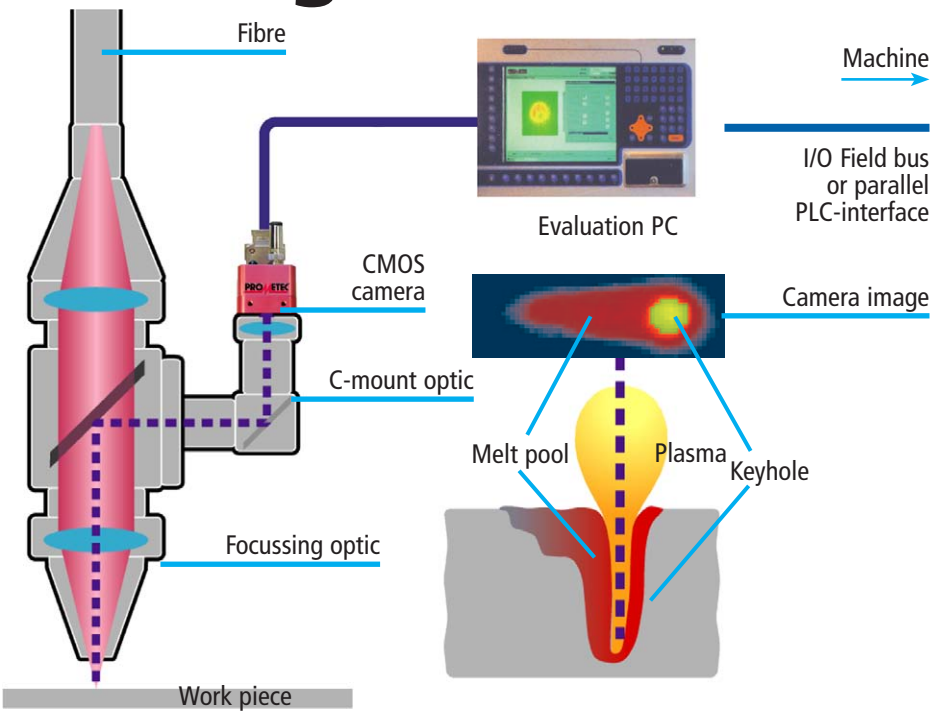
PROMETEC®
Monitoring Solutions

Continually measuring Monitoring System
for Quality Control and Assurance of Laser manufacturing processes

Process Monitoring System Welding Monitor PD 2000



Assure efficient production through objectively assessed quality

for processes with high power lasers (CO_2, Nd:YAG, HDL)

What you see is what you get

Transparent set-up monitoring through the use of CMOS-cameras. Changes in the process image equal physical effects. This delivers the basis of a stable monitoring.

Versatile system application = protects your investment

Newest image processing technologies enable you to analyze and solve yet unknown monitoring tasks. The systems usage is not bound by empirically determined results and experiences from the past. This allows the solution of your present as well as your future tasks thereby securing a long life for your investment.

Process optimization

The direct image of the process as well as the generated signals offer a tool to determine the optimum process parameters.

Documentation of process quality

Field of application

- **In-process monitoring of welding processes using high power lasers (CO_2, Nd:YAG and HDL)**
  From simple one dimensional welding operations with constant weld parameters to complex parts with a large number of welds with mixed seam configurations.
- **In-process measuring and monitoring of characteristic process dimensions for laser processes. e.g.:**
  – Focal position
  – Weld position
  – Energy density
  – Feed rate
  – Shield gas
- **In-process monitoring of e.g.:**
  – Seam position
  – Seam width at a given depth in the material
  – Welding depth
  – Full penetration
  – Melt pool geometry
  – Humping
  – Spatter
  – Holes
  – Gap in seam preparation

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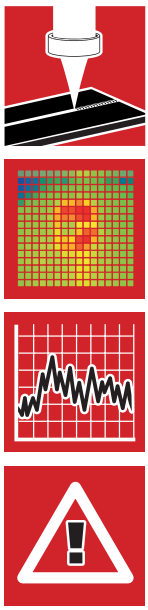
Function principle



Process
Camera records process and delivers

↓

Process image
Evaluation of the process image through algorithms delivers

↓

Signal curve
Monitoring of the signal curve by limits delivers

↓

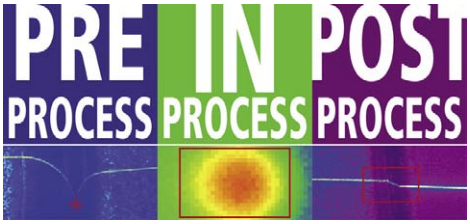
Alarms, Report Messages of OK / NOK parts etc.

A CMOS-camera is orientated coaxially to the laserbeam. This position delivers geometric dimensions as well as intensity distributions of the surface of the zone of interaction as well as from the depth of the keyhole. Signals which mirror changes in specific process or weld dimensions are generated from this camera information. These signals are monitored by limits.

The determined signal and monitoring data can be secured for the documentation of process quality.

System properties

- In-Process Monitoring
- Image processing with CMOS camera technology
- Monitoring frequency ≥ 1 KHz
- Communication with machine controls using field-bus or parallel interface
- Simultaneous monitoring of up to 8 process- or weld dimensions
- Option for compact multi-camera solutions
- "Ready for Industry 4.0"
- **New: Additional Pre- and Post-Monitoring** for seam preparation *(faulty seam preparation, misalignment of weld edges, gap, seam trakking, …)* and process result *(faulty surface, top bead depression, surface pores)*



Monitoring examples:
Lap Joint (zinc-coated sheets)

IN PROCESS MONITORING

Welding Result	*Camera image*	*Monitoring Result (false weld)*
top view / reverse view	evaporating zinc coating; film analysis	OK; laser beam; zinc coating; side view; false weld detection
		A small gap enables the evaporated zinc to exhaust from the zone of interaction. The weld is okay.
top view / reverse view	2nd keyhole; film analysis	Fault; laser beam; zinc coating; side view; false weld detection
		We see more than you: Once the gap exceeds a certain value the welding result still appears to be perfect, but this time PD 2000 detects a second keyhole, which indicates **no connection** between the sheets.

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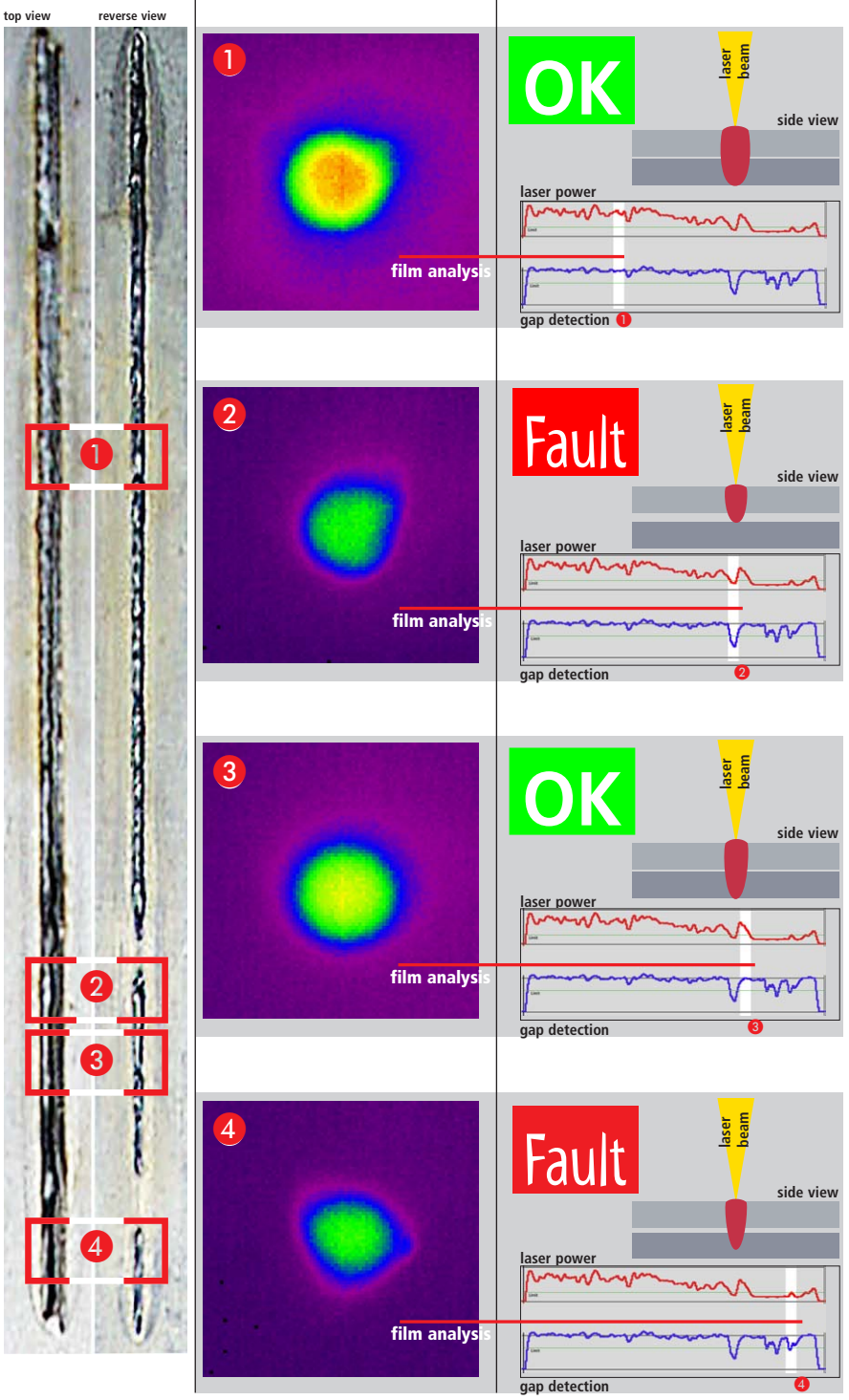
Monitoring example: Lap Joint

IN PROCESS MONITORING



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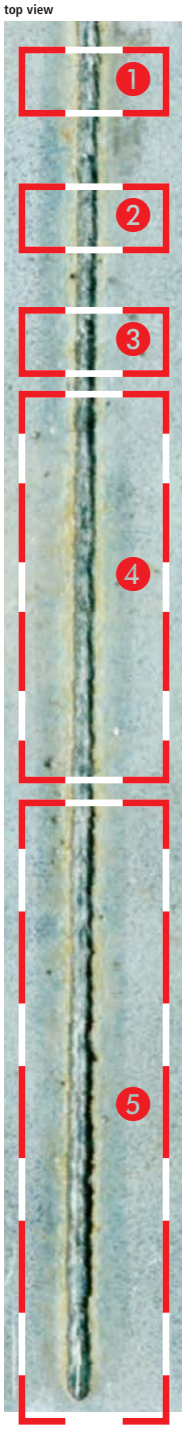
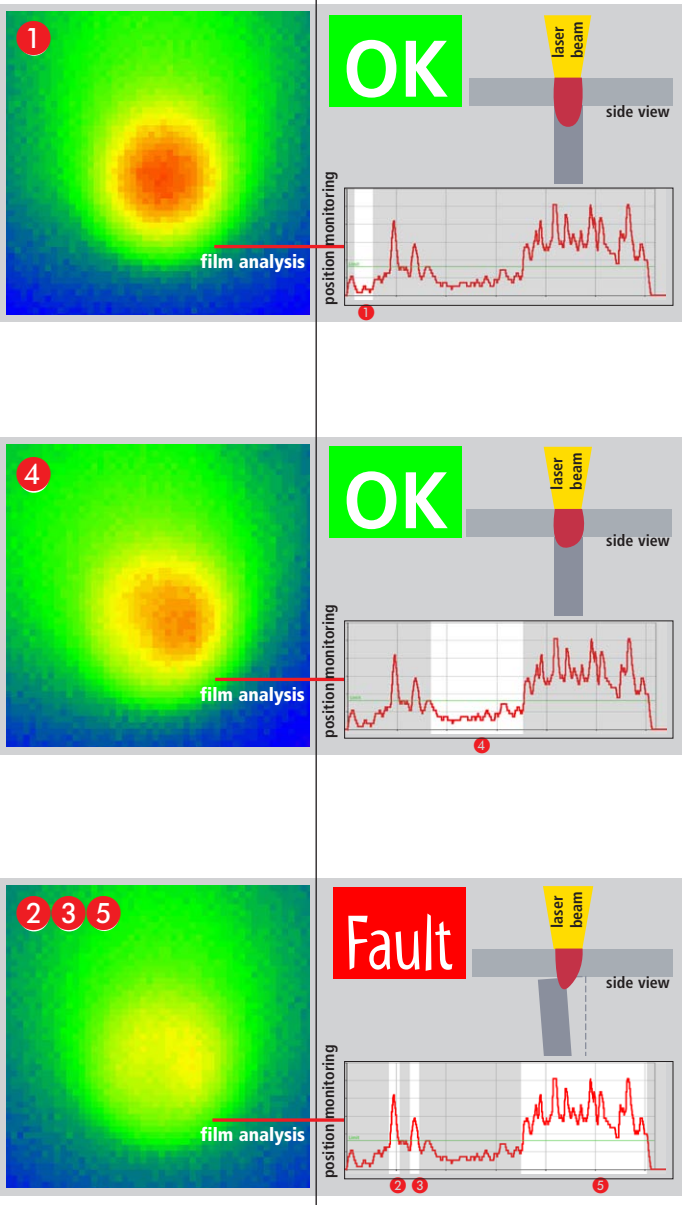
IN PROCESS MONITORING

Monitoring example: T-Joint

Welding Result	*Camera image*	*Monitoring (Position)*
top view		





We see more:
While the welding result as seen from above seems to be perfect, PD 2000 clearly shows (in-process!) an incorrect weld joint at positions 2, 3 and 5!

Monitoring of Machines, Processes, Tools and Lasers
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