

The power of light

RWS

Remote Laser Welding

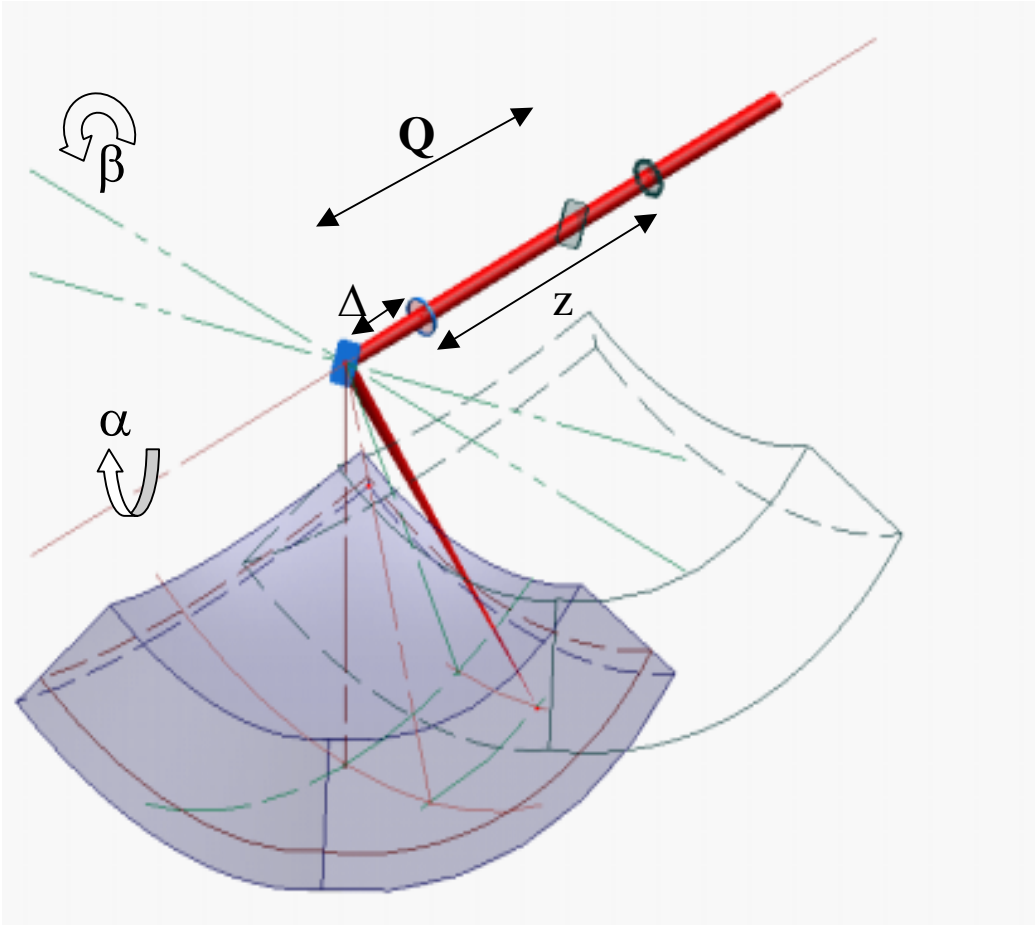
The Remote Welding in industrial applications

The power of light

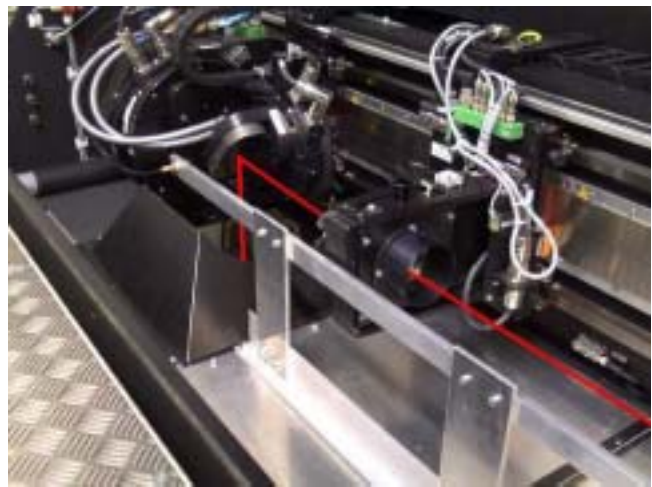
- Basic principle of a Remote Welding System
- Main Components (Laser, scanning head, plasma suppression, clamping)
- Target market (typical products, number of welding joints)
- Key advantages (flexibility, joint size adjusted to the necessary stiffness)
- Physical limits (Laserpower and welding speed)
- Economical aspects
- Samples for industrial installations (videos)
- Requirements for the future (availability, high productivity, On-line process control, process simulation -> Robcad)
- Summary

Basic principle of a Remote Welding System

The power of light

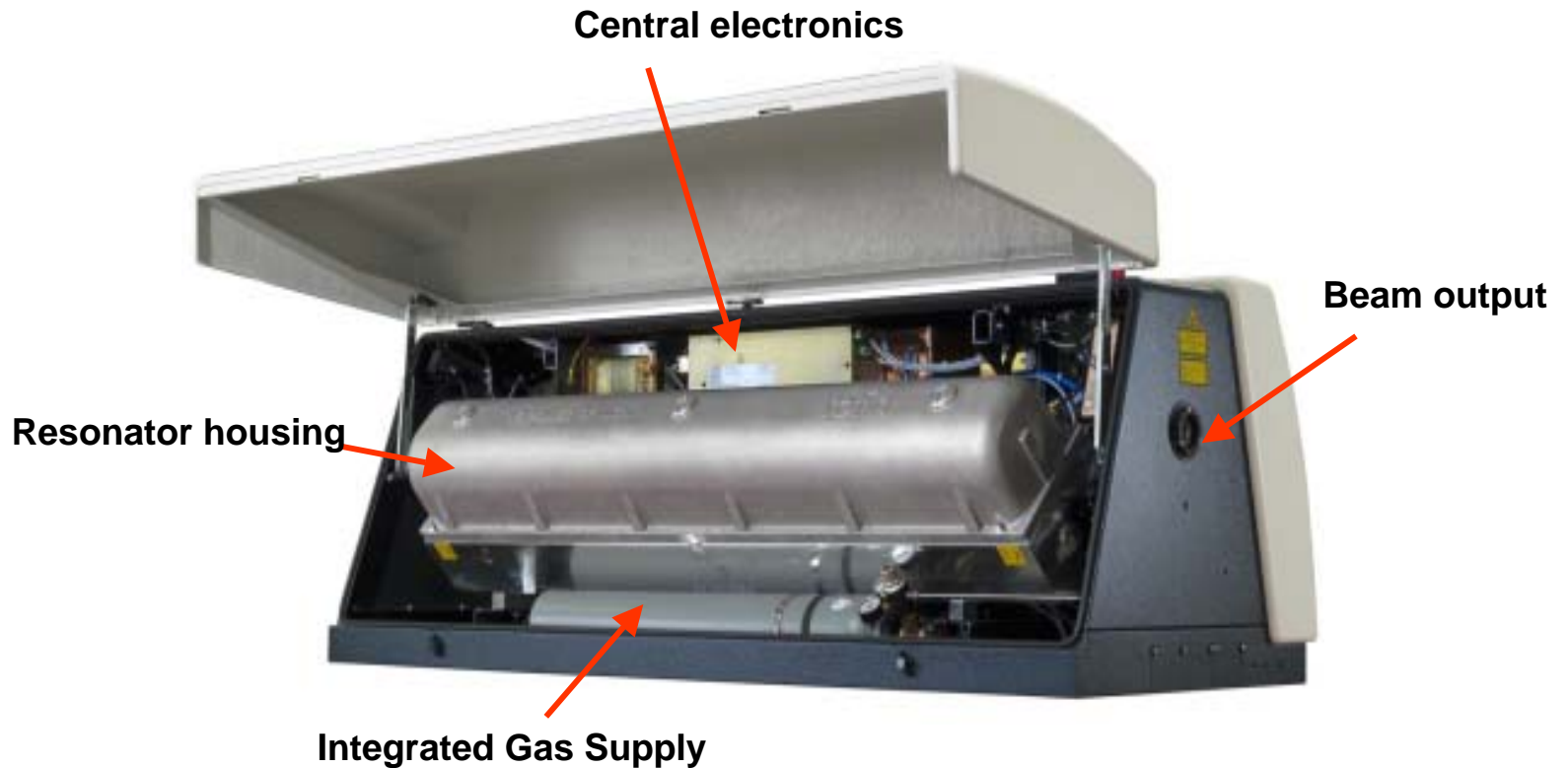


- z : lens movement
- α : scan axis
- β : scan axis
- Q : Movement of the scanning mirror
- Δ : distance lens - scanning mirror



Selection of Laser, CO₂ Slab laser

The power of light

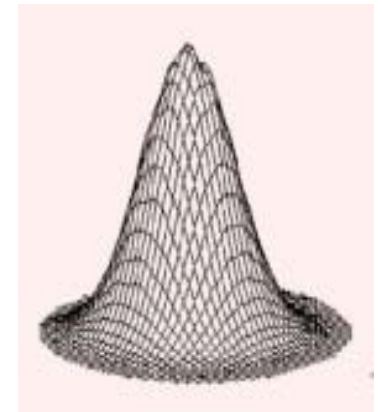
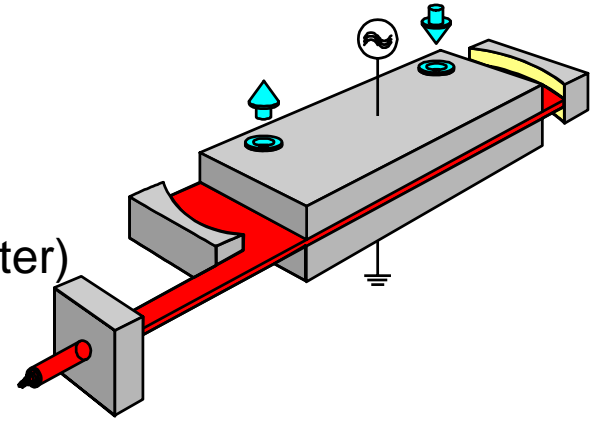


- **fund. mode CO₂ laser** : high intensity at max. working distance
- **CO₂ Slab laser**: highest quality, low service requirements

Advantages of Slab Technology

The power of light

- ⇒ **Compact**
- ⇒ **Excellent mode structure** (K-factor 0.9 or better)
- ⇒ **Low service and running costs**
 - * no moving parts
 - * resonator optics made from copper
 - * Diamond window as only transmissive component
- ⇒ **No external gas supply necessary**
- ⇒ **Extremely low gas consumption**

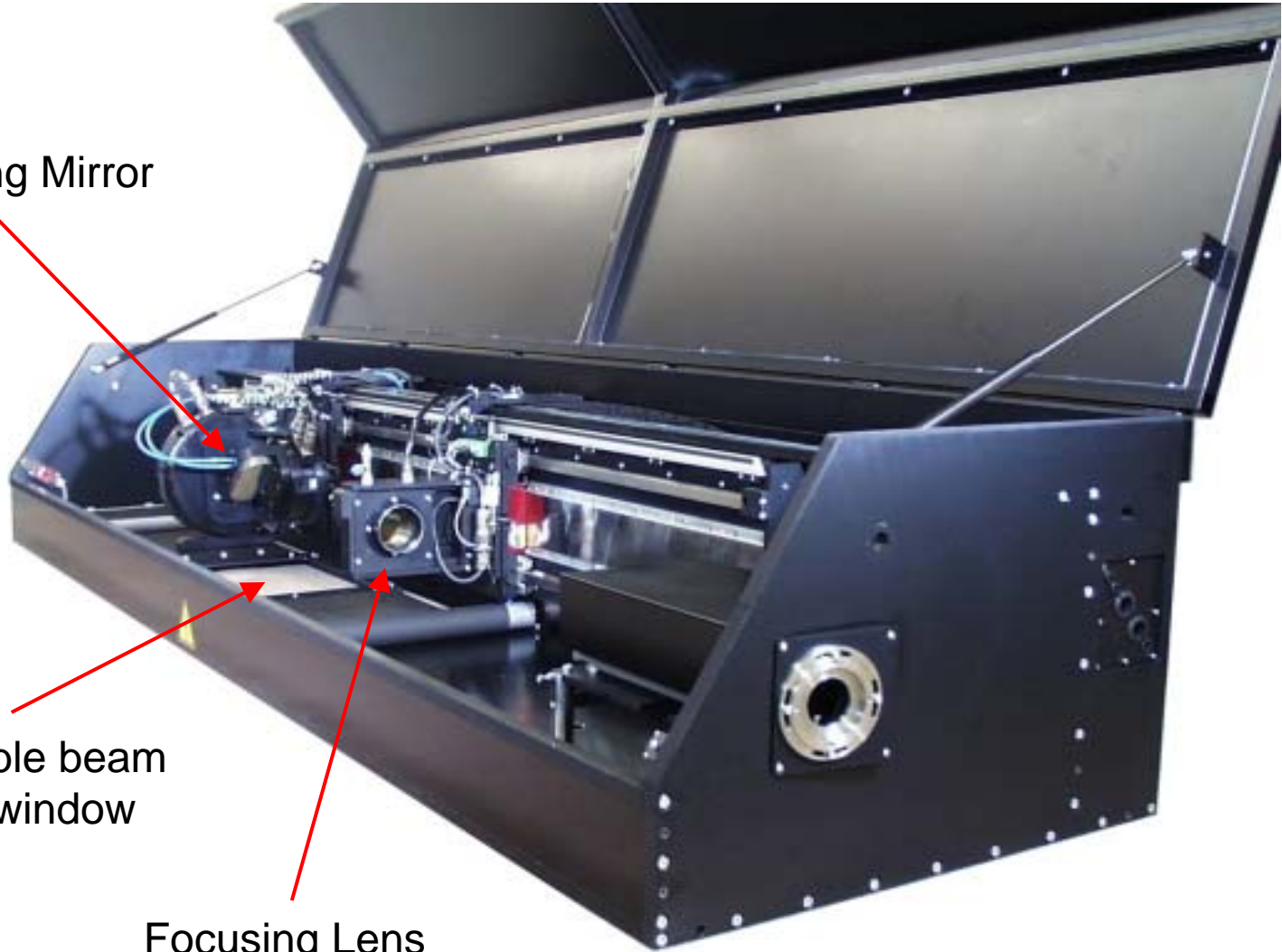


The power of light

Scanning Mirror

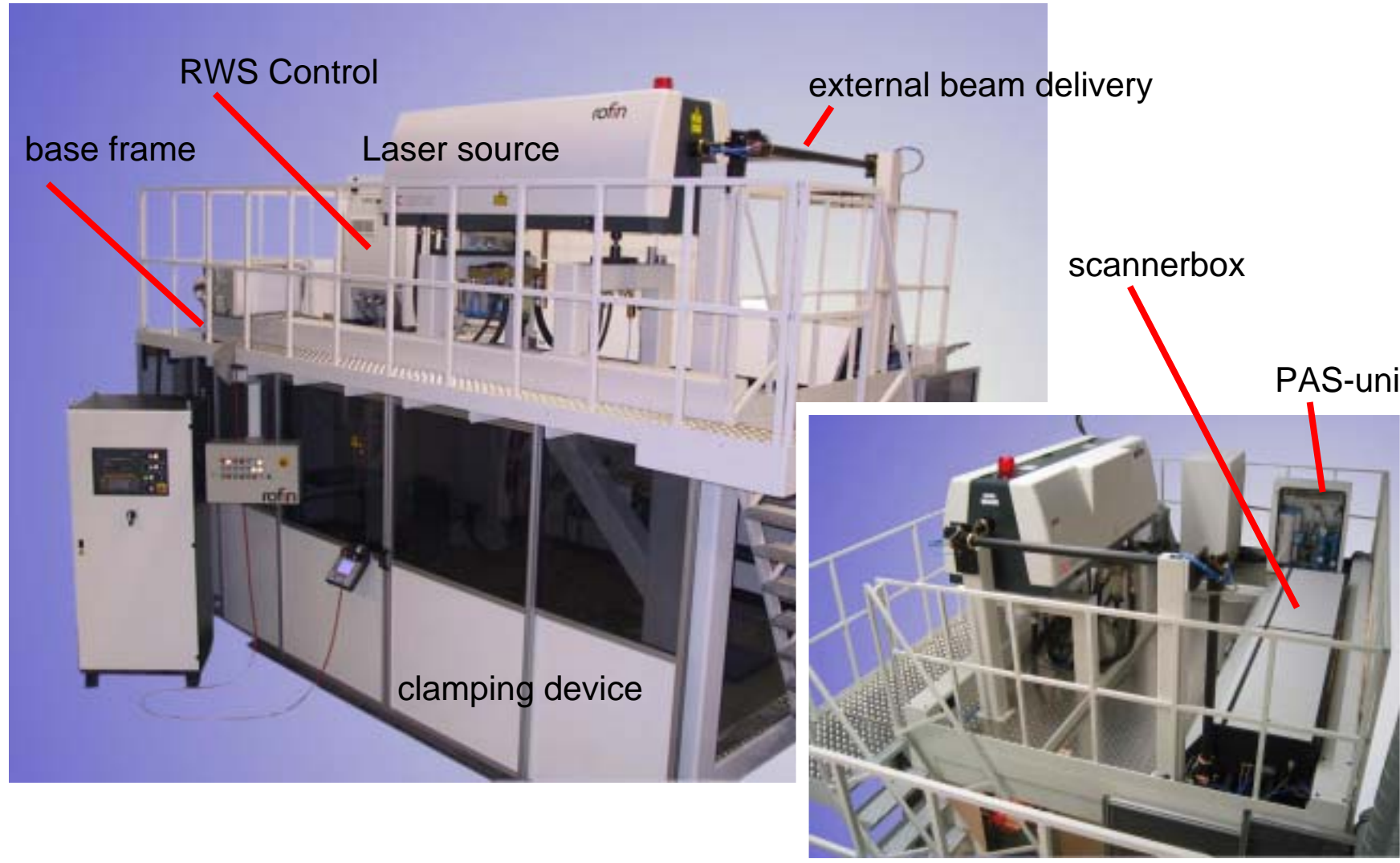
Moveable beam
output window

Focusing Lens

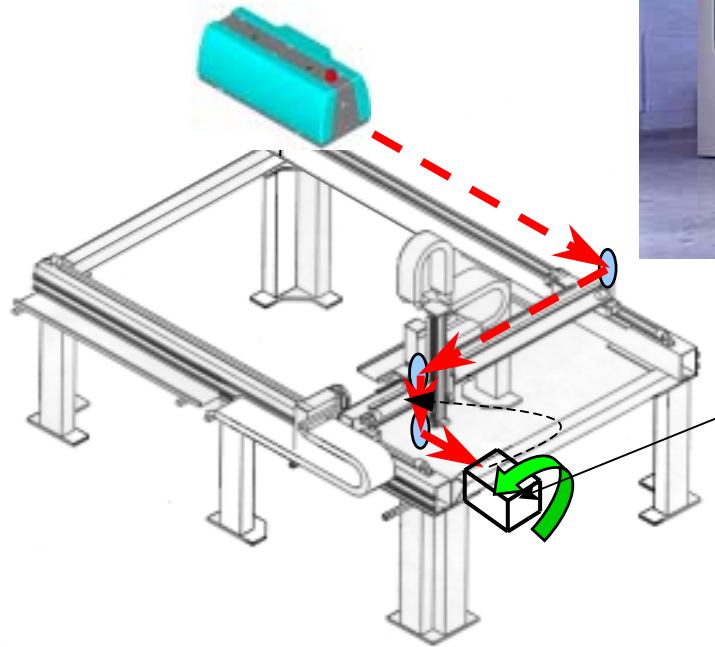


RWS 3.0 Main Components

The power of light



The power of light



SCAN SYSTEM
(3 OPTICAL AXES)



Target Market

The power of light



Commercial aspects

The power of light

Theoretical sample: car components, 100 welding positions, cycle time: 35 sec



3 sec/ Spot -> 300 sec welding time

-> 8,5 spot welding guns -> 9 welding guns

-> min. 9 robots necessary

costs:

50.000 €/ gun -> 450.000 €

plus: transport inside the working area

Assumption: 2 additional robots

-> plus ca. 100.000 €

total costs: 550.000 €

Not included: clamping, safety housing, Station PLC, load and unloading device, necessary floor space, running costs



3 m/min welding speed,

15 mm weld seam length

-> 100 x 0,3 sec = 30 sec welding time

+ 100 x 0,05 sec = 5 sec positioning time

-> 35 sec cycle time (-> one station)

costs:

500.000 € invest to move the focuspoint

total costs: 500.000 €

Key advantages (-> flexibility)

The power of light

- Flexibility:
- free programmable
 - different material thickness weldable with the same tool (1mm ... 5 mm thickness without any change of hardware)
 - different welding geometry's possible (stitch length adjusted to the strength requirements)

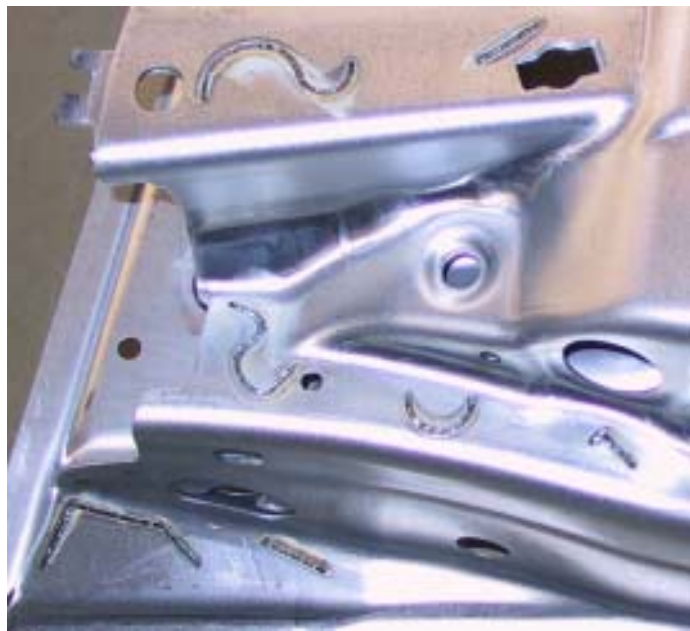
Aluminum, 1100
stitches /m²



Zn coated, 1,8 mm thickness
30mm/s, 3,5 kW, Helium



Zn coated, total thickness 2,5 / 2 mm
0,2 mm gap

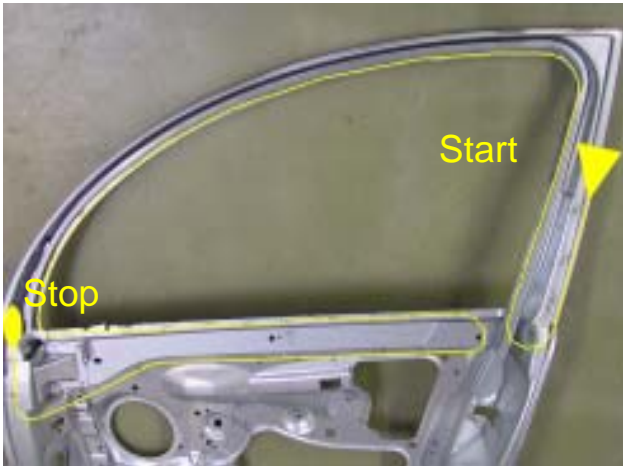


Key advantage (-> access to the welding position)

Door of a passenger car, 53 welding positions

The power of light

Robot+ fiber + solid-state laser
average moving speed (welding and movement) 5 m/ min
Total moving distance: 4,2 m
Total time: **50,4 sec**
Without any movement around the clamping devices



RWS:
welding time: 32,2 sec
movement time: 2,6 sec

Total time: **34,8 sec**

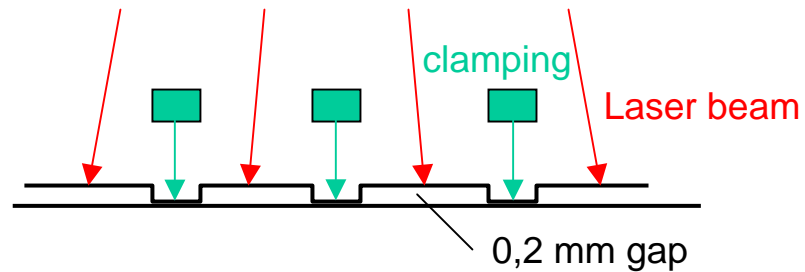


In the future:
up to 200 welding positions / min

-> real process time will increase
-> real process time depends on the clamping concept

Laser optimized design

The power of light



3-dimensional Surface, designed for resistance spot welding

- > Nearly impossible to create a defined gap for each welding position
- > poor welding quality

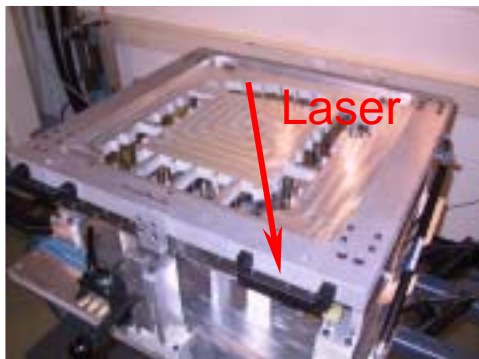
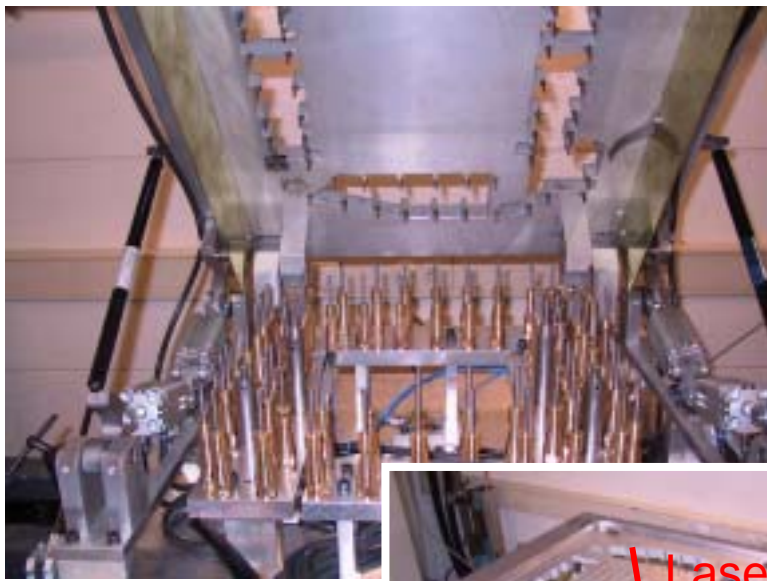
New clamping concepts

The power of light

Clamping device, designed for the special requirements of the Remote Laser Welding:

- „Access“ for the laser through holes in the upper clamping plate
- simple mechanical structure
- spring loaded clamping pins

Design by:



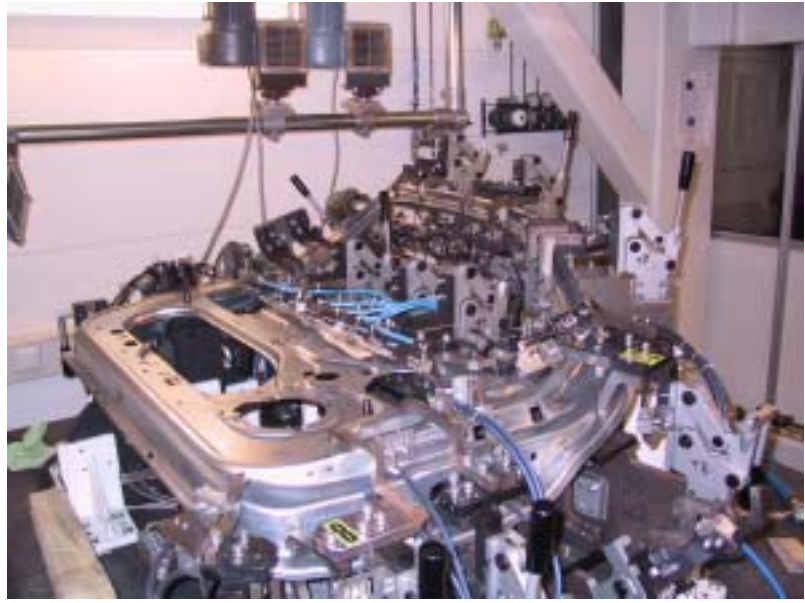
56 stitch welds,
 15 mm length
 0,6 mm to 1,5 mm
 3 KW Laserpower
 f = 1400 mm
 T= 22 sec

Design by:



Clamping device, designed in conventional technology:

- high number of separately operated clamping units
- high assembly and adjustment amount

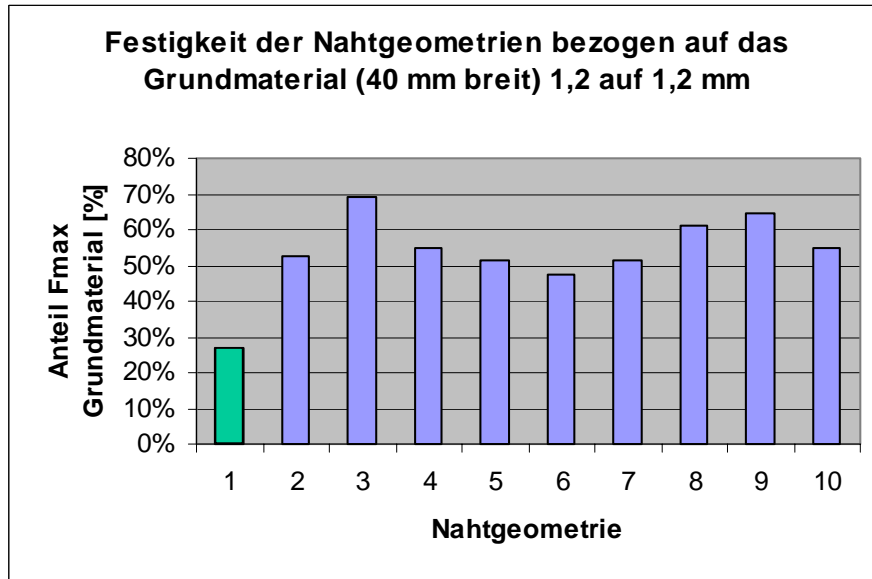


rofin

LASER MACRO

Tensile strength comparison between stitch weld and resistance spot weld

The power of light

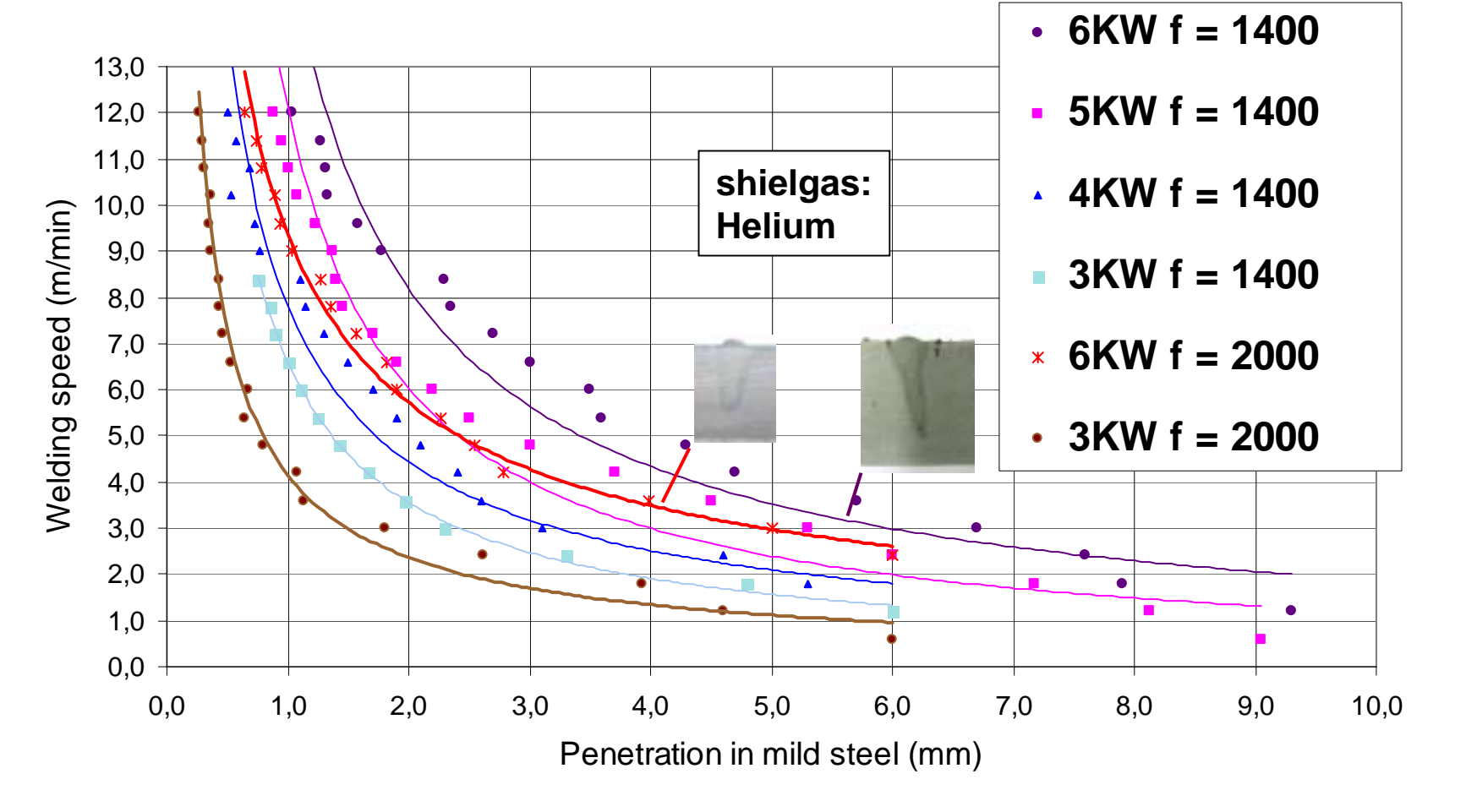


- 1: resistance spot weld
- 2: RWS linear stitch weld, 20 mm length
- 3: linear stitch weld, conventional, 20 mm length
- 4: RWS laser circle, diameter: 7mm
- 5: RWS linear stitch weld, 20mm without start- and endpoint
- 6: RWS linear stitch weld, start- and end direction parallel to pulling direction
- 7: RWS 2 half circles, end parallel pulling direction
- 8: RWS stitch weld (20 mm) micro weaving
- 9: RWS stitch weld (20 mm) micro spiral
- 10: RWS stitch weld (20 mm) shield gas: air

RWS 3.0: 6KW mit $f = 1400$ und $f = 2000$ mm

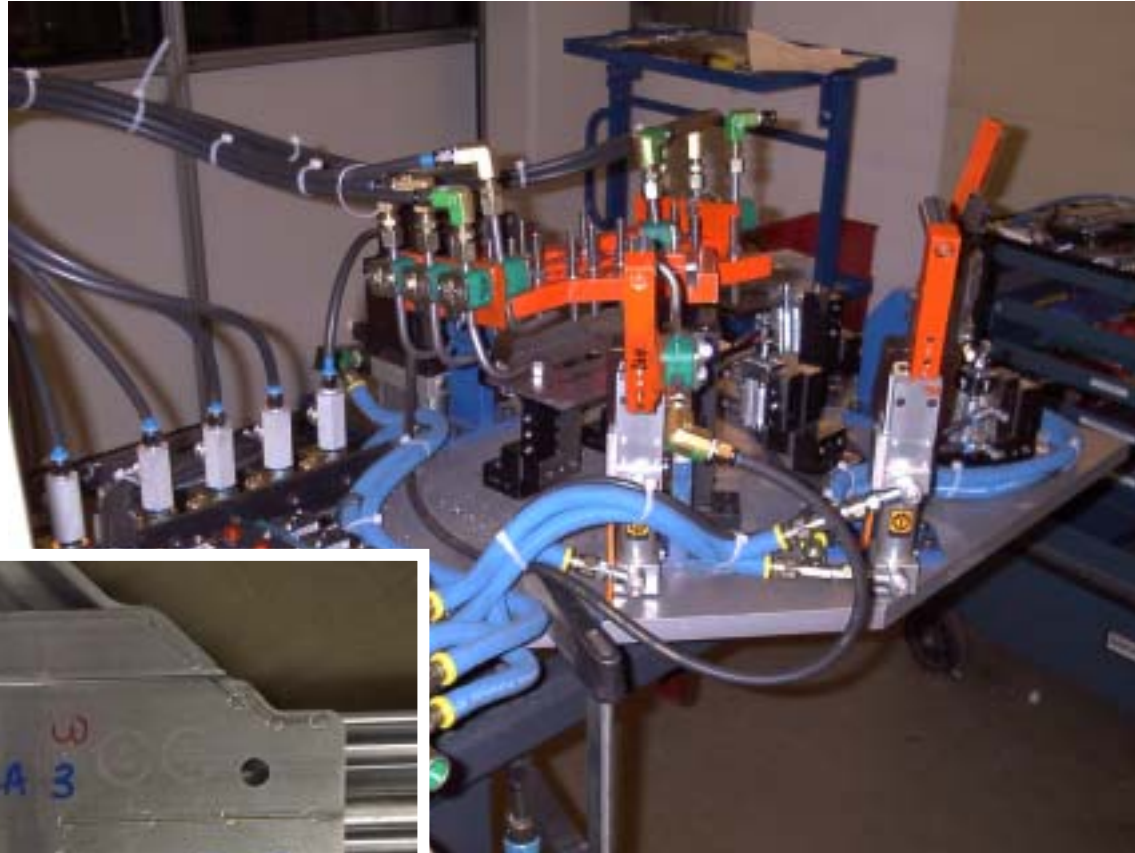
The power of light

Welding DC 060 RWS



Clamping device with integrated shield gas supply

AUTOTEK
INDUSTRIAL
de MÉXICO,
S.A. de C.V.



The power of light

Possible Laser operating rate

The power of light

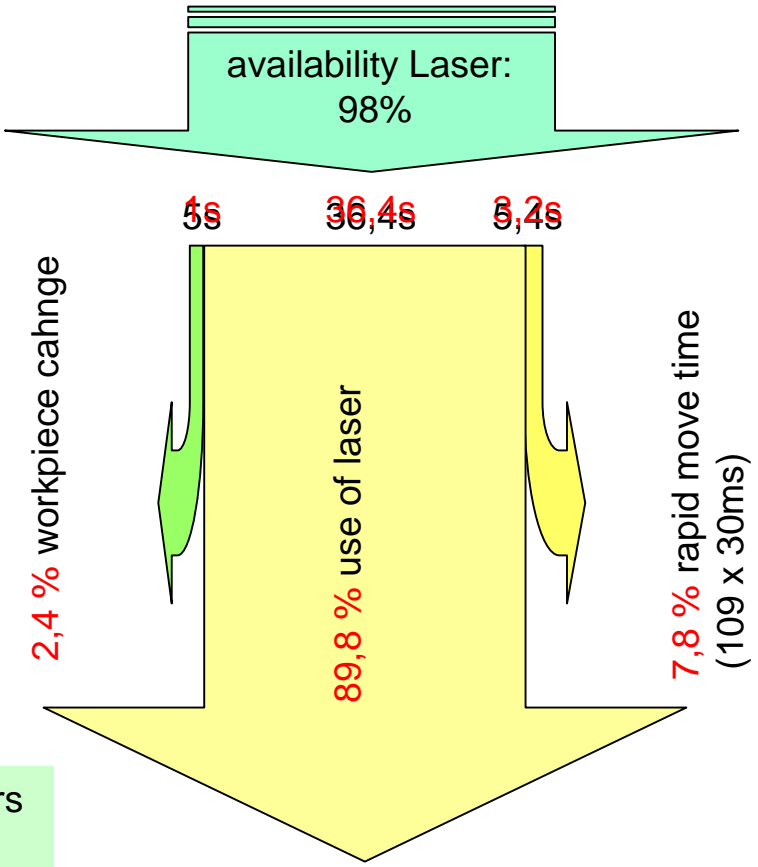
Typical System configuration:

- Automotive subassembly part
- 1mm / 1mm, overlap
- 109 stitch welds, each 15 mm
- welding speed: 45 mm/s
- Laser power: 3,5 KW
- f = 1600 mm
- Shield gas: no
- Cycle time: 47 sec
- Loading / Unloading by rotary table

Potential for optimisation:

- workpiece change over time can be reduced with the help of the movement of the scanning head, change over time < 1 s possible -> **4 sec cycle time savings**

- detailed fine tuning of all movement Parameters will reduce the rapid move time from 50 ms to 30 ms -> in total: **2,2 sec time savings**



Aspects of availability

The power of light

Remote Welding System, running in Production:

- High productivity
- high material output
- reduced floorspace
- short cycle times
- min. 2 (better 3) shift operation
- complex clamping devices
- just in time production
- up to 100 stitches / 30 sec



What happens in case of system repair or maintenance?



No chance for manual stand by

⇒ No Output

Requirements for easy maintenance and repair:

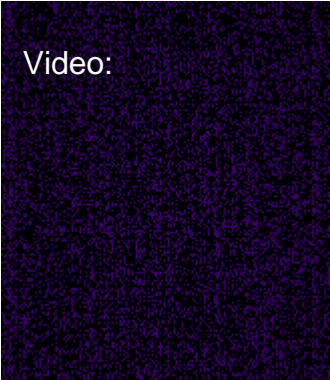
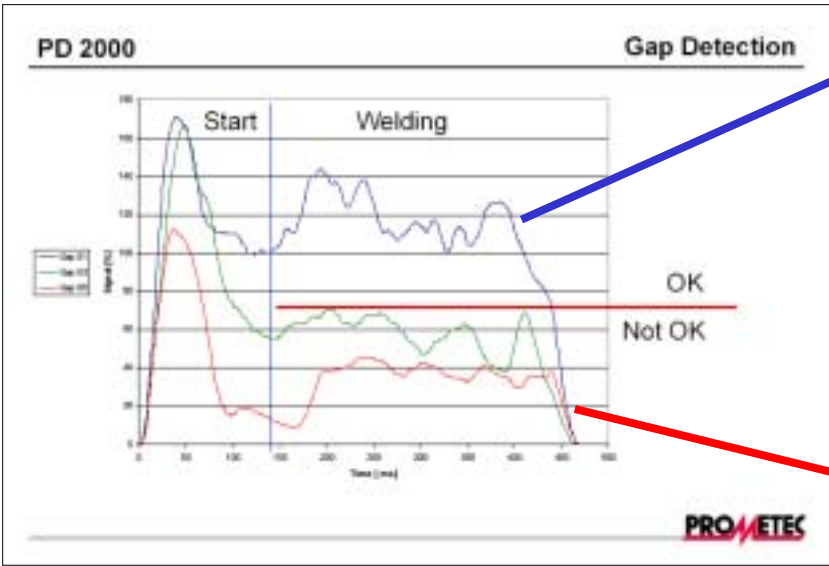
- easy access to all components inside the scanning box
- easy quick change feature for all “critical” components (scanning mirror, focussing lens)
- quick change feature for the complete scanning box in case of total failure

rofin

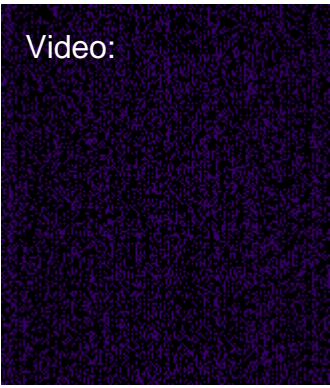
LASER MACRO

On-line process control

The power of light



0,1mm Spalt
complete
penetration



0,5mm Spalt
incomplete
penetration

References

The power of light

Installations, used for process qualification and system tests:

- RS Inc.	USA		DC 035	1998
- Aetna	USA		DC 035	1998
- CRF	Italy		DC 035	1999
- Sofedit	France		DC 035	2000
- FIAT	Italy	RWS 2.1	DC 035	2001
- SEF	Germany	RWS 3.0	DC 045	2001
- VW	Germany	RWS 2.2.	DC 035	2001 (9 month system test)
- Volvo	Sweden	RWS 2.1	DC 035	2003 (4 month system test)
- RS Inc.	USA	RWS 3.0	DC 045	2003
- Hyundai	Korea	RWS 2.1	DC 045	2004
- RBJ	Japan	RWS 3.0	DC 050	2004
- Magna	Canada	RWS 3.0	DC 050	on order
- Gestamp	Spain	RWS 2.2	DC 040	2004
- Uni-Madrid	Spain	RWS 2.2	DC 035	2004

Installations for Production:

- Laple	Germany	RWS 2.2	DC 035	2001
- Conf. 2	Germany	RWS 2.2	DC 040	2002 3-shift operation
- Conf. 2	Germany	RWS 3.0	DC 040	2003
- Magna	Mexico	RWS 3.0	DC 045	2003
- Conf. 3	USA	RWS 3.0	DC 060	2004 on order
- Conf. 4	USA	RWS 3.0	DC 060	2004 on order
- Conf. 5	Germany	RWS 3.1	DC 035	2004 Delivery by SEF

- Remote Welding technology is going into use in real production
- Economic efficiency depends on detailed check of the application and welding task (-> correct selection of laser power and focal length)
- According to the long focal length, new and mostly cheaper clamping concepts are possible
- Compared to conventional laser welding a cycle time reduction between 30.. 50 % is possible
- Integration into new systems is supported by standard tools (like ROBCAD simulation)