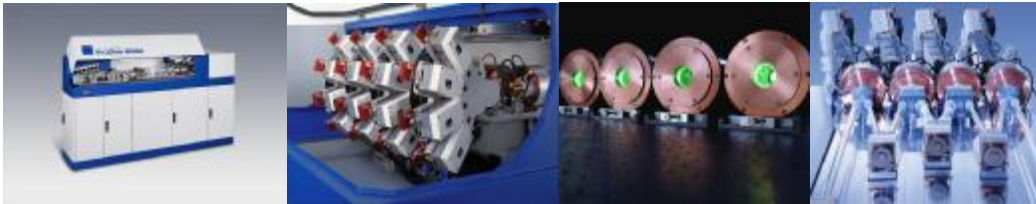


TRUMPF



Material Processing with the TRUMPF Disk Laser

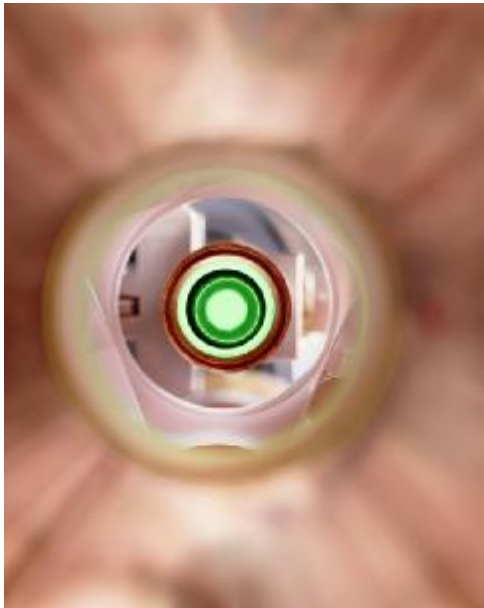


Rüdiger Brockmann
Product Management
TRUMPF Laser
Schramberg
07.05.2007

Mikael Mimer
Laser Product Manager
TRUMPF Sweden
Alingsås



Outline



§ TRUMPF Disk Laser

§ Further Development

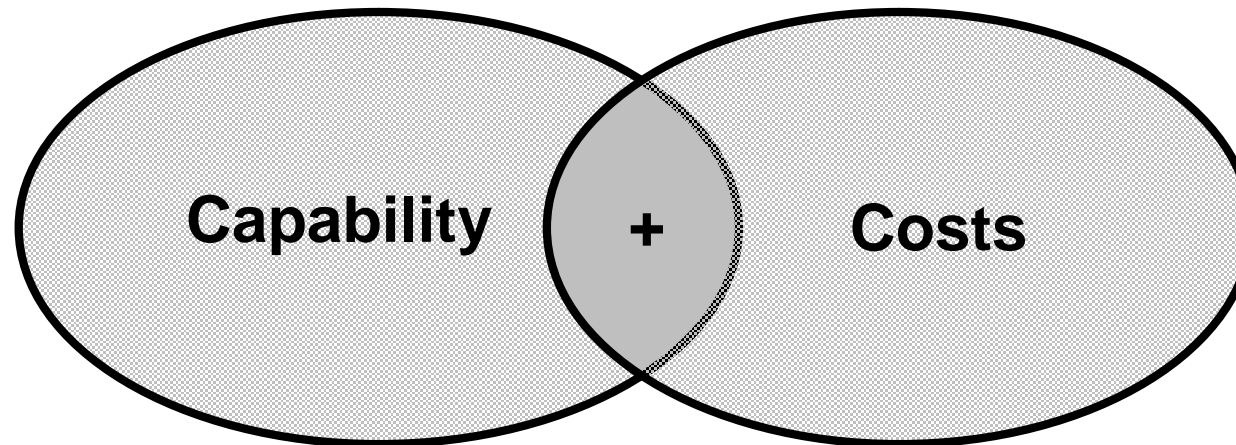
§ Applications of the Disk Laser

- Welding
- Cutting

§ Conclusion



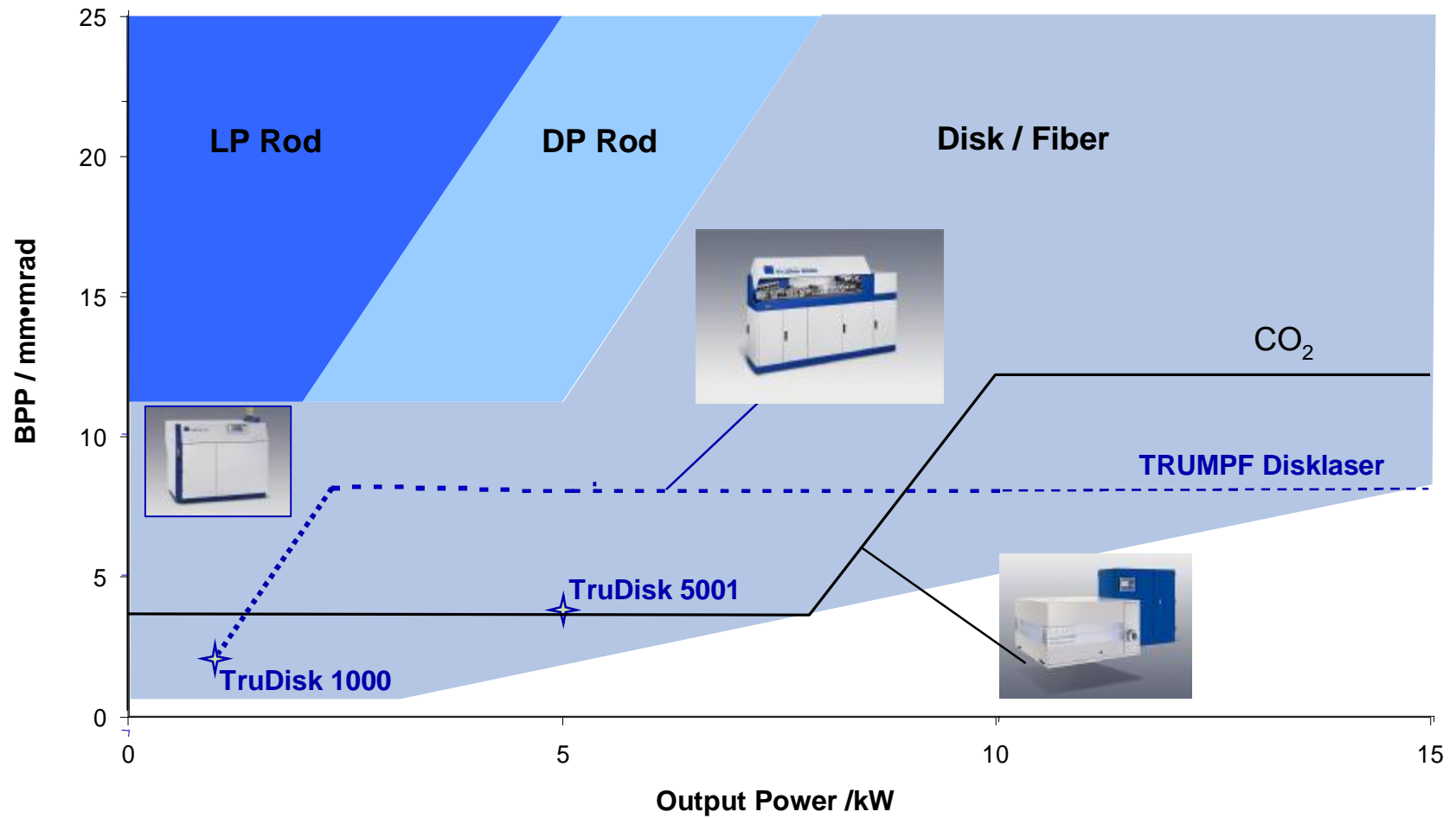
Criteria for the Use of Lasers



- Laserpower
- Beam quality
- Adapted Interfaces
- Reliability
- Investment costs
- Running costs



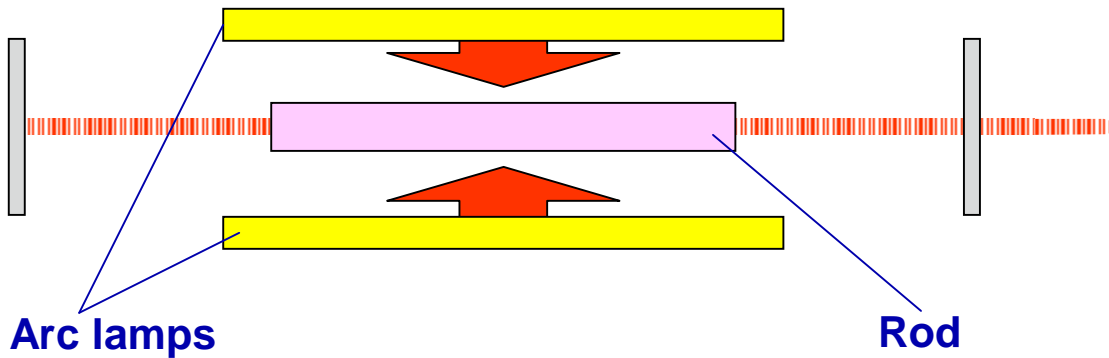
Beam Quality of High Power Lasers





Rod and Disk Laser

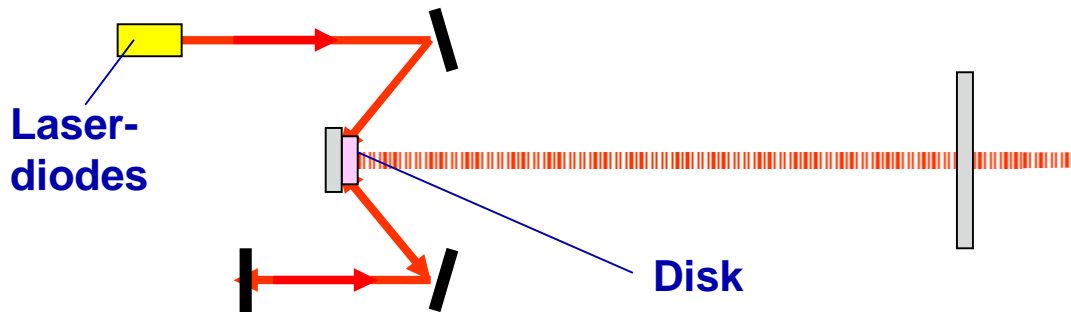
§ Lamp pumped rod



Beam quality
Efficiency

D
D

§ Diode pumped Disk



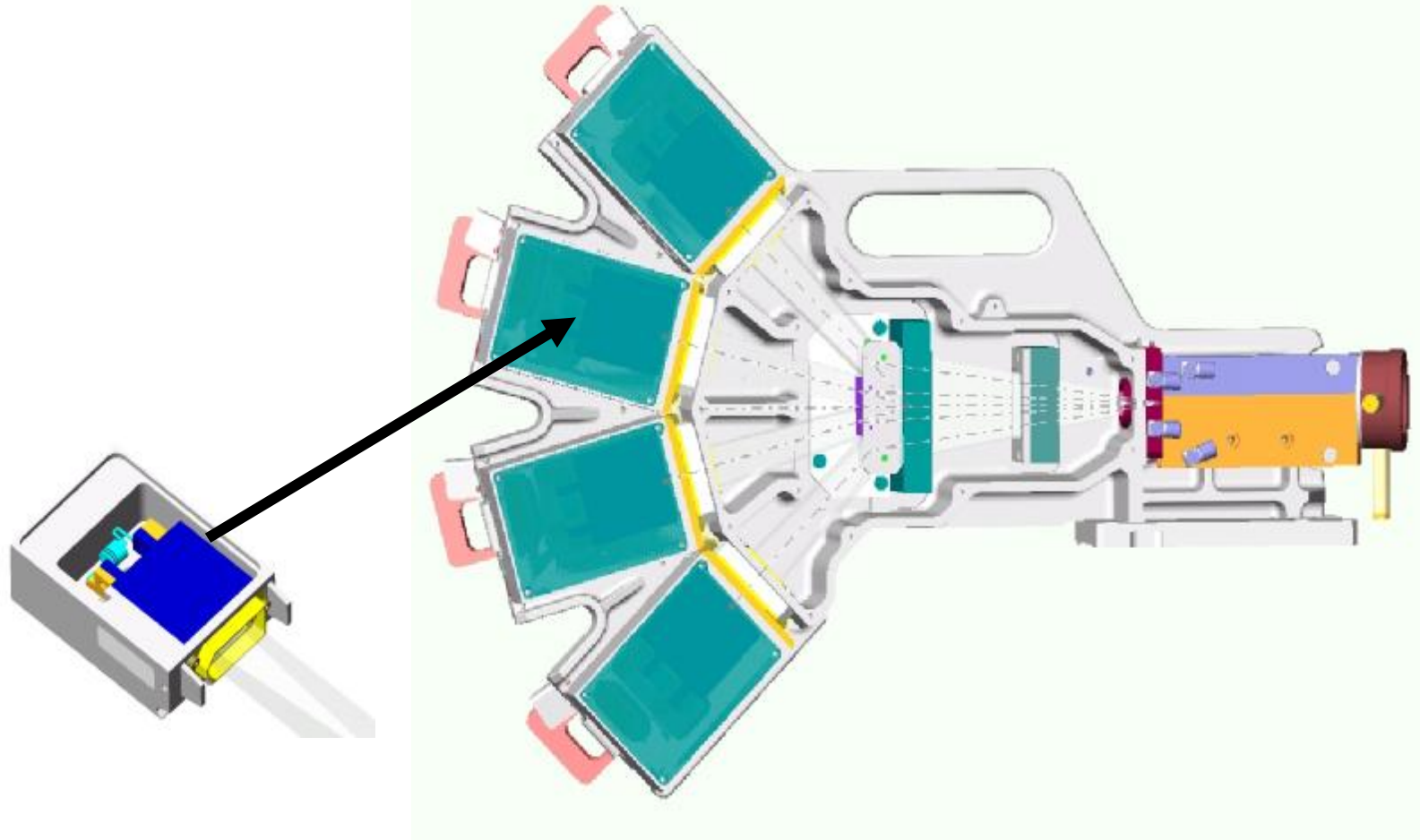
Beam quality
Efficiency

25% @
workpiece

C
C

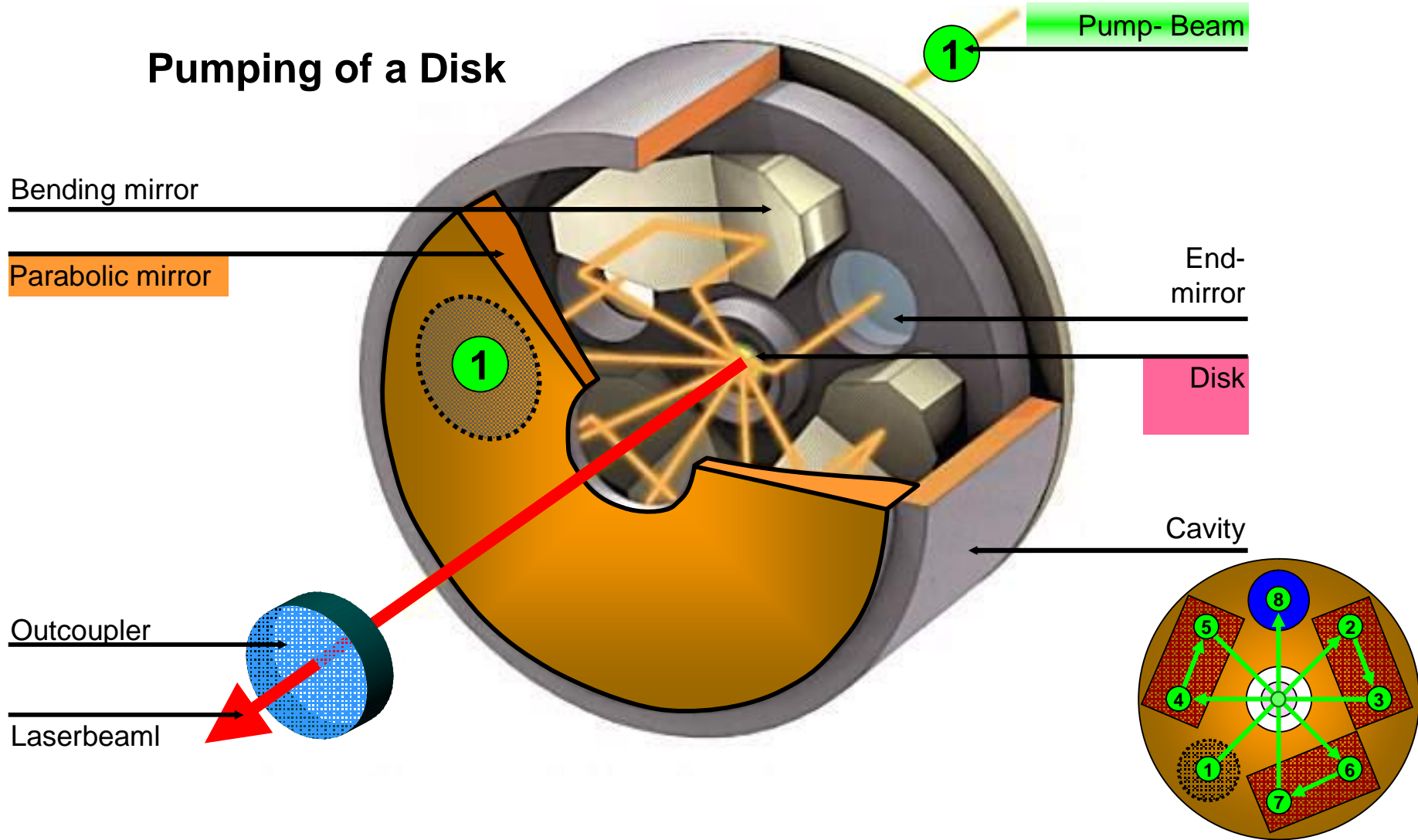


Pump Unit of a Disk Laser



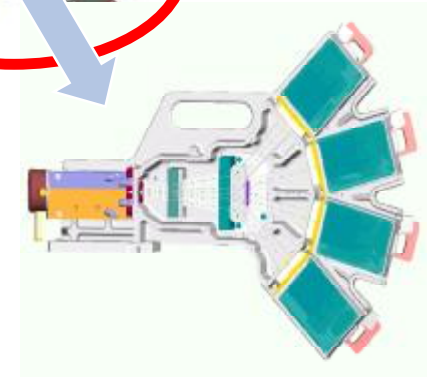
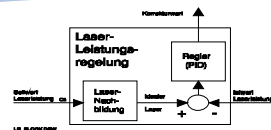
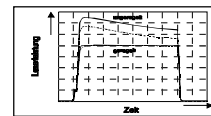
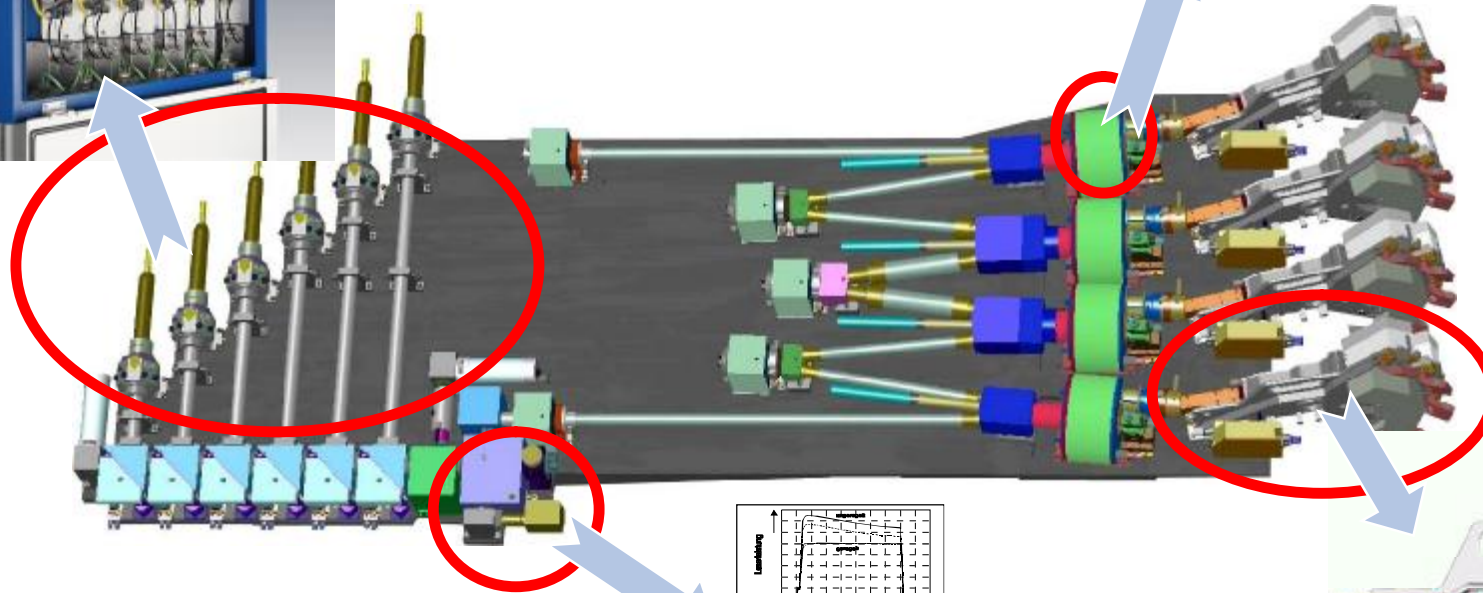
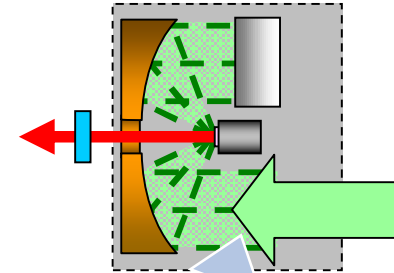
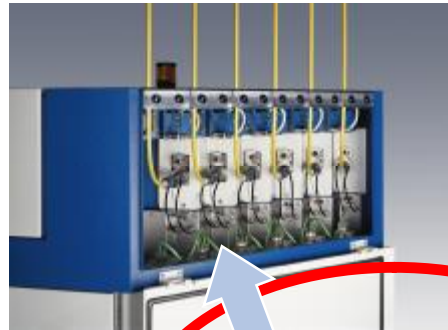


Pumping of a Disk



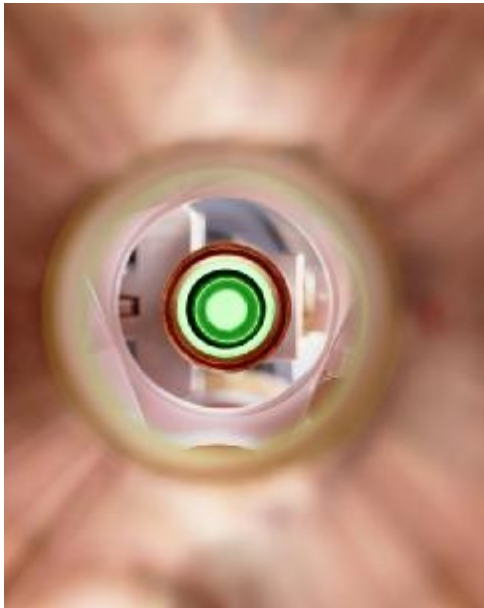


Disk Laser Design





Outline



§ TRUMPF Disk Laser

§ Further Development

§ Applications of the Disk Laser

- Welding
- Cutting

§ Conclusion

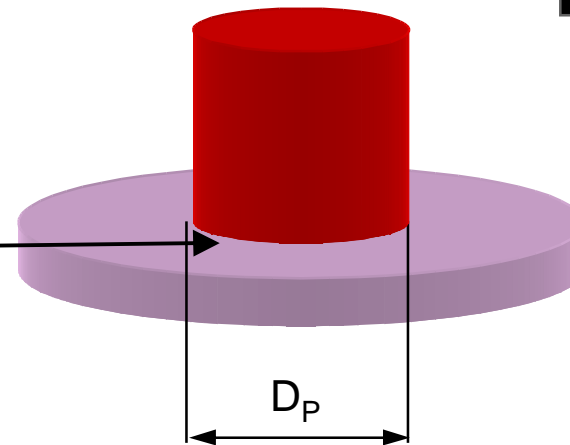
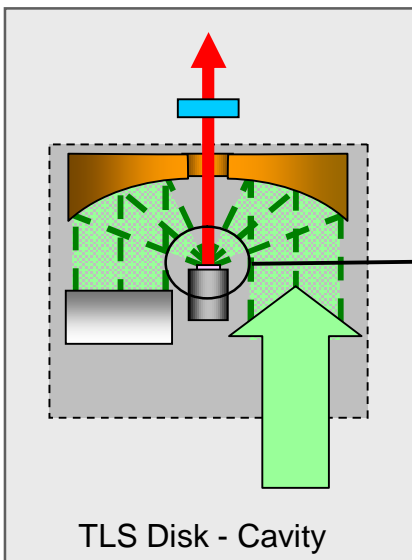
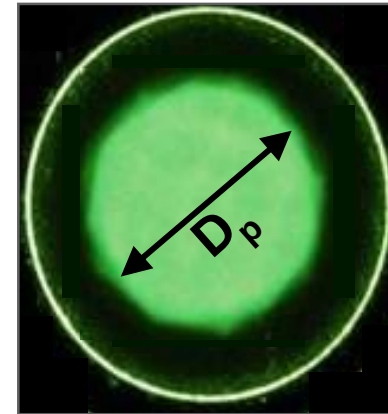


Scalability of Laser Output Power



a certain laser power
can be extracted per
unit of area

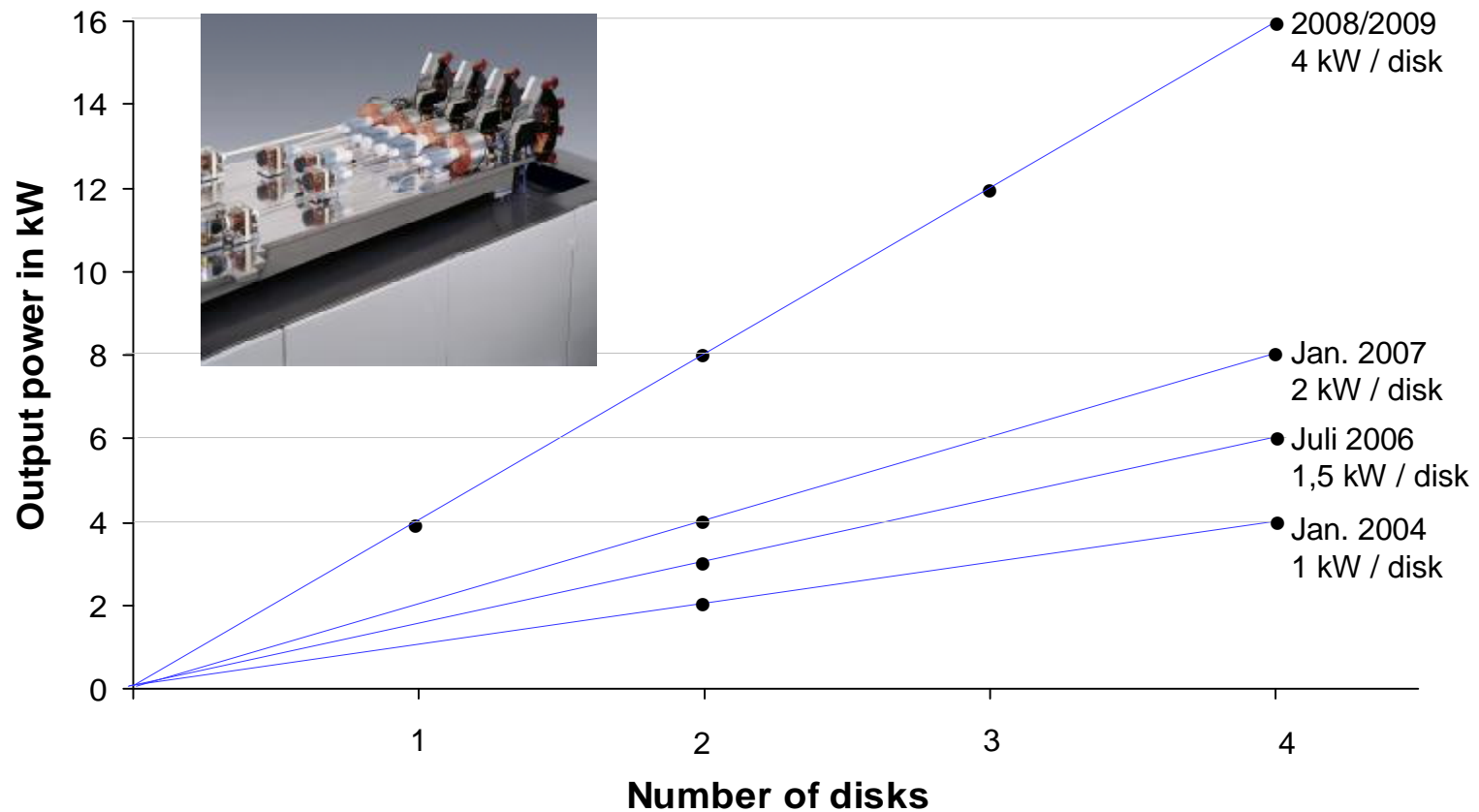
$$P_L \sim D_p^2$$



Pumped Spot

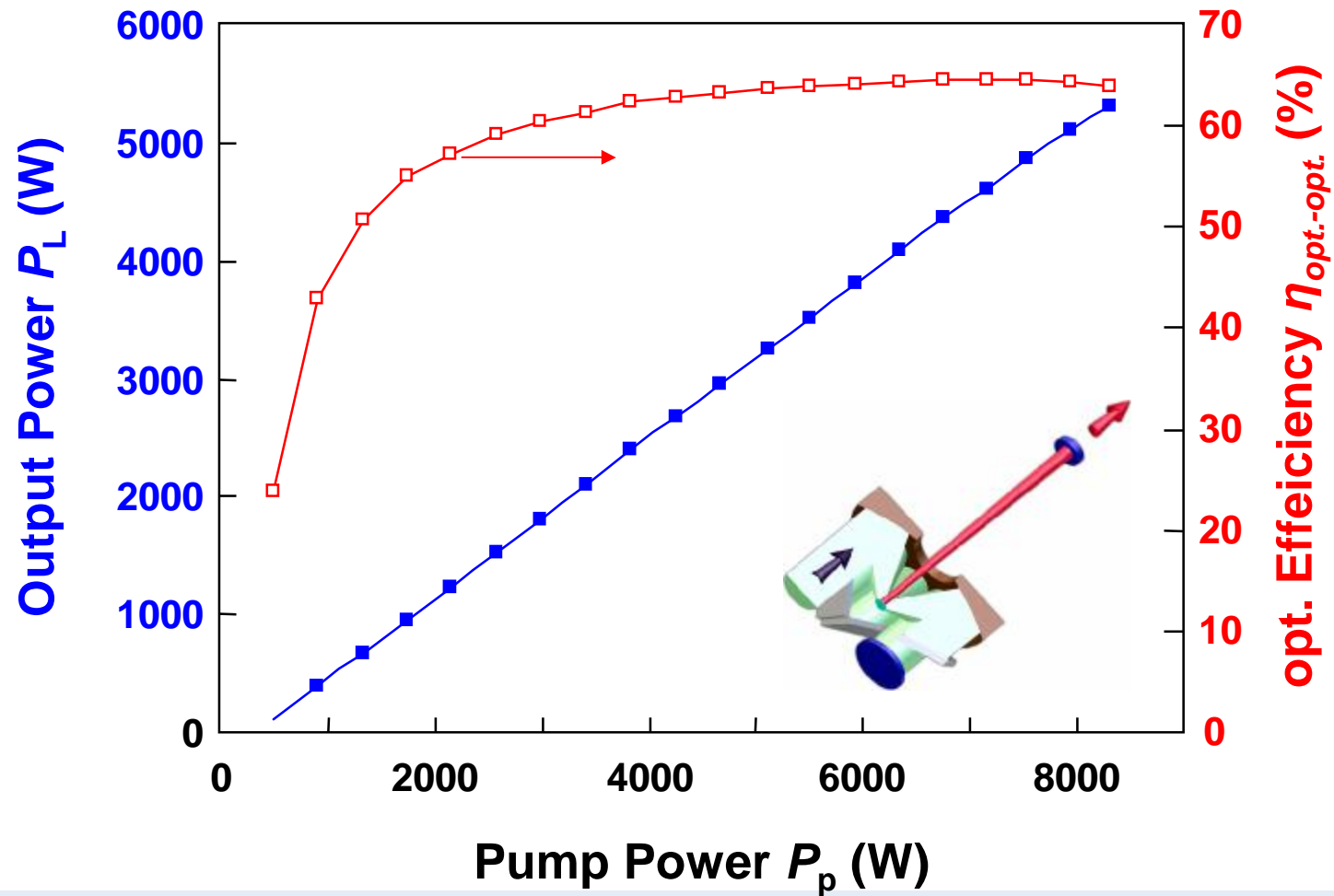


Output power of a disk laser depends on the pumping power per bar and the number of disks



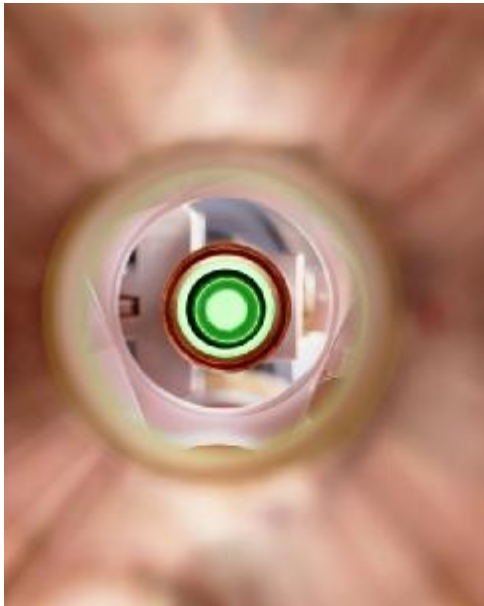


> 5 kW Output Power per Disk





Outline



§ TRUMPF Disk Laser

§ Further Development

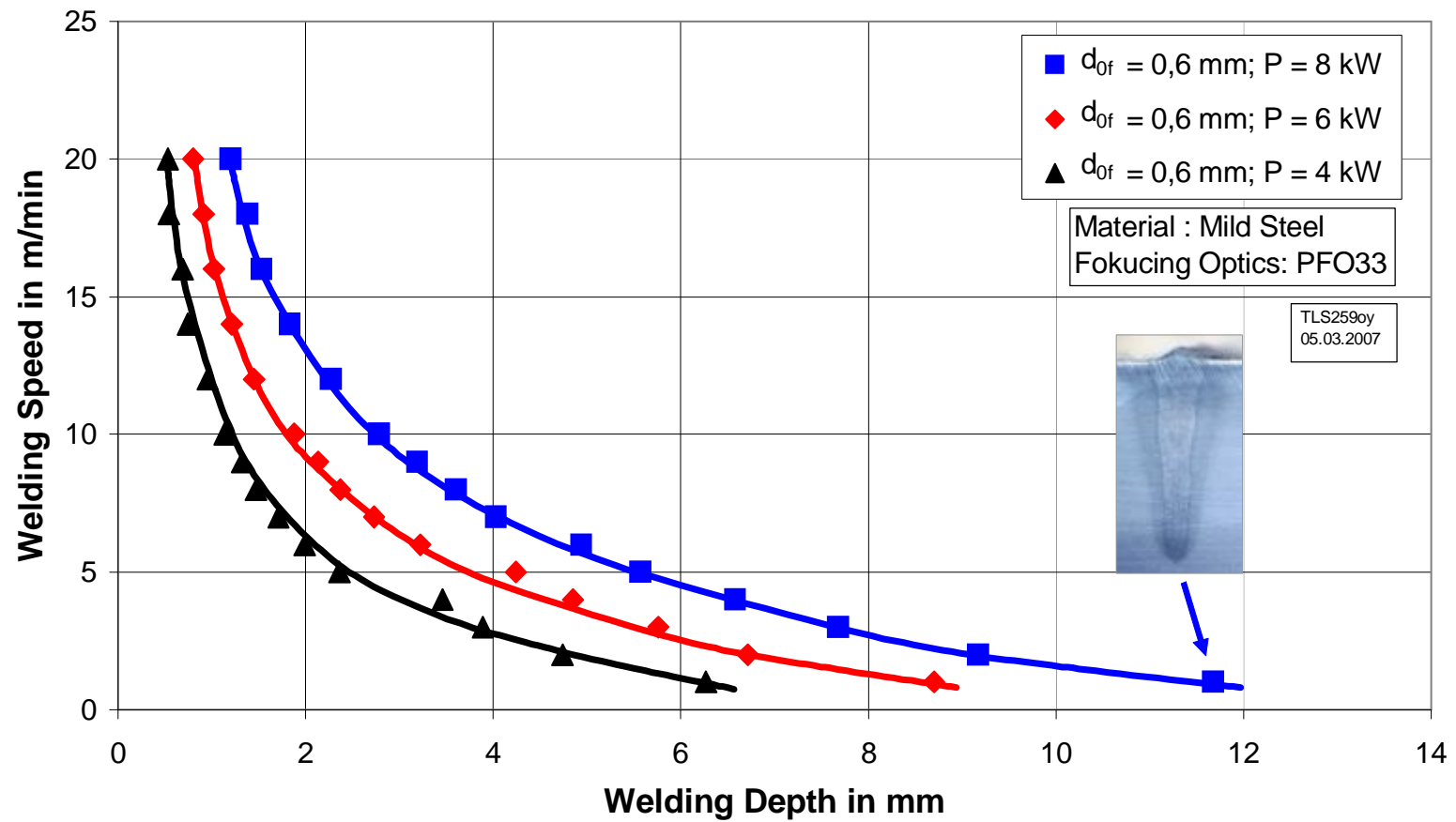
§ Applications of the Disk Laser

- Welding
- Cutting

§ Conclusion



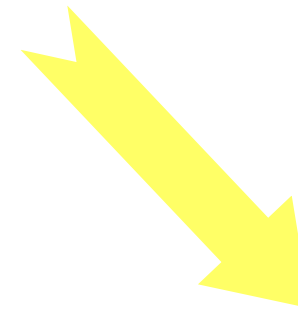
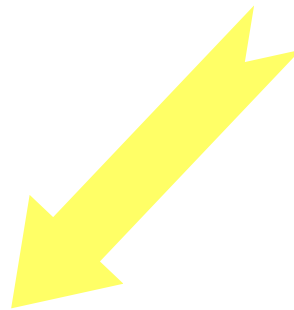
Welding with TruDisk 4002 / TruDisk 6002 / TruDisk 8002





Welding Applications with the Disk Laser

Laser Beam Welding



**Conventional
Laser Beam Welding**

Scanner- Welding



Laser- Scanner- Welding at TRUMPF



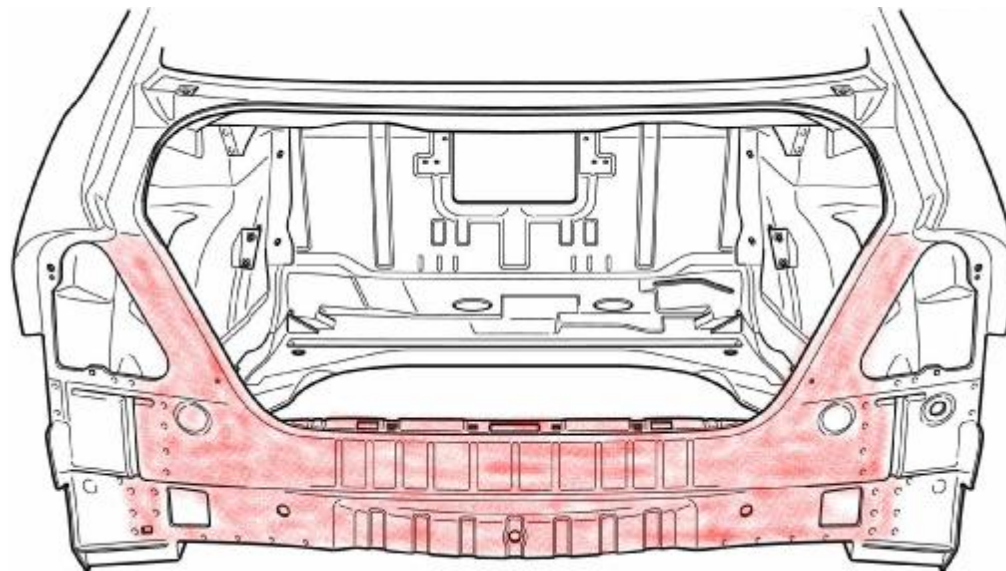


Scanner Welding with Robot





Scanner Welding in Body in White



Außenteil
(Blechstärke: 0,8 mm)



Innenteil
(Blechstärke: 0,6 mm)



Schlossverstärkung
(Blechstärke: 2 mm)



Pictures: DaimlerChrysler



RSW:

34 ● + Shift Stamp

4 Robots, 5 Welding Guns

Process Time: 34.7 sec



Laser Scanner Welding:

34 ◡ + Shift Stamp

1 Robot, 1 Scanner Optics

Process Time: 13 sec



Source: Volkswagen AG



Welding of Seat Components

Frames



Rear Seat Panel

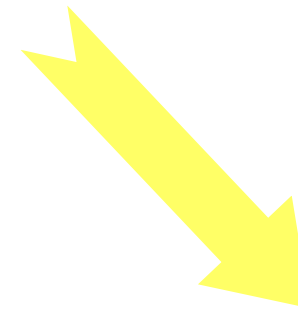
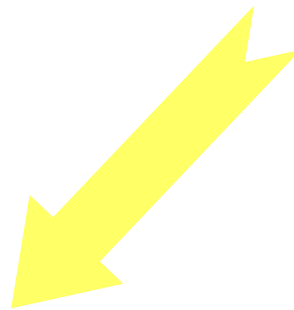
Enforcements





Welding Applications with the Disk Laser

Laser Beam Welding

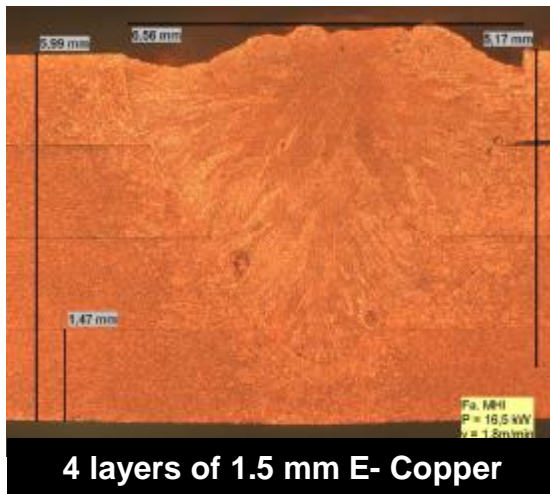


**Conventional
Laser Beam Welding**

Scanner- Welding

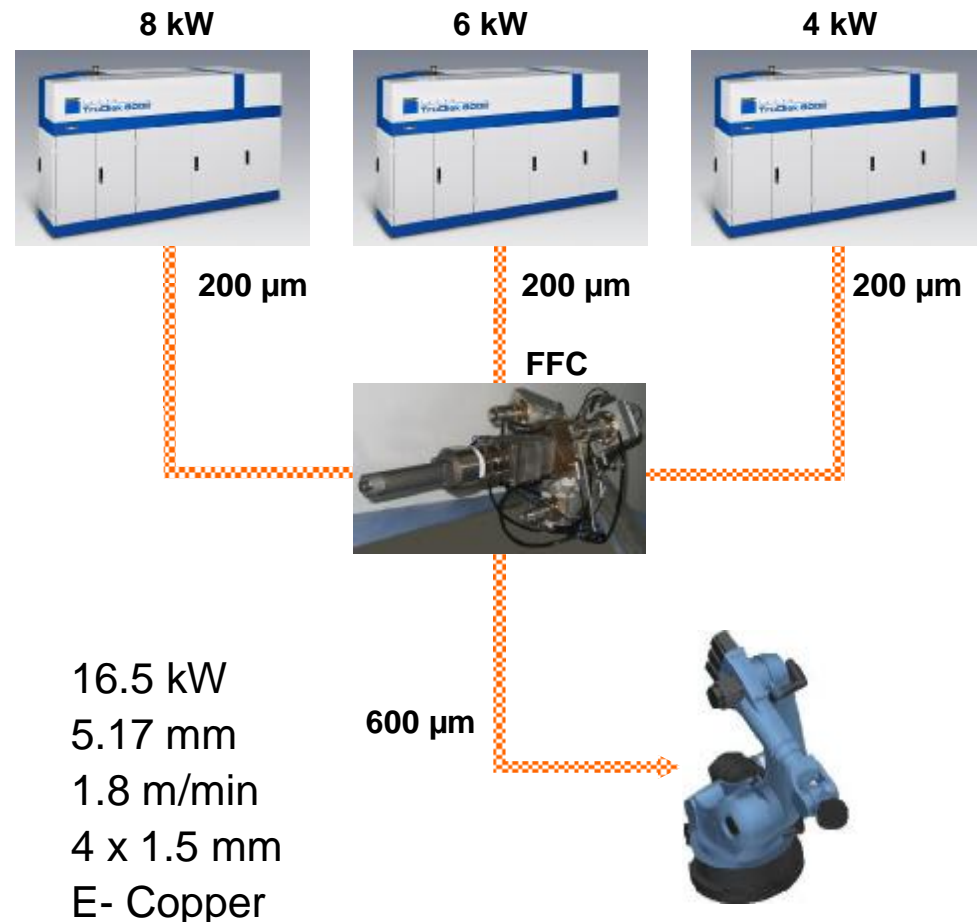


Laser Welding of Copper



4 layers of 1.5 mm E- Copper

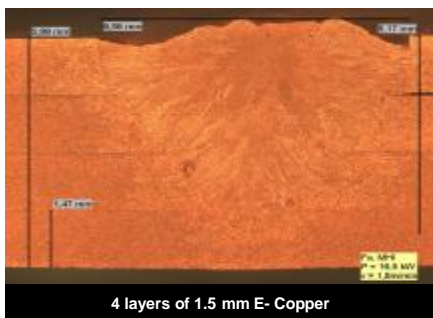
Laserpower @ workpiece
 Penetration depth
 Welding speed:
 Butt Joint:
 Material:



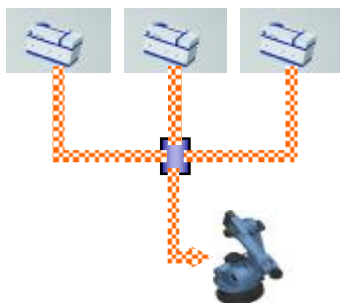
16.5 kW
 5.17 mm
 1.8 m/min
 4 x 1.5 mm
 E- Copper



Laser Welding of Copper



Laser power @ work piece	16.5 kW
Welding Depth:	5.17 mm
Welding Speed:	1.8 m/min
Butt Joint:	4 x 1.5 mm
Material:	E- Copper



§ **Power Scaling with
Fiber- Fiber- Combiner (24 kW)**

§ **Synchrone Controle of the Lasers with
TRUMPF *Lasernetwork* / TLN**

§ **Insensitivity for Backreflection**



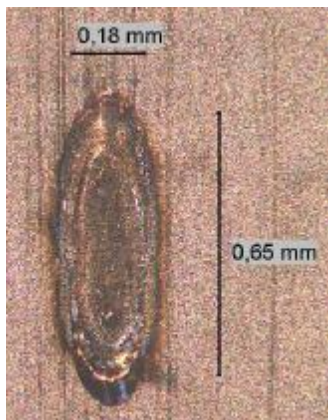
Hybrid Welding with 8 kW Disk Laser

12 mm sheet thickness, $P_L = 8\text{ kW}$, $v = 1,3\text{ m/min}$





Welding of Coil Materials



Joining of thin foils

Stainless steel: 0,1 mm to 0,2 mm

§ no influence on back side allowed

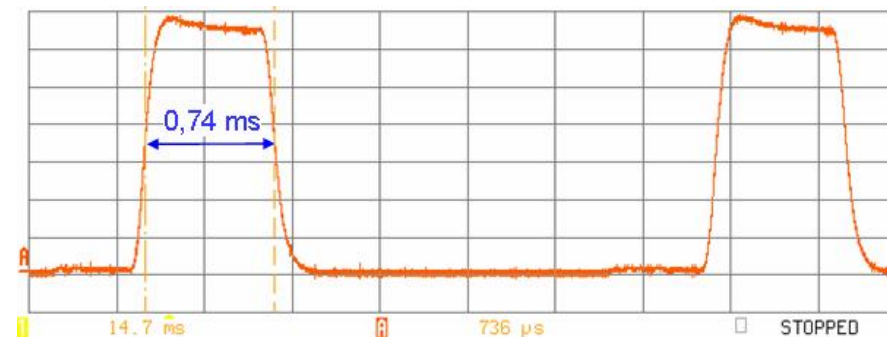
Welding parameters:

§ simultaneous welding of 2 rows with Bifocal – Optics

§ Laser Power 2x 0,5 kW

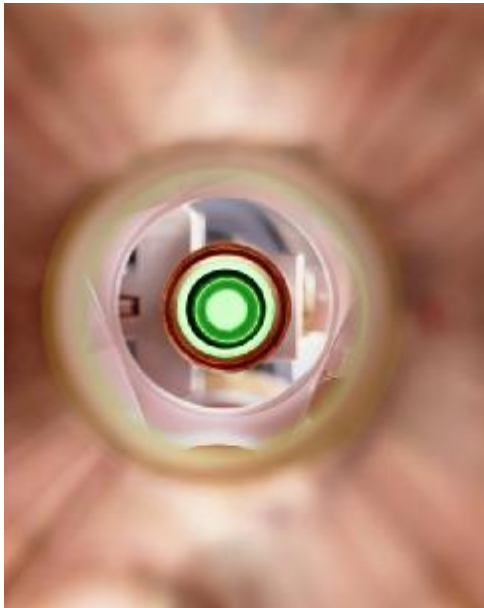
§ Welding Speed 60 m/min

Endurance of one Welding: < 1 ms





Outline



§ TRUMPF Disk Laser

§ Further Development

§ Applications of the Disk Laser

- Welding

- Cutting

§ Conclusion



Cutting of Thick Sheets



§ Uranus
§ 4 x 13 mm

§ P_L :	6 kW
§ Gas:	Pressed Air
§ Pressure:	4 bar
§ Speed:	~ 60 mm/min





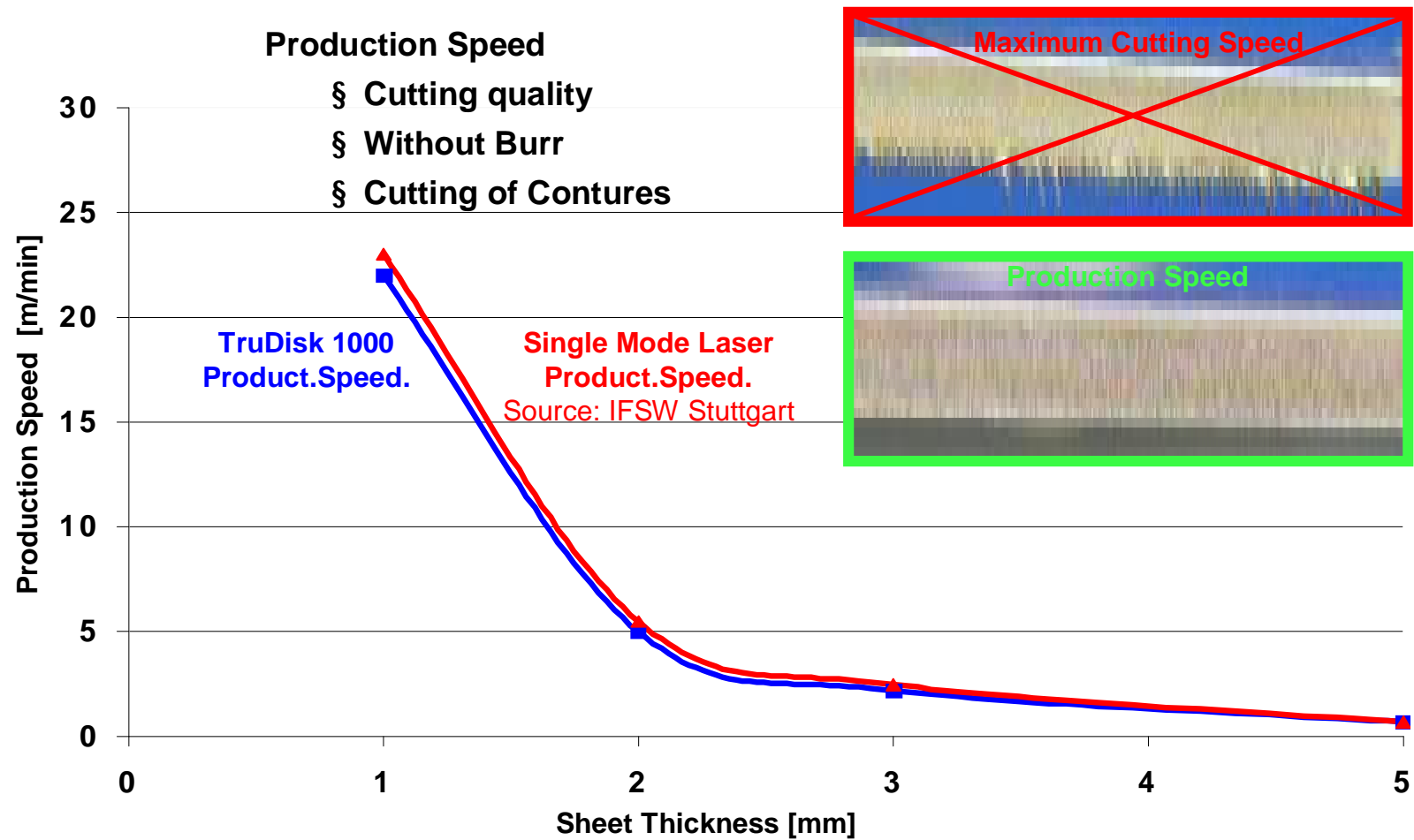
Cutting of Thick Sheets – multi layer

- § P_L : 6 kW
- § Gas: Pressed air
- § Pressure: 4 bar
- § Speed: 150 mm/min
- § Kerf Width: 1,4 mm





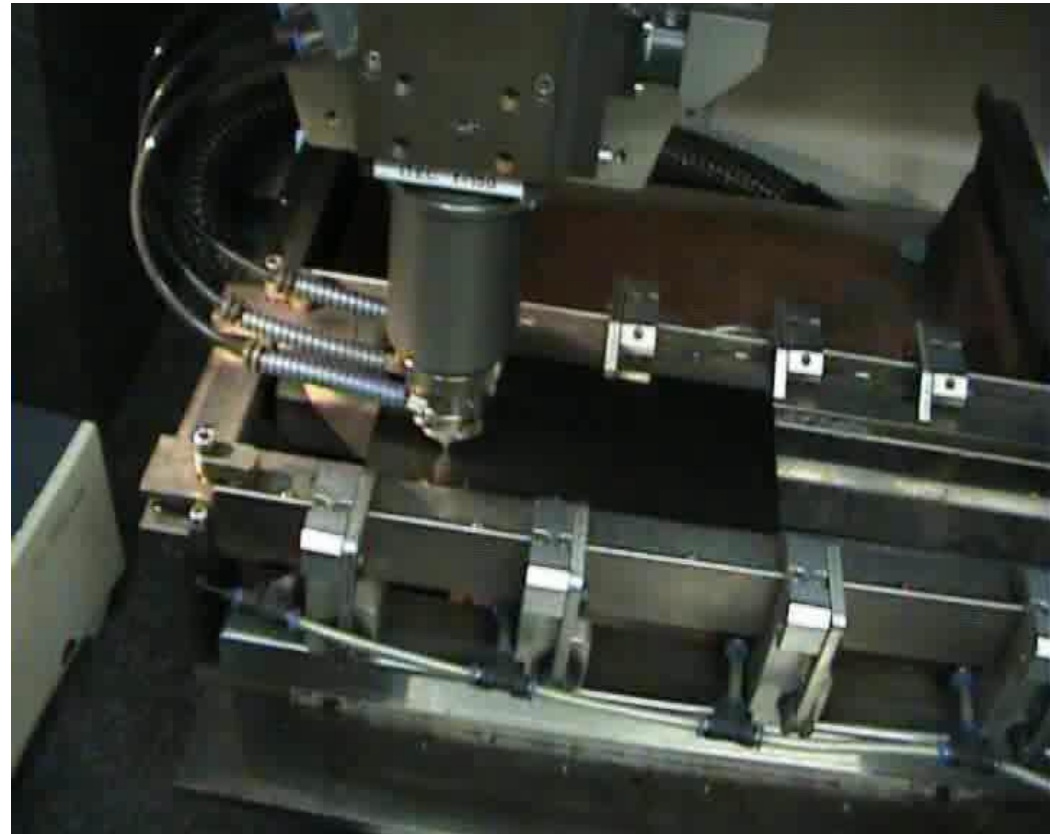
Cutting with Disk Laser





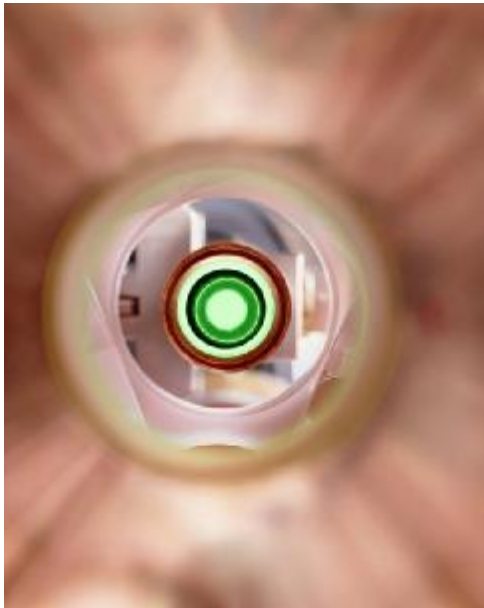
Cutting with the Disk Laser: Stainless Steel (1.4301)

- § **Material:** 1.4301
- § **P_L :** 1000 W
- § **Focus:** 100 μm
- § **Thickness:** 0,8 mm
- § **Speed:** 15 m/min
- § **Gas:** N_2
- § **Pressure:** 12 bar





Outline



§ TRUMPF Disk Laser

§ Further Development

§ Applications of the Disk Laser

- Welding

- Cutting

§ Conclusion

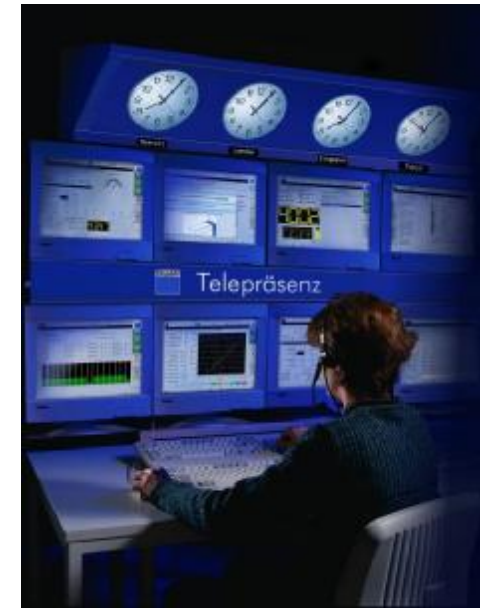


Training, service, telepresence



Holistic support:

- § Cooperation in planning
- § Trial in application lab
30 years of experience
- § Schooling in our training center
- § Worldwide service net
 - § short response time
- § Telepresence from laser to optic:
 - § obvious reduction of service costs
 - § preventive maintenance
- § Application support on site





Conclusion

- § The Disk Laser is an industrial Laser Source with Output Powers ranging from 1 to 8 kW
- § Until now, Disk Lasers have not reached any fundamental limitations regarding the Beam Quality or Output Power
- § Disk Lasers covers industrial applications ranging from Microdrilling to Welding Thick Sheet Metal
- § The Robot guided Laser- Scanner Welding in Automotive Industry is done with the Disk Laser
- § 4 kW per Disk will be developed within the next years
- § Therefore, the Investment Cost per kW Output Power can be reduced significantly!
- § TRUMPF delivers not only the Laser Source, but also all necessary Know How, Service and Support

TRUMPF



Thank you for your attention!

Dr.-Ing. Rüdiger Brockmann
TRUMPF Laser
Aichhalder Str. 39
78713 Schramberg
ruediger.brockmann@de.trumpf-laser.com

Mikael Mimer
TRUMPF Sweden
Aleforsvägen 5
414 11 Alingsås
mikael.mimer@se.trumpf.com