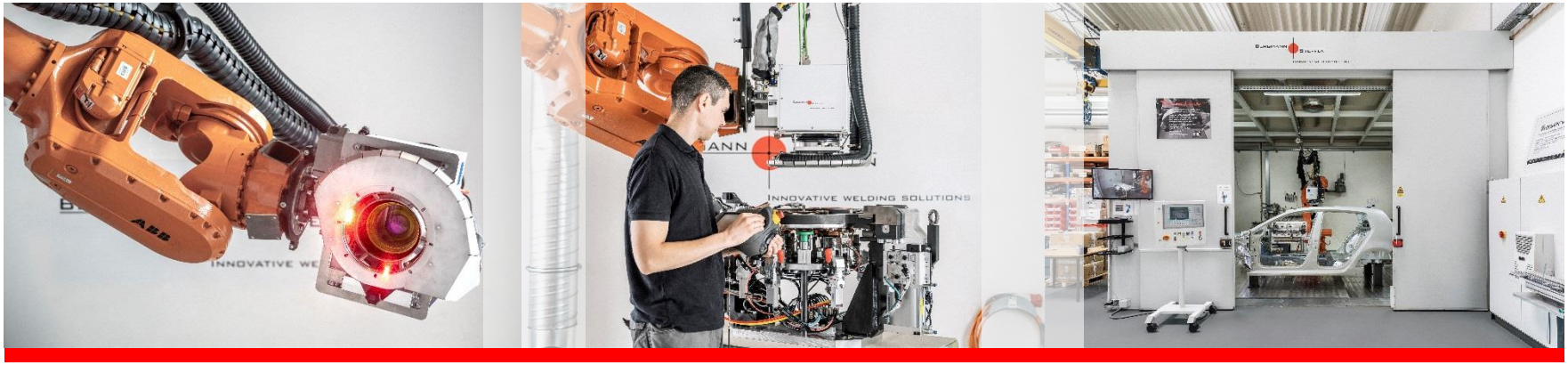
Remote laser welding –

Blower airknife for weld scanner optics and air management in laser welding cells



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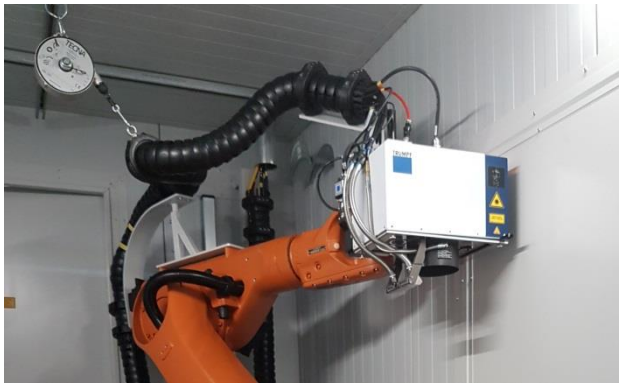
Agenda

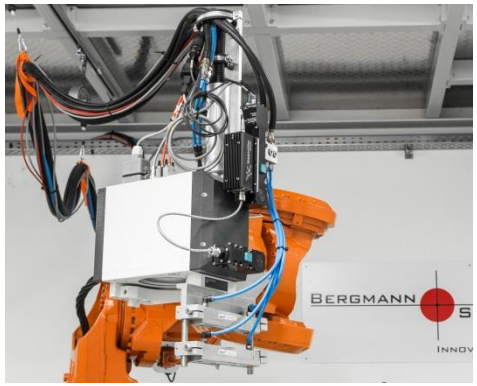
content:

- **motivation**
- **operating principle „Tornadoblade®“**
- **technology „Tornadoblade®“**
- **operating principle air managment**
- **practice and welding results**
- **summary and outlook**

motivation

Remote laser welding process





- scan head mounted to robot
- focal lenght up to 1 m
- free beam through atmospheric space
- power and quality loss

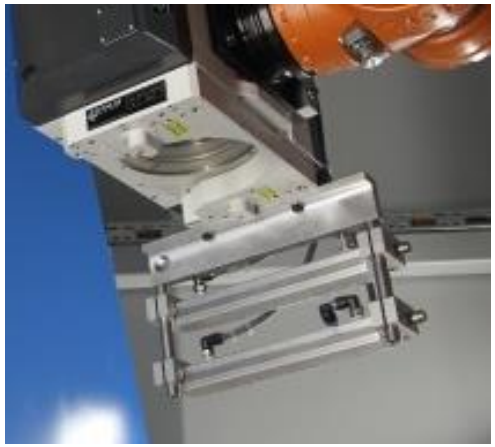
➔ welding process pollutes optic and free space
➔ protection of optic by shield glass and crossjet
➔ protection of free space by air management

motivation

state of the art

3300 l/min @ 4,5 bar

2000 l/min @ 6 bar

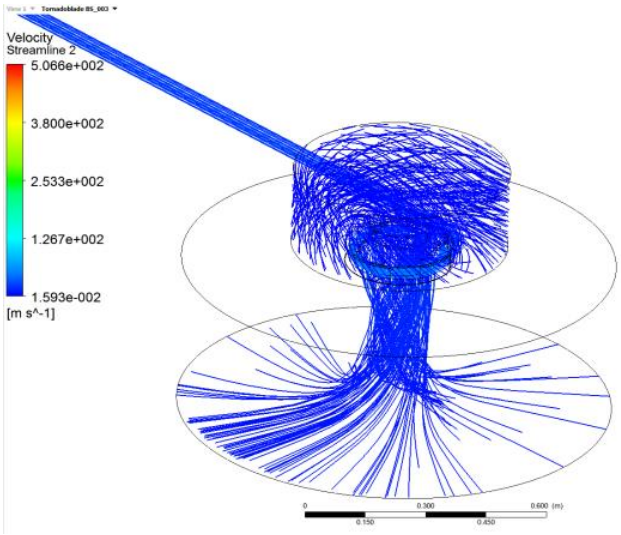


2400 l/min @ 5 bar

- investment cost and running cost for creation and supply of compressed air
- shield glass is consumable part
- downtime of laser welding machine for change

motivation

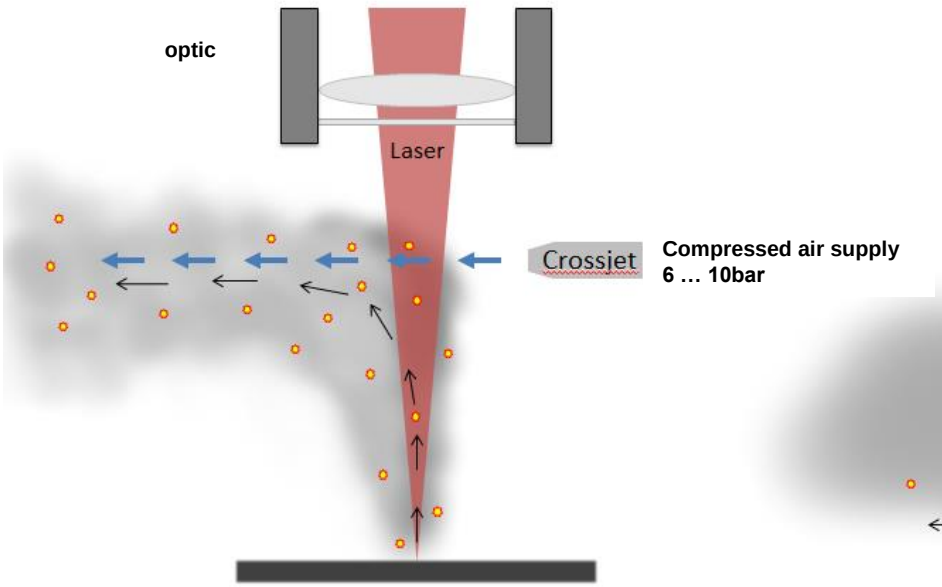
in-house development: blower airknife



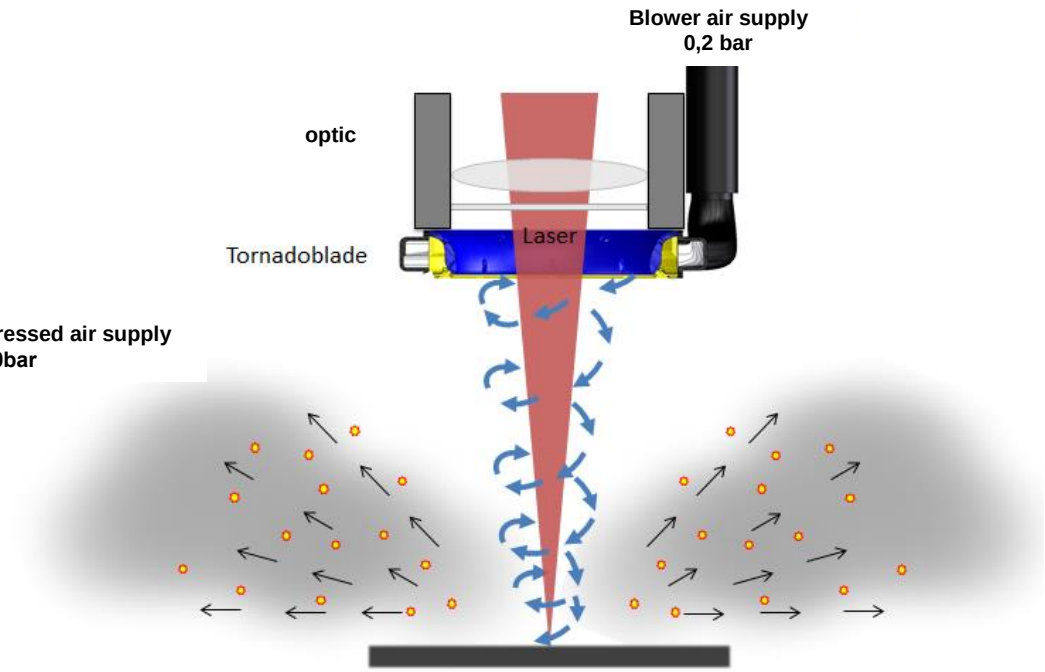
Tornadoblade®

- low pressure blower generates high volume air stream
- this is set into rotation in ring chamber
- ring nozzle shapes rotating and downpointing vortex
- protective function from weld spatters and fume

operating principle Tornadoblade®



state of the art: compressed air crossjet

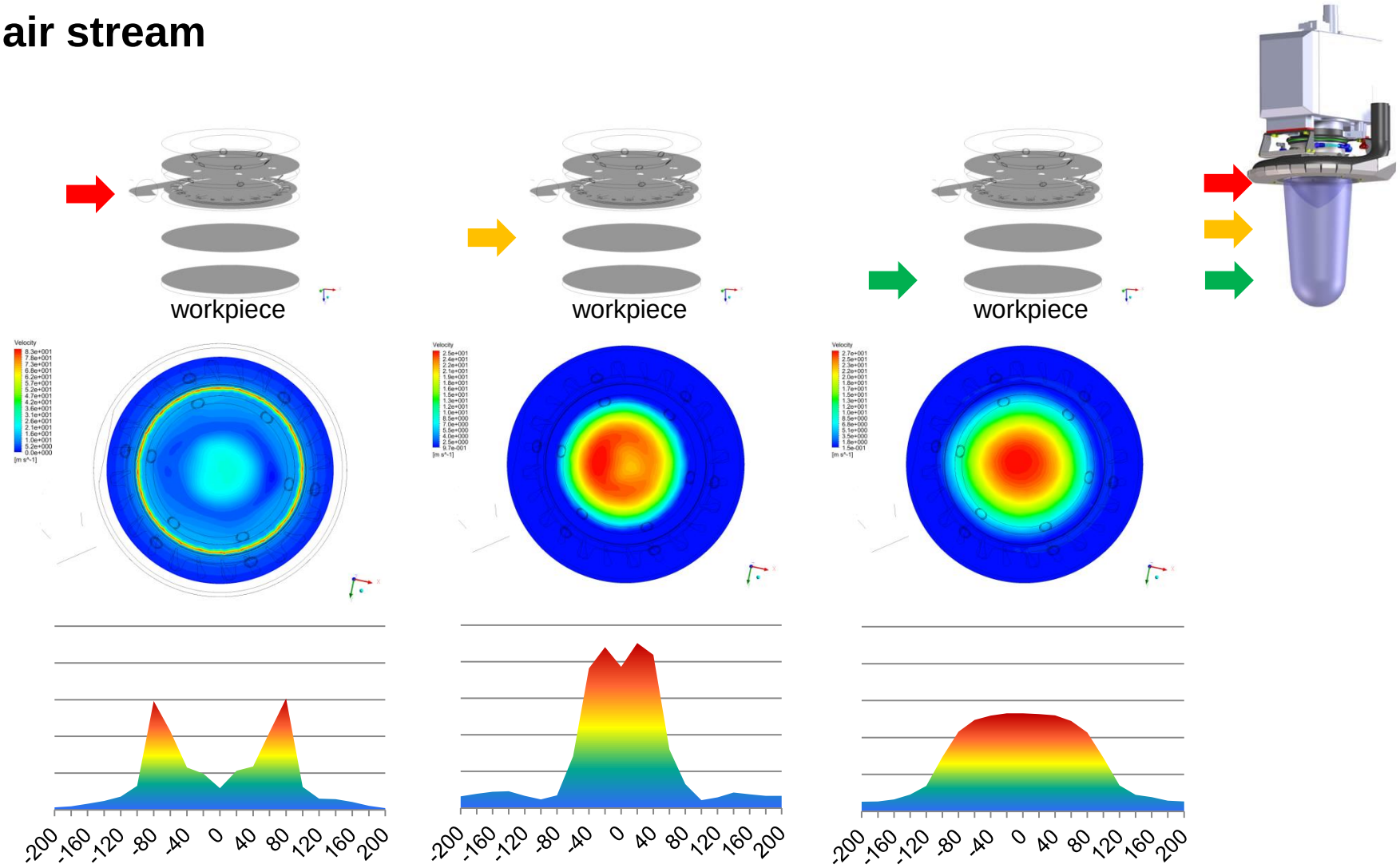


Innovative blower airknife „Tornadoblade®“

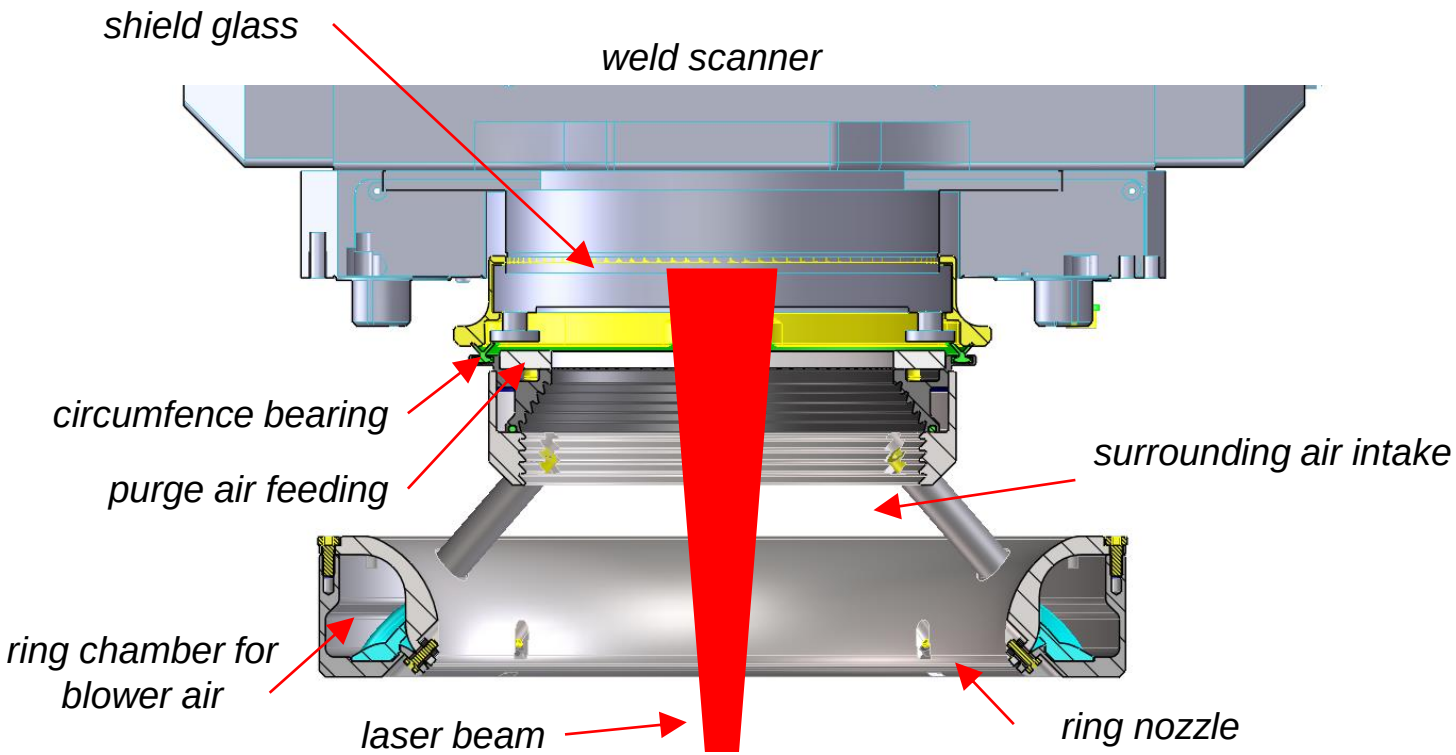
- vortex reaches welding position ➔ free beam path relative clean
- deflection of welding spatters and fumes at point of origin
- quality improvement➔ optimization laser power / welding speed

operating principle Tornadoblade®

air stream



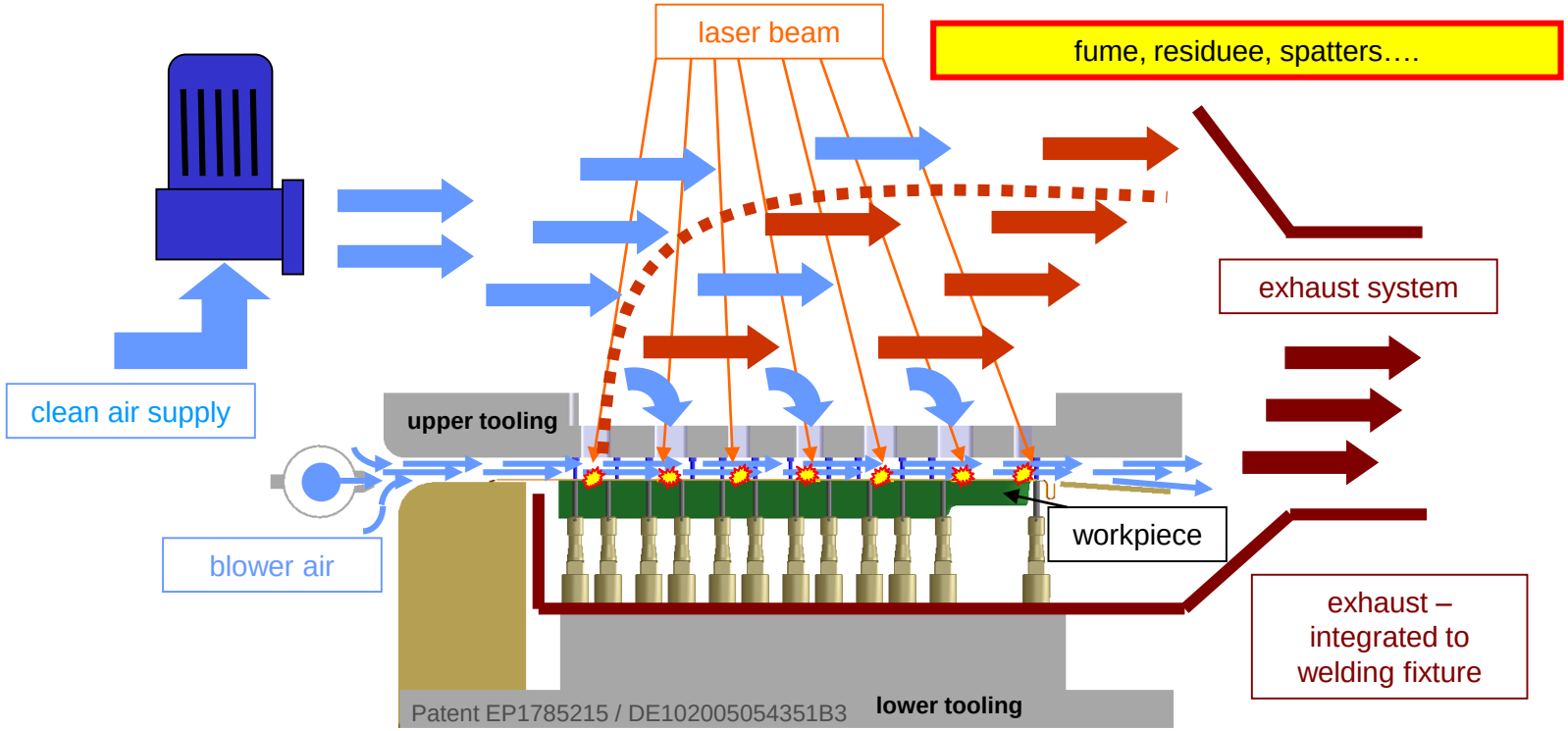
Principle sketch



- purge air bell: small amount of clean, dry compressed air
- distance to nozzle unit allows sweep of surrounding air

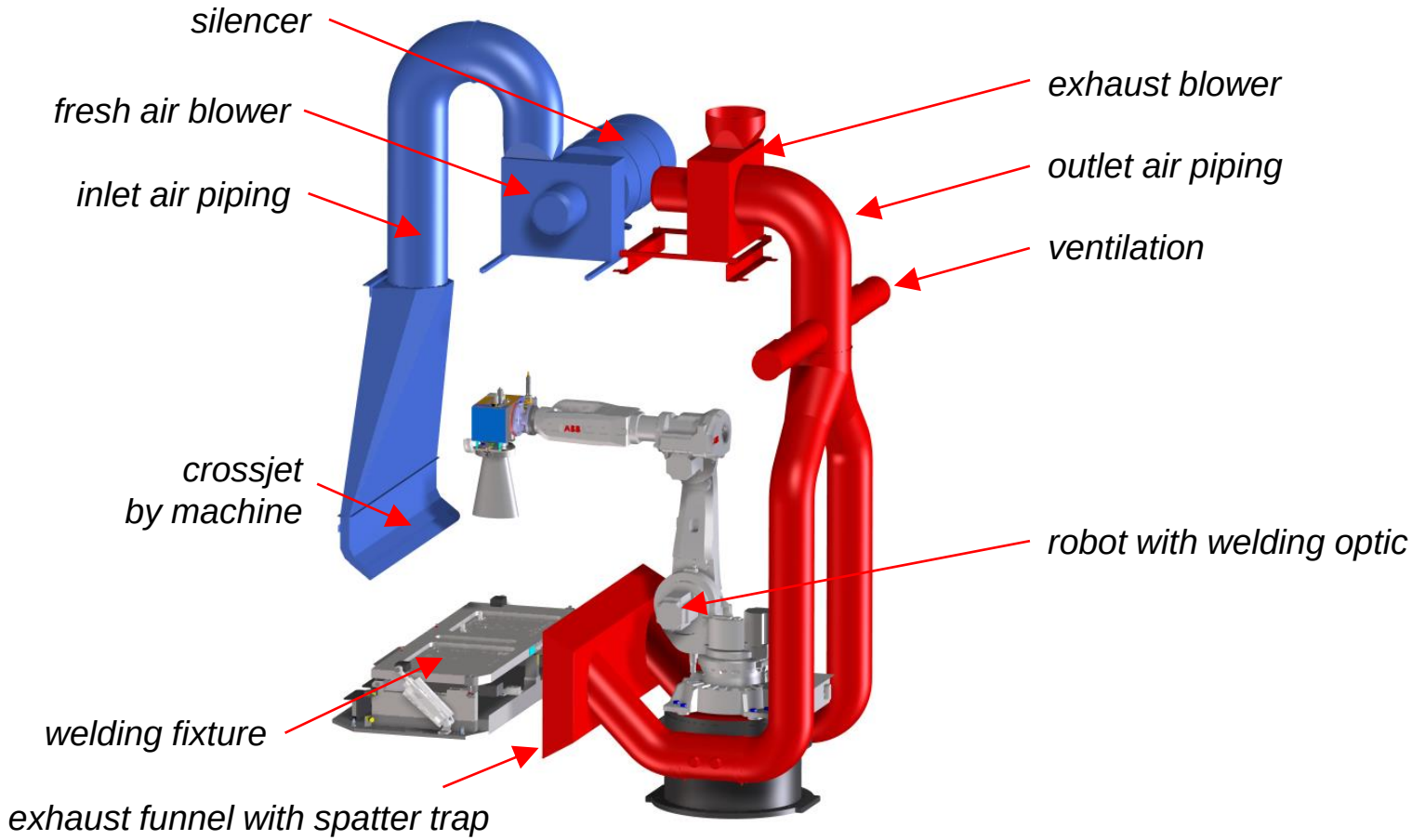
operating principle air managment

air interchange for remote laser welding processes



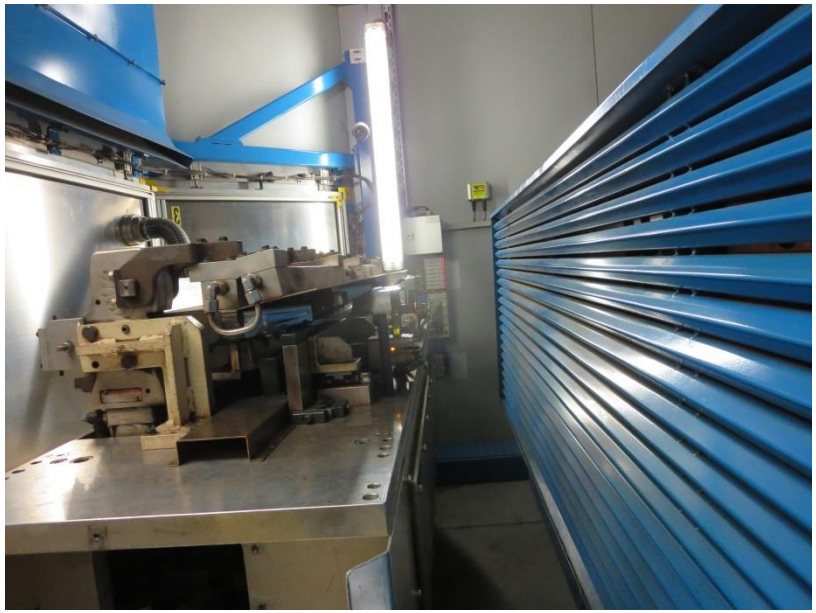
operating principle air managment

air interchange for remote laser welding processes



operating principle air managment

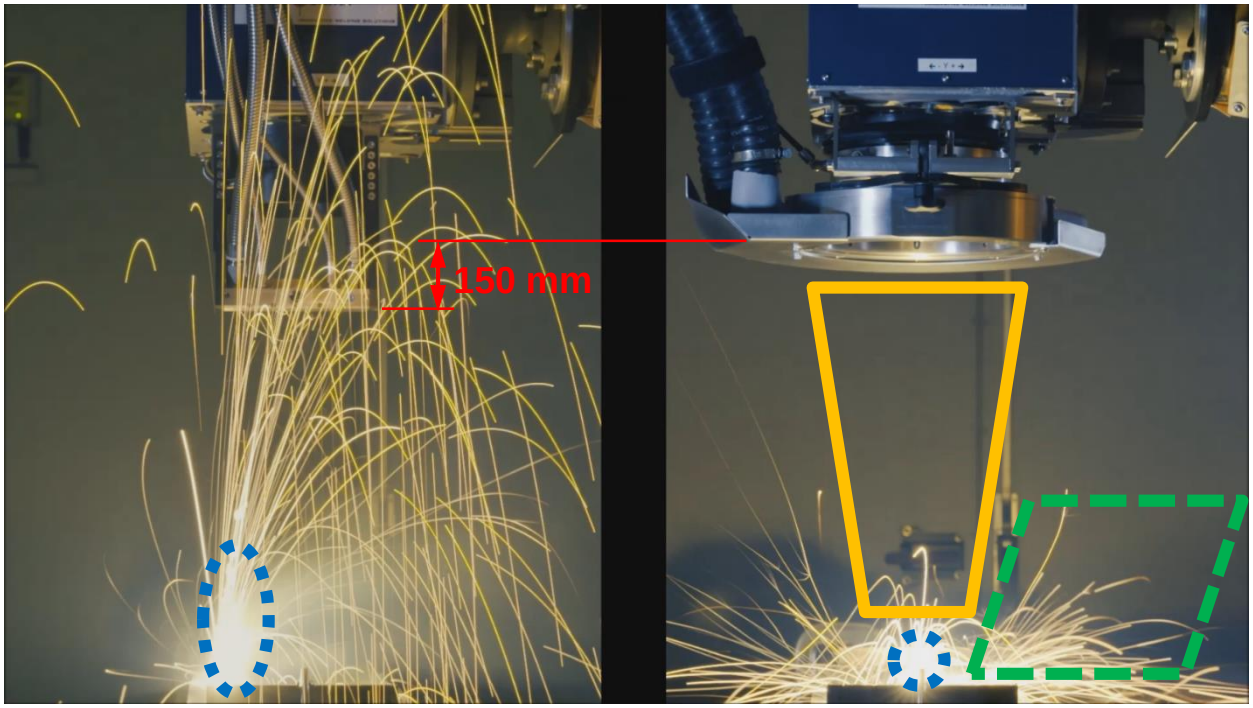
example: integration to laser welding cell



- air interchange at welding position (fixture)
- supply of fresh air and extraction of polluted air (cell)
- amount of interchange depending on cell size and application

practice and welding results

side view of welding process

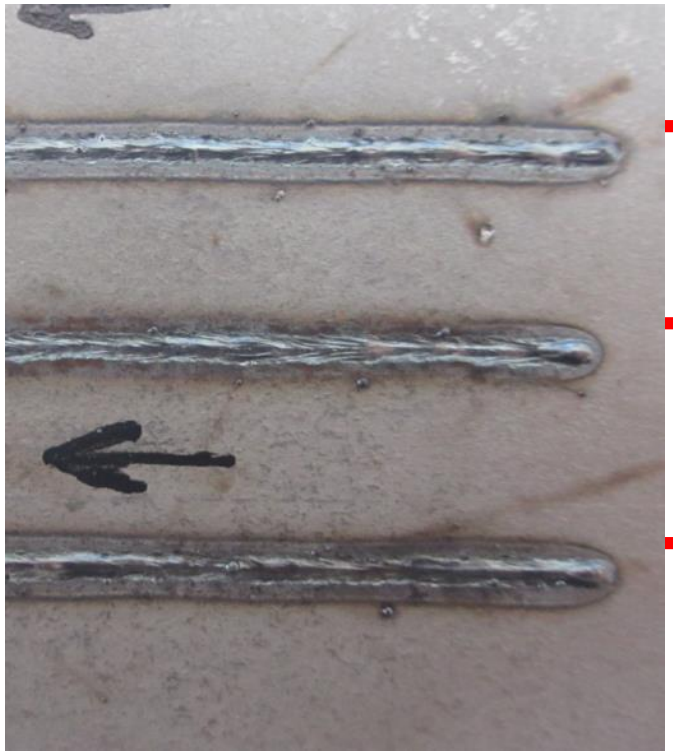


compressed air crossjet *blower airknife „Tornadoblade®“*

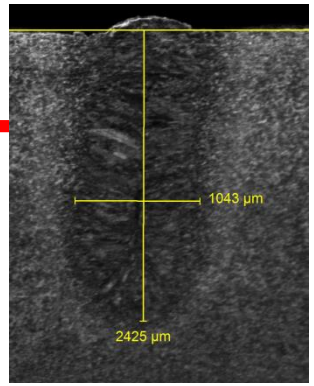
- reduced process light
- Deflection at point of origin
- beam path free of spatters and fume

practice and welding results

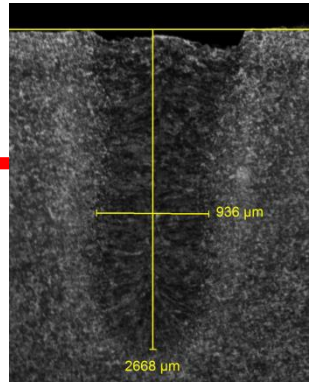
welding penetration tryout*



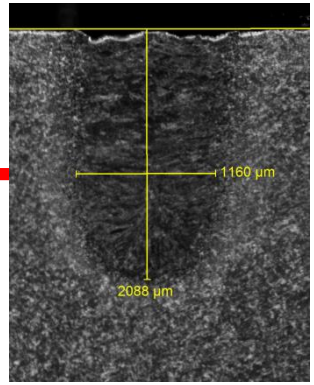
blower airknife „Tornadoblade®“



compressed air crossjet



without



- compressed air crossjet: narrow and deep, notch on topside
- without: wide and shallow
- blower airknife: average, no notch

* sample sheet St1203, t = 4 mm, Trumpf I-PFO f = 450 mm, d_{Fok} = 640 µm, P = 5 kW, v = 100 mm/s

summary and outlook

BERGMANN STEFFEN
INNOVATIVE WELDING SOLUTIONS

blower airknife and sophisticaded air managment…

- drip running costs
  - compressed air consumption ≈ 1800 l/h = 30 l/min
  - energy consumption = 4 kW
  - piece costs shield glass ≈ 100 € (depending on manufacturer and application)
- increase process stability and quality
  - better protection of laser welding optic
  - reduce disruptive factors at formation
- allows cycle time reduction (depending on application)
  - higher welding speed due to more stable welding process
  - shorter cycle time due to optimized robot path
- simplification of weld fixture tooling if applicable
  - omit of integrated air nozzles

Many thanks for your kind attention!

<u>your contact person</u>

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