

# SMART FIXED WING AIRCRAFT (SFWA) REPORT

WP 1.1.3 LAMINAR WING TECHNOLOGIES

PROJECT STATUS cleancompFIELD – **Final report**

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Germany

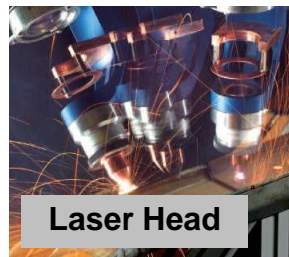
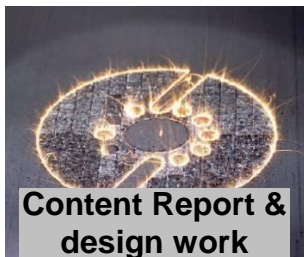
[www.cleanlaser.com](http://www.cleanlaser.com)

[buechter@cleanlaser.com](mailto:buechter@cleanlaser.com)



# WORKPACKAGES cleancompFIELD

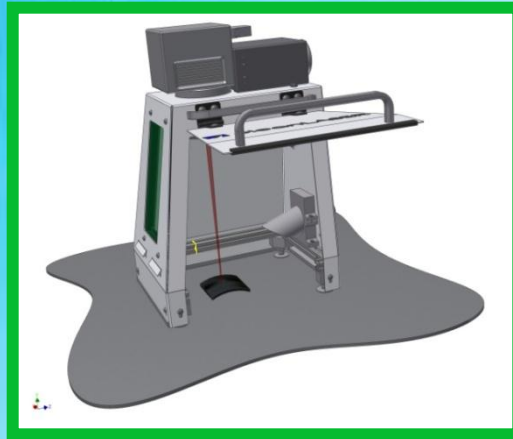
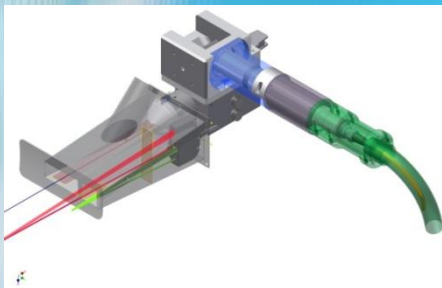
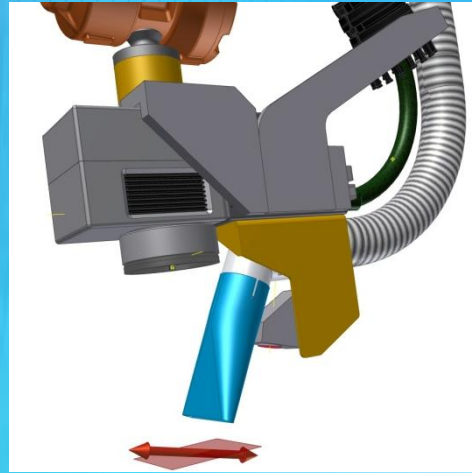
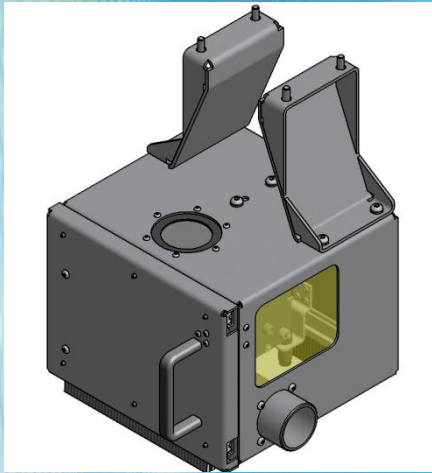
## OVERVIEW WORKPACKAGES PERSON MONTHS AND STATUS



Start month	1	2	3	6	9
Progress	completed	completed	completed	completed	completed
Deliverables	Design (conceptional drawing)	Existing optics modified Engineering support (in progress), manufacturing in progress, interfaces modified	<ol style="list-style-type: none"> <li>1. Re-designed nozzles</li> <li>2. concept of suitable fume extraction</li> </ol>	<ol style="list-style-type: none"> <li>1. Shielding system concept</li> <li>2. Flexible shielding system selected</li> </ol>	Test report, drawing
Scheduled end month	3	6	9	18	22
Revised end month	8 completed	16 completed	18 completed	17 Completed	22 Completed

# WORKPACKAGE 1: CONTENT REPORT & DESIGN WORK

## DELIVERABLE: CONCEPTIONAL DESIGN WORK



### General Concepts:

- BOX Design for laser class 1 covered workspace Front door, space for small samples (~100x100mm) suitable for basic testing connection for fume extraction
- Open style laser head, attachable to robot unit, nozzle (optimized position attached) distance sensor applicable no sample size restrictions
- Alternative concept: 1D Scanner (compact version) with integrated distance and plasmar sensor for ablation signal control (in line production)

**Final design and concept has been selected**

# OUR LASER OPTICS FOR CLEANING

## EXAMPLES – SOLUTIONS FOR (ALMOST) EVERY APPLICATION



### Automated Optics

- OSA 20
- OSA 70
- Stylus

### 2D Optics (manual or automated use)

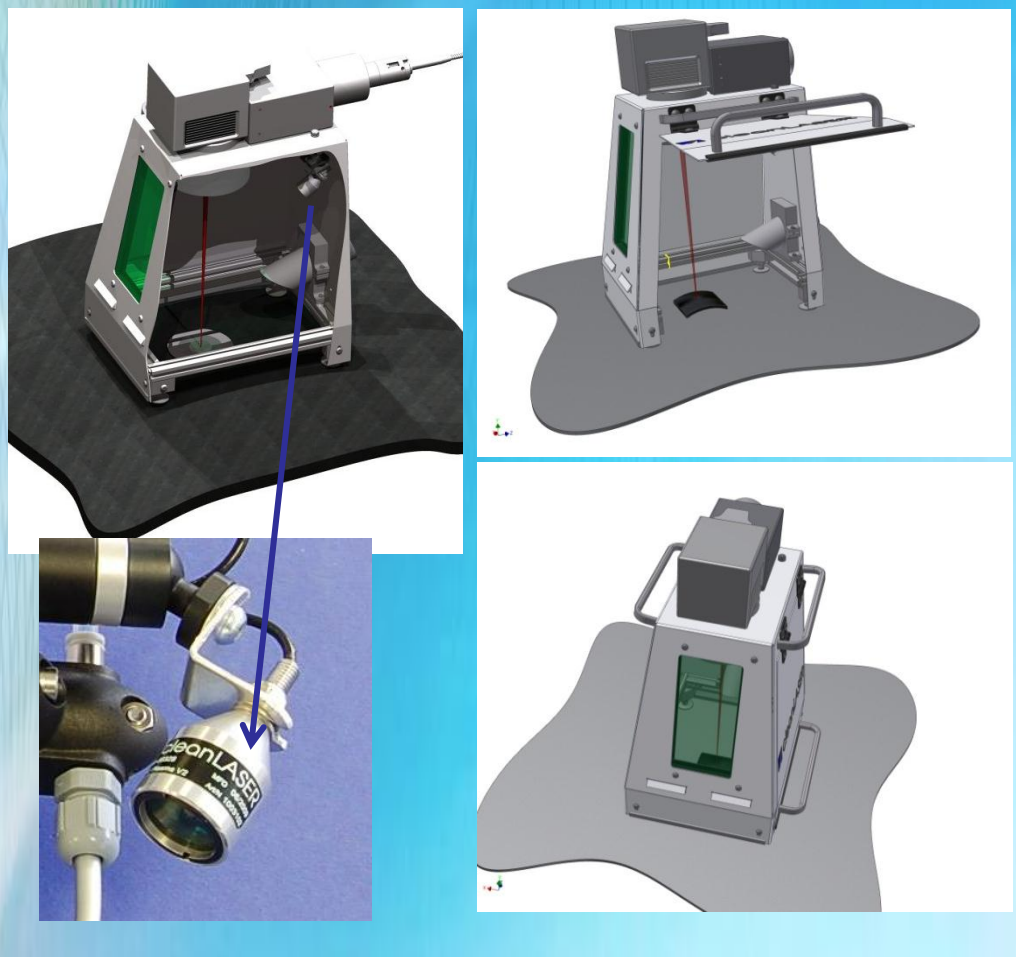
- Stamp 10
- Stamp 14

### Handheld Optics

- Stylus
- OSH 20
- OSH50
- OSH80

## WORKPACKAGE 2: LASER HEAD

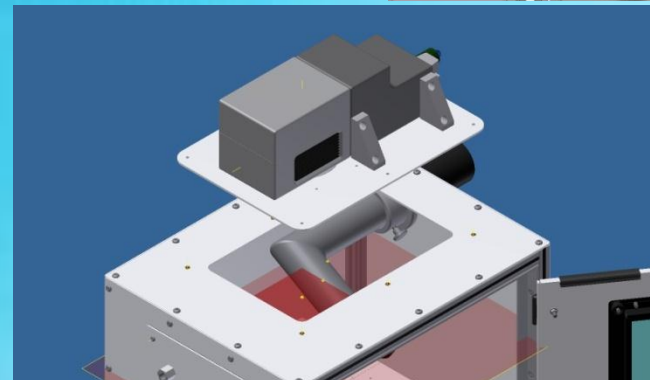
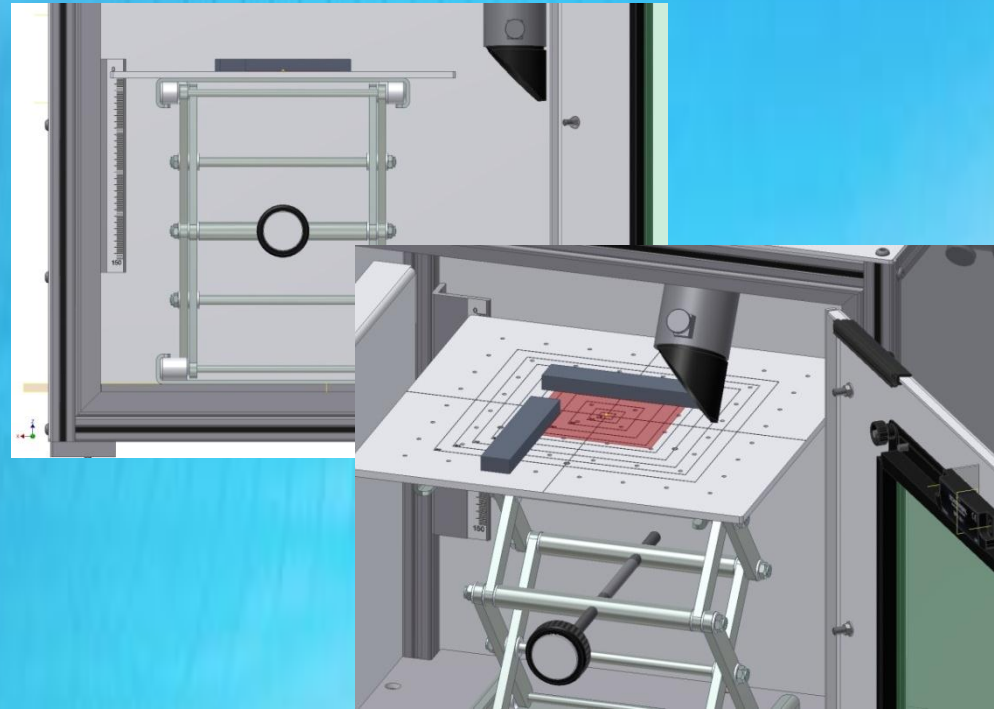
DELIVERABLE: Existing optics modified **Engineering support**



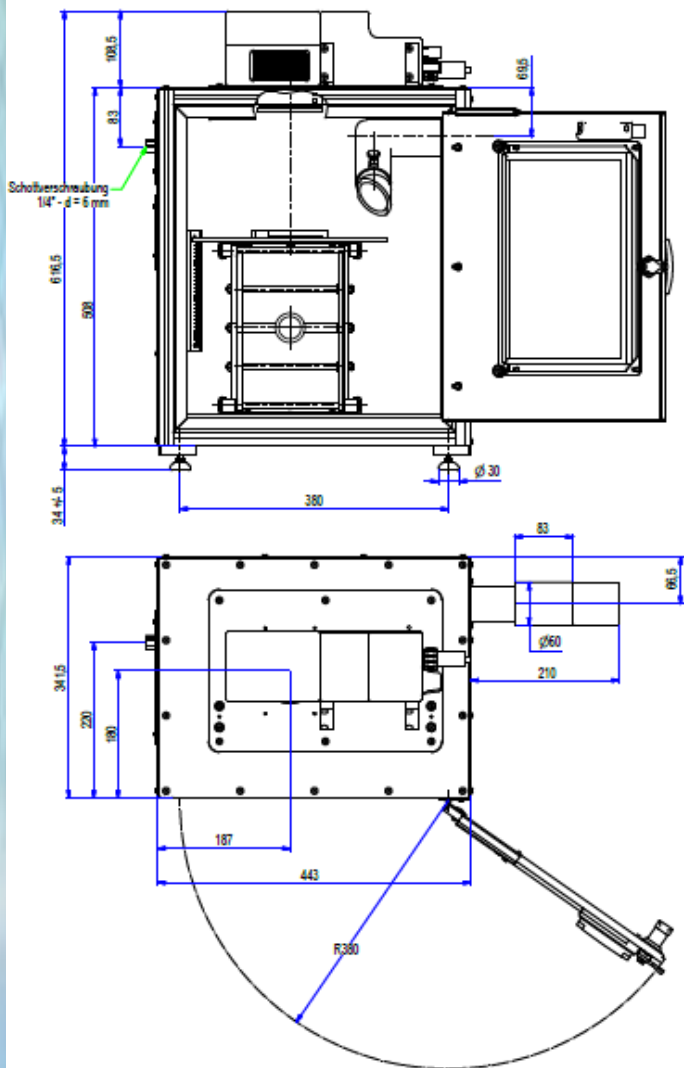
### Optics design:

- Synergic design combining the possibility of small and big area treatment optional upgrade with plasma sensor
- Easy entry flip door and optional place on surface treatment
- Front access window (class 1)
- Interlock switches
- Airflow optimization applied
- Focus shift under investigation not scope of the project
- **Engineering support (for IFAM) regarding parameter selection is in completed**

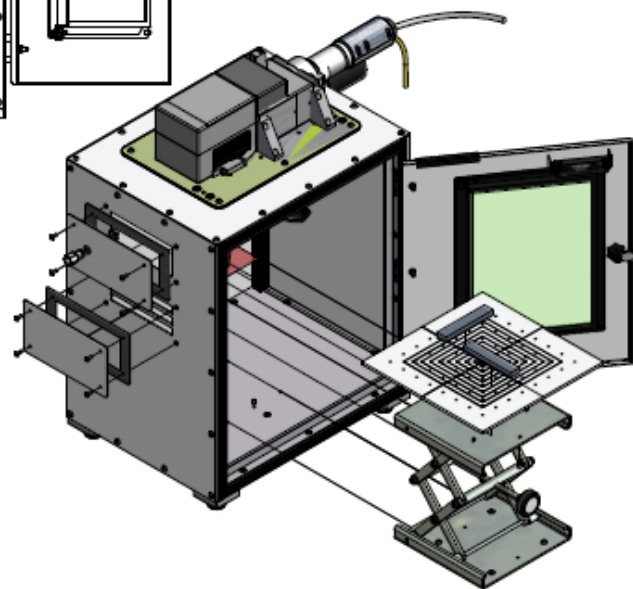
# WORKPACKAGE 2: DETAILS



# WORKPACKAGE 2 : LASER HEAD DRAWING (delivered)



## Dimensions:



<b>cleanLASER</b> P. 02134 Prologstraße 11 www.cleanlaser.de Tel. +49(0)391 490115 Fax. +49(0)391 490111	Abgleichnorm ISO 2708	Normenreihe DIN 6784	Abbau 1:4 Material Stahl (kg) - ca. 25 Kg Farbe	Einheitskurve [mm]
	Datum 21.02.2011	Name Prologstraße	CLEAN SKY	
Aktual Stand 03.11.2011 11:48 h	E10-2096.1130			3
	Seriennr. E10-2096.1130 idr			42 105

## WORKPACKAGE 2 and 4: LASER HEAD AND LASER SAFE ENCLOSURE

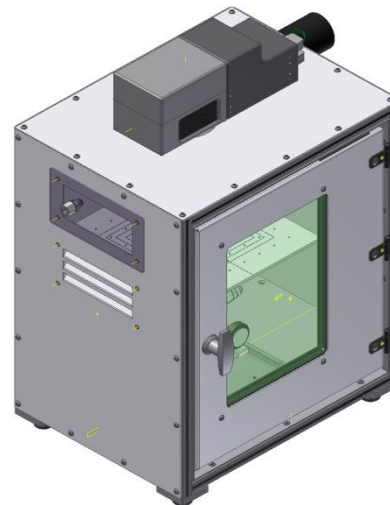
DELIVERABLE: Existing optics modified & engineering support ongoing)

DELIVERABLE: Shielding system for modified optics (design completed)



### Optics design of the safetyBOX:

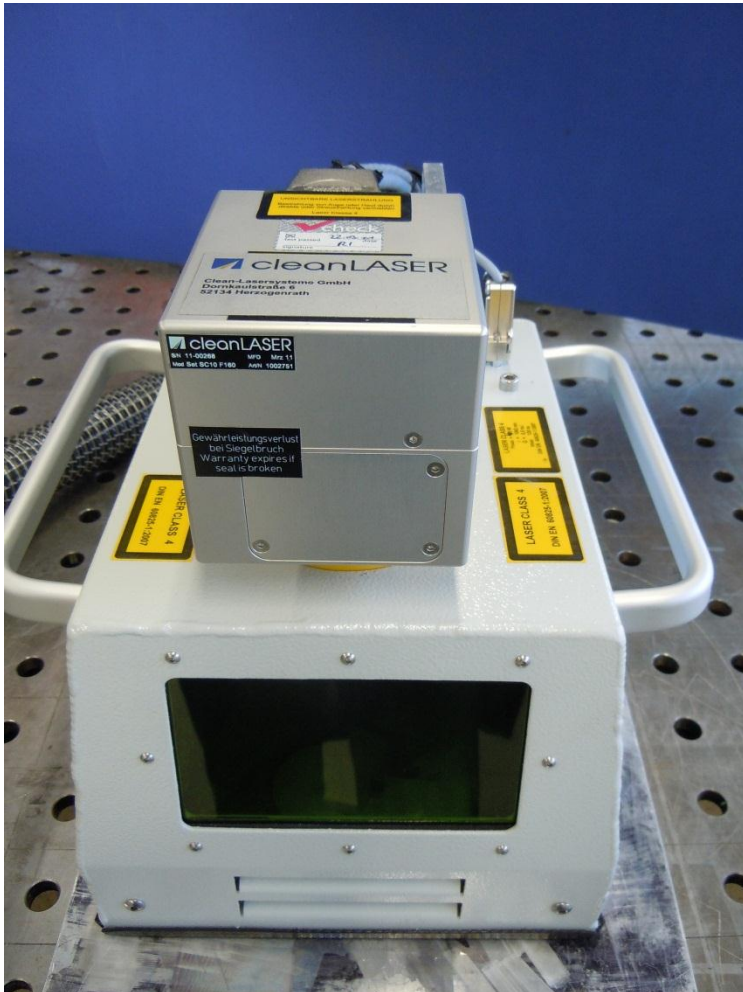
- Re-designed optics and shielding system design work is completed, released by IFAM
- Manufacturing and assembly completed
- Installation at IFAM completed
- Ongoing parameter support and application testing at IFAM will be proceeded





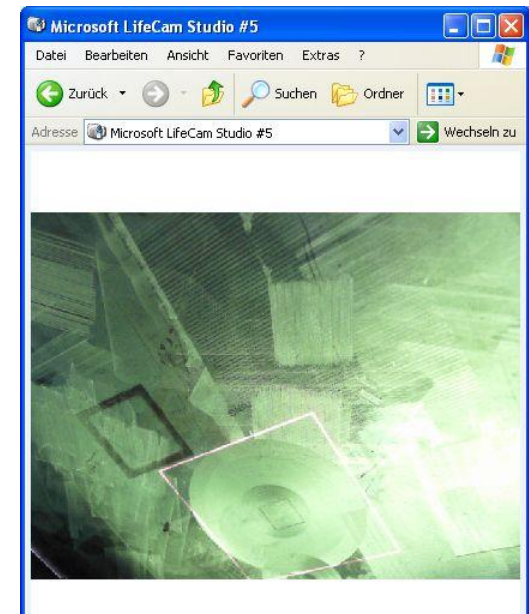
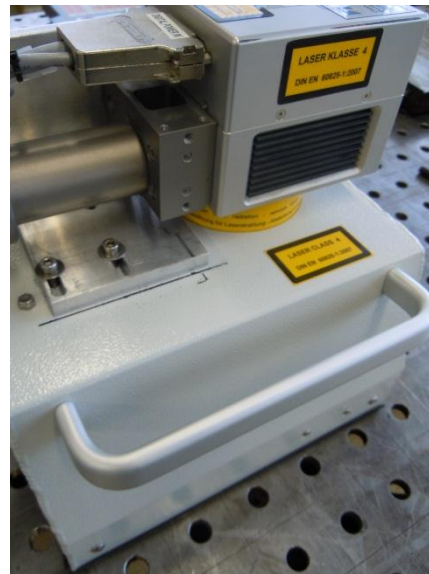
# WORKPACKAGE 2 and 3: EXHAUSTING SYSTEM AND NOZZLE

## 1. DELIVERABLE: Re-designed nozzles (integrated in laser head)



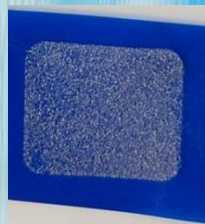
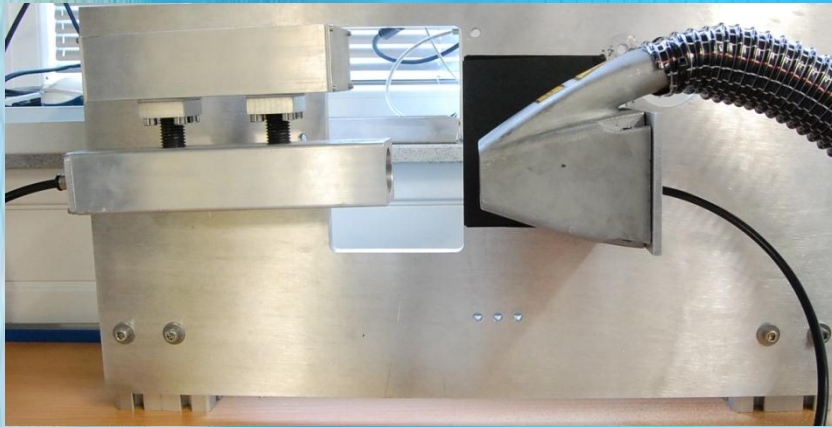
### Nozzle design:

- For local coverage (in field)
- The housing is completed in design has been delivered to IFAM
- Optional camera can be attached



## WORKPACKAGE 3: EXHAUSTING SYSTEM AND NOZZLE

### 1. DELIVERABLE: Re-designed nozzles (integrated in laser head)



Before optimisation

After optimisation

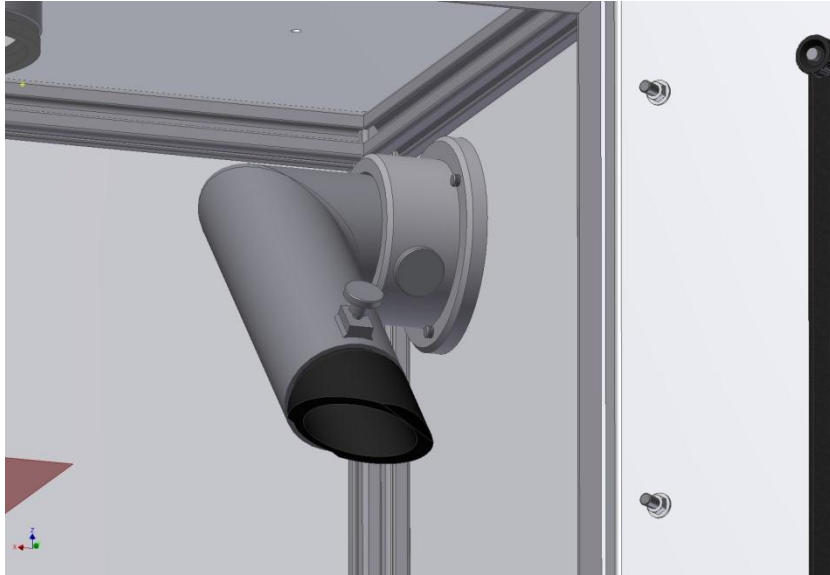


#### Nozzle design:

- Air flow optimisation by generation of laminar flow
- Cross jet investigated
- Investigations of air flow and particle & dust extraction/collection based on 1D Optics
- Worstcase simulation (sandblaster and adhesive tape)
- Engineering support (for IFAM) regarding parameter selection done

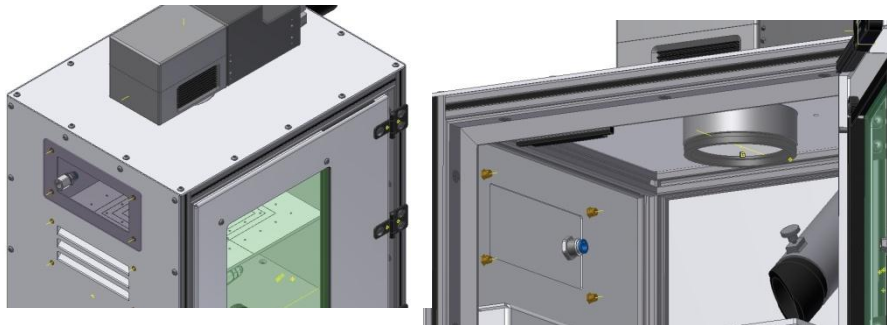
# WORKPACKAGE 3: EXHAUSTING SYSTEM AND NOZZLE

## 1. DELIVERABLE: Re-designed nozzles (integrated in laser head)

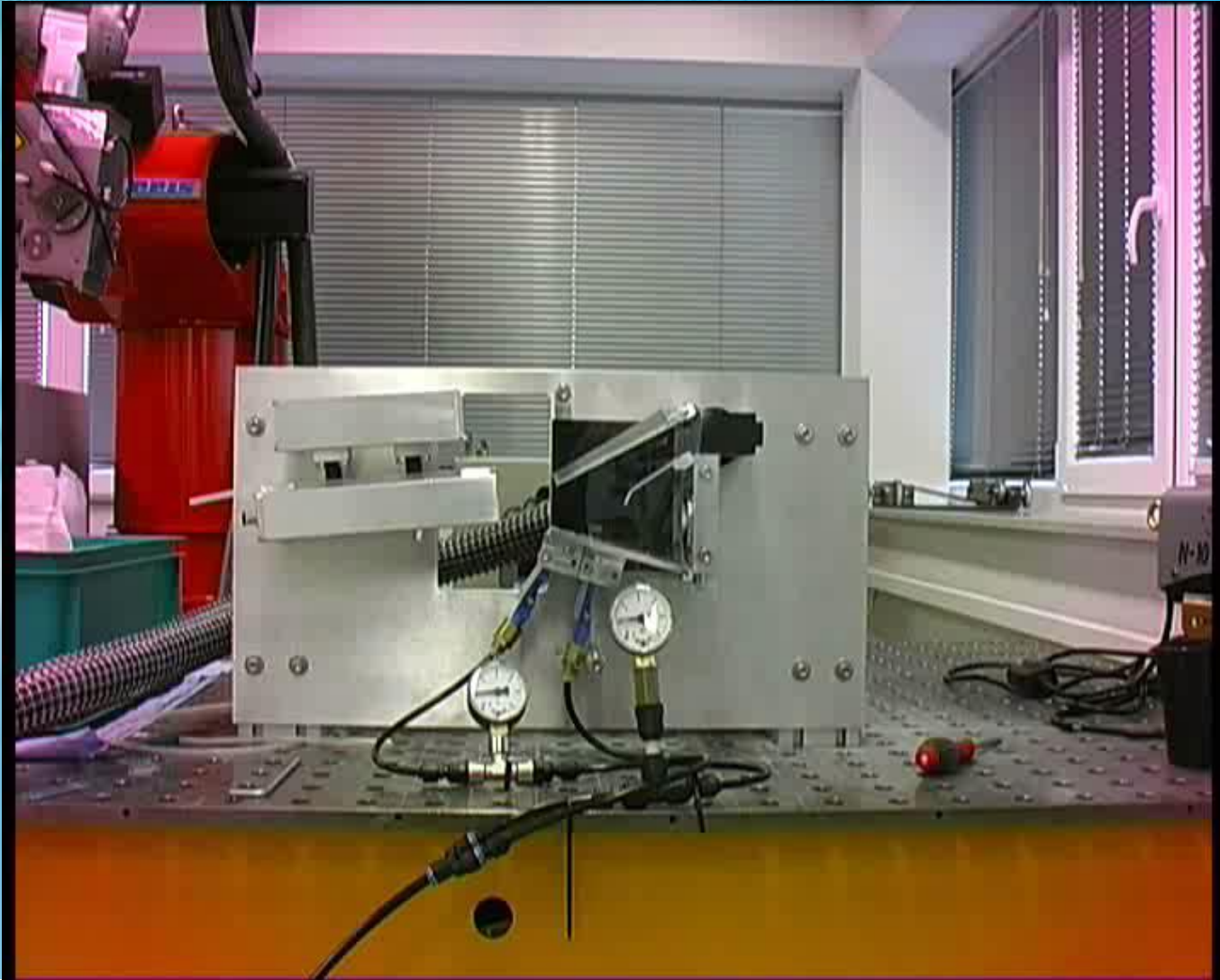


### Nozzle design:

- Air flow optimisation (nozzle diameter)
- Cover gas support attachable
- Best collection rate by distance adjustment
- Function of nozzle has been tested



# VIDEO NOZZLE TESTING – AIR FLOW INVESTIGATIONS



# WORKPACKAGE 3: FUME EXTRACTION UNIT

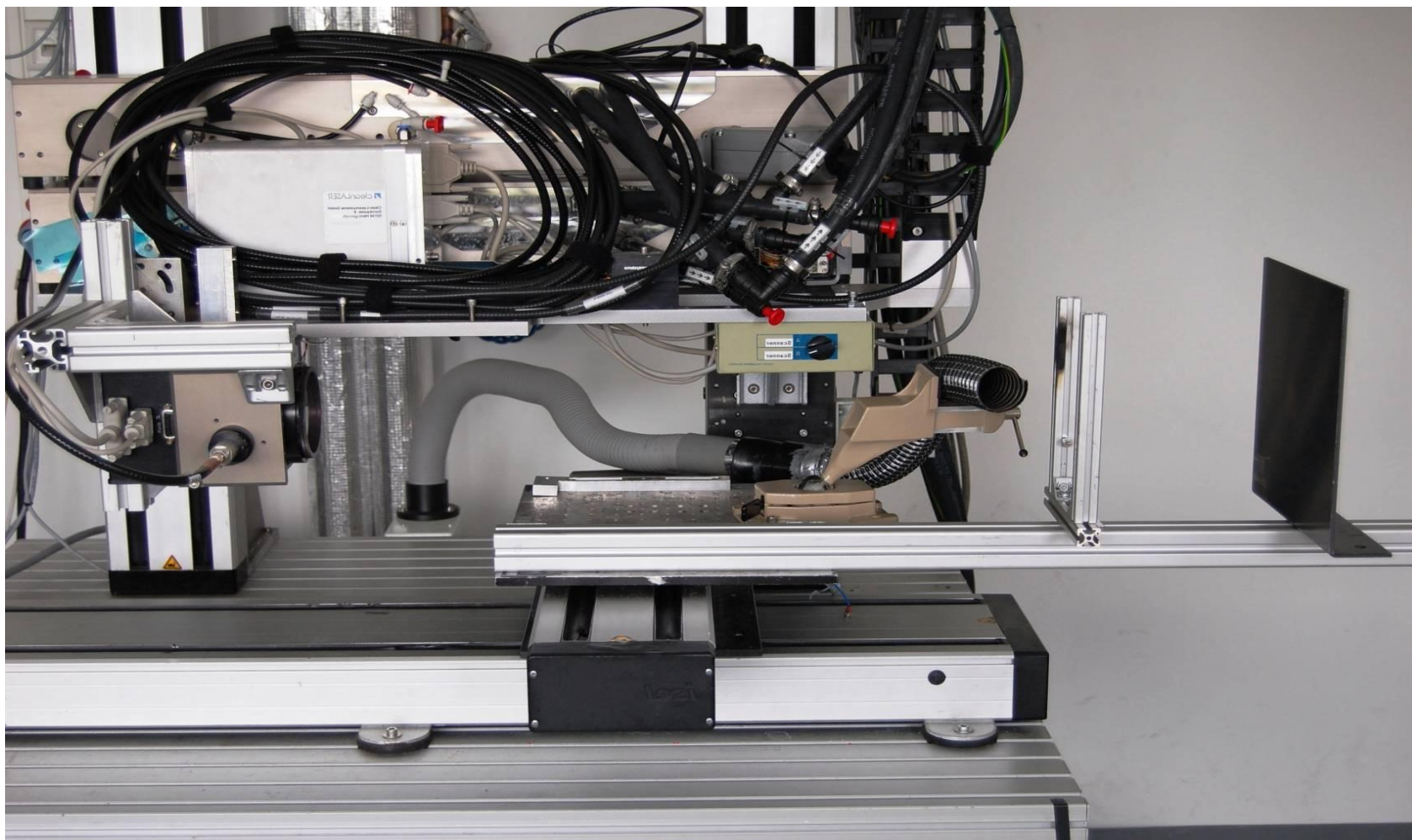
## DELIVERABLE #4: Potential Concept of suitable fume extraction



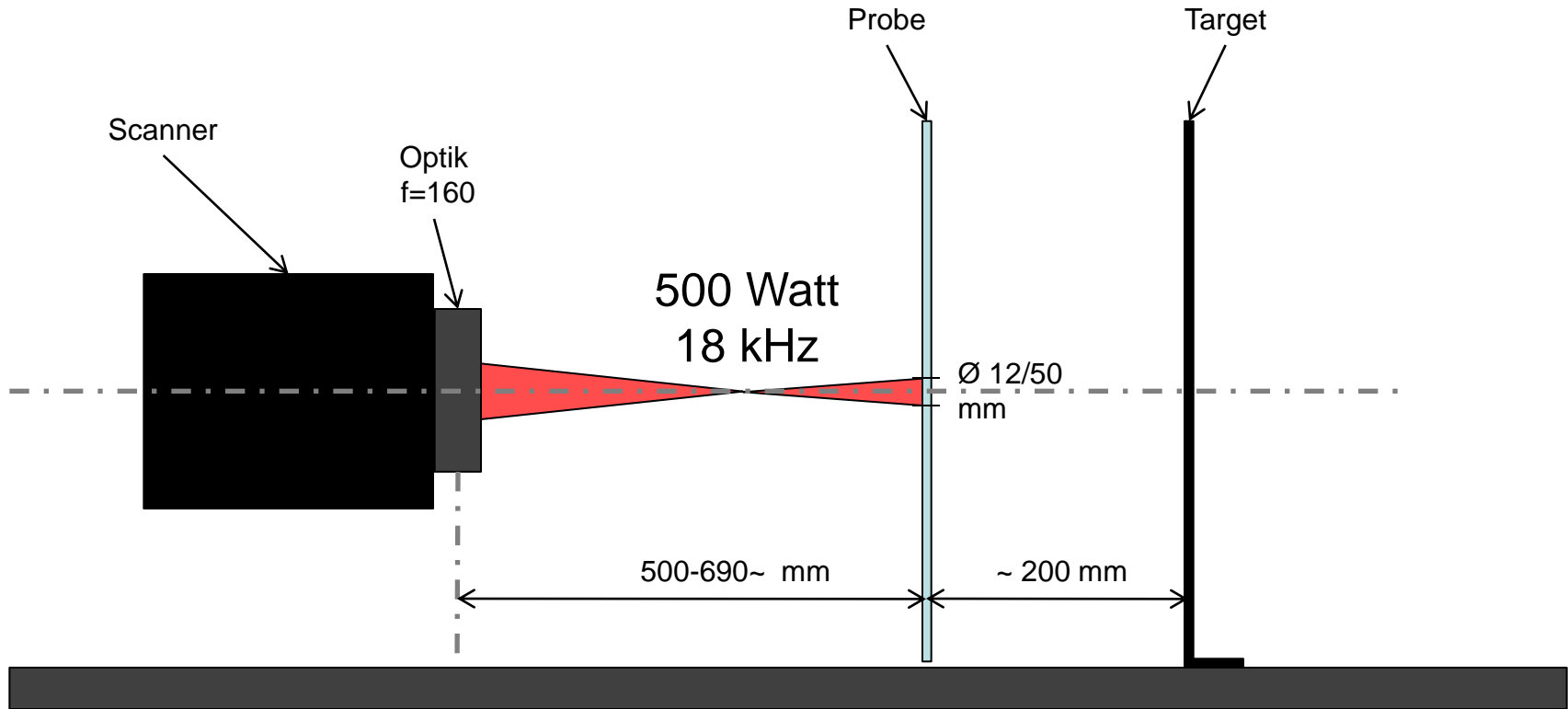
### Filter unit requirements:

- Compact size
- Suitable filter capacity
- Environmental friendly
- Particle filter Standard HEPA13 or more, optional ULPA Filters applicable
- Gas filter cartridge
- High pressure suitable flow rate (adjustable)
- Low noise, safe
- Potential solution (result of market investigation):
- Turbine powered filter unit, noise damped
- Modular design with controller
- Pre coating optional
- Self cleaning particle filters

# TEST SETUP FOR PROTECTIVE CURTAINS

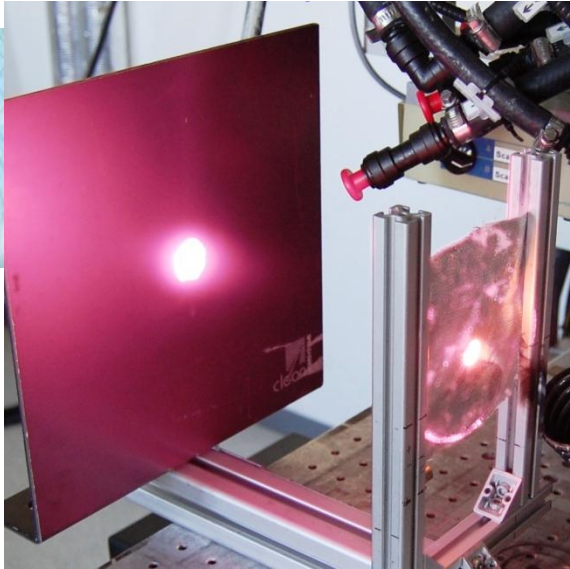


# TEST SET UP

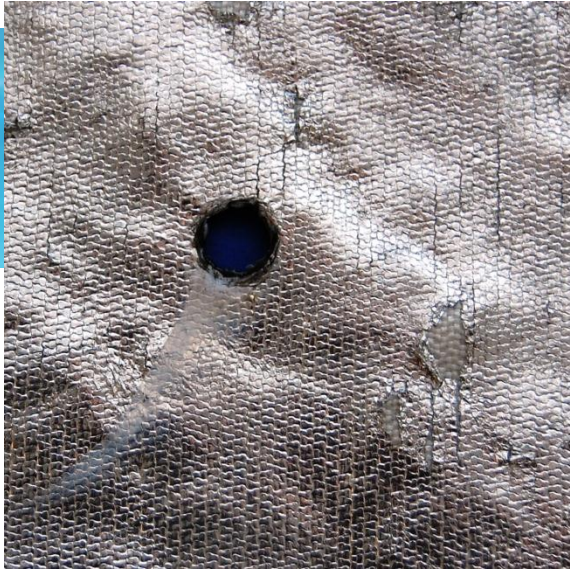


# „CLEANLASER PROTECTIVE CURTAIN CURRENT STATUS“

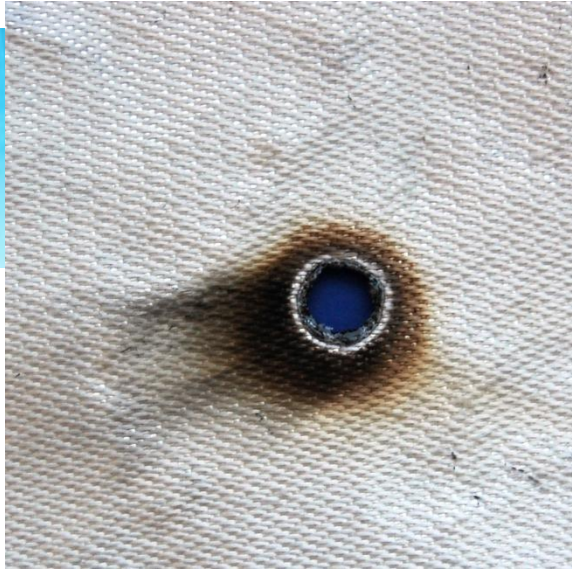
RADIATION EXPOSURE 10 SECONDS 12mm Diameter, 500W



Target nach 10 Sek



Vorderseite nach 10 Sek



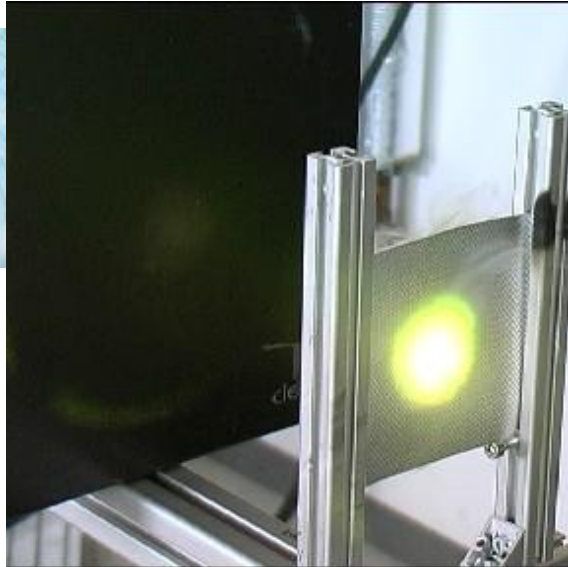
Rückseite nach 10 Sek

Spot- durchmesser	Arbeits- abstand	Bestrahlungsdauer 10 Sek	Beschädigung Vorderseite	Beschädigung Rückseite	Durchlässig nach	Brennt nach	Selbst- löschend
12 mm	323 mm	n.i.O.	< 1 Sek	< 1Sek	ca. 2 Sek	ca. 2 Sek	Ja

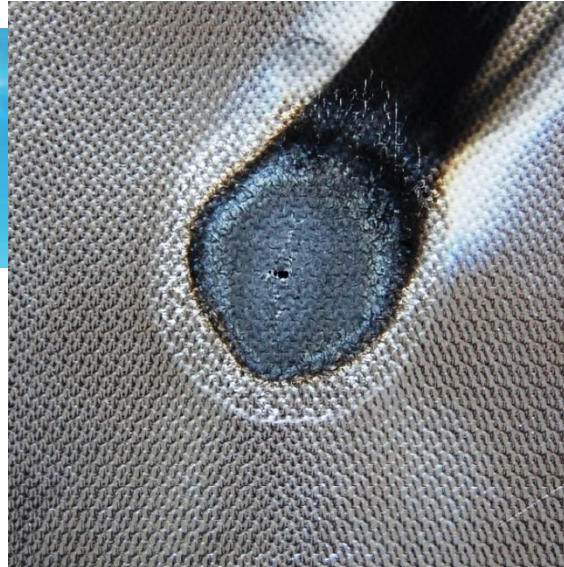


# Alternative Material – More flexible High mechanical strength

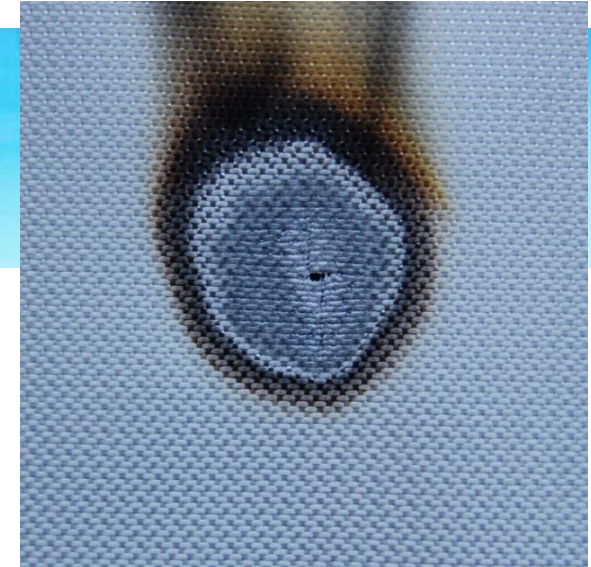
RADIATION EXPOSURE 10 SECONDS 50mm Diameter, 500W



Target nach 10 Sek



Vorderseite nach 10 Sek

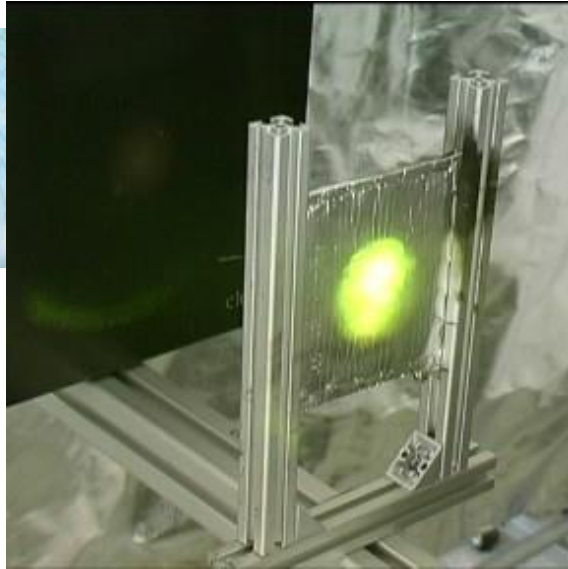


Rückseite nach 10 Sek

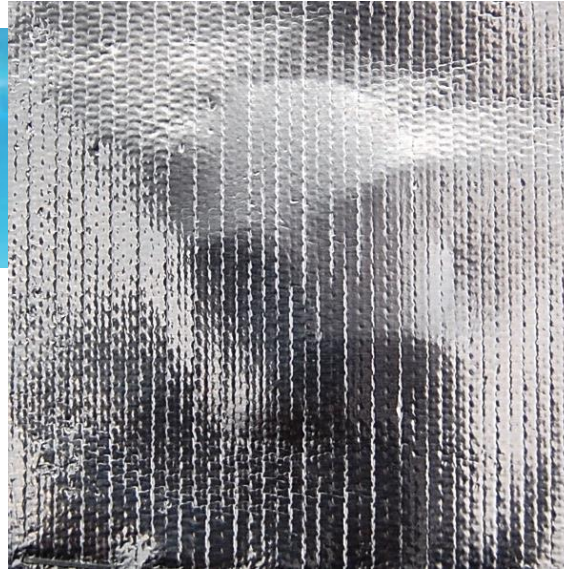
Spot- durchmesser	Arbeits- abstand	Bestrahlungsdauer 10 Sek	Beschädigung Vorderseite	Beschädigung Rückseite	Durchlässig nach	Brennt nach	Selbst- löschend
50 mm	750 mm	i.O.	7 Sek	7Sek	15 Sek	14 Sek	Ja

# „CLEANLASER PROTECTIVE CURTAIN RESULT STATUS“

RADIATION EXPOSURE 1000 SECONDS 50mm Diameter, 500W



Target nach 1000 Sek



Vorderseite nach 1000 Sek



Rückseite nach 1000 Sek

Spot-durchmesser	Arbeitsabstand	Bestrahlungsdauer 1000Sek	Beschädigung Vorderseite	Beschädigung Rückseite	Durchlässig nach	Brennt nach	Selbstlöschend
50 mm	695 mm	i.O.	keine	keine	nicht	nicht	Ja

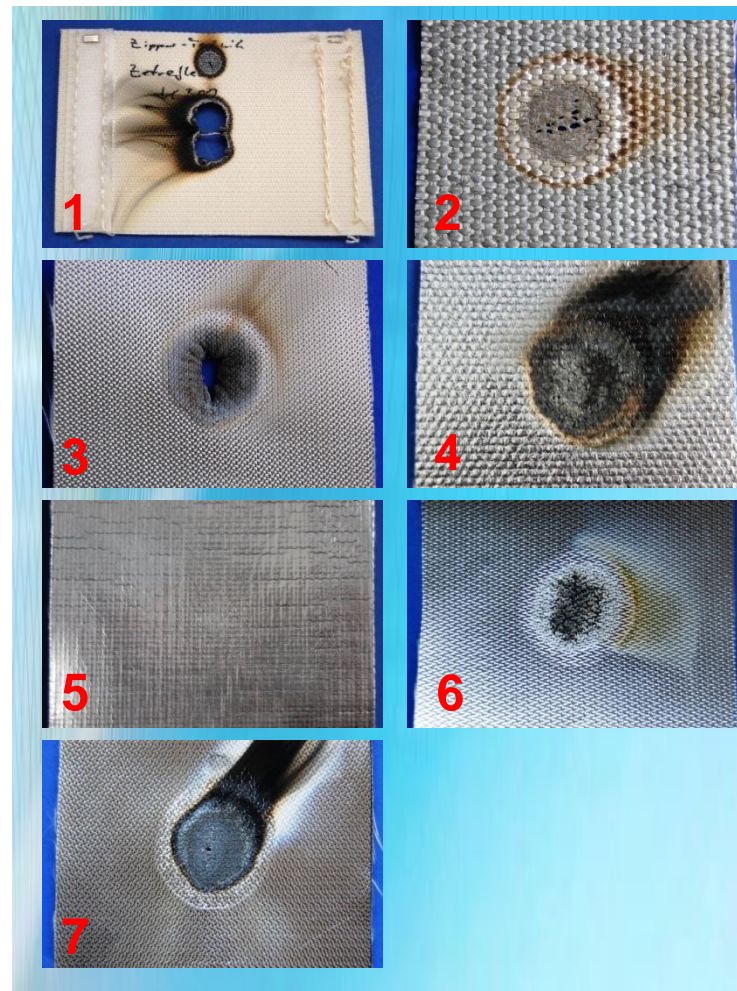
## Further TESTING RESULTS

### NEW CURTAIN SYSTEM MATERIAL HAS BEEN SELECTED

Different material was under investigation

One material combination was capable regarding:

- Laser stability
  - Tests with up to 500W average power have been completed according to EN 60825-4
- Mechanical stability (long term bending)
  - Initial test have shown a better stability compared to existing material
  - Long term stress tests have been successfully completed



# WORKPACKAGE 4: SHIELDING SYSTEM (Demonstrator)

## 6th DELIVERABLE: Shielding system/Material

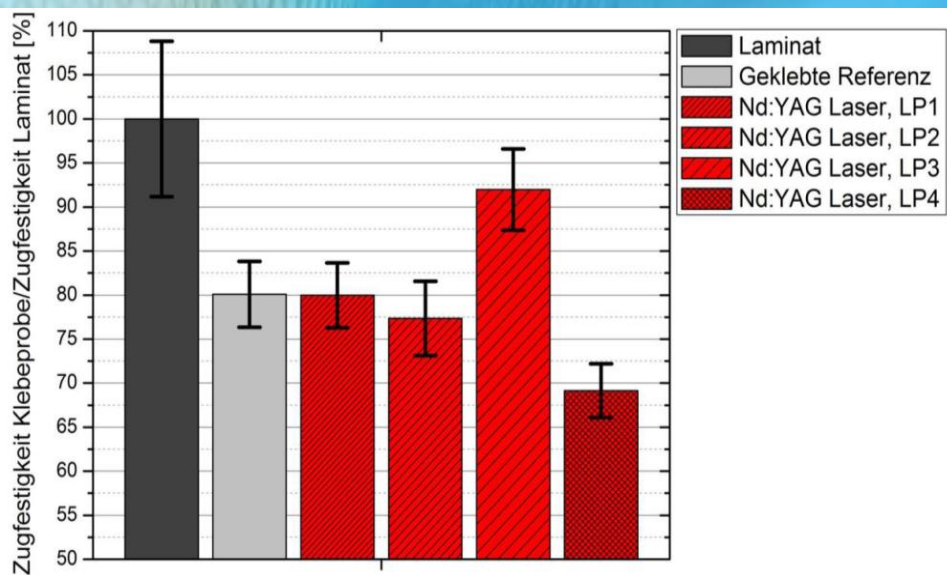


Glass fiber (aluminised)-  
AL-Foil  
Glass fiber (aluminised)

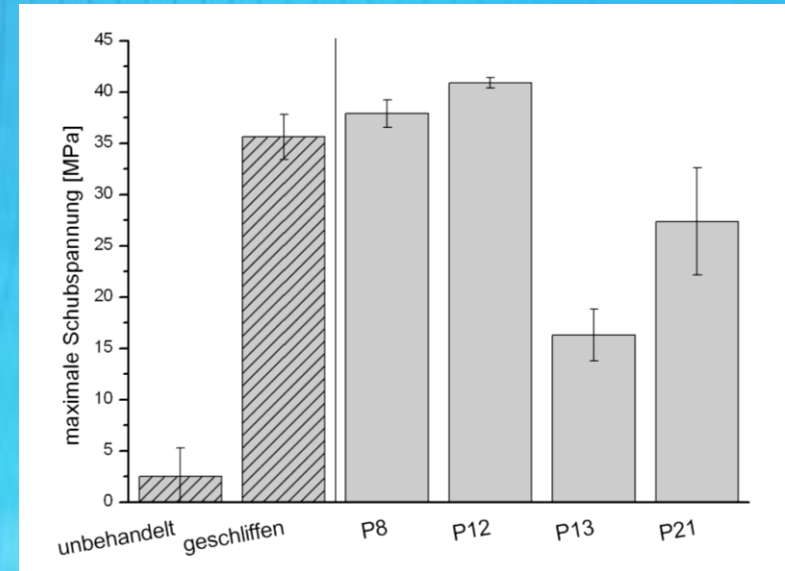
### Shielding requirements:

- Laser shielding system for flexible protection against laser radiation (only necessary if class 4 laser is in use)
- Multi layer curtain system with glass fibre based curtains in combination with metalised protection layer
- Personal protective wear: laser glasses
- Current situation: curtain flexibility is limited due to inner aluminium foil layer
- Increased mechanical stability has been achieved

# ADDITIONAL INFORMATION: ADHESIVE BONDING OF CFRP - RESULTS



*Mechanical scarfing with additional laser cleaning*

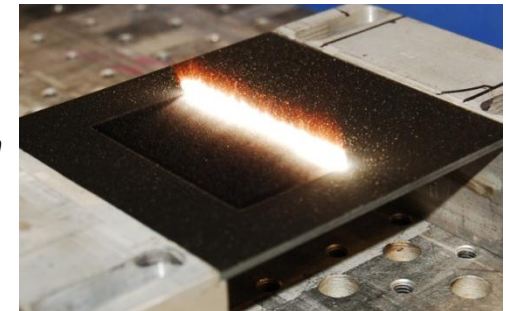


*Shear strength tests (Reference:grinded Surface)*



*Laser ablated material (by LZH)*

*Laser Bonding preparation with cleanLASER*



## cleanCOMFIELD - SUMMARY

### In Field application of laser based CFRP is applicable

- Optics are adaptable based on existing tools
- Fume extraction is capable
- On site laser safe shielding is available
- All deliverables completed

