

SMART FIXED WING AIRCRAFT (SFWA) REPORT

WP 1.1.3 LAMINAR WING TECHNOLOGIES

PROJECT STATUS cleancompFIELD – **Final report**

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Germany

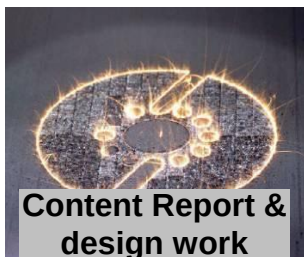
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WORKPACKAGES cleancompFIELD

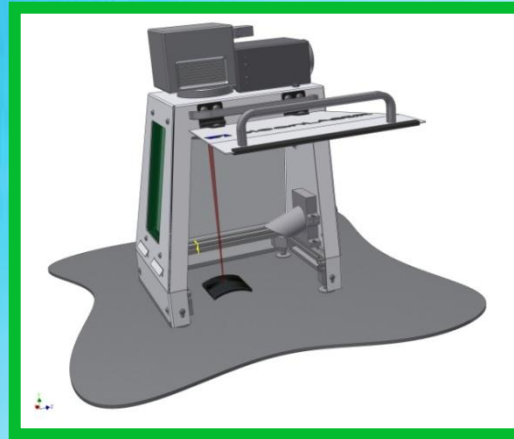
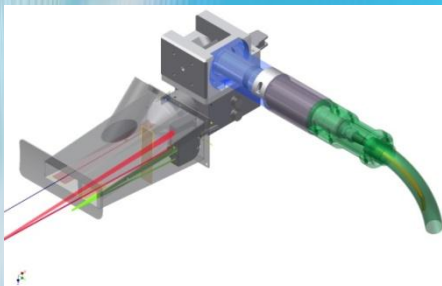
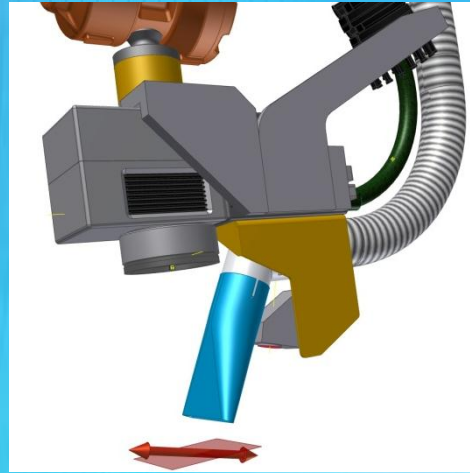
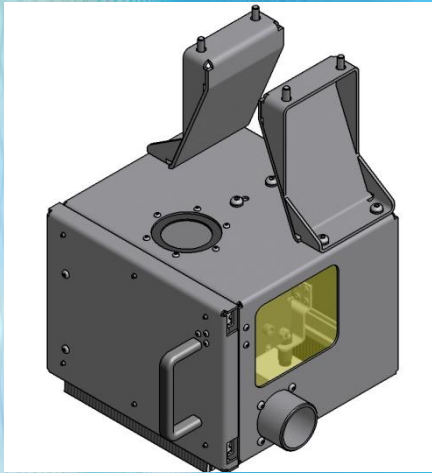
OVERVIEW WORKPACKAGES PERSON MONTHS AND STATUS



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	1. Re-designed nozzles 2. concept of suitable fume extraction	1. Shielding system concept 2. Flexible shielding system selected	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)

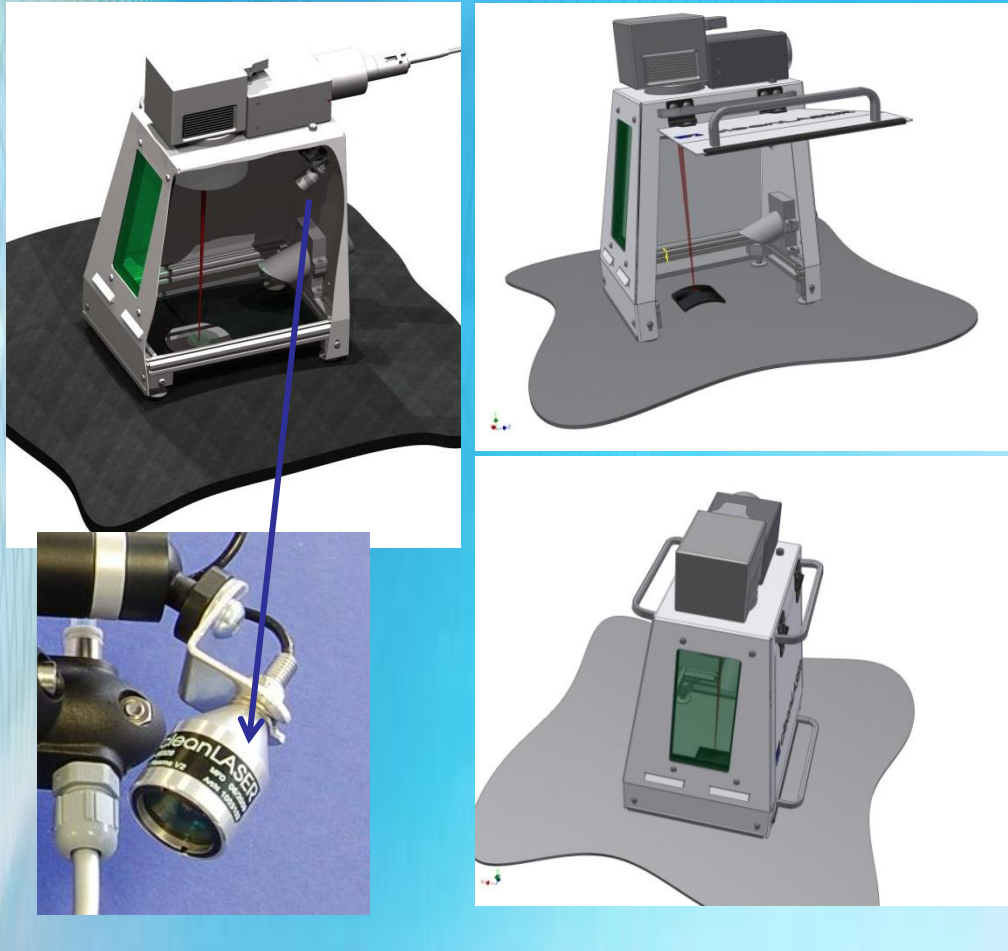
- Stamp 10
- Stamp 14

Handheld Optics

- Stylus
- OSH 20
- OSH50
- OSH80

WORKPACKAGE 2: LASER HEAD

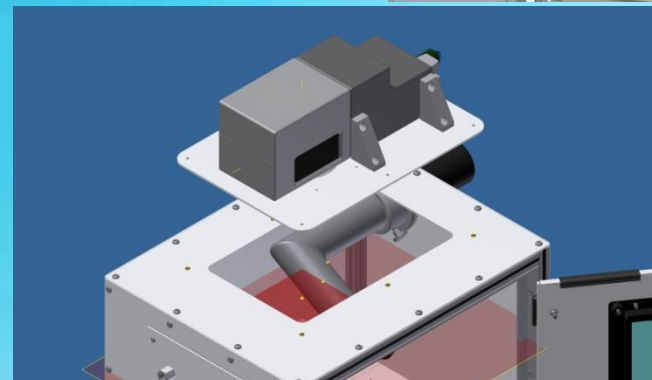
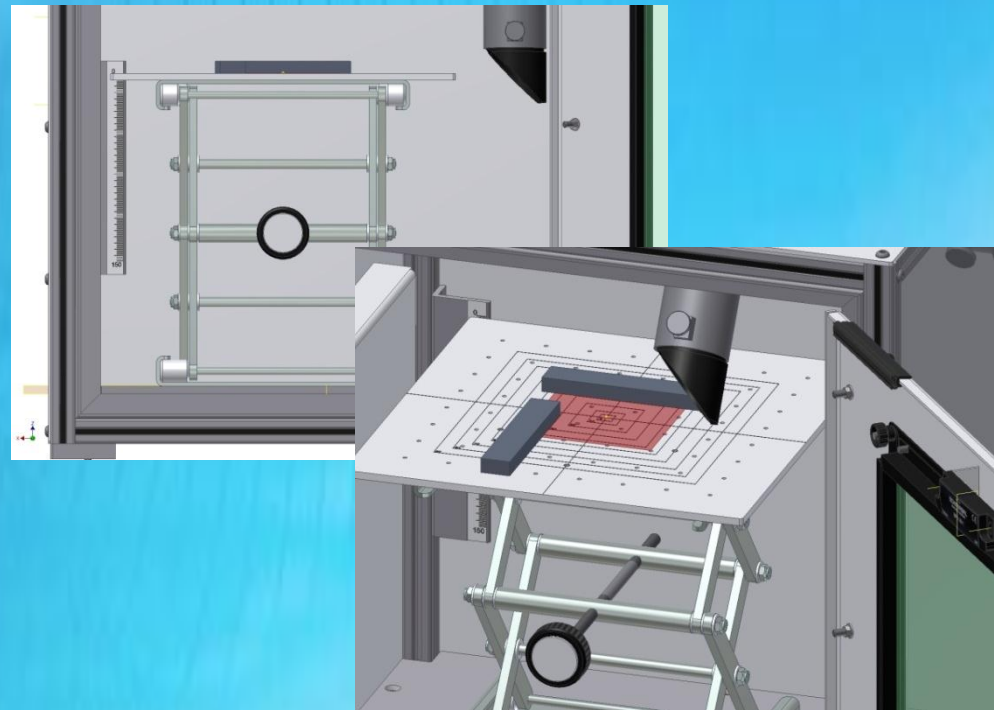
DELIVERABLE: Existing optics modified **Engineering support**



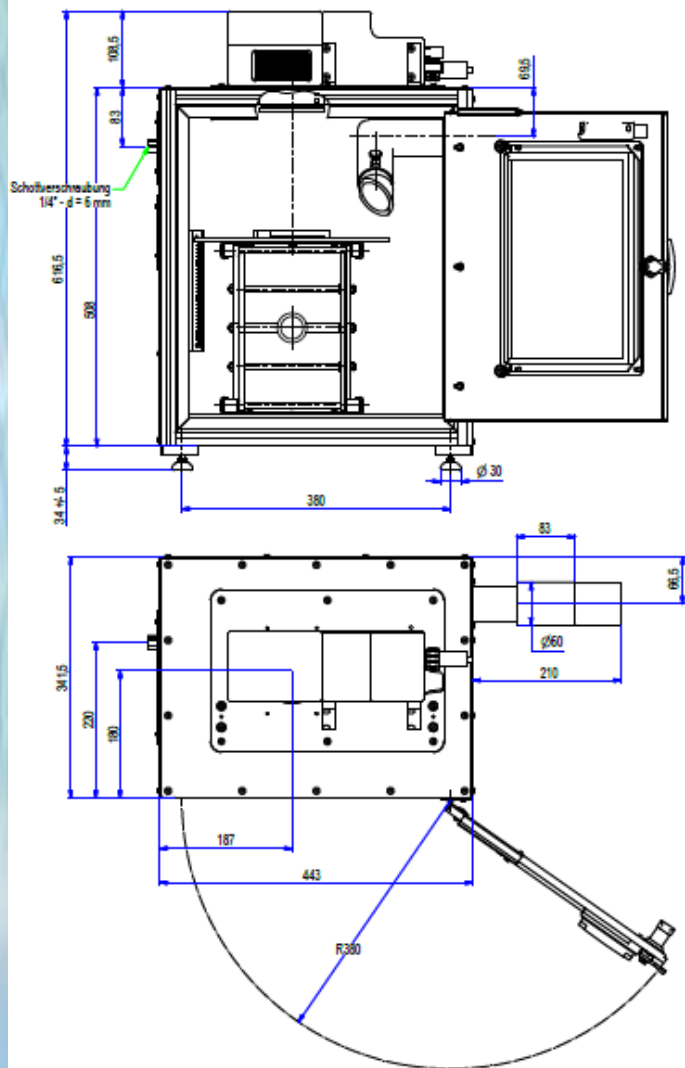
Optics design:

- 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**

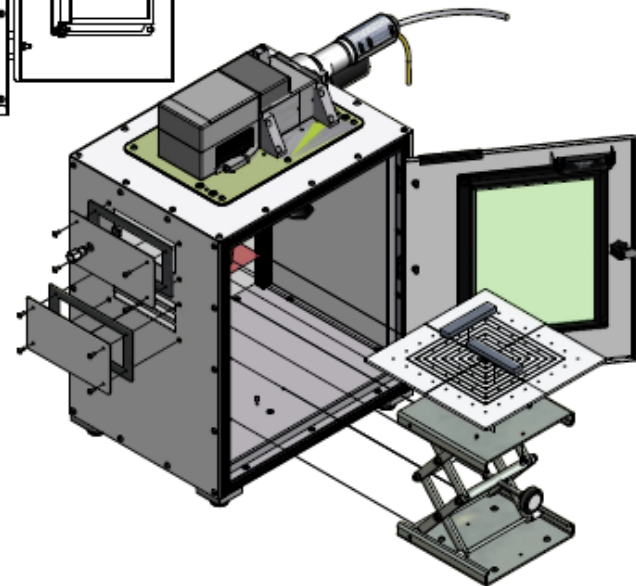
WORKPACKAGE 2: DETAILS



WORKPACKAGE 2 : LASER HEAD DRAWING (delivered)



Dimensions:

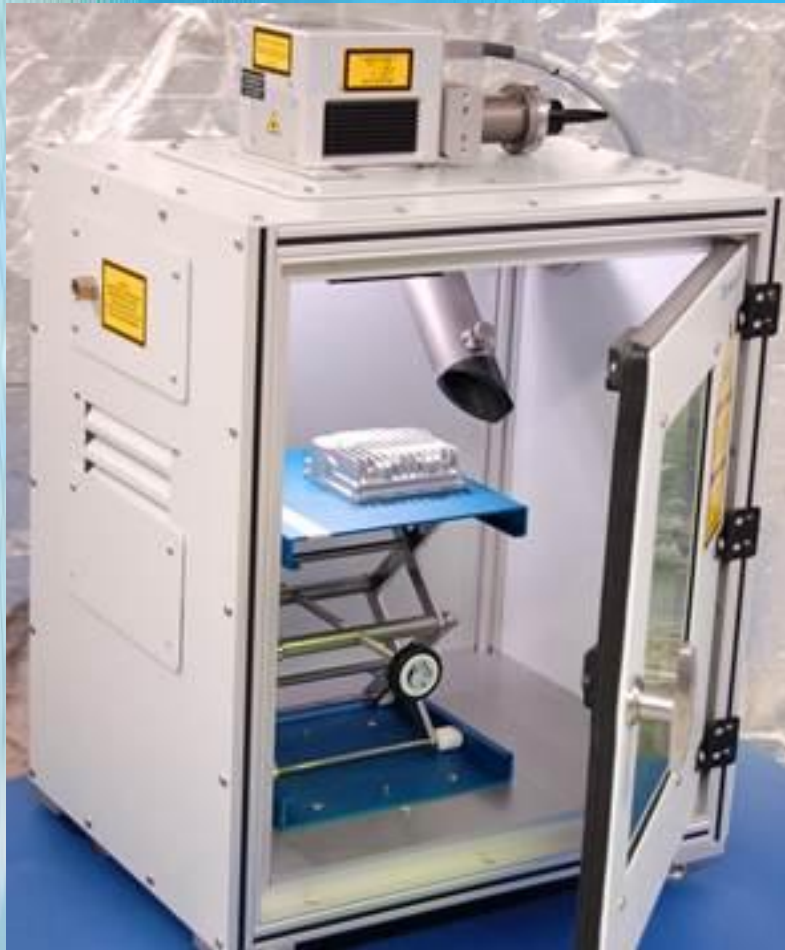


 cleanLASER Laserreinigungstechnik 0-20134 Pörschach - www.cleanlaser.de E-Mail: support@cleanlaser.de Fax: support@cleanlaser.de	Algorithmenreihe ISO 27005	Reichtabelle DIN 6794	Version 1.4 Gewicht (Netto) - ca. 25 Kg	Einheiten [mm]
	Datum 01.08.2017	Name CLEANSKY		
	Bearb. 01.08.2017	Geprüft 01.08.2017		
	Freigegeben 01.08.2017	Freigegeben 01.08.2017		
Artikel CLEANSKY 1130	E10-2096.1130			3

WORKPACKAGE 2 and 4: LASER HEAD AND LASER SAFE ENCLOSURE

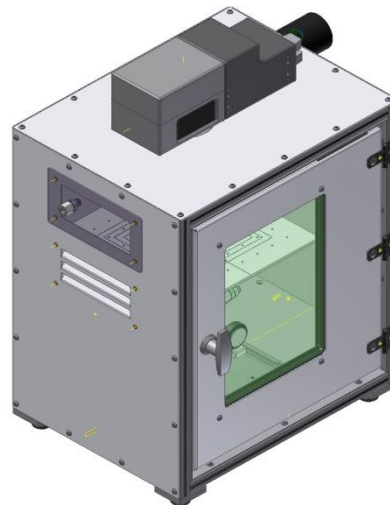
DELIVERABLE: Existing optics modified & engineering support ongoing)

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



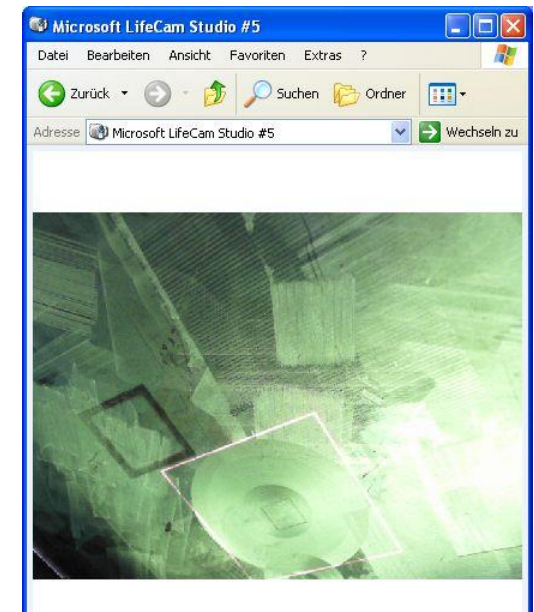
WORKPACKAGE 2 and 3: EXHAUSTING SYSTEM AND NOZZLE

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



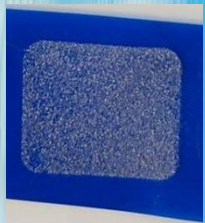
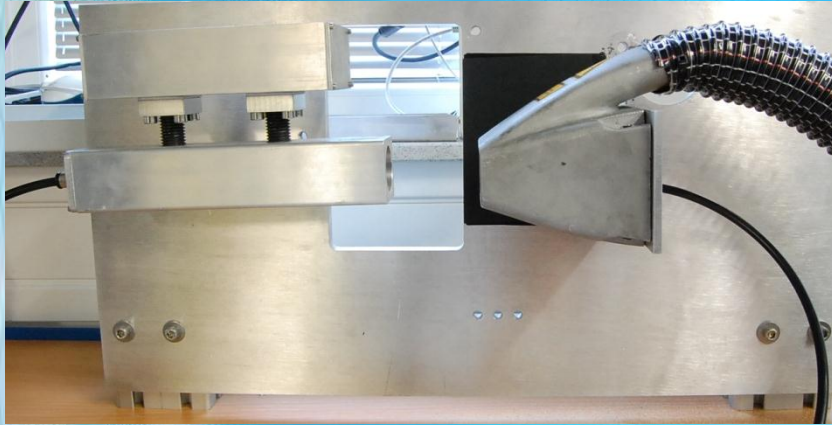
Nozzle design:

- 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

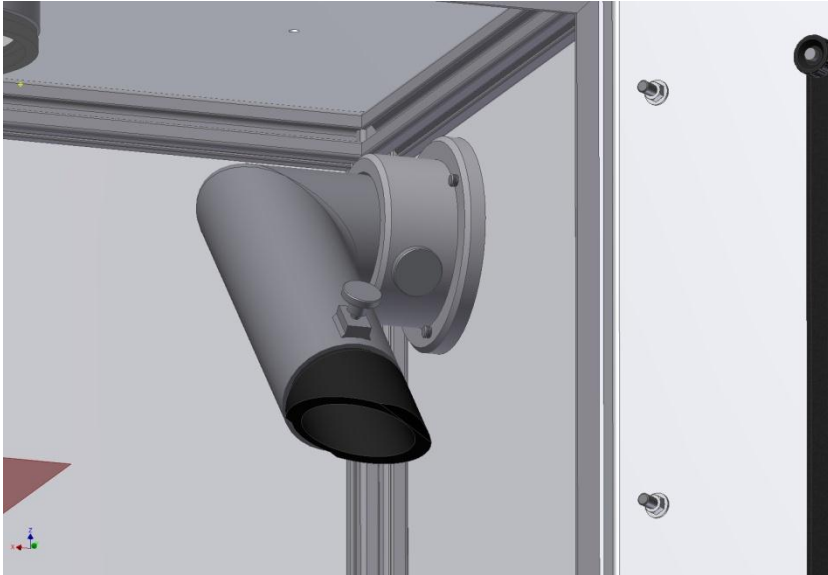


Nozzle design:

- 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

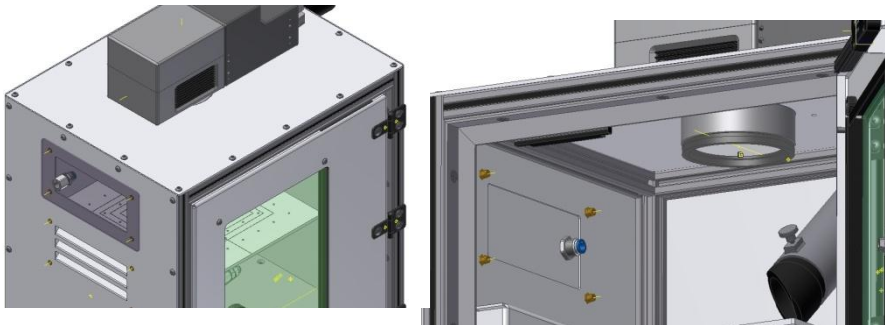
WORKPACKAGE 3: EXHAUSTING SYSTEM AND NOZZLE

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

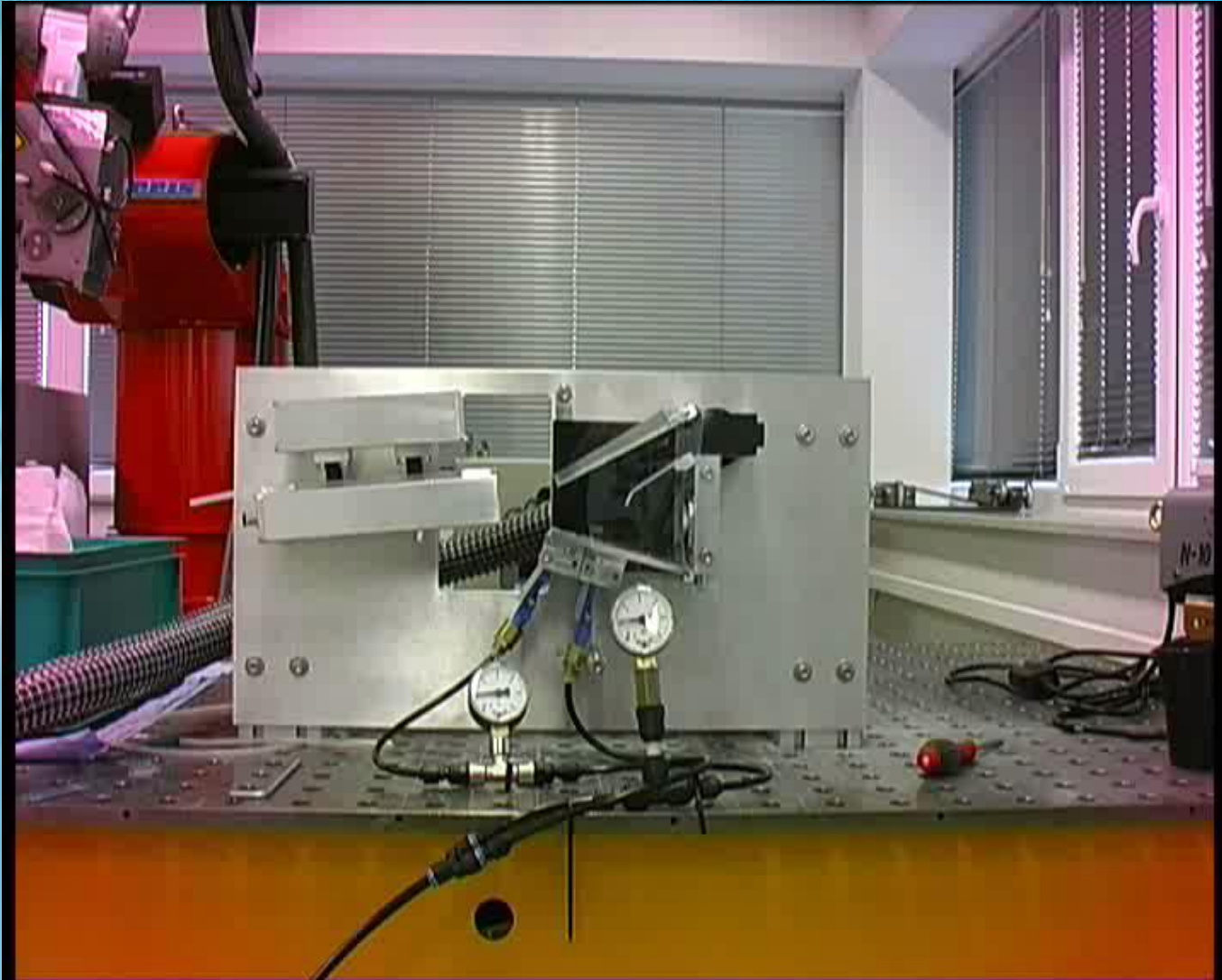


Nozzle design:

- 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

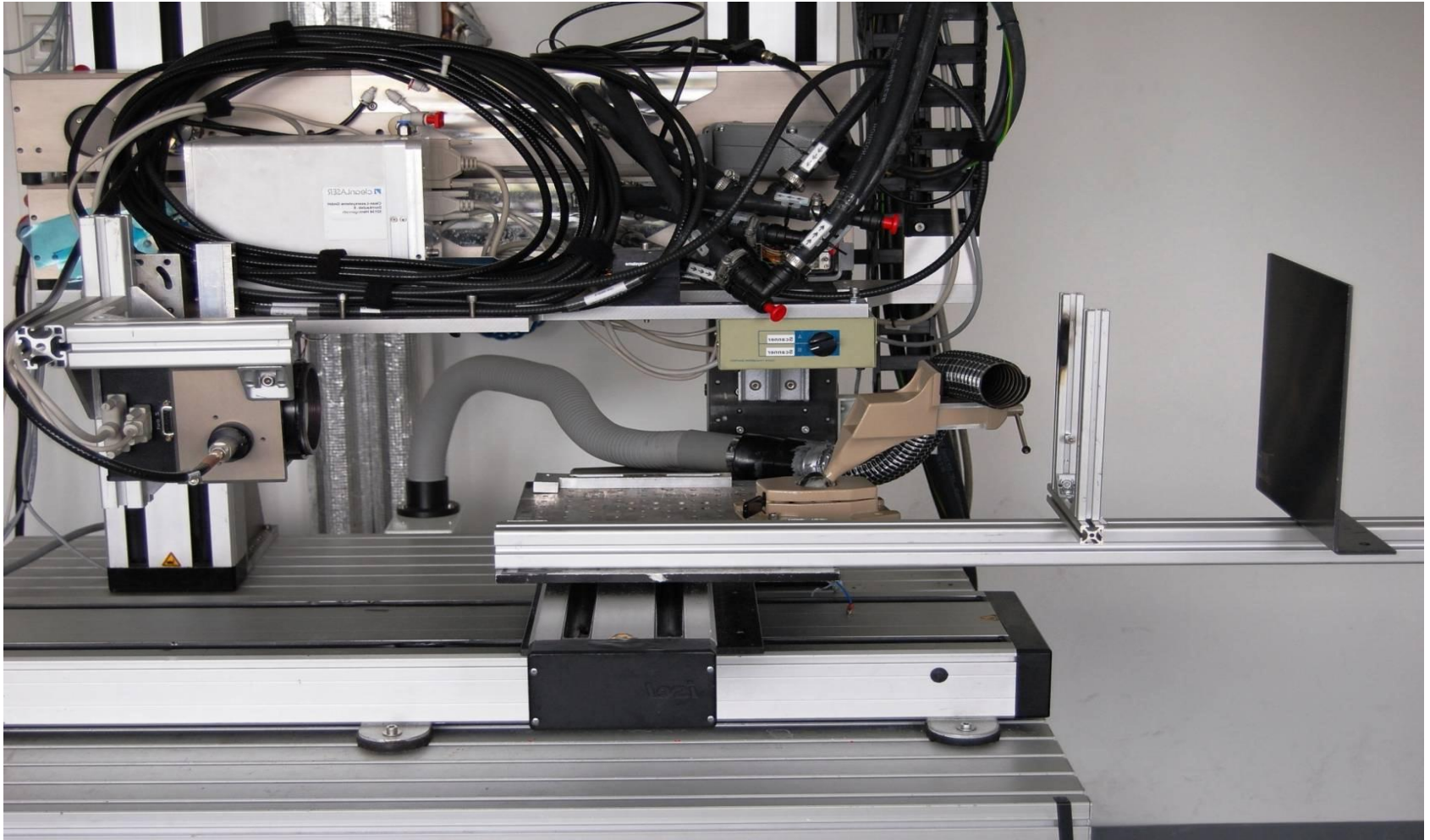
DELIVERABLE #4: Potential Concept of suitable fume extraction



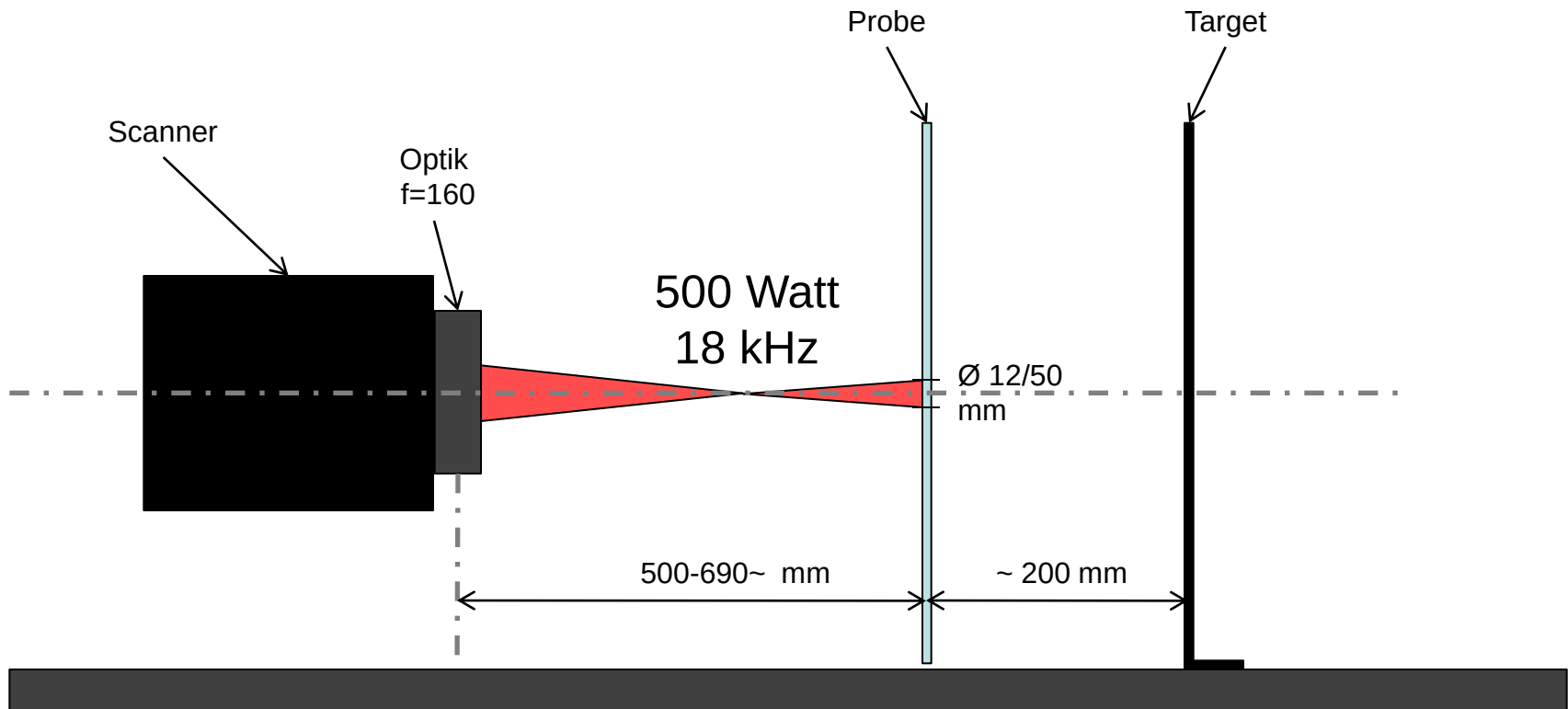
Filter unit requirements:

- 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

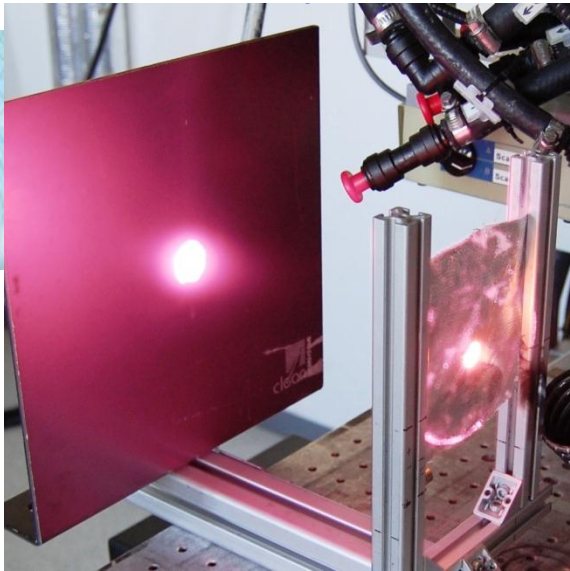


TEST SET UP

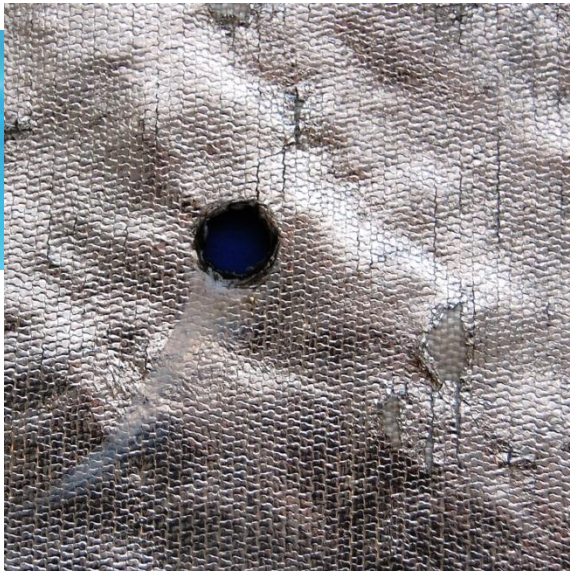


„CLEANLASER PROTECTIVE CURTAIN CURRENT STATUS“

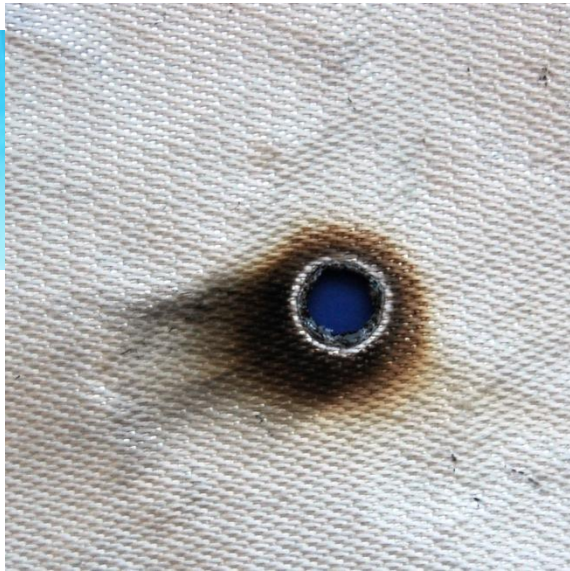
RADIATION EXPOSURE 10 SECONDS 12mm Diameter, 500W



Target nach 10 Sek



Vorderseite nach 10 Sek

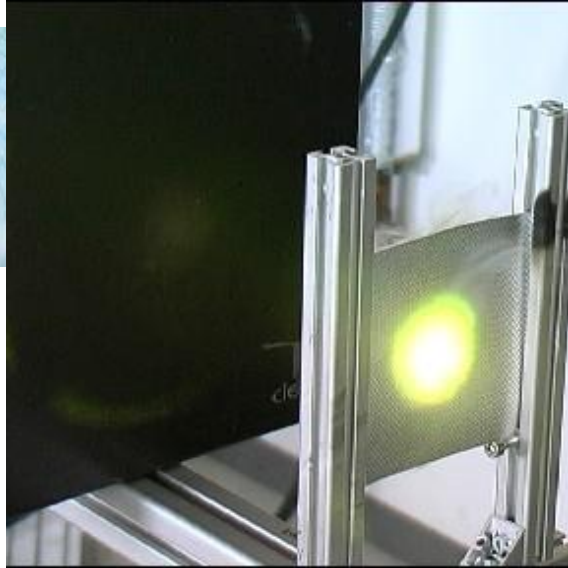


Rückseite nach 10 Sek

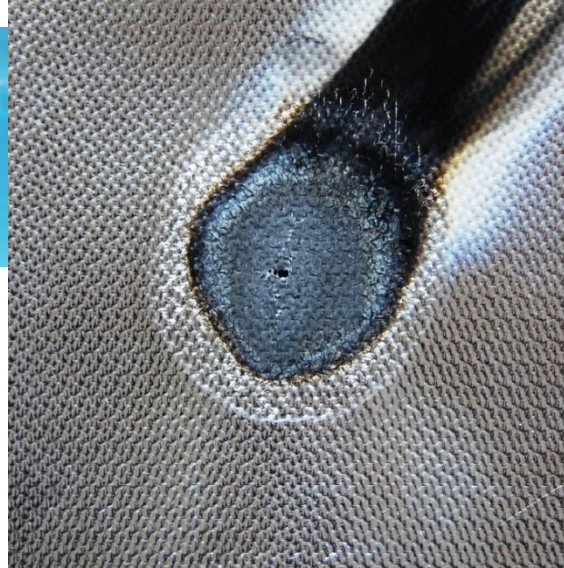
Spot- durchmesser	Arbeits- abstand	Bestrahlungsdauer 10 Sek	Beschädigung Vorderseite	Beschädigung Rückseite	Durchlässig nach	Brennt nach	Selbst- löschend
12 mm	323 mm	n.i.O.	< 1 Sek	< 1Sek	ca. 2 Sek	ca. 2 Sek	Ja

Alternative Material – More flexible High mechanical strength

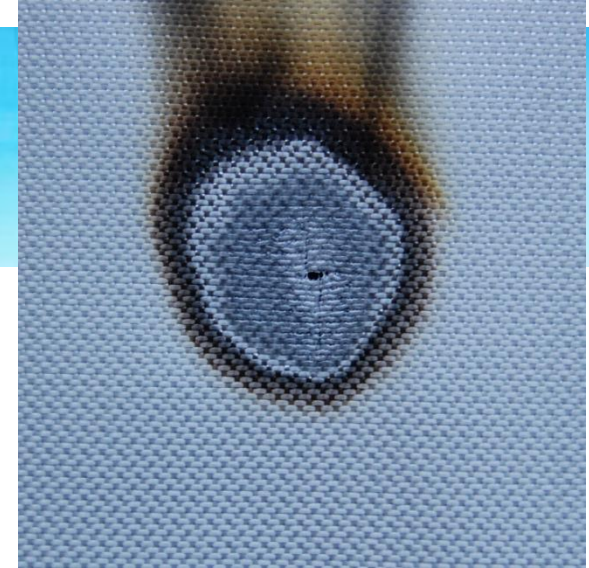
RADIATION EXPOSURE 10 SECONDS 50mm Diameter, 500W



Target nach 10 Sek



Vorderseite nach 10 Sek

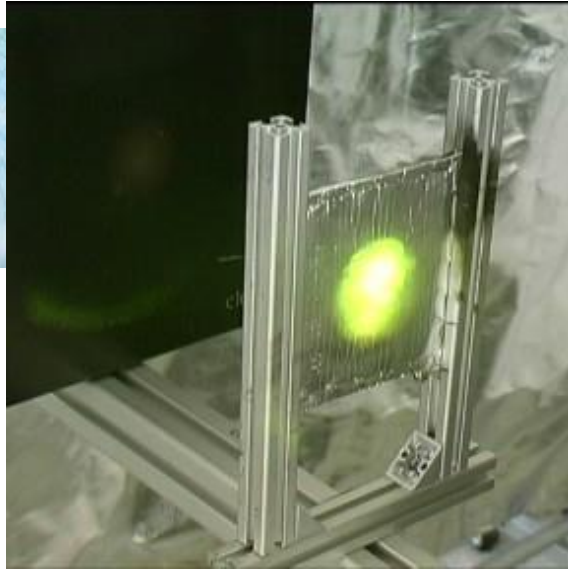


Rückseite nach 10 Sek

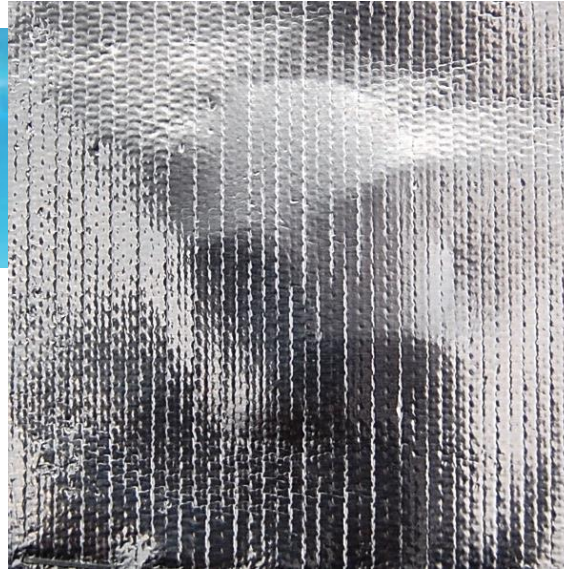
Spot- durchmesser	Arbeits- abstand	Bestrahlungsdauer 10 Sek	Beschädigung Vorderseite	Beschädigung Rückseite	Durchlässig nach	Brennt nach	Selbst- löschend
50 mm	750 mm	i.O.	7 Sek	7Sek	15 Sek	14 Sek	Ja

„CLEANLASER PROTECTIVE CURTAIN RESULT STATUS“

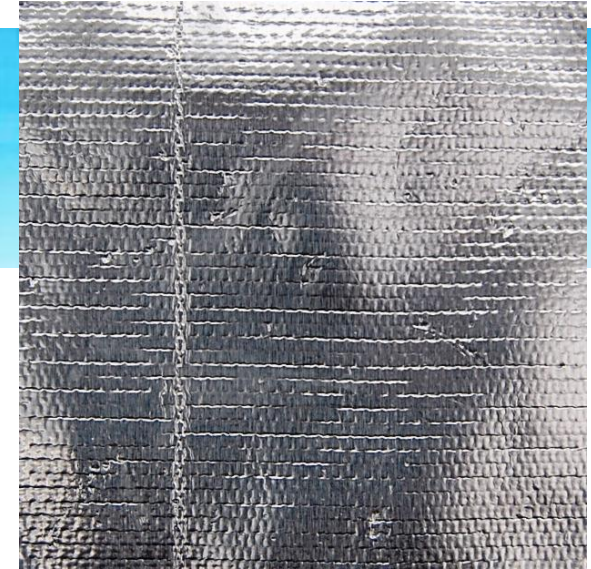
RADIATION EXPOSURE 1000 SECONDS 50mm Diameter, 500W



Target nach 1000 Sek



Vorderseite nach 1000 Sek



Rückseite nach 1000 Sek

Spot- durchmesser	Arbeits- abstand	Bestrahlungsdauer 1000Sek	Beschädigung Vorderseite	Beschädigung Rückseite	Durchlässig nach	Brennt nach	Selbst- löschend
50 mm	695 mm	i.O.	keine	keine	nicht	nicht	Ja

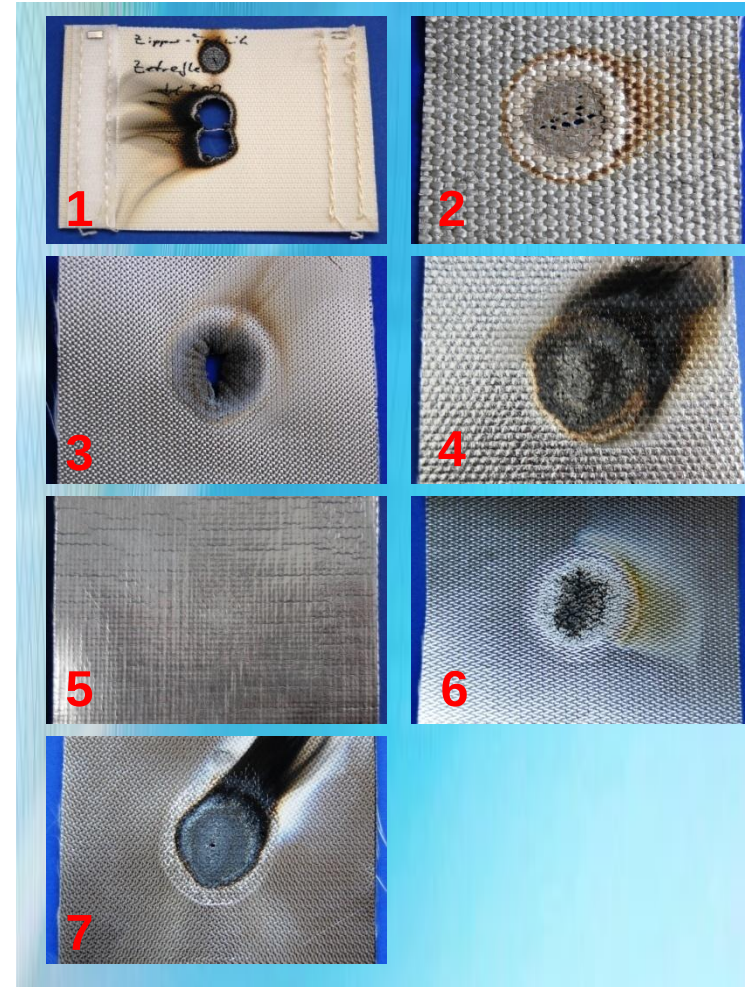
Further TESTING RESULTS

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

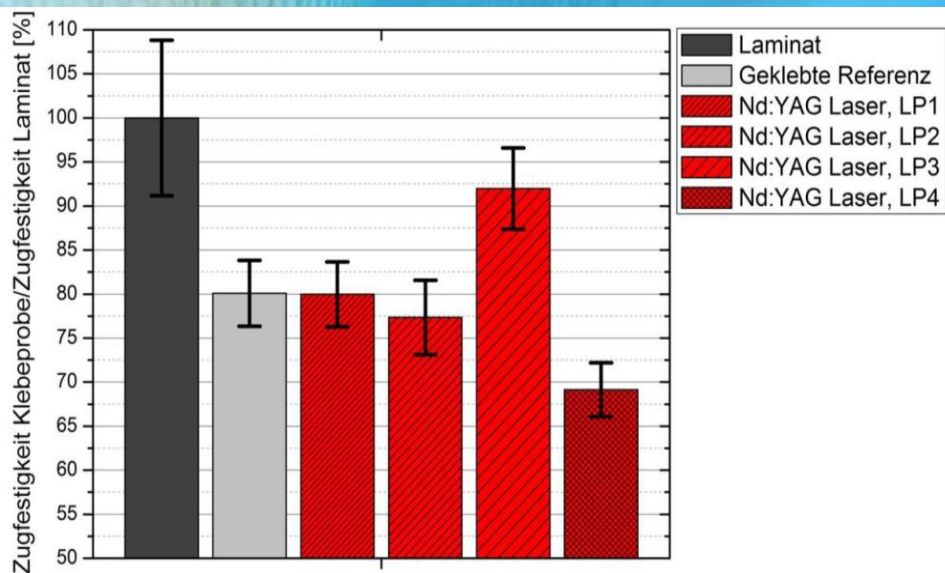


Glass fiber (aluminised)–
AL-Foil
Glass fiber (aluminised)

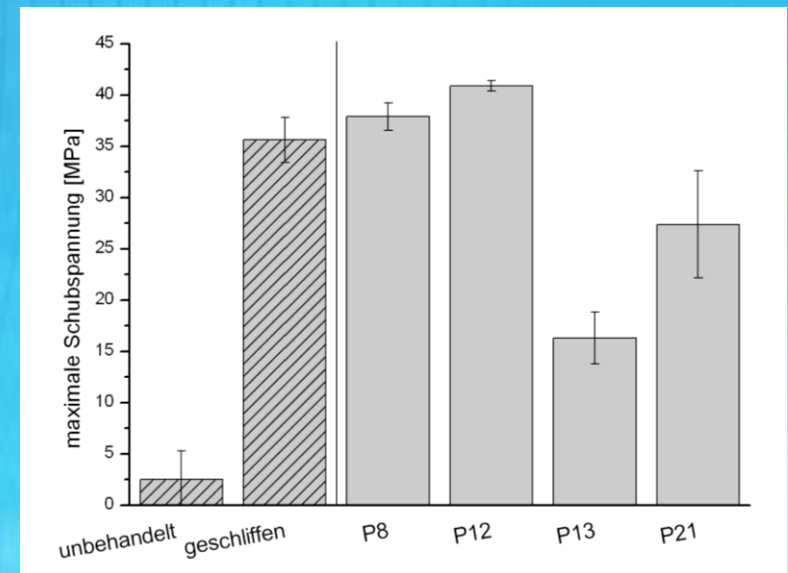
Shielding requirements:

- 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

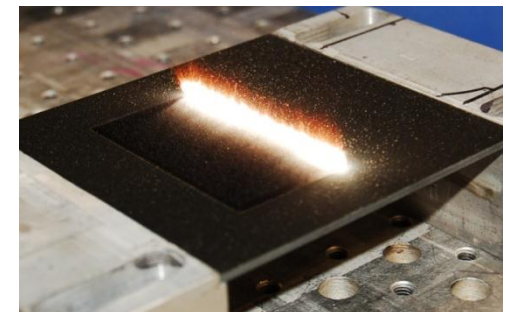


Shear strength tests (Reference:grinded Surface)



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

