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Safer profit.

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Competence in Aerospace industry

Innovative solutions in metal working fluids for aircraft production

May 2019

Content

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1. General introduction of Rhenus Lub

2. Solutions for the aerospace industry
   - The current foot print in aerospace business
   - References

3. Added value for aerospace customers
   - Innovative metal working fluids
   - R&D power for customized solutions
   - Approvals

RHENUS LUB

The company for innovative special lubricants

Founded in 1882 and has subsequently achieved worldwide success as a German family business.

270 employees, 20% in Research & Development
2018 volume: 30,000 t of goods sold
2018 turnover: EUR > 97 million

Certifications:

ISO 9001
ISO 14001
IATF 16949
OHSAS 18001

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RHENUS LUB

We develop and produce with excellence

- Modern, privately-run family business
- High level of expertise in processes and development
- Quick decisions due to a flat hierarchy

RESEARCH AND DEVELOPMENT

Innovation is in our DNA

New lubricants for tomorrow's world

- New metal working fluids and greases based on alternative raw materials
- Metal working fluids that are always a step ahead of rising health and safety requirements
- REACH compliance
- Lubricants for new materials and technologies

RESEARCH AND DEVELOPMENT

Collaboration with the following research facilities

- German Aerospace Centre (DLR)
- Hochschule Niederrhein, University of Applied Sciences
- RWTH Aachen, Technical University
- Westsächsische Hochschule Zwickau (West Saxon University, Zwickau)
- BiSafe — Microbiology and Biological Safety
- Starrag Group
- et al.

DLR

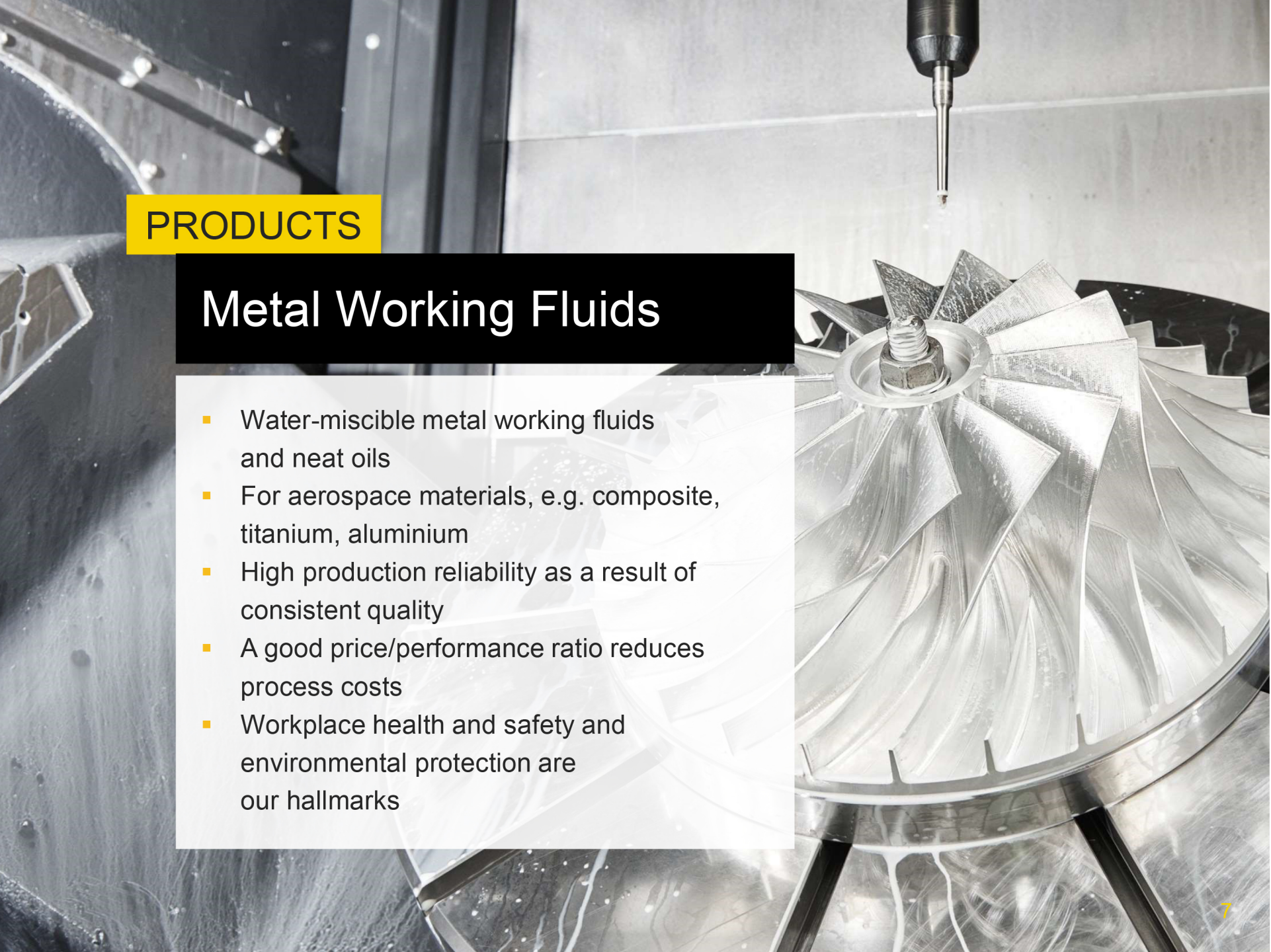
Hochschule Niederrhein
University of Applied Sciences

RWTH AACHEN UNIVERSITY

Westsächsische Hochschule Zwickau
University of Applied Sciences

BiSafe

starrag
Starrag Group



PRODUCTS

Metal Working Fluids

- Water-miscible metal working fluids and neat oils
- For aerospace materials, e.g. composite, titanium, aluminium
- High production reliability as a result of consistent quality
- A good price/performance ratio reduces process costs
- Workplace health and safety and environmental protection are our hallmarks

FLUID MANAGEMENT

rhenus lubrineering — system expertise

- Take control of complete fluid processes
- Optimisation based on transparent metrics methods

→ Reduce production costs
→ Reduce unit costs

FluidSafe — in real time, every time

- All influencing factors at a glance — anytime, anywhere
- Continuous measured values
- Metal working fluid integration in Industry 4.0

→ Identifying and setting the coolant values typical to the system
→ Permanently stable coolant
→ Reduced consumption of concentrates and additives

RHENUS LUB

Satisfied customers across the world — from multinationals to hidden champions

BOĞAZİÇİ ENDÜSTRİYEL

Satisfied customers across in TURKEY

RHENUS LUB

Added value for our customers around the world

- International subsidiaries and distributors on all continents
- Expertise in international delivery concepts

2. Solutions for Aerospace industry

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Metal working fluids approved by:

- Airbus Group (F80T-30-4010, AIMS 12-10-001)
- Rolls Royce
- Safran Group (PR 6300, PCS 4001, former Snecma and Messier Bugatti Dowty)
- And others: Embraer, GE, MTU, Sikorsky, Bombardier

Quelle: Internet

References aerospace Germany (extract)

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rhenus FU 60

rhenus TU 65

rhenus FU 52 TD, rhenus EDD10

rhenus TU 43 P

rhenus FU 50 W, rhenus EA 11 S

rhenus FU 60

rhenus FU 50

rhenus FU 60

References aerospace Europe (extract)

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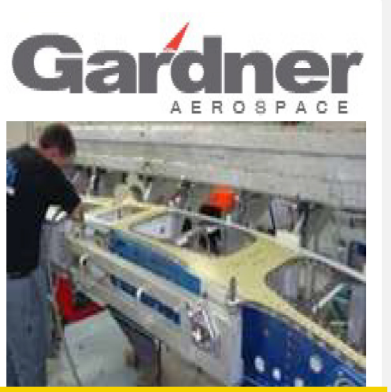
rhenus FU 70 W, rhenus FU 800

rhenus R-Flex, rhenus TU 65-2

rhenus FU 53 W, EP 10 M

rhenus TS 46

rhenus TU 65-2



rhenus FU 60

rhenus FU 70 W, rhenus TU 44

rhenus FU 70 W

Overview of supplied companies

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Overview of supplied companies

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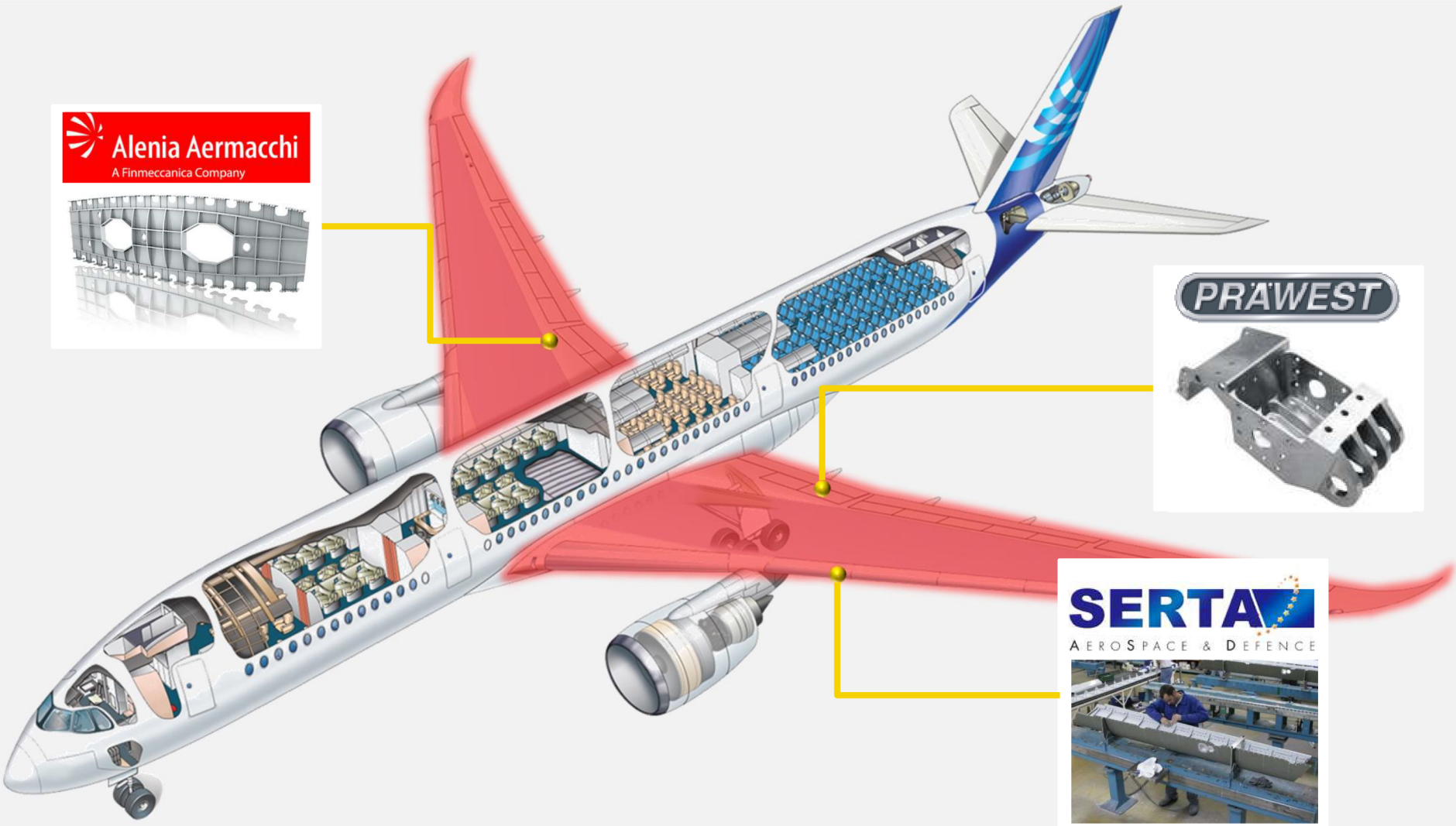

Overview of supplied companies

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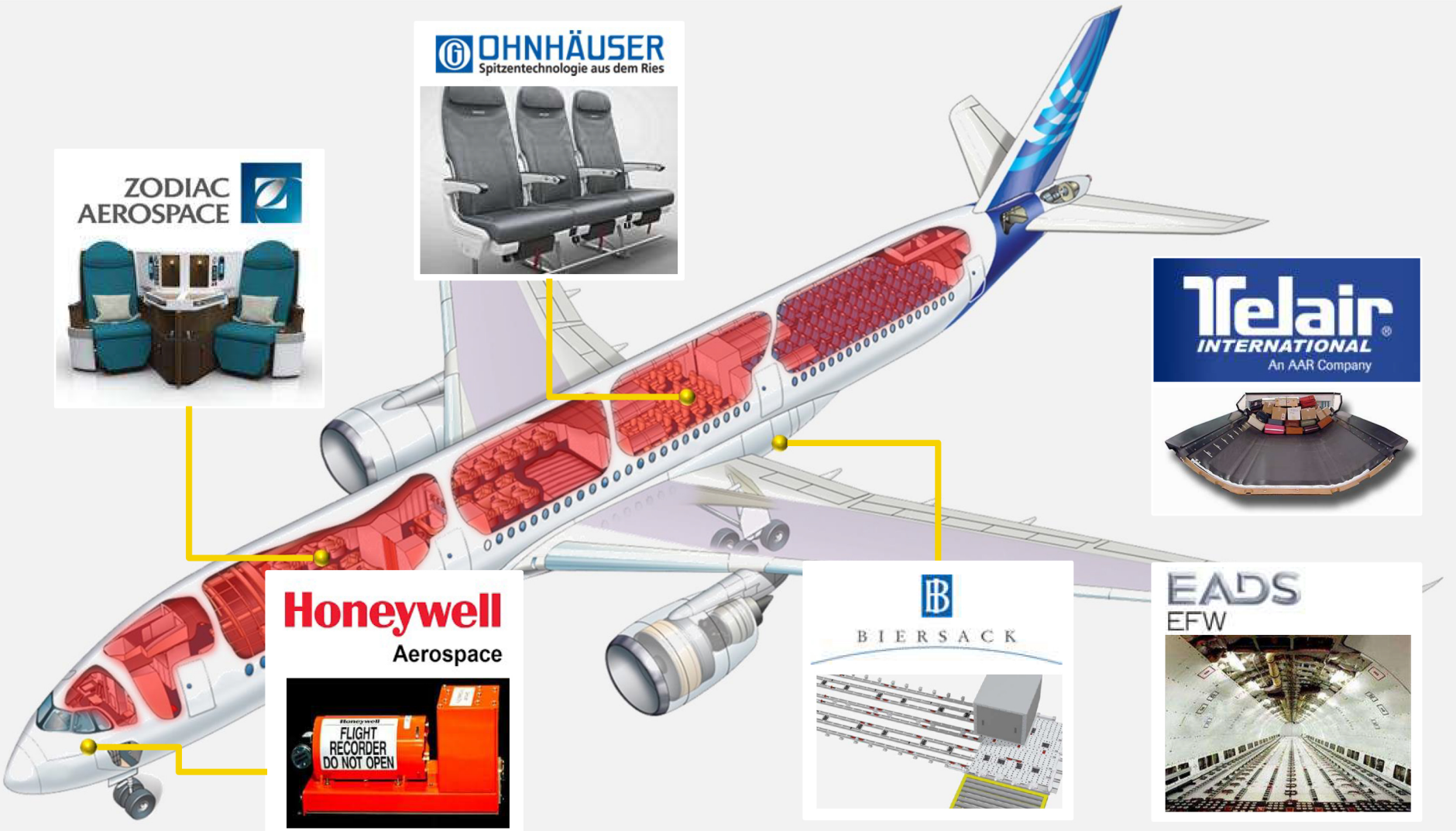

Overview of supplied companies

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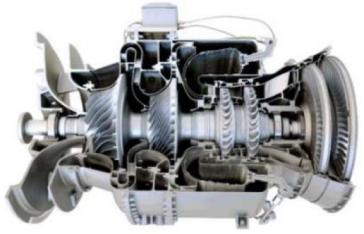
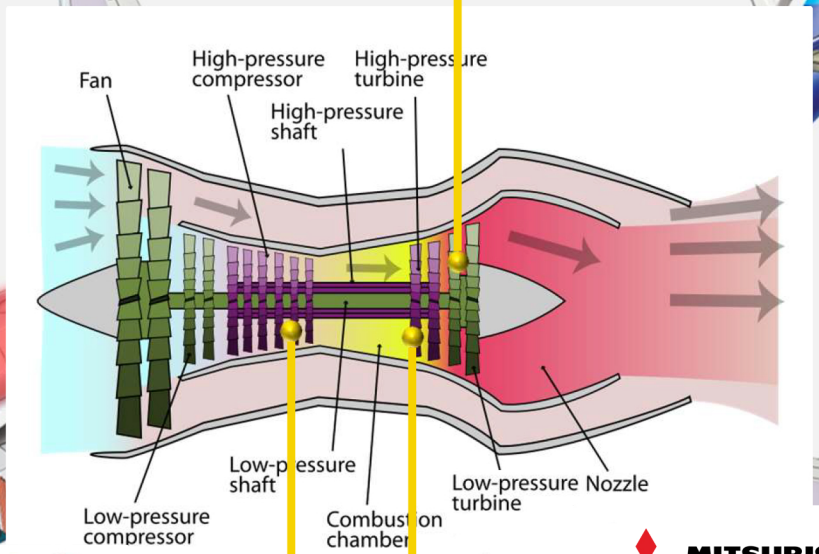
TEI
TUSAŞ MOTOR SANAYİİ A.Ş.
TUSAS ENGINE INDUSTRIES, INC





SAFRAN
Snecma

MTU
Aero Engines

TEC
Turkish Engine Center
Pratt & Whitney
A United Technologies Company

MITSUBISHI
AIRCRAFT CORPORATION

Rolls-Royce

2. Competence in Aerospace industry

Supply of metal working fluids and fluid management services at:

- **Airbus Group**
  - Premium Aerotec, Augsburg plant
    - More than 15 years of partnership
    - Supply of metal working fluid for machining of aluminium and titanium
    - Service for coolant central system
  - Airbus Operations, Hamburg
    - Supply of metal working fluids since the year 2000
    - Machining of all materials

2. Competence in Aerospace industry

Supply of metal working fluids and fluid management services at:

- **Safran group, several plants in France**
  - Supply of water miscible coolants and neat oils
- **Rolls Royce, Oberursel plant, Germany**
  - Long lasting partnership, more than 18 years
  - Supply of water miscible coolants and neat oils for high alloy materials
  - Fluid Management
- **MTU Aero engines, Munich and Langenhagen plant, Germany**
  - Supply of water miscible coolants for grinding operations
- And many other aerospace customers world wide

3. Added value for Aerospace customers

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The specialists

rhenus TU 560

Water-miscible coolant

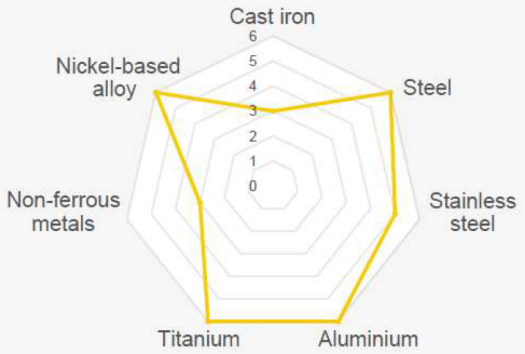
- Tried and tested: premium product with excellent performance in titanium processing
- Technologically advanced: suitable for aerospace alloys and aluminium
- Efficient: exceptionally cost-effective in high-performance applications

Key features

- Allows very good tool life in titanium machining
- Very low foaming in the application
- Tested for PU compatibility
- Tested for material compatibility in accordance with AIMS 12-01-001

rhenus Aircraft Technology

Material suitability



6 = ideally suited 0 = less well suited

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rhenus TU 560

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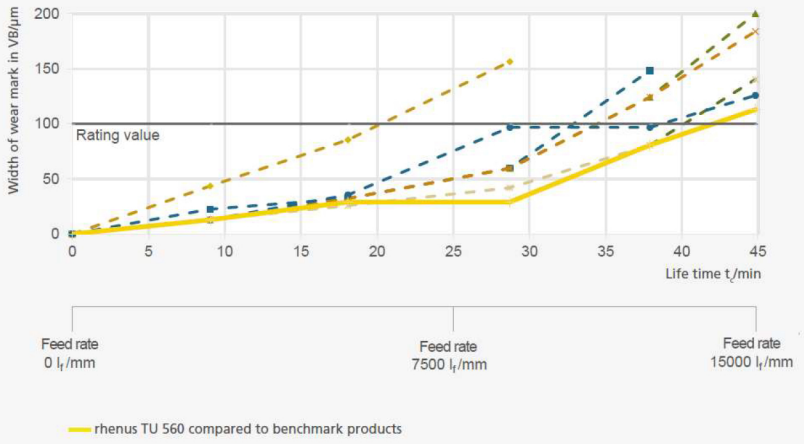
Areas of application

Grinding	Turning	Drilling	Milling	Thread machining
⊕	⊕⊕⊕	⊕⊕⊕	⊕⊕⊕	⊕⊕⊕

Performance

Wear test VB (end milling, TiAl6V4)

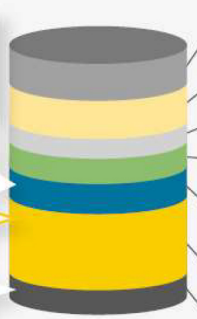


Cost benefits

Enables increased production reliability and more productive working hours

Approx. 30% longer tool life (independent test performed during titanium processing)

Easy handling due to water hazard class 1



- Maintenance of the coolant
- Coolant consumption or price
- Use of service agent
- Maintenance of machine tools
- Rejects and downtime
- Tool
- Storage

Cost factors influenced by coolant

Environment and health and safety

- No SVHC ingredients
- No GHS pictograms
- Good skin compatibility
- Water hazard class 1

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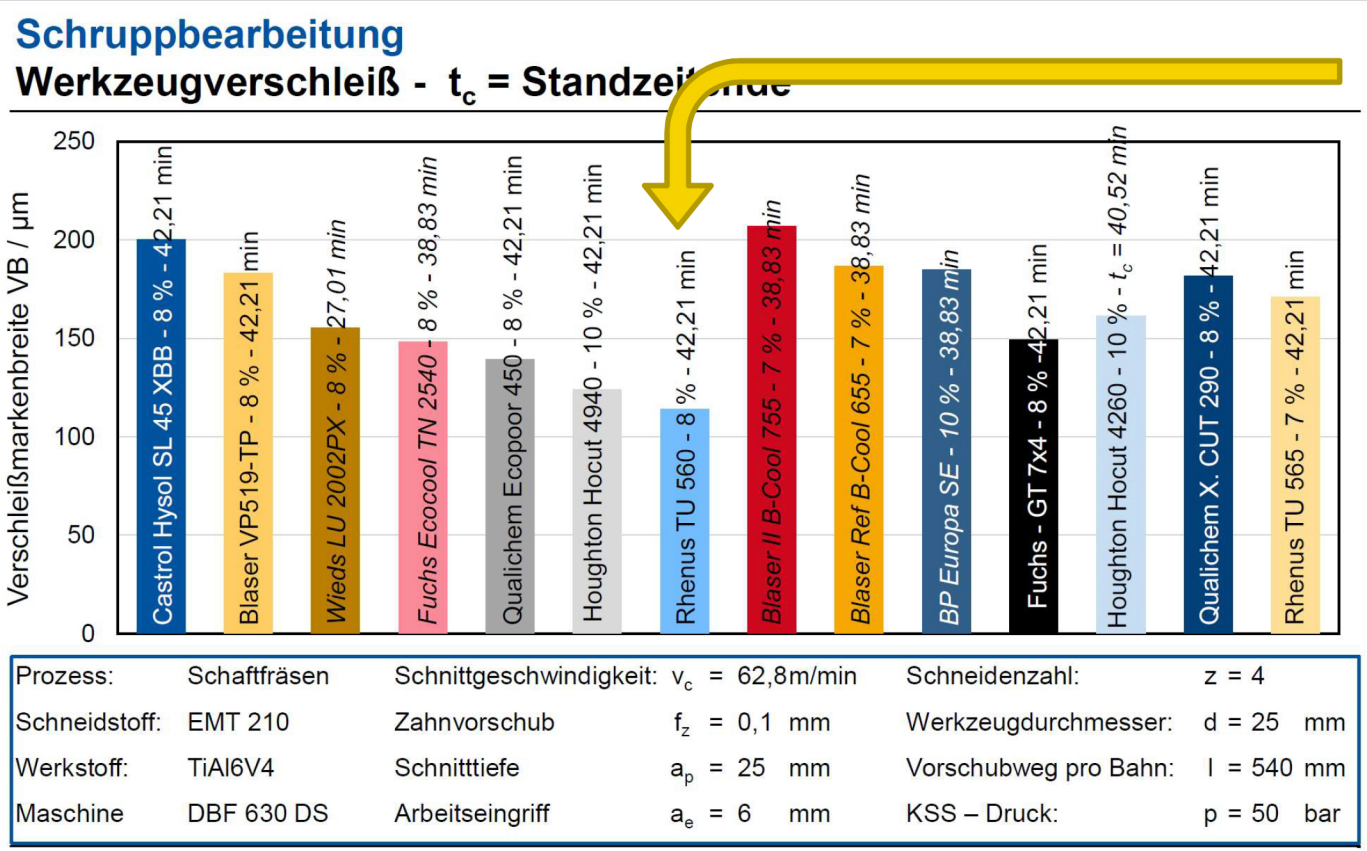
R&D power for innovative metal working fluids



Prozess:	Schaftfräsen	Schnittgeschwindigkeit:	v_c	= 62,8	m/min	Schneidenzahl:	z = 4
Schneidstoff:	EMT 210	Zahnvorschub	f_z	= 0,1	mm	Werkzeugdurchmesser:	d = 25 mm
Werkstoff:	TiAl6V4	Schnitttiefe	a_p	= 25	mm	Vorschubweg pro Bahn:	l = 540 mm
Maschine	DBF 630 DS	Arbeitseingriff	a_e	= 6	mm	KSS – Druck:	p = 50 bar

New customized coolant

rhenus TU 560

for machining of titanium and aluminium

Best performance in benchmark trial at university of Aachen.

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- **Business case for cost benefits due to coolant performance of *rhenus TU 560***
- Calculation sample based on benchmark results for titanium machining
- **Huge prolonging of tool life saves costs for Aerospace customers**

Costs for cutting tools (per machine, per year) (3 shift production, 200 working days per year)	500.000 €
Extending of tool life based on benchmark results	20 %
Cost benefits for Aerospace customers (per machine, per year)	**- 100.000 €**

- **Further benefits in terms of increasing productivity**

(based on Lab Test university Aachen, sheet 15)

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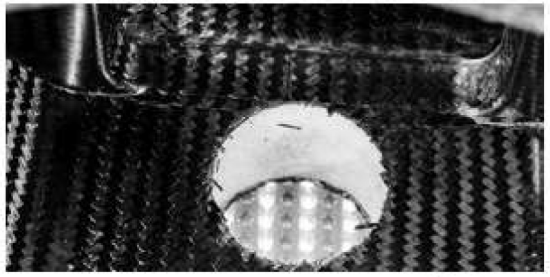
rhenus special coolants for efficient composite machining

For the machining of:
- Carbon fibre reinforced polymers (CFRP)
- Glass fibre reinforced polymers (GFRP)
- Combined lightweight construction materials/stacks



Machining processes compared: dry (left), rhenus special coolant (right)

Quality and cost benefits in the machining process
- Reduced tool wear minimises tool costs
- Higher feed rate results in increased cutting speeds and therefore shorter production times
- Increased component quality
- Improved health and safety and working environment during use whilst maintaining compatibility with specific aerospace alloys

3. Added value for Aerospace customers

rhenus special coolants for the composite machining process

- rhenus XY 190 FC
- rhenus XT 46 FC

Practical results

Tool	Cutting data without coolant	Cutting data with coolant	Without coolant	With coolant
Solid carbide milling cutter, pyramid profile, Ø6	8500 rpm 1200 mm/min	13,500 rpm 2000 mm/min	6 parts = 42 m	40 parts = 150 m
Solid carbide milling cutter, Ø4.8	7600 rpm 700 mm/min	7600 rpm 700 mm/min	10 parts = 1.7 m	40 parts = 6.8 m

Up to 60% higher feed rate and six times more parts produced

Health in focus

When it comes to the essential issue of health and safety in the workplace, the benefits of this machining process are obvious:

- Optimal dust suppression during machining
- Prevent potentially carcinogenic dry dust from forming in the workplace
- Maximum acceptance among process owners and machine operators

Next steps?


RHENUS LUB
More than you expect
Acting with sophistication
Always your benefit in mind
Let´s move forward together!
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