Angst+Pfister AG

Your Global Engineering Partner for High-Performance Components

Philippe Kirsch, CEO Angst+Pfister Switzerland

SWITZERLAND
GLOBAL
ENTERPRISE

Angst+Pfister

Agenda

- Angst+Pfister: an international solution provider for engineered industrial components
- Antivibration components for rolling stock
- Business case: Rubber metal parts for bogie

Angst+Pfister: an international solution provider for engineered industrial components

Leading developer, manufacturer and global supplier of sophisticated component and engineering solutions for more than 20’000 OEM customers in a variety of industries

103
years of growing: from a small Swiss company into a globally operating enterprise

International supply chain partner serving more than
50
countries all over the world

250’000
articles in our industrial components range

1’500 employees
in Europe, Turkey, Asia and U.S.,
with over 300 engineers

Production capabilities
in 15+ countries

23’000 m^2
of Global Logistic Centre
with over **140’000** SKU

Sustainable and cost efficient production platform founded on a robust double sourcing strategy and long term global production network

Location: Helsinge, Denmark
Major:
- Technical engineering and manu-facturing of sealing solutions in PTFE and high-performance plastics
- Spring energised seals, rod & piston seals and back-up rings

Location: Huaping Intelligent Innovation Park, China
Major
- Start 21 injection moulding presses
- Design and production of anti-vibration elements
- Center of Excellence for Engineering and Testing

Location: Zurich, Switzerland
Major:
- HQ
- Group Engineering
- Switzerland Innovation Park Zurich

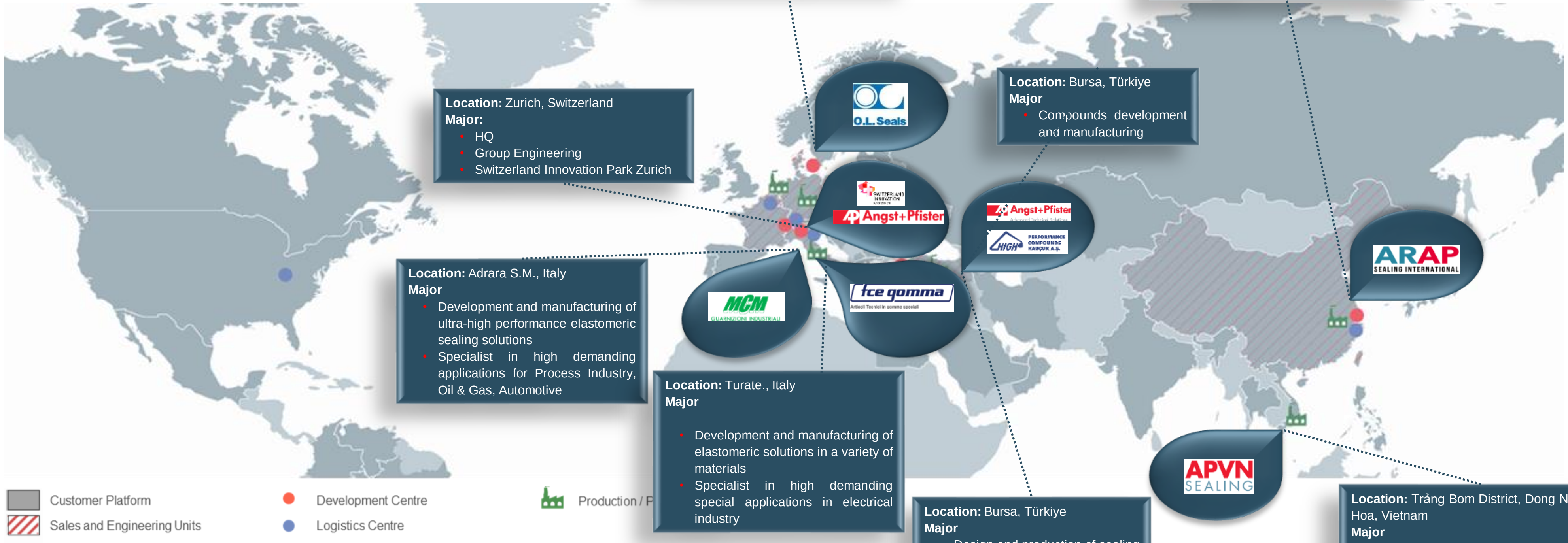
Location: Bursa, Türkiye
Major
- Compounds development and manufacturing

Location: Adrara S.M., Italy
Major
- Development and manufacturing of ultra-high performance elastomeric sealing solutions
- Specialist in high demanding applications for Process Industry, Oil & Gas, Automotive

Location: Turate., Italy
Major
- Development and manufacturing of elastomeric solutions in a variety of materials
- Specialist in high demanding special applications in electrical industry

Location: Bursa, Türkiye
Major
- Design and production of sealing and anti-vibration elements
- Center of Excellence for Engineering and Testing

Location: Trảng Bom District, Dong Nai, Bien Hoa, Vietnam
Major
- Development and manufacturing of high performance elastomeric sealing solutions
- Production of high demanding appli-cations for Process Industry, Oil & Gas, Automotive



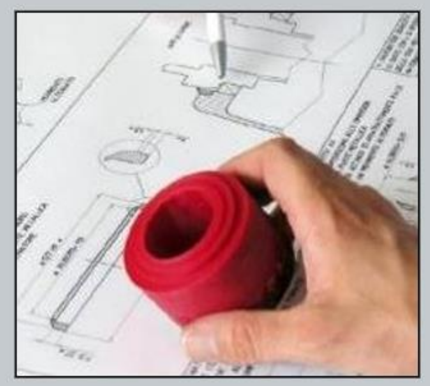
A Group that generates innovation for its customers across the elastomer whole value chain

Material design and compounding

Providing state-of-the-art material in terms of performance and certifications

Engineering

Tailor made customer solutions and accelerating the time-to-money



Production

Ensuring access to the most advanced and effective production capabilities

Supply Chain

Improving working capital allowing customers to optimize their supply chain

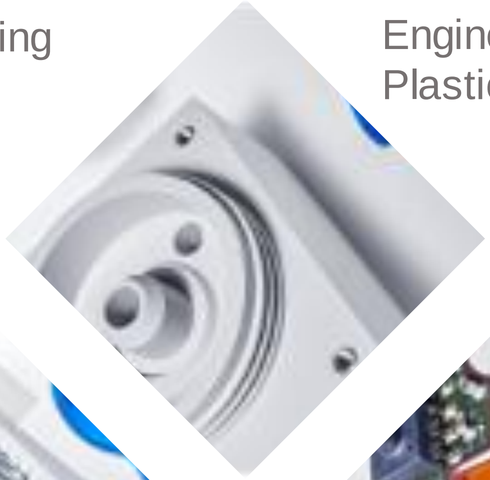
Angst+Pfister Advanced Technical Solutions
Angst+Pfister
APSOparts® the Online Shop of Angst+Pfister
APVN SEALING
HIGH PERFORMANCE COMPOUNDS KAUÇUK A.Ş.
MCM GUARNIZIONI INDUSTRIALI
O.L. Seals A/S
Angst+Pfister Sensors and Power
ARAP SEALING INTERNATIONAL

A wide industrial components range organized in six technologies

Nearly 75% of assortment are customized parts

Sealing Technology

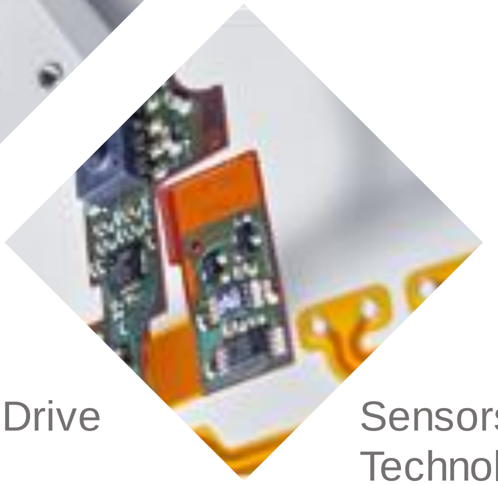
Fluid Handling Technology



Engineering Plastics Technology

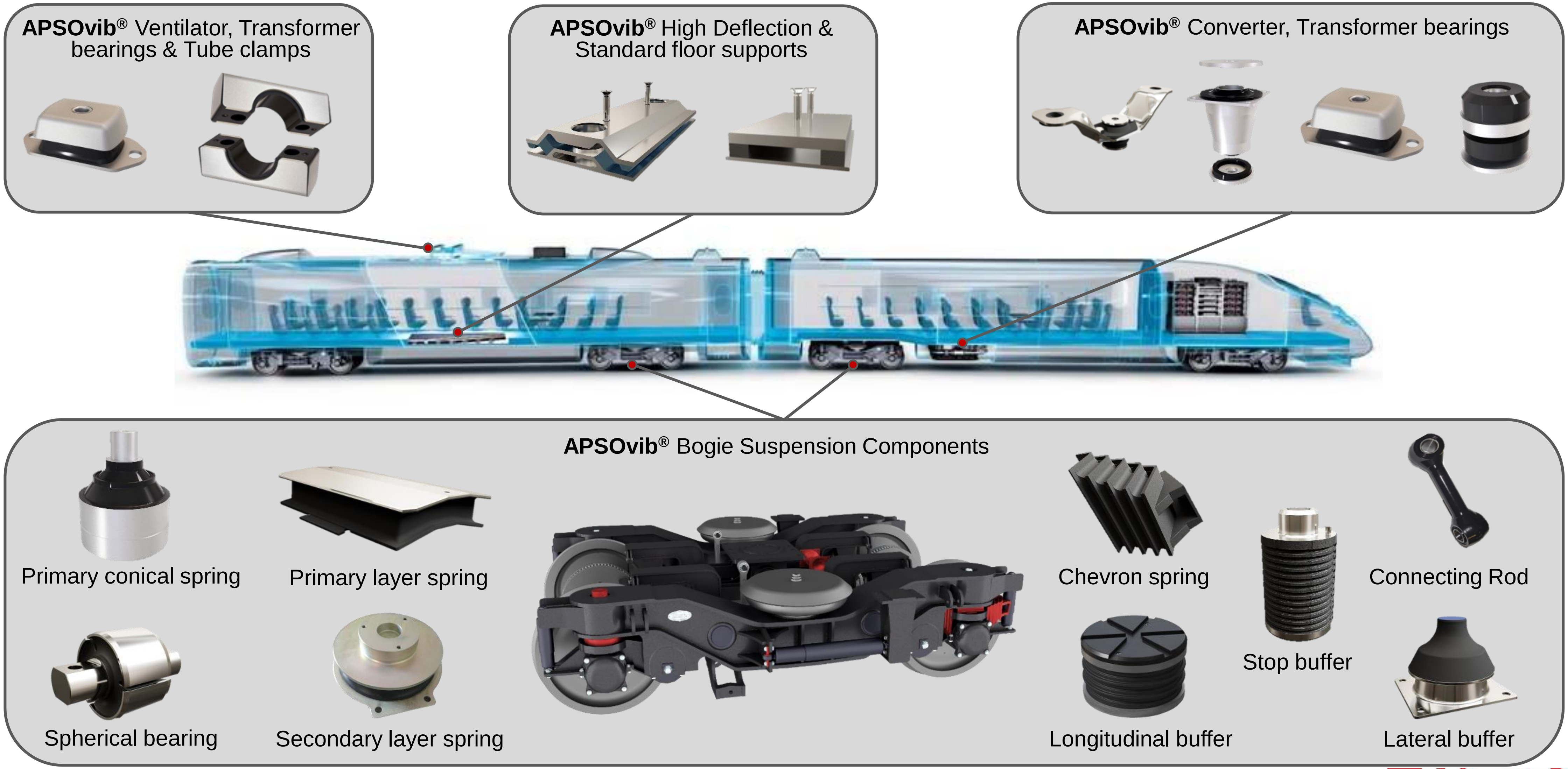
Antivibration Technology

Mechanical Drive Technology



Sensors and Powers Technology

Global Overview – Antivibration components for rolling Stock



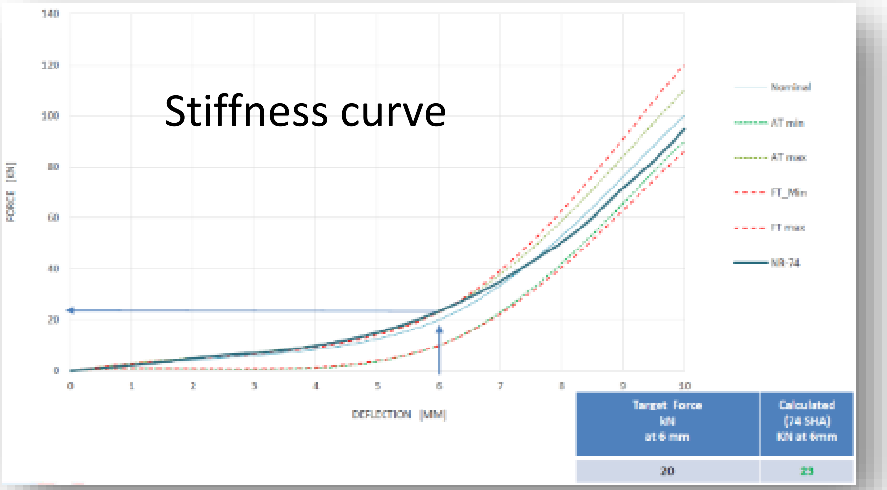
Angst+Pfister

Design optimization : Finite Element Analysis

What we define with FEA:

- Rubber stiffness prediction
- Rubber utilisation (stress / strain)
- Rubber thermal shrinkage
- Bush sleeve calibration
- Preload
- Lifetime prediction

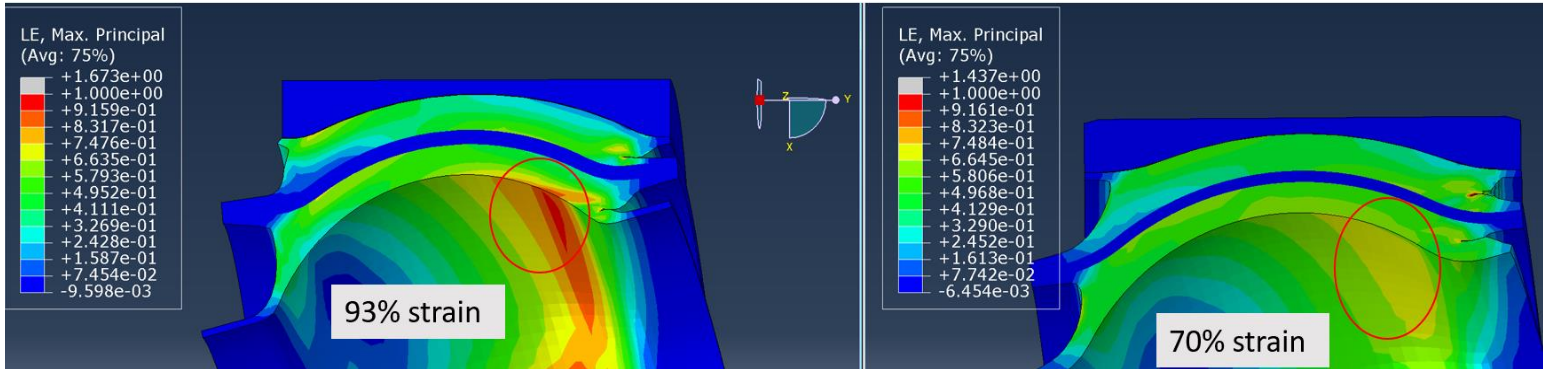
Examples:



Old

New

Strain levels

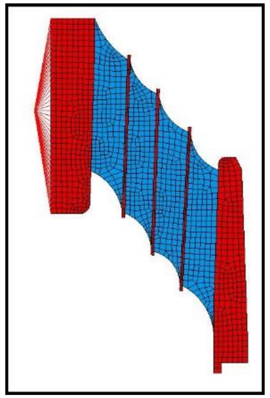


Design optimization : Rubber strain simulation

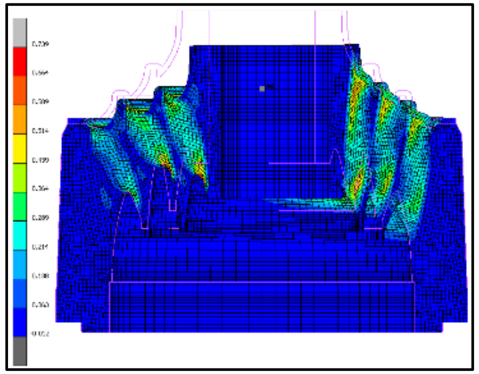
Shape optimization in correlation between stiffness and lifetime

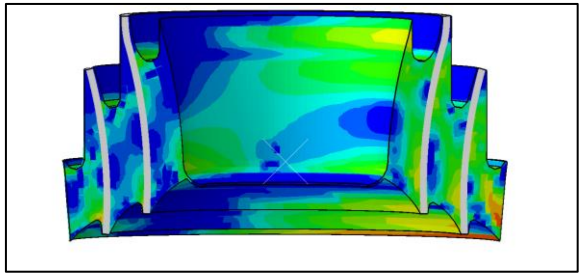
Iterations

3D Modelling and Meshing

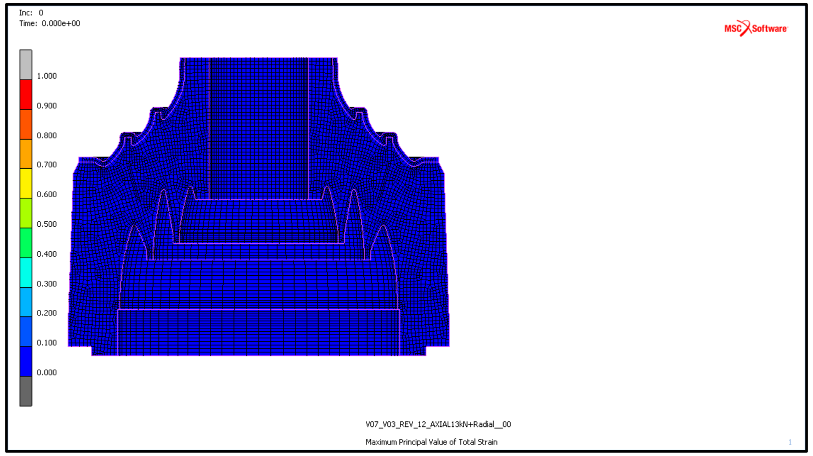


FE Simulation

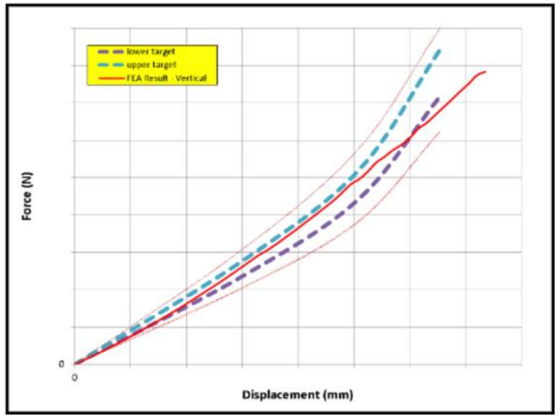




Durability estimation



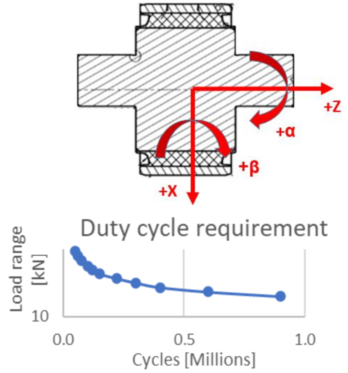
Homogeneous distribution of deformation / load peaks



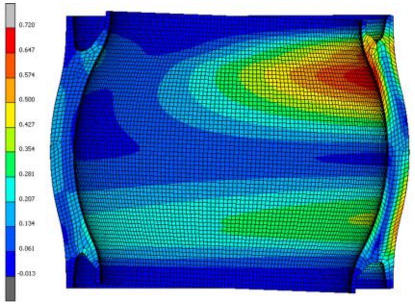
Force vs. Displacement Curve

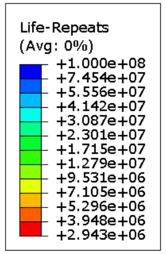
Rubber Durability Calculation

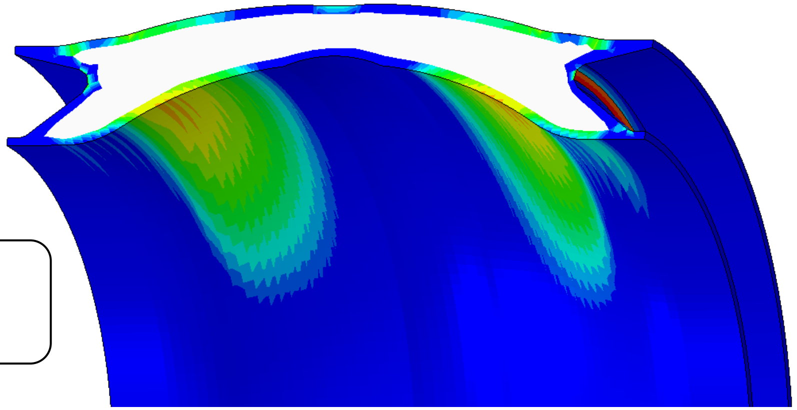
Load Cases definition



FEA of the final part
σ-ε(LC_i)

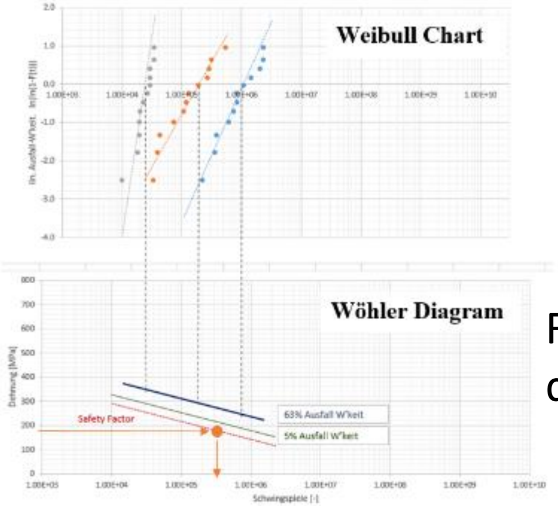






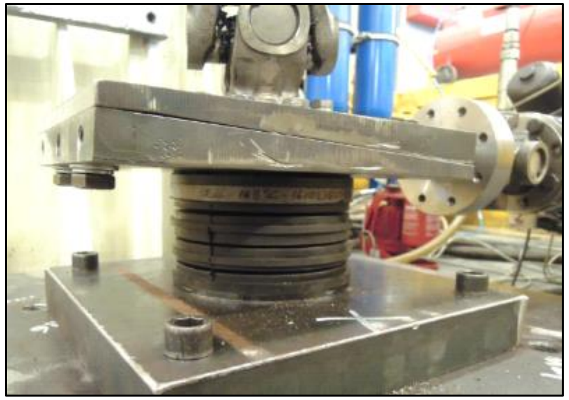
Durability calculation

Experiment

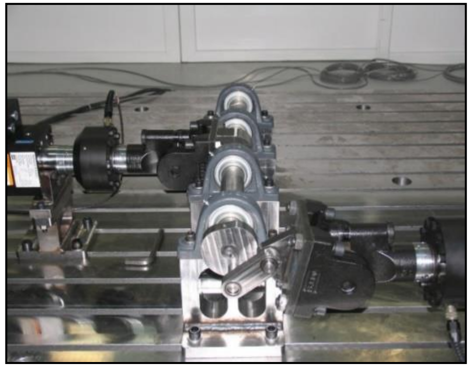


Fatigue curve database

Development Process: Product testing



- Test benches for compression, tension, shear and torsional loads
- MTS Multiaxial test benches
- Static characterization
  - Stiffness
  - Hysteresis
- Dynamic characterization
  - Dynamic stiffness
  - Damping constant and hysteresis
  - Input energy
  - Energy loss
- Durability / fatigue tests
- Possibility to run real time signal
- Modal shaker
- Heating and cooling possibilities
- High frequency testing to 3kHz.



Compounding and Manufacturing

IATF 16949 Certified Production

Example of documentation for the initial sample approval of one buffer

PSW

Failure Modes and Effects Analysis (Process FMEA)

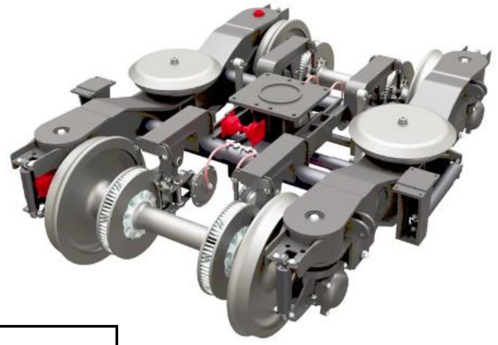
Control plans

Process flow chart

Initial sample report

Certificates

Business case: Rubber metal parts for bogie



Challenge

Development of 3 different rubber metal parts according to the technical specifications (Lateral buffer, axle guide bush and traction link bush)

Very demanding technical requirements (e.g. change in stiffness during lifetime, lifetime test). Safety critical parts and maintenance free operation during the service lifetime.

Solution of Angst+Pfister

A+P did a FEA and due to the results proposed a design that considered the technical requirements as well as the interfaces that were given in the customer's specification.

Added Value for customer

our customer was able to benefit from our experience and knowledge in the field of testing, FEA and development of rubber-metal parts in railway industry

Angst+Pfister customer

DAWONSYS

Angst+Pfister partner in South Korea

SEALSTAR
SEALING SOLUTIONS

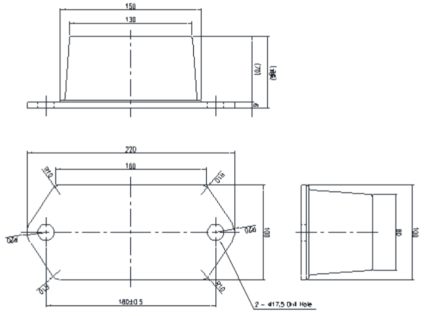
Inspection Institute

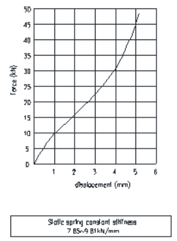
KR E&C
E&C Co.,

Angst+Pfister

Lateral buffer for bogie – Customer requirement

Customer requirement





2.1 Requested geometric data of the lateral buffer (main dimensions)

Maximum dimensions of plate:	approx. 220 mm x 100 mm
Height of lateral buffer:	60…80 mm
Hole diameter:	13,5 mm for 4 bolts (M12)
	17,5 mm for 2 bolts (M16)
Distance between fixing holes:	180 mm[1]
Thickness of the fixing plate:	approx. 6 mm

Other requirements:

Metal surfaces:	zinc plated or other similar coating

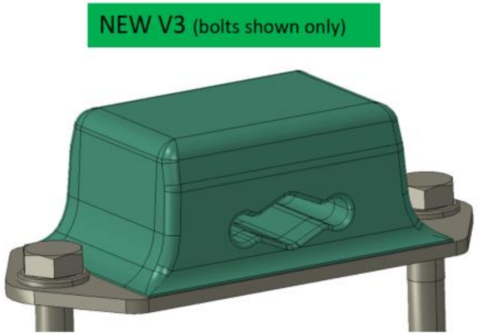
2.2 Loads of lateral buffer

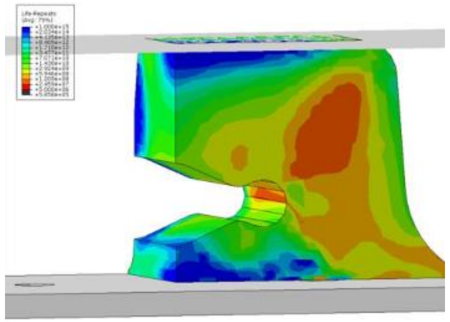
Max. service load:	20 kN
Max. deflection:	~28 mm
Max. exceptional load:	60 kN (rubber buffer may not get damaged under this load)

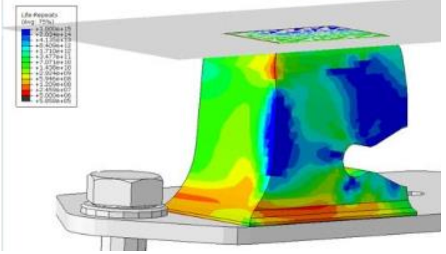
2.3 Requested characteristic of lateral buffer

Deflection (mm)	Load (kN)
5	2
10	4
15	9
25	30
28	60

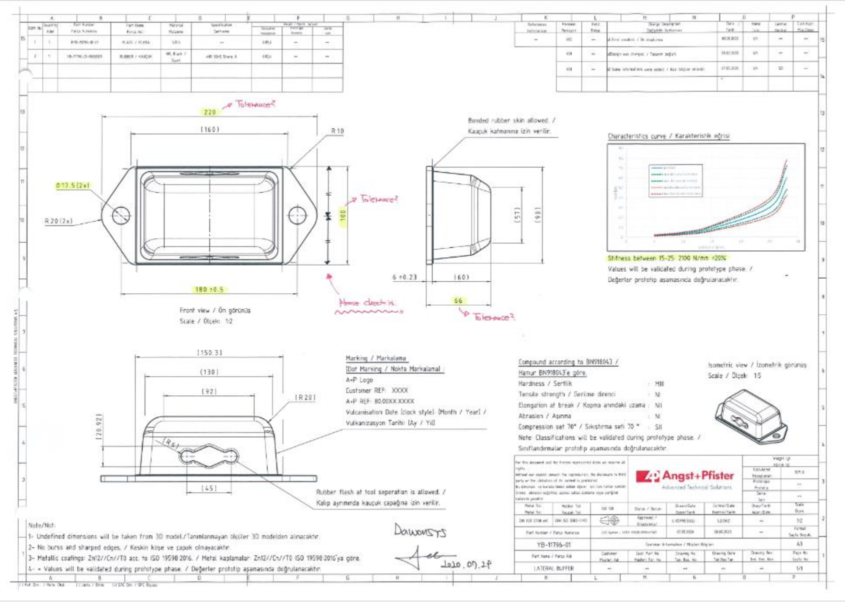
Angst+Pfister FE simulation







Angst+Pfister drawing



Lateral buffer for bogie – First sample measurements

Customer approval

Static axial Test

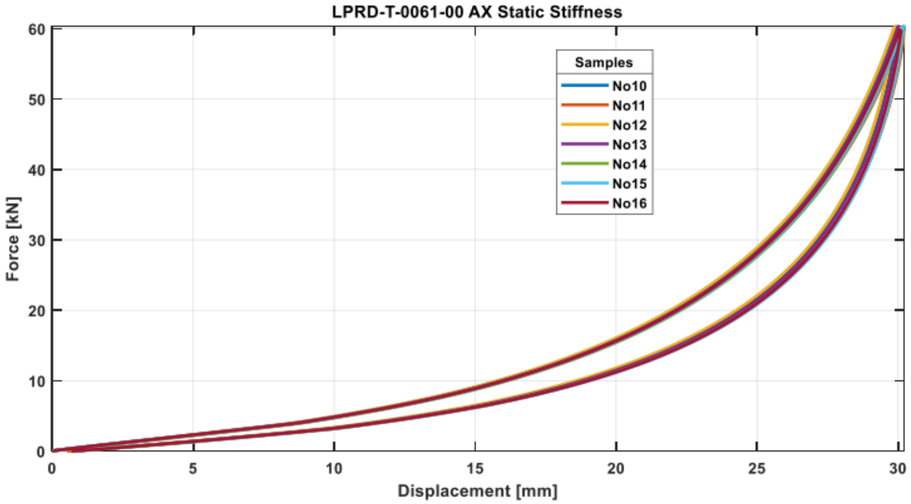
Table 2 Acceptance Criteria

	Target [N/mm]	Tolerance	Meas. Area
Axial	2100 N/mm	±%20	15-25 mm (Loading Curve)
Displacement at 60 kN	28 mm	±2.8 mm	--
Height Before Test	66 mm	±1 mm	--

Table 3 Stiffness Test Results in Axial Direction

Specimen No	Axial Stiffness (Loading) [N/mm]	Displacement at 60 kN	Status	Height Before Test [mm]	Status	Height After Test (24h) [mm]
No10	1966.1	29.92	OK	66.10	OK	65.40
No11	1881.9	30.2	OK	66.11	OK	65.20
No12	1986.8	29.9	OK	66.08	OK	65.30
No13	1921.9	30	OK	66.12	OK	65.25
No14	1884.7	30.22	OK	65.98	OK	65.10
No15	1878.0	30.19	OK	66.14	OK	65.44
No16	1895.4	30.05	OK	66.13	OK	65.29

Figure 1. Static Testing in Axial Direction (All samples)



Summary

Angst+Pfister is able to promote innovation while saving both time and costs thanks to:

1. In-house material development
2. In-house advanced design methodologies
3. In-house advanced test rigs
4. Its own production (compliant with automotive standard IATF 16949), tools design and processes expertise
5. Its solid network of connections to leading research institutions, accredited laboratories and suppliers
6. Its dedicated engineering team with long term experience on leading-OEMs projects

Angst+Pfister is your competent and innovative development partner for rolling stock applications!

Angst+Pfister