Angst+Pfister

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magazine

INTERNATIONAL ENGINEERING SOLUTIONS

A RUBBER FOR WINNERS

Angst+Pfister ensures quiet handlebars on BMW sports motorcycles – how the cooperation of development departments brings performance to the road.

BUFFER FOR EXTREMES

Buffers for Siemens rail vehicles combine fire protection, sliding properties, long service life and extremely progressive resistance in one material.

REDUCE EMISSIONS

The requirements in engine design are increasing: AGCO relies on heat-resistant high-tech elastomers for cab mounts – for the comfort of the drivers.

Editorial

Keeping fit together

Dear Reader,

Did you know that in 2020 Angst+Pfister will be looking back on a history of one hundred years? A proud old age usually leads – for people and companies – to praise experience and wisdom. We prefer to look forward and keep fit for times of profound change. Any company that has been a market success for such a long time has a proven willingness to embrace change as an opportunity, and to adapt flexibly to new requirements – be they, for instance, requirements in the digitalisation or electromobility sectors.

The challenge of change is multifaceted. We are responding with more than business agility and adaptability. It is our strategy to anticipate new developments in your industry, to learn about your business, and understand your value chains and way of thinking. As we would like to be in a position to consistently produce new solutions, we put great emphasis on savvy, creative personalities. They network with each other and network their expertise across the world – internally and externally – in skilled teams, who can deliver added value to a customer consultation. This is also how we keep evolving and remain a trusted partner for you in the development, manufacture, sourcing and qualification of innovative industrial components and their logistics.

We are also taking concrete action in response to the much-discussed changes by producing breakthroughs in engineering, design and materials. A few examples on the topic of compounding:

- In antivibration technology, our new efficient methods mean there are next to no limits when it comes to calculating the exact life span of rubber metal parts or designing new materials.
- In sealing technology, we now offer elastomers with unique properties and the associated approvals. Our PERTEC® range continues to expand.
- Our material expertise extends to sensor technology. We are staying fit by being in contact with leading research institutes and start-ups so that in the future, electroactive polymers can also play their part in delivering “artificial muscle”.

We frequently co-design with our customers. We work with you, as a loyal and open partner, in line with the concept of networked teams, to find specialised solutions for you, together. Our first priority is to add value to each individual customer.

In the following pages, you can read how we find solutions working together with our customers. I would be delighted if you could recognize one or the other inspiration for your company.

Erich Schmid
Chief Technology Officer

Content

Do you have any further questions about one of the magazine topics?

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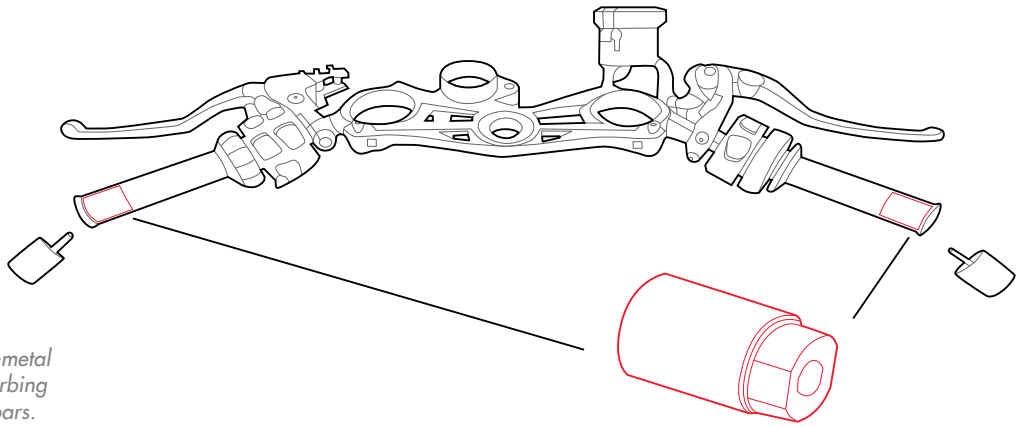
Pole position for Angst+Pfister

In the race for new customers, the engineers of Angst+Pfister believe trust is earned through expertise. Moreover, when the focus is on sport bikes such as BMW's new RR motorbike model, then in addition, both a good development pace and a top quality product are essential. A look-back to the beginnings of a performance-driven partnership.

«The close cooperation between both development departments and the test driver was decisive for the successful project.»

Mario Eckel, Product Application Engineer, Angst+Pfister Germany

The superbike of superlatives: With the "BMW S 1000 RR", the world-famous motorcycle manufacturer heralded the next level of performance.



Angst+Pfister's rubber-to-metal bilge drivers reduce disturbing vibrations on the handlebars.

"When we got the very first order from BMW, the aim was to prove our engineering expertise and win the trust of this new customer," recounts Marion Eckel, Product Application Engineer at Angst+Pfister Germany. Back then in October 2017, they were looking for a rubber-metal vibration damper – to deaden irritating handlebar buzz. The vibrations were caused by the counterweights on both outer edges of the handlebars.

When it comes to superlatives …

BMW has built motorbikes since 1923 – in 2018 over 160,000 were sold worldwide. The company's sales have been increasing for years. Ten years after the first generation of the "RR model" captivated the motorbike world, in 2018 the world-renowned motorcycle manufacturer took performance to the next level with the "BMW S 1000 RR". This involved reworking nearly every single component of the "RR" – from front to rear. The result: The superbike of superlatives. Hence the need for the super rubber-metal vibration damper for the handlebars. A challenge had been set for the engineers of Angst+Pfister.

"After the first meeting with BMW's engineers, we quickly realised that we would not be using the standard bushings from our catalogue," says Mario Eckel. BMW required an axial rigidity of 350 to 500 N/mm. In addition to demonstrating our engineering skills, we also needed to impress the new customers with a good development pace – and this in the face of ultra-high quality requirements. BMW supplied Angst+Pfister with data and two concept proposals. Following a brainstorming session with BMW, Angst+Pfister's engineers opted for the concept involving vibration dampers in the handlebars – counterweights would be screw-fixed to the vibration damper. This is beneficial as both the counterweight and the vibration damper can be replaced. In addition, it looks good optically.

BMW then provided Angst+Pfister with detailed specifications. "After the first results were in, we discussed a few design adaptations with BMW so several different bushing rigidities could be used in the first prototypes," recounts Mario Eckel. Angst+Pfister had already delivered three different samples at the end of 2017 – with several rigidities and rubbers.

Compounding for winners

BMW had its focus on one of the options but required further experiments with and enhancements of the rubber compound. "Then we arrived at our favourite subject – compounding," enthuses Mario Eckel – and saw a good opportunity for the Angst+Pfister team and the in-house compounding laboratory. With full throttle engaged, the laboratory supplied BMW with new vibration dampers. BMW now had several materials such as natural rubber and neoprene rubber in different rigidities for in-house bench tests and test rides at a test site. At the same time, the standard production tool was commissioned so as not to jeopardise the planned launch of the bike series.

The bench test results were good, but the test rider was waiting with unexpectedly critical feedback. "Unanticipated vibrations had occurred during the test rides that had not been detected on the test bench. This led to the failure of some of the handlebar fittings," recalls Mario Eckel. After a meeting with the test rider and the new test results to hand, Angst+Pfister repeated the finite element analysis and cautiously increased the rigidity of a vibration damper – and hit the mark on the second run, as the next samples confirmed.

A standard-setting production drawing

Further tests followed before going into serial production: In order to guarantee a long operating life, the handlebars with the new bushings were mounted on a shaker table to test the material at critical points – for 72 hours at 500 Hertz and 60 degrees Celsius. Frequency deviation had not to exceed a maximum of ten percent. The new vibration dampers made it without deformation or cracking. In the axial load-to-failure tests, they achieved perfect values of over six Kilonewton. The tests and the accompanying documentation were endorsed by Angst+Pfister. In October 2018 – just one year after the project tender – the development partners were ready for serial production. Angst+Pfister's bushings were awarded PPAP Level 3 acceptance – an automotive component production standard.

"Joint definition of the requirements for the component was fundamental to the success of the project as was the close collaboration of both development departments and the test rider," explains Mario Eckel. The production drawing contained such a wealth of detail that BMW was able to use it for other motorbike series. Our engineering performance has secured us pole position for the racing motorbikes. Angst+Pfister Germany is already working on two follow-up projects.

Entering a new business area with top marks

When things get technically tricky, Angst+Pfister is on the spot: applying their expertise and network, frequently on-site with the customer. For automotive supplier PWO, this partnership means positioning itself more broadly in the market and generating new orders. New rubber-metal bolts decouple the housing of the air conditioning system from the company's already highly-developed dashboard supports.

«Working in partnership with customers allows us to respond to unexpected problems early on.»

Mario Eckel, Product Application Engineer, Angst+Pfister Germany

When it comes to technically sophisticated production processes, Angst+Pfister's wealth of knowledge in the rubber-metal components sector allows the company to work hand in hand with the customer to come up with solutions that are ready for mass production. "In close cooperation with our partners, we can react swiftly to unexpected problems," says Mario Eckel. The Product Application Engineer at Angst+Pfister Germany is able to rely on the many years of broad experience offered by his own development team. In this case, it was possible to support PWO in becoming the supplier of a complete unit with integrated antivibration dampeners, thus broadening its position in its markets.

Connecting two experts

PWO is a supplier to the automotive industry with its headquarters in Oberkirch, Germany. 3400 employees work in five production facilities and four assembly sites on three different continents – in Germany, Mexico, Canada and China. Among over 1,000 products for safety and comfort in automobiles are dashboard supports, for example for the new BMW 3 Series. These hold the centre console, steering wheel and displays in place, and ensure safety by intelligently supporting the complex crash structure of modern passenger cars. At the same time, they create comfort by absorbing vibrations and thus reducing noise – all while meeting the highest standards of precision and durability. Thanks to its expertise in cost-effective lightweight construction, PWO contributes to environmentally-friendly driving and a greater range.

PWO receives requests to equip the dashboard supports with additional components. One request was for rubber-metal vibration dampeners to be used in this type of assembly. When BMW asked for a decoupler, ready mounted on the steel supports for the housing of the air conditioning system, PWO turned to the experts at Angst+Pfister. The rubber-metal dampener that was required needed to connect the housing of the air conditioning system to the supports in such a way that it prevented both vibration and noise.

Overcoming challenges together

BMW defined the technical requirements for the design. Because Angst+Pfister is proficient in the specific technical language, they are able to apply it to the respective require-

These instrument panel supports are decoupled from the air conditioner housing with rubber-to-metal bolts.

ments. “It was a matter of supporting PWO technically, in order to comply with BMW’s standards: how is vulcanisation carried out? How do you join rubber to metal?” Mario Eckel explains. The decoupler consists of two cold-pressed, threaded metal bolts, which are connected with rubber. Although the component resembles a standard buffer, the challenge lay in the design of the threaded bolts. It is not possible to change the 23 millimetre diameter. The problem: the large diameter of the bolt head in comparison to the threads makes it vulnerable to cracking when screwed in automatically. This task is carried out by robots on the production lines at PWO and BMW. The challenge was to define the right production process for the metal components and to find a qualified partner. Last but not least, the entire solution had to work for very high volume series production.

The manufacture of cold-pressed bolts of this type is highly demanding. To meet the challenge, Angst+Pfister activated its large Europe-wide network. At the same time, the branch in Turkey was searching in Asia. “Nothing but rejections!” stated Mario Eckel. No company wanted to touch this “hot potato” – it was too risky. Fortunately, the Angst+Pfister engineers finally found a qualified subcontractor who is not only able to manufacture complex connecting parts such as this, but also has experience in the automotive industry. But even these experts needed some time to design the individual steps of the production process in such a way that the hexagonal bolt ends were suitable for automatic assembly. At the same time, this partner had to be audited as quickly as possible and accepted into Angst+Pfister’s supplier base – the start of series production was approaching fast.

“The next challenge was vulcanisation”, Mario Eckel continues. The primer used to bond the rubber to the metal was incompatible with the surface coating defined in the BMW standard. Some of the substances in the coating prevented it bonding cleanly with the rubber. Because of this, the first components failed the tests. The Angst+Pfister-team had, therefore, to find another material that demonstrated the same properties as the standard specifications in tests, but was suitable for the vulcanisation process. In so doing, Angst+Pfister relied on a great deal of internal knowledge – thanks to their own coating systems and their extensive experience with bonding agents. It was possible to carry out the tests immediately in-house.

One of these tests is the salt spray test, which addresses corrosion caused by weathering: how quickly do the components rust? Another test checks the bonding points between the metal and rubber, and involves stressing the components until they fail completely. The torques to be applied are also tested: how does the decoupler behave when the two bolts are turned against each other? “We were able to exceed BMW’s requirements – the part only broke when subjected to extreme forces,” says Mario Eckel. So they took care of the final step in producing the finished component; stamping the part number into the rubber.

Completion with an A rating

After successful approval of the component in accordance with the “PPAP Level 3” automotive approval process, the PWO and Angst+Pfister teams met at the Turkish plant in Bursa. As this was PWO’s first order, an audit in accordance with VDA 6.3 was due. Angst+Pfister has IATF-16949 certification, and passed with an A rating. PWO now has a certified partner for the decouplers, can accept further orders for assemblies with rubber-metal components in the future, and has this to say in praise of Angst+Pfister: “One key to success was the customer focus demonstrated by Angst+Pfister. They responded to our needs fast and visited our site in person on a number of occasions. You can rely on Angst+Pfister.”

Fast results thanks to experience, design skills and material knowledge

If a customer is planning an ambitious launch, the engineers of Angst+Pfister power through with their efficient methods – from design to prototypes to serial production. For Warmhaus, a leading manufacturer of radiators and boilers, the Angst+Pfister team developed control buttons for printed circuit boards made from silicone that were both aesthetically highly pleasing and functional, so as to meet the demands of the domestic sector.

The Turkish company of Warmhaus in Bursa was founded in 1996 as a subsidiary of Beyçelik Holding and produces a range of radiators and boilers. Beyçelik Holding employs 5,000 people in 20 different companies and offers services in various industries and according to international standards. Warmhaus is one of the world's top ten producers of radiators and exports its products to over 35 countries.

Market-specific designs

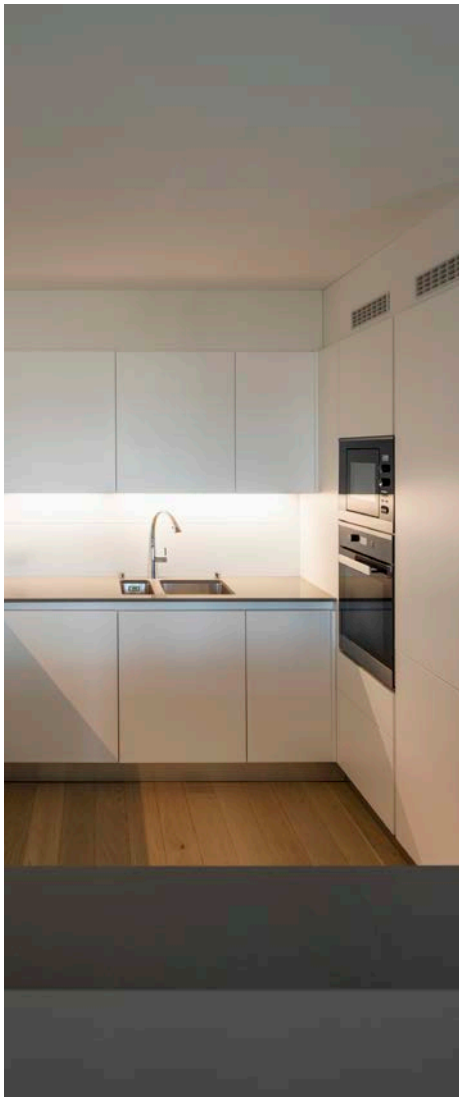
In 2018, Warmhaus has won design awards for the worlds' smallest and lightest combi-boilers. Accordingly, the company is on a quest to continuously improve and adapt the products to new markets and new specifications. "That was also the case when Warmhaus sought technical support for the design and development of the new control buttons for its combi-boiler," says Mehmet Sarı, who is a Sales Executive for Angst+Pfister in Turkey. The new control buttons were to be made from a silicone-based material – both the buttons themselves and the conductive parts within the control elements.

"Silicone is a very tough material that also works well in outdoor installations – in varying temperatures and difficult weather conditions," explains Mehmet Sarı. The control buttons are for the end customers to regulate the water temperature. They are also fitted with a "reset" function. The design of the buttons needed to coordinate with the colour scheme of the boiler; they are going to be installed in private households and must look good. "The visual aspect played a very big part in the project," says Mehmet Sarı. "In addition, the control buttons have to be ultra sensitive and respond immediately so that they are easy for the end customer to use." The surface structure was consequently an important consideration.

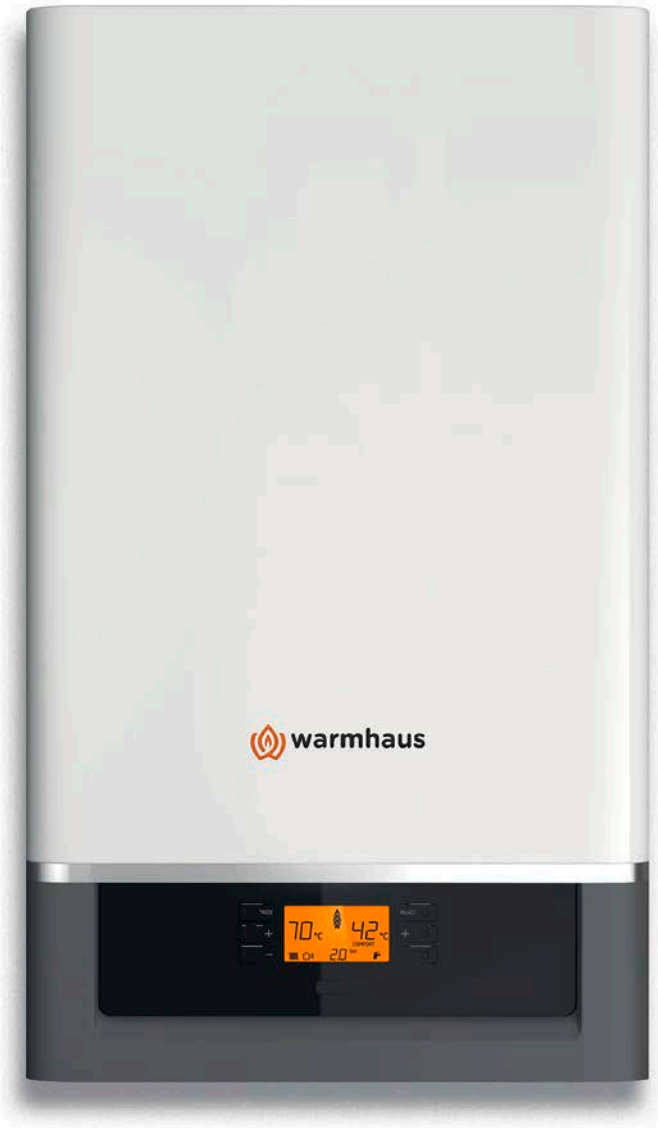
High flexibility and efficient methods

The experts at Angst+Pfister faced an extra challenge because Warmhaus was pursuing an ambitious market launch. The development team had to push ahead with the project, developing working protypes in a limited time frame together with material approval so serial production could begin on time. "Our flexibility in projects like this is one of our strengths," says Mehmet Sarı. The customers can rely on Angst+Pfister's highly efficient methods when it comes to timing and costs.

The engineers were also able to excel with their many years of experience in control elements for combi-boilers. They convinced



Aesthetic and functional: The silicone control buttons of the combi boiler.



Warmhaus that Angst+Pfister is the right business partner with their experience, with their design skills and their material knowledge. The engineers in Turkey developed silicone control buttons for the circuit boards – in accordance with the values specified for thermal contact resistance. The research and development team was also responsible for the final design of the control buttons. This was to be in line with the customer's plastic housing.

Satisfying high standards

"Our solution met the high standards of aesthetics, functionality and durability," says a delighted Mehmet Sarı. And the customer, Zafer Bayram, Purchasing Engineer of Warmhaus signalled his satisfaction: "With Angst+Pfister, we have found a valuable partner that can develop market-specific rubber components like our silicone buttons. Even at tough time constraints."

«Using the most efficient methods, we help our clients meet ambitious schedules and reduce costs.»

Mehmet Sarı, Sales Executive, Angst+Pfister Turkey

A partnership in hygiene design that offers more

Whether fish or poultry, there are no compromises when it comes to hygiene. Van der Graaf produces drum motors for belt conveyors – for the food industry too – and was looking for the right partner to seal its motor shafts. Angst+Pfister is now working together with the European Hygienic Engineering and Design Group (EHEDG) on these projects. The know-how from both is thereby combined to open up new possibilities in hygiene design.

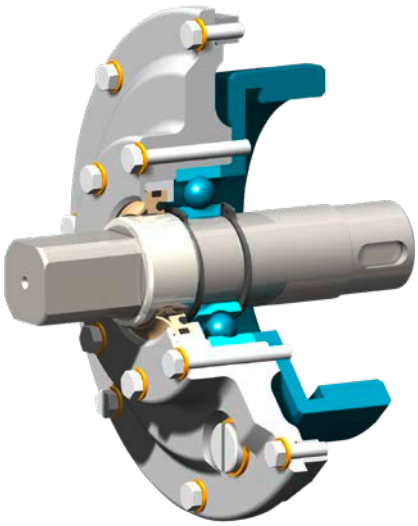
The drum motor for belt conveyors in the food industry: its seal nestles against the protruding shaft.

Home sweet home is the scent of a crispy roast chicken coming out of the oven, then the world is as it should be. Anyone who spoils their family or friends in this way no doubt relies on the proper quality and hygiene of this hearty treat. In order to foster this trust, engineers are constantly developing hygienic designs in food technology – from individual materials and components to complete industrial facilities. Angst+Pfister's sealing specialists contribute to this process.

With the highest level of expertise behind them

In 2019, Angst+Pfister joined the European Hygienic Engineering and Design Group (EHEDG) – a non-governmental organisation dedicated to optimising hygienic design in food technology. Since the 80s, it has been in dialogue with suppliers in the fight against bacterial contamination and issued the strictest requirements. They comply with all regulations from the European Union and the United States' Food and Drug Administration (FDA). "EHEDG membership grants us access to the most qualified specialists in hygiene design" says Jan Boomsma, Product Application Engineer at Angst+Pfister Netherlands.

When it comes to materials, rubber compounds or individual components, Angst+Pfister already commands a high level of hygiene expertise. "Thanks to EHEDG



One design: inner and outer seal (sand-coloured)

«We combine EHEDG's hygiene expertise with ours on components and materials. This opens up completely new possibilities.»

Jan Boomsma, Product Application Engineer, Angst+Pfister Netherlands

we are now expanding this hygiene expertise to include entire machines in operation, that is, integrated solutions that meet certain industry standards", explains Jan Boomsma. Angst+Pfister combines this with specific client needs like chemical resistance for the cleaning or longevity of components – based on their own know-how. "EHEDG is an exclusive competence network that opens up entirely new possibilities for us and our clients." Together with the Dutch firm Van der Graaf, the first project has been successfully launched.

Drum motors for the food industry

Van der Graaf's customers manufacture belt conveyors. These in turn are used in agriculture, dispatch centres or for baggage transport at airports, and in the bulk goods, automotive and food industries. Whether fish or poultry, when it comes to hygiene design there are no compromises. Van der Graaf manufactures drum motors for such belt conveyors and occupies a leading position in the market because of it; they are suitable for continuous use under the toughest conditions. Drum motors have no external components – everything is enclosed in the drum: The motor and gearbox operate in an oil bath that ensures lubrication and cooling.

Van der Graaf required a seal for its drum motors, which are used, for example, to power digital poultry sorting systems. The seal sits between the shaft and the motor (see picture). Internally it seals against engine oil, and on the outside it should withstand hot water under high pressure during cleaning. In addition, the outer seal must be incorporated into the metal cover so evenly that bacteria have no chance. "Our design prevailed over several competitors", Jan Boomsma notes. The price also played a role in this.

Cost-effective engineering with an eye for the bigger picture

Initially, the project only focused on the external seal against water and dirt – Van der Graaf planned to use an AS type standard seal on the inside. "Thanks to the idea of integrating the inner seal into the whole design and replacing the existing metal spring with a high-tech O-ring made of a polytetrafluoroethylene (PTFE) mixture, we became very attractively priced", Jan Boomsma reports. Because it reduces assembly and maintenance costs. This motivated Van der Graaf to keep working with Angst+Pfister. The teams were all the more delighted when their final design was approved by EHEDG. Tests were also carried out by the expert organisation Dekra – with good results. Angst+Pfister's solution achieved IP69K protection class. The protection class generally indicates how well a casing protects against solid objects and liquids. IP69K means: Neither dust nor hot water can penetrate under high pressure.

Final challenge: Use in the factory

The protection class IP69K by itself does not mean that the solution covers all customer needs. Because of this, Van der Graaf ordered a pre-production series to test in a factory. No small undertaking, as Jan Boomsma recalls: "These companies depend on their production running smoothly. Even if promising innovations hit the market, they have little interest in experimenting, as long as their equipment runs smoothly." It is not easy to receive substantive and relevant feedback when one is testing the customers of the customer's overseas clients. The test phase accordingly took some time. "If things go badly, the feedback is immediate – if things go well, it just takes some time to be sure." The tests have now shown this, and the first series of seals has been delivered.

Angst+Pfister is looking forward to providing more innovative contributions in hygiene design for food technology in the future. Now that's a hearty promise.

Concentrated know-how for cable laying

Angst+Pfister is known for its technical expertise and engineers who are always able to bring together powerful teams with a wide range of competencies from different areas. By working together with the customer and subcontractor, Open Innovative solutions have been created that are driving cross-technology developments on global markets. Working with the Swiss cable-laying specialist Plumettaz, Angst+Pfister is contributing to the optical fibre network for people and companies.

Whether it's bringing home entertainment to the masses, enabling remote work, on-line medical services, digital security or power to communities, it's likely that Plumettaz, the Swiss-based cable-laying specialist, will have played a part. As one of the leaders in its sector, the company builds underground network infrastructures utilising ground-breaking technology that continues to push the boundaries.

Connecting people with the world

Plumettaz is based in Bex, Switzerland. The company found its first niche in the hills of the country, taking the strain out of wine-makers who had historically struggled to work the slopes of the region. Plumettaz designed custom ploughs that did not need to be pulled manually but were operated by means of overhanging capstan winches, which were also easy to transport and install. Since that time, the company has elevated its status to leader in its field by going underground. Until 1987, cable laying was generally achieved by pulling, but Plumettaz changed the landscape with its patented jetting systems that have the capacity to push cables through pipes using air or water propulsion – known as the jetting method.

Innovative, robust and powerful

The company's 130 employees have continued to develop several layers of technology offering greater reliability in installation and lower technical intervention – optimising customers' potential and allowing them to achieve more than they ever thought possible. Today, the jetting method has advanced to become IntelliSerie-based smart technology. Thanks to its embedded sensors and control systems, it monitors, records and supervises the performance of installations.

The red drive belts push the cables into the tubes. The new coating allows an optimal cable grip.

Early in 2020, the new Optijet-E150 jetting machine will be released on the market – together with its associated digital services. During the development phase, Plumettaz was looking for an experienced partner who could collaboratively support the design and supply of critical parts for the Optijet – to ensure perfect integration of the elements not manufactured by its own factory. Engineers from Angst+Pfister in Versoix, Switzerland, working together with their long-standing customer, reviewed the initial prototype and worked-out enhancements from specification to production, delivery and costs. Angst+Pfister supplied Plumettaz with the technical expertise to carry out the optimizations.

Smart teams for smart solutions

Based on Plumettaz's specifications and requirements, the Angst+Pfister team calculated and defined component parameters for the Optijet. The drive belt, which pushes the cable into the duct, required a new coating.

"It had to guarantee optimum cable grip – without causing damage to the cable, and in addition, the cable clamping system has to accommodate for various cable diameter," explains Mélanie Delonca, Product Application Engineer at Angst+Pfister in Versoix. Ultimately, the focus was not only on the drive belts, but also design services and the technical development of twenty different aspects such as vibration, fluid, sealing and plastics technologies for pullies or belts as well as the global logistics.

"We were very excited about this project as several departments had to team-up to drive the project forward and coordinate very diverse skills," says Philippe Oetiker, Sales Application Engineer at Angst+Pfister in Versoix. All the results were as required – and, as usual, produced under time pressure. "In order to be on track and successful, each member had to play their part. Thanks to cross-border teamwork, we succeeded in creating Open Innovation solutions and helped Plumettaz to introduce their new Optijet machine to the market."

«We worked on twenty critical components for a new generation of devices.»

Mélanie Delonca, Project Application Engineer, Angst+Pfister Switzerland

«If required, we coordinate expertise in antivibration, fluid, sealing and plastics technology in a single project and take care of global logistics.»

Philippe Oetiker, Sales Application Engineer, Angst+Pfister Switzerland

“That is real engineering for a real winner – Massey Ferguson MF 7719 S – the award-winning Machine of the Year 2019 at SIMA show”

There are no compromises for Angst+Pfister when it comes to compounding. Even the high thermal resistance elastomer compounds do not lose their exceptional mechanical properties. The agricultural machinery manufacturer AGCO has been utilising this expertise to reduce the emission levels of its engines – and to adapt to the new Stage V EU standards.

“I need a new global partner who can assist us with technical development, meet our quality standards, deliver punctually and manufacture in a location where costs can be kept down,” demanded Richard Tillett. He is the Purchasing Director France and Purchasing Director Global BCC Sourcing at the American agricultural machinery manufacturer AGCO. “Designing components jointly with customers like this is right up our street,” replied Philippe Kirsch at the time, International Business Development director at the Zurich headquarters of Angst+Pfister. And: “As a partner, we do not shy away from taking responsibility for the engineering.”

Geared up for agriculture

Next year, Angst+Pfister will have been operating in the agricultural industry for 100 years. Highly trained technical advisors make use of the extensive portfolio of standard products and also design custom products for sealing, fluid-handling, drive, plastics and antivibration systems. For the latter, the APSOvib® range sets the standard in industry – be it for rubber shock cords for swivel joints, absorbers for power steering pumps, bushings for axles, antivibration mounts or even conical bearings for driver cabs – as is the case with AGCO. The conical bearings are jacks-of-all-trades: As a standard product, they are available in eleven sizes each with three different stiffnesses to cushion knocks and braking forces or absorb engine vibrations.

Ever increasing demands on engines

However, the cab bearings for AGCO was a case in point for the development team of Angst+Pfister. AGCO was looking for cab bearings, for its tractor brand “Massey Ferguson” produced in Beauvais, France, as part of the conversion process for its engines to meet the new Stage V EU standards – introduced at the beginning of 2019 for all mobile machines. A reduction in emissions increases the specifications for constructing engines. The major difference in the Stage V EU standards is the use of catalysers and particle filters. Catalysers reach a temperature of about six hundred degrees Celsius. As they are located quite close to the cab, this has implications for the bearings. The natural rubber that had been used previously had excellent mechanical properties – but only to about seventy degrees Celsius.

“We did not want to lose the great properties of natural rubber or its longevity,” relates Philippe Kirsch. Nowadays a higher standard of comfort is required for the driver cabs of agricultural machinery – people spend their working days in them. They are often equated to passenger vehicles; in some ways they are even superior. Quality vehicles eliminate vibration and noise.

Comfort and safety guaranteed

The APSOvib® HD conical bearings are made to achieve maximum absorption of low frequencies, which are always difficult to absorb. “HD” stands for “High Deflection” – referring to the large spring deflection of six millimetres – and this performs particularly

«With genuine engineering, we develop extremely heat-resistant elastomers that simultaneously compete with the mechanical properties of rubber.»

Philippe Kirsch, International Business Development Director, Angst+Pfister Group

Fewer emissions without compromising safety and comfort thanks to Angst+Pfister conical bearings.

well on working tractors dealing with hard knocks. The stiffness is both progressive and limited. In other words, they initially react softly to vibrations, but become stiffer – as the cab is subjected to more force. This effect is a result of the geometry of the conical bearing, which can be customised case by case. The APSOvib® conical bearings are also calibrated to comply with the Roll Over Protection Systems rules. The cab remains on the vehicle in certain accidents. In addition, each tractor must pass the ROPS (Roll Over Protective Structure) tests.

The challenge was not only to avoid compromising the comfort and safety of the tractor, but at the same time to support AGCO in the changeover to more environmentally friendly engines. For the conical bearings, this meant designing an elastomer that could withstand 110 degrees Celsius – and also match the excellent mechanical properties of the natural rubber. "When you try to take into account extreme conditions, such as temperature in this case, you usually lose some of the mechanical properties," explains Philippe Kirsch.

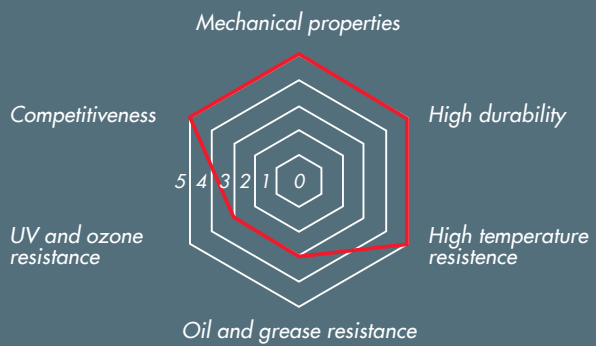
One thing is sure: Angst+Pfister was able to draw on its vast experience for compounding. In this way, thanks to the innovative high temperature rubber elastomer the development team was able to minimise the aggravating noise in the cab. This was confirmed both by the tests conducted by Angst+Pfister and those conducted by AGCO.

Creating added value for customers

"That is real engineering," says a happy Philipp Kirsch. Getting to understand the problems, shouldering responsibility, looking for solutions – this is how to generate added value – and it suits the engineers of Angst+Pfister right down to the ground. The Angst+Pfister laboratory and its production site are certified compliant with the highest standards of the automotive industry and supply conical bearings for Stage V tractors to AGCO factories worldwide.

APSOvib® HD cone bearings withstand the hardest blows and the temperatures of emission stage V engines.

Ultra high-performance elastomeric materials



Key requirements to meet AGCO expectations:

- Excellent mechanical properties
- High durability
- High temperature resistance

Co-Design for extreme requirements

Together with Siemens Mobility Austria GmbH (Fahrwerke Graz), Angst+Pfister developed rubber-metal buffers for limiting longitudinal traction in bogies for rail vehicles. The homogenous single-component rubber compound from Angst+Pfister sets standards in combination with the European fire protection regulations. In addition, not only were the excellent sliding properties of the stops required – the engineers also designed a component whose stiffness had to follow an extremely narrowly tolerated characteristic curve.

With their many years of transport expertise, Siemens Mobility sets standards for tomorrow's mobility and is constantly developing new solutions. The rail transport sector comprises vehicles, infrastructure and automation solutions – from light rail through regional transport to high-speed lines.

Damping longitudinal movements and structure-borne noise

Wheelsets of rail vehicles are attached to bogies. They allow rotations in relation to the car body. The primary suspension is provided by dampers between the wheel axles and the bogie. The secondary suspension takes place between the bogie and the car body, which are connected to each other by a pivot bearing. When accelerating or braking, longitudinal movements occur between the car body and the bogie. In addition, structure-borne noise is transmitted. Both would affect the comfort for the passengers in the body. To prevent this, a so-called plunger pin projects from the secondary suspension into two rubber-metal buffers. These are mounted on one side of the bogie by means of an adapter plate and on the other side come into contact with the plunger pin with a slight preload. For this reason, the buffers end there with a plastic plate, which must have good sliding properties with a long operating life.

Siemens Mobility Fahrwerke Graz came to Angst+Pfister in order to jointly develop the buffers in accordance with the European fire protection regulations EN45545 and set the specifications. The Angst+Pfister specialists then checked whether the requirements – also with regard to operating life – were possible and submitted their offer. Then it's on to design: "The fire protection regulations have already severely restricted the choice of materials," says Michael Forrer, Senior Engineer Antivibration Technology at Angst+Pfister in Zurich. Determining the correct rubber compound in this project was, however, also "tricky".

Special characteristic curve as a challenge

The stiffness of the buffers does not require a linear characteristic curve – it demands extreme progression: At the beginning, the stop is supposed to offer a relatively weak resistance, which however increases stron-

The three grooves of the buffer ensure the extreme progression of the characteristic curve.

Tomorrow's mobility demands new engineering solutions. Angst+Pfister is there.

gly at a certain pressure - until the stop. Angst+Pfister's solution for this was a special three-stage rubber contour. Three grooves provide the required progression of the characteristic curve: As soon as they are compressed, the resistance increases abruptly – until the built-in stop takes effect. It took a good dozen designs and simulations of stiffness using the finite element method before the correct rubber contour was found. It took the engineers a few weeks to do this and they repeatedly discussed their new proposals with the customer, who brought in his experience. The competence of two strong partners results in products of exceptional quality thanks to close cooperation. "We appreciated Angst+Pfister's transparency in component development."

Testing and universal application

Once the design was right, Angst+Pfister set to work on the prototypes. Some final changes were made to meet the special progression. The prototype then had to go through various tests: With 14 days' heat exposure in a 70°C oven, the stops were subjected to artificial ageing – and an operating life test of several hundred thousand cycles. The characteristic curve of the stiffness is examined before and after. Angst+Pfister also carried out pull-out tests. The adhesive bond between rubber and metal must hold – only the rubber is allowed to tear. Finally, the electrical resistance and corrosion resistance of the coated material were investigated. Once all the tests had been successful, the "Design Freeze" was given as the starting signal for series production. For the series components, random sampling checks were then carried out again before delivery.

"In close cooperation with the customer, we developed a universal rubber-metal buffer that Siemens Mobility is now installing in various vehicles," says Michael Forrer. So the wheel no longer has to be reinvented with every new type of train, which saves development costs.

«Co-design with customers and the exchange of skills lead to products of exceptional quality.»

Michael Forrer, Senior Engineer Antivibration Technology, Angst+Pfister Group

Rugged over rocks and roots

Quivogne is a French family company that cares about its reputation. When you tout the benefits of high-quality farm machinery, the last thing you want is problems or extra costs due to parts that malfunction quickly. Hectare for hectare – the swivel joints fitted with Angst+Pfister's high-performance rubber cords deliver on Quivogne's promise of high-quality.

There are two options for swivel joints in disc harrows: You can just hope for the best, but then it is only a matter of time until the rubber cords show visible damage and your equipment can no longer be used. "Particularly for the key components like rubber cords, if you use so-called cheap materials sooner or later you can expect customer complaints," says Philippe Kirsch, who knows from experience. The International Business Director of Angst+Pfister has seen more than a few frayed rubber cords as his teams supply several disc harrow manufacturers.

Extreme working conditions

Disc harrows are used for preparing soil. The metal discs (or tines) frequently have to till soil under tough conditions – stones can deal sharp knocks. Soil is rarely homogeneous, and every single disc has to be protected and insulated with a swivel joint. The inclination of the discs means they also have to absorb lateral forces. The company Quivogne, in the French region of Haute-Saône, builds agricultural machinery with 150 employees and sells in forty countries – around 15,000 items of equipment annually, including umpteen disc harrows.

As an innovative business, Quivogne's focus is on high-quality machines and improving quality. It can prove expensive if a machine that has been delivered to the other side of the world does not function as desired. And the Frenchmen do not want to jeopardise their good reputation. The disc harrows have to penetrate and breakdown compacted soil – in this case, over a span of about 12 metres. To do this, they need a couple of hundred rubber cords – four per disc, that is, per swivel joint. Each group of four is mounted between an internal shaft and an external bracket applying pre-stress. (see image).

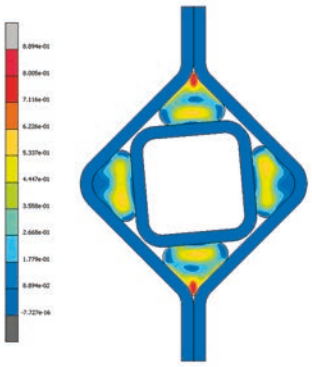
Software for durability

"If you understand the importance of rubber cords and you want to do more than cross your fingers and hope, then you come knocking at our door," says Philippe Kirsch pleased. Even advance field trials do not guarantee a long service life. Some manufacturers perform field trials – nothing happens, the machines are delivered, but then the complaints come in anyway. "Poor material is often done for after one year – especially with really tough soil," says Kirsch. Many companies resort to excessive pre-tensioning of the rubber cords to compensate for the characteristics of cheap rubber. But even top products achieve nothing if they have not been installed correctly or the design is unsuitable.

Service life is always curtailed by such mistakes. But where do manufacturers begin to analyse the stresses? How and what feeds into the calculation? This is precisely why Angst+Pfister is far more than your standard supplier of rubber, because as a responsible technical partner, it can provide customised support. Angst+Pfister calculates the service life of the swivel joints by applying finite element analysis. Software scrutinizes the stress the materials are placed under and the rubber is adapted accordingly. Selecting and developing suitable materials are among Angst+Pfister's core competencies. The analysis is carried out at the in-house laboratory and production facilities in Turkey. Close collaboration between the Development and Production departments means Angst+Pfister can offer cutting-edge high-tech compounds to meet stringent requirements and specifications. Even highly specialised requirements and bespoke needs regarding quality, plasticity and properties of customers can be satisfied. Particular attention is paid to flow qualities and processability. Ultimately, the in-house advanced testing facilities provide the required quality.

High performance rubber compounds

The relaxation properties of the cord, for example, are crucial for high performance. The cords are compressed by 25 percent and then stored for 24 hours – a standard method. Angst+Pfister's products maintain their original shape after compression set tests such as these to the greatest possible extent. "We do not manufacture extruded cords. They are injected into a forming mould under a pressure of five hundred tons," explains Philippe Kirsch. This results in optimum rebound capacity and improved tensile strength. The engineers and material specialists at Angst+Pfister have developed elastomers able to function when not in their



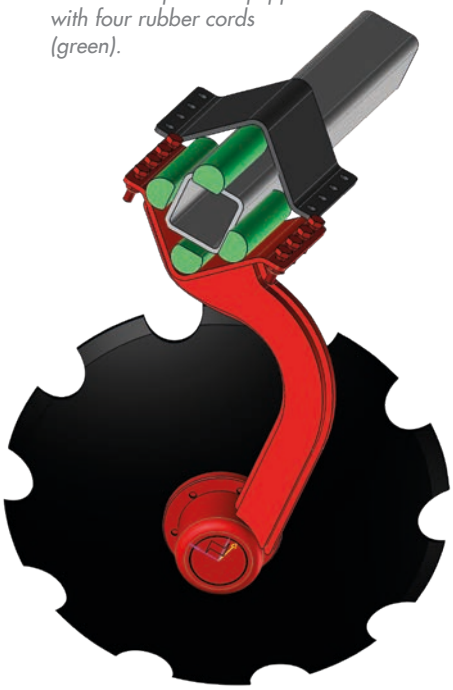
«Thanks to state-of-the-art testing, we can quickly and accurately predict how long rubber components will last.»

Philippe Kirsch, International Business Development Director, Angst+Pfister Group

comfort zone and that show no sign of degradation even under extreme mechanical stress. The relevant properties are clearly defined and measured by Angst+Pfister.

"After the tests, we know straight away how long the cords will last," says Philippe Kirsch. Only then are prototypes handed over for testing on site at their customers' premises. Top quality materials are essential for swivel joints! Quivogne has been a regular customer of Angst+Pfister's rubber cords for two years now – to the benefit of the French family company's good reputation.

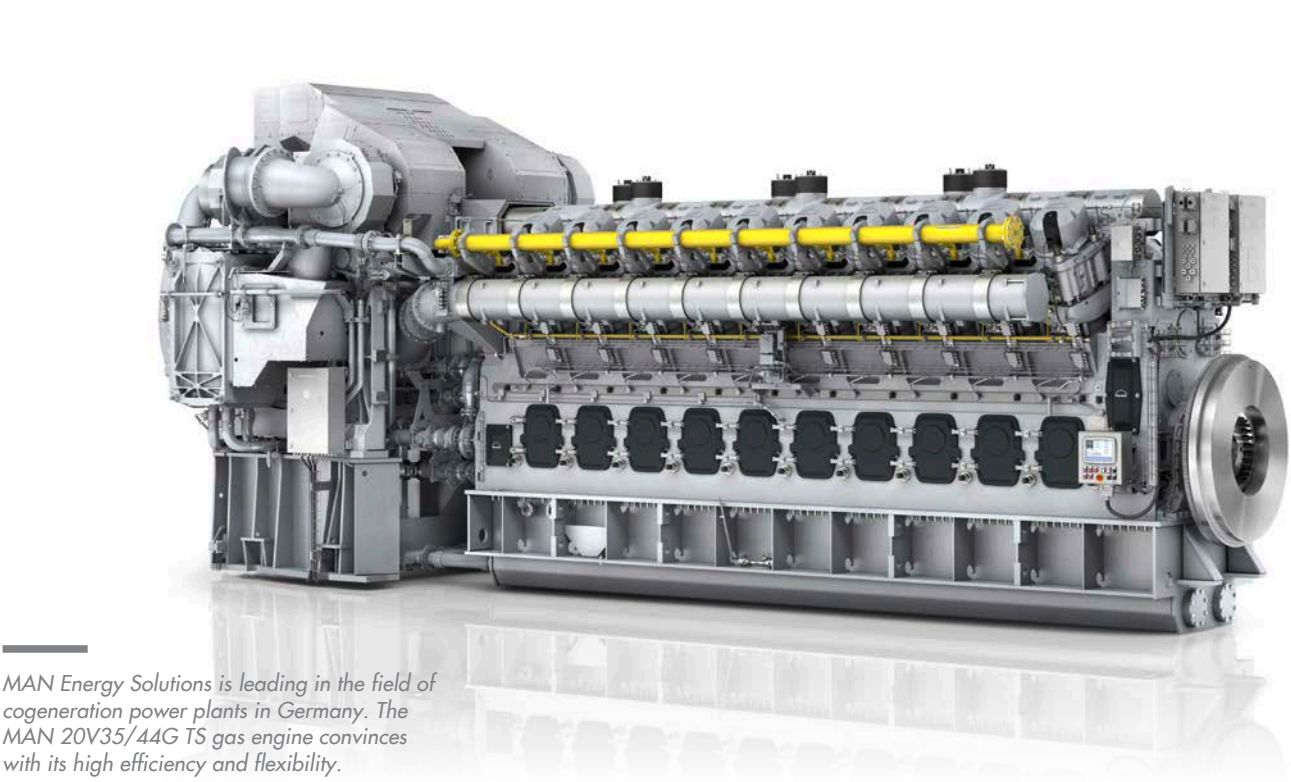
Each swivel joint is equipped with four rubber cords (green).



Disc harrows are pulled through stony, unruly soils. Swivel joints protect the individual discs.

MCM – high end development partner, even for high production volumes

MAN Energy Solutions strives to build its marine and stationary power engines in an ever cleaner, more powerful and more efficient way – at the same time, customers must continue to benefit from the long service life of its high-quality machines. This also applies, of course, to all of the sealing rings within the engine area. A higher level of performance is required for ever more demanding conditions – and, where possible, lower costs.



MAN Energy Solutions is leading in the field of cogeneration power plants in Germany. The MAN 20V35/44G TS gas engine convinces with its high efficiency and flexibility.

MCM SpA, located near Bergamo in Italy, has been part of the Angst+Pfister Group since the beginning of 2019. The company specializes in tailor-made rubber seals for industries such as the automotive, aviation and petrochemical industries. MCM is also known for its highly-fluorinated material solutions, which feature a high level of chemical and heat resistance.

In 2017, MAN Energy Solutions began the search and validation of various suppliers of new O-rings for its marine and stationary power engines. The reason for this was a new corrosion protection agent, which is widely used in Asia and the USA in particular, requiring the O-rings to have the necessary long-term resistance. In addition, resistance to high temperatures and, depending on the product, to hot water, steam and coolants, fuels, engine oils or a combination of all of these was also required. “We wanted to take advantage of this opportunity”, says Paola Ghirardelli, Sales Manager at MCM. “Our strength is that we’re flexible and can respond quickly to requests or problems during a project. We wanted to convince our customers with the highest level of attention, flexibility and competence in order to build up a relationship based on trust.” Supplier approvals for other leading global corporations also helped here.

MAN – The highest performance with the lowest emissions

MAN Energy Solutions, headquartered in Augsburg, is a 'big player' in the sector. Amongst others, the company develops and produces large liquid-fuel and gas engines as well as turbomachinery for its marine, power and industrial customers, making it a world leader. MAN Energy Solutions employs more than 14,000 people at over 120 locations worldwide. With its sophisticated and reliable technologies, the MAN brand stands for longevity, efficiency, flexibility and environmental performance. The aim is to make its engines more sustainable, more powerful and more efficient – take the MAN 35/44G TS gas engine. Gas engines from MAN Energy Solutions are an ideal solution for cogeneration power plants as they offer the highest flexibility. Within three minutes, the motors can be switched from idle to full load operation and switched on and off as required. Operating at a total efficiency of up to 90 percent, these cogeneration solutions make particularly effective use of its fuel. Such gas engines require numerous sealing rings in the engine area – whether for the cylinder head, nozzle leakage, valve guiding, fuel flow or the pressure control valve. The sealing rings must be able to run for long periods within a large temperature range and be highly resistant to any of the chemicals mentioned above. Here, MCM's development expertise was also in high demand.

"As in the automotive industry, for example, this sector also demands more and more performance from materials. They have to withstand ever more demanding conditions", says Paola Ghirardelli. At the same time, cost optimization is a continuous topic. "So, it's often a matter of identifying new compounds that are also more competitively priced - and within a reasonable period of time".

More performance despite cost optimization

For validation by MAN, MCM carried out the O-ring test in accordance with the new requirements, procured the liquids and other media for ageing tests and managed the implementation of all of the tests in a laboratory recognized and accredited by MAN. MCM evaluated the results and identified the most effective materials. MCM technicians and experts Paolo Lavelli and Oliviero Mismetti shared the results with MAN laboratory managers to define the new specifications and identify the materials needed for the new requirements.

"We have the capacity for large deliveries and this type of development, as well as a very high degree of flexibility with regard to solution development.", says Paola Ghirardelli.

Another potential advantage: A specially colored coating can distinguish original MAN parts from the rest. Other manufacturers aren't able to copy them so easily. For MAN, it's important that original seals are used on the engines. Incorrect seals can pose a risk to engines if their resistance to corrosion inhibitors, oils or fuels does not meet the highest standards.

Proven at sea

MAN is testing the O-rings in a number of engines which are equipped with O-rings in four different materials and several sizes from multiple suppliers, one of which is MCM. The customer continuously reports on results, and so far seems very impressed with the materials from MCM: MCM has already received orders for seals for some of the engines. "Our goal, of course, is official approval from MAN to be able to supply O-rings worldwide for various applications", says an optimistic Paola Ghirardelli.

«As in the automotive industry, for example, this sector also demands more and more performance from materials. They have to withstand ever more demanding conditions»

Paola Ghirardelli, Sales Manager, MCM

Radial shaft seals – upsizing, upgrading…

Angst+Pfister is the go-to company for custom technical solutions: The German agricultural machinery company Bernard Krone needed radial shaft seals almost one metre in diameter – and tough enough to get through several seasons in the field. Angst+Pfister's engineer Jan-Ole Rienhoff and his team developed a product to the high quality standards that Krone expects.

They can do 1,000 hours of work: New radial shaft seals with a diameter of one meter protect the gearbox of the pellet harvester.

In 2015 at Agritechnica – the world's largest trade fair for agricultural technology – Krone presented an innovative machine: The first pelletiser to produce pellets in one operation in the field at the moment of harvest that can be delivered straight to retail customers. The "Premos 5000" is hauled by a tractor and gathers straw, which is then compacted into straw pellets by two matrix rollers. The pellets serve both as animal fodder and to heat buildings.

Meeting technical challenges

Krone was seeking a better way to seal the gear unit as dirt found its way too quickly into the internal machine parts, and this overstressed the drive shafts. The metal shaft seal rings in use were not performing to Krone's high quality standards. The company's focus is not only on innovative, but also high quality products that are continually being improved – which is exactly what its customers want. This was the background to the managers of Krone contacting Jan-Ole Rienhoff, Product Application Engineer at Angst+Pfister Germany with the question: "Would it work better with rubber?"

Angst+Pfister develops and supplies all types ofsshaft sealings in a wide variety of sizes for a range of applications, drawing not only from its extensive range of standard products, but also developing custom solutions. "To begin with, we were not one hundred percent certain that we would be able to eliminate this problem," remembers Jan-Ole Rienhoff. But he wanted to take on the challenge and so discussed openly the potential issues with Krone. The difficulty was primarily the size of the shaft sealings with a shaft diameter of 900 millimetres. The seals need to prevent straw and dirt entering the gear unit, and, conversely, no oil can be allowed to escape the gear unit.

Finding solutions together

The question was what sort of design and suspension preload would increase the seal strength of the two large rings? In addition, they had to be sufficiently robust to get through around a thousand hours before service – one machine is in operation between 200 to 500 hours per season. "Thanks to our know-how, we are also able to tackle technically difficult projects," says Jan-Ole Rienhoff. The idea was to design a radial shaft seal with metallic reinforcement to maintain its toughness. In order to optimally protect the internal area of the machine, the ring required an axial lip with the addition of grease lubrication to enhance performance. The engineers of Angst+Pfister produced a rough estimate for the design and production of the shaft seal ings. Then it was a matter of looking at the details, making the tools and manufacturing the prototypes.

Proactive – from design to installation

Angst+Pfister has an excellent production platform, "So, we were in constant communication with Production," explains Jan-Ole Rienhoff, who supported the feasibility study to work what, if anything, could be manufactured. Another hard nut to crack was the preload. "If it's too weak, the seal will not seal correctly – if it's too strong, it closes too quickly," explains Jan-Ole Rienhoff.

The first prototype failed immediately because there was straw ingress in the gear unit. Jan-Ole Rienhoff soon found himself in the Krone workshop and together with the customer analysed the contaminated gear unit. The joint analysis and repeat tolerance tests demonstrated that Krone could implement a simple adaptation to the gear unit to increase the preload on the seal lip. The next assembled gear units passed all tests at Krone and are already being deployed by the first farmers. In the meantime, Angst+Pfister has put the shaft sealings into production and supply as a standard product. As an additional service, detailed installation instructions were also provided.

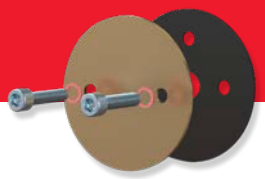
Angst+Pfister came up with the goods to the satisfaction of the customer. "It was important to me that the project was more than working through a list of specifications and that based on our basic knowledge, we discussed the problem together, looked at various ideas and optimisations and jointly developed a solution," explains Kai Lüpping, who has construction responsibility for the Premos at Krone.

«What is technically feasible? We like to be challenged by customers with difficult tasks.»

Jan-Ole Rienhoff, Product Application Engineer, Angst+Pfister Germany

“One producer, one product, all approvals”

The engineers at Angst+Pfister have produced a clever logistics and technical solution, that in combination with their expertise in plastics and sealing technology, and consultancy on the approvals processes, has culminated in new APSOplast® POM-C seat valves for the latest generation of ULTRAMIX® thermostatic mixing valves. Now, the customer, Watts Industries, can provide a single type of mixer for the entire European market.



Athletes will agree that no matter whether you have won or lost, it’s a great feeling to relax under the shower for a while – and in no time at all, you’re back ready for action. But it only works and feels good when the temperature is right and stays right. Watts Industries France manufactures products for sanitary and heating systems as well as drinking water installations. Convinced by the high quality of Angst+Pfister’s PTFE components, the company has been a customer for many years.

Combining strengths

Watts Industries planned to widen its customer base in additional European countries for a new product: thermostatic mixing valves for municipal sanitary installations such as swimming pools, sports halls, hospitals or camping sites. The industrial water mixers regulate the cold and hot water stream to maintain a set temperature. To do this required a precise, stable and dependable regulator – and a new business partner who not only had a complete grip on the minimal tolerances of the seat valve, but also knew the approval processes for plastics technology inside out.

The mixers are intended for sale in France and beyond in the Netherlands, Britain and Germany. There is no such thing as one single EU standard – there are several different national certificates and approvals. Angst+Pfister knows a lot about this subject and got involved when Watts Industries put the project out for tender. “Even at the first meetings with the Watts research department, we were able to demonstrate expertise in additional areas,” says Anita Kouakou, Product Application Engineer at Angst+Pfister France. Not only was knowledge of plastics technology and approvals beneficial, so was Angst+Pfister’s experience in sealing technology.

Meeting complex challenges

“From then on, we talked over the sealing technology with our experts in-house,” says Oubihi Abderahmane, who heads the French Profit Center for Engineering Plastics Technology in France. Consequently, his team was therefore already able to propose technical modifications based on the drawings provided by the customer and in line with the customer's needs. The issue was one of finding the optimum texture of the seat valves for a perfect seal – this had been a problem with the previous solution. Angst+Pfister engineers in France then focussed on the right material and the relevant approvals. The seat valves had to comply with the following market requirements:

- France – Sanitary Conformity Certification (ACS)
- Britain – Water Regulation Advisory Scheme (WRAS)
- Germany – Plastics-Drinking Water Standards (KTW) and the test procedure W270
- Netherlands – KIWA certificate

Anita Kouakou advised her customers that the KIWA certificate would be unnecessary as the two German approvals KTW and W270 are equivalent to this certificate and generally recognised in the Netherlands. This meant lower costs for the Watts Industries as the German approvals have only to be renewed every five years, unlike the KIWA certificate which has to be renewed annually. The quality managers of Watts Industries were also in agreement. Then Anita Kouakou’s team looked to purchasing suitable materials. This was no easy task as some producers keep their formulas secret – and if

the ingredients are not known, the approval procedure cannot be passed.

Cost optimisation

The answer lay in the synthetic resin Hostaform® M25AE. This is a polyoxymethylene (POM-C). To manufacture the components, Angst+Pfister's Italian company bought semi-finished parts in large quantities. The logistics set-up of the Angst+Pfister Group worked in Watt Industries' favour and the high minimum order quantity for the material was avoided.

Just one year after the tender, Angst+Pfister is now at the stage of delivering the new seat valves as a standard product to Watts Industries: "One manufacturer, one product, all approvals." Anita Kouakou and Oubihi Abderahmane are delighted.

«Advice on regulations, approvals or standards for individual markets is also part of our service.»

Anita Kouakou, Product Application Engineer, Angst+Pfister France

«For optimal solutions, we bring together the expertise of different areas and their specialists.»

Oubihi Abderahmane, Profit Center Leader Engineering Plastics and Antivibration Technology, Angst+Pfister France

High-performance sealing solutions for highly innovative dosing pumps with all approvals

Angst+Pfister is proud to work with innovative customers and find solutions using a mix of off-the-shelf and specialist products. For Dosatron, the pioneer of dosing pumps, Angst+Pfister's engineers utilised standard O-rings from the HITEC® range, specialist components and other mouldings that are all in compliance with the American and European food safety regulations. A FKM developed in-house is looking particularly promising.

Customers buy their industrial components from Angst+Pfister because they value the engineers' technical expertise, and now word about their highly-regarded knowledge of regulatory requirements is spreading fast. "When the issue is combining the regulations from several markets in one material, then the manufacture of these components can be a really complex challenge," says Ludovic Morice, Product Application Engineer Sealing Technology, at Angst+Pfister France.

Keeping step with highly innovative customers

The French company Dosatron needs such business partners to maintain its high quality. Cooperation with Angst+Pfister on the FKM project began in 2013. At Dosatron, near Bordeaux, almost one hundred employees design, develop and manufacture high-precision proportional dosing pump solutions and market these in approximately one hundred countries around the globe. The electricity-free proportional dosing pumps made by Dosatron is regarded as revolutionary and awarded prestigious innovation prizes. The mechanical pumps can dose, for example, vitamins or medicine into the feeding and drinking systems for farm animals. The dosing pumps do not require electricity, but instead make use of the flow and pressure to dose a concentrate and mix it homogeneously into water. Dosage is always determined in proportion to the volume of water – and is unaffected by pressure fluctuations or the amount of water in the piping system. The system yields huge technical and economic benefits.

Understanding the regulatory jungle

About three years ago, Dosatron began the development of a new generation of dosing pumps – and Angst+Pfister's engineers were on board right from the start. The "Dosatron D25+" is one of the first dosing pumps to fulfil both the regulations of America's Food and Drug Administration (FDA) and those of the EU Regulation 1935/2004. Regarding the latter, the aim is to satisfy the harmonising regulation (EU) 10/2011 for plastics. The situation is more complex for elastomer materials as, "For elastomers that come into contact with foods, there is no unifying regulation at the European level, which makes things more complicated," explains Ludovic Morice. "The regulation states that EU members in this case can also introduce their own national regulations, and France has very strict specific regulations for rubber materials that come in contact with food, which stipulate overall and specific migration testing. The maximum permitted migration limit of a substance in the French regulations is one fifth that of the German Federal Institute for Risk Assessment (BfR)."

"We understand these regulations and are in a position to incorporate the mechanical and chemical requirements in our components," continues Ludovic Morice. Such expertise is held in high esteem by internationally active customers like Dosatron. In this project, the focus was on O-rings and mouldings for several static and dynamic seals for a dosing pump. The seals have to withstand aggressive chemicals for their entire operating life and demonstrate specific mechanical properties – while at the same time complying with the various regulatory guidelines. "Angst+Pfister has been able to fulfil all the requirements in the specification document," says Ludovic Morice with a sense of pride.

Solution: a combination of standard and specialist solutions

The dosing system for foods by Dosatron combines a sealing solution, incorporating HITEC® O-rings that comply with the high requirements of the regulations. The used FKM seals are very suitable for contact with strong chemicals.

Angst+Pfister now makes several components for the Dosatron pumps. “We are always looking beyond our product group,” explains Ludovic Morice – and Angst+Pfister is working with Dosatron not only on seals, but also fluid handling and plastics technologies.

The dosing pumps contain HITEC® O-rings.

«We know the regulations of international and national markets and implement all requirements in one product.»

Ludovic Morice, Product Application Engineer Sealing Technology, Angst+Pfister France

The new innovative LoadSensor technology from Pewatron and Angst+Pfister: attractively priced sensor technology in a customised design including mounting

Sensors are one of the key components when it comes to the Internet of Things (IoT): sensor information is essential for making products more intelligent. Particularly in the industrial market, it is vital to design sensors in a tailored manner, according to the customer's specific requirements. The LoadSensor technology from Pewatron and Angst+Pfister is a great example of this.

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Which variables are measured by a sensor depends on the applications and the various technologies. The range of sensors on the market is equally vast and diverse. Sensors in consumer applications are usually very different to sensors in industrial applications. The consumer market is dominated by big sensor manufacturers. For us, the industrial sector is far more exciting: it offers numerous interesting niches in which the right sensors usually remain in one design for several years. The whole sensor market is worth hundreds of billions and grows by five to 10% every year. However, it is also inhomogeneous and segmented as there are hundreds of measurement variables and countless applications.

Sensors for force measurement

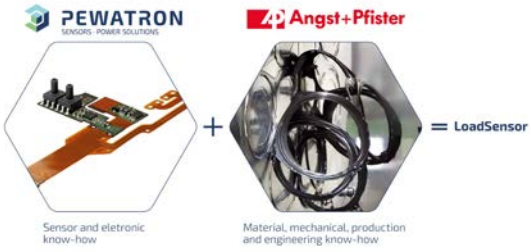
Force is one of the most important and common physical measured variables. In principle, every force sensor could also be used to measure weight. Weight can be calculated via force and gravity.

However, it must be noted that force and gravity are vectors.

$$\vec{F}_G = m\vec{g}$$

This means that the angles must also be taken into account. In practice, this is a problem for numerous applications. If the load is not transmitted 100% vertically to the load cell, this will affect the measurement. This can be illustrated with a bathroom scale: if you shift your weight on the scale, the measured value changes – an effect we're all likely to have observed. If a weight or mass is to be determined precisely, then the vectorial relationships must also be considered. This seems clear but is not always easy in practice, and the execution often requires a great deal of design work. Let's use as an example one of the most common and oldest electronically analysable sensor technologies – the strain gauge.

The strain gauge, developed in 1938, is based on an electrical resistance that changes its value when stretched or compressed. Owing to this simple principle and the cost-effective production, the strain gauge has become commercially established and is now one of the most commonly used sensors. Nevertheless, further principles have been established for load measurement in addition to the strain gauge. One major disadvantage of the strain gauge is the aforementioned vectorial relationship. Depending on the application, ensuring that the load to be measured is correctly 'redirected' to result in a resistance expansion can involve highly complex design work. When it comes to bathroom scales, as an example, this is very simple. This is reflected in the price of a consumer scale, particularly if high precision is not a crucial criterion. High-precision scales are usually based on other principles, such as an inductive control loop. Most high-precision weighing systems of the renowned American company headquartered in Switzerland rely on this principle. In other applications, where the redirection of the load is not as easy to implement, the manufacturing costs of the mechanical construction often greatly exceed the cost of the actual sensor. Different measurement principles are required



Key expertise in the LoadSensor development: Pewatron contributes knowledge and experience in electronics and sensors; Angst+Pfister contributes comprehensive expertise in materials science and engineering.

Innovative, versatile and focused on the future: the Pewatron LoadSensor

«New cost-effective, application-specific sensor technology will make possible the predicted exponential growth of IoT.»

Philipp Kistler, Product Manager Pewatron

here since the cost of production in complex designs can usually only be reduced to a limited extent, even at high volumes.

Fewer mechanical parts means lower costs

A great everyday example is the good old video recorder. Despite unit sales in the millions, it was almost impossible to find a device for under USD 100 in shops during the peak of the video recorder's popularity. But when DVD players hit the market, it wasn't long before their price dropped to below USD 50. This is because these consist of significantly fewer mechanical components. This clearly illustrates the advantage of electronic solutions – they can always be produced more cheaply or made more efficient over time. The main reason is Moore's Law (transistors double every one to two years). It cannot be applied to mechanics, but it brilliantly explains the rapid development in electronics in recent decades. In other words, sensors with the simplest possible mechanics have the best potential for low production costs. Although simple concepts have many advantages, they also have one disadvantage: they are usually relatively easy to copy. However, in the field of sensor technology, imitability must be viewed in relative terms. The key knowledge lies in the compensation algorithms, the material properties and the production and calibration process. Nevertheless, the issue of imitability should be taken into account as with any product development. The capacitive measurement principle is conceptually very simple, but places high demands on the specific expertise of developers.

Capacitive sensors: a future technology

Loads are applied to two conductive layers. This reduces the distance – and the smaller the distance, the higher the capacity. This measurement principle has been understood for many years. So far, however, capacitive sensor technology has been quite limited, particularly when compared to resistive sensor technology. This is because in comparison to a simple resistive bridge circuit, the electronics for the measurement of a capacitance were much more complex, inaccurate or expensive. This has changed in recent years. Owing to the development of touchscreens in popular consumer products, this technology has evolved rapidly. Now is the time for precise and attractively priced capacitive sensors. We must now ask the question: what are the key components in such a sensor? The first component is the material between the two electrodes (capacitor plates). This material forms both the spring element and the dielectric. Further important components are the algorithms for the compensation of temperature, humidity, non-linearities, ageing and other undesirable effects. The less the material properties change as a result of environmental conditions, the easier and better the compensation.

In-house collaboration for innovative solutions

Thanks to a setup that combines Pewatron's sensor technology expertise and the material expertise of Angst+Pfister, specialised knowledge from all disciplines flowed into the development of the Pewatron LoadSensor. This expertise is notably combined for the elastomer – it forms the aforementioned spring element/dielectric. The consolidation of comprehensive specific knowledge in one company is arguably unique. This is because most sensor companies have in-depth knowledge in the field of electronics and of the typical materials used in sensors such as silicon, ceramic and often stainless steel. However, knowledge in the field of elastomers is lacking. Conversely, companies that deal with materials and elastomers lack the expertise in the fields of internal electronics and sensor technology.

Here, both come together under one roof. This arrangement has enabled us to develop the capacitive LoadSensor within a very short time – it also guarantees the further development of this technology in coming years. Driven by key customers from Pewatron, the sensor is already being optimised and produced for individual customer-specific applications.

Further applications for the LoadSensor are certainly expected. It is essential that the main advantages bring real added value to the customer: they benefit from the low thickness, the 'integrated mounting', the customer-specific design and, above all, from the attractive price in high quantities – in contrast to traditional solutions with strain gauges or load cells. How many such applications exist is yet to be seen. The market for sensors is enormous, and the trend in the field of IoT will see pronounced growth over the next few years. This will certainly bring forth countless new applications that we cannot even fathom today. The future will unveil them.

From a Swiss family business to an international corporation

Elfriede Wenger and Hans Luginbühl have been part of the Angst+Pfister family for decades, and likewise, Angst+Pfister a part of them. In conversation, they described what it is that makes Angst+Pfister special and how challenges were mastered, both in the past and today, to secure the future of Angst+Pfister and the growth of the international corporation.

At the start of the chat, Elfi showed us an old company guide, which over 50 years ago was handed out to new Angst+Pfister employees and designed to get them off to a good start in the company. Values such as commitment, performance focus, teamwork and respect formed the basis of the company culture. These values have endured to this day, and only recently been updated in line with current market requirements for release of the new company strategy at the start of 2019.

Our number one focus always was, and continues to be, the customer. Then, as today, the first priority was to provide the customer with the best possible service from consultation right through to delivery. First and foremost this entails providing an added-value solution for the customer that meets the highest of technological and quality standards. The great variety of customer testimonials on a huge range of projects – national and international – is evidence that again and again challenge is met with success in projects that extend from high-tech engineering solutions to customized standard components.

In the entire history of the company, one competency in particular has stood out, is still emphasised by customers, and has become a kind of hallmark. And that is the unfailing flexible, courteous and very personal type of customer consultation offered, something that nowadays can no longer be taken for granted.

Looking back

Angst+Pfister originally dealt only in technical components. The product offering was continually extended and updated in line with customer requirements. For example, shortly after WWII, fluoroplastic was introduced to the product range, only one of many innovations. Starting in 1944, in early recognition of the signs of globalisation, the company expanded, establishing sales offices in the major European countries. In order to fully meet the requirements of customers, in 1987 the visionary Hans-Jürg Angst introduced a fully automated European Logistic Centre near to the German border – a further innovation, and for Angst+Pfister the opportunity to expand the scope of logistics services in supply chain management.

Pioneering strategies

Solid foundations were thereby laid. Shortly after, it became clear that a fundamental change in strategy was needed to keep pace with the increasingly challenging requirements posed by the then, and future, markets. It was a question of having the resources in place to be able to adapt to the constantly changing challenges, without losing sight of who we are or where we came from. Initiated by Christof Domeisen, CEO and Delegate of the Board of Directors, who joined the company over 15 years ago, the necessary radical strategy adaptation was implemented.

Angst+Pfister evolved from a purely commercial enterprise to an international, digitalised company with a comprehensive value creation strategy. Its engineering service was established and production integrated. Further, a unifying company culture was created, built on the basis of the different companies in different countries. Each location was able to develop independently, so

that the global group could profit internationally from national strengths and potential.

Today, this is a tried-and-tested recipe for success, rooted in the core values of the company. It is said that companies consist of people who develop and live a common cultural code together. The culture we wish for as a group is defined by values that we share and the way we live those values.

Continued growth

After the turn of the millennium followed the opening of strategic sites in China, and in 2006 the takeover of Pewatron resulting in expansion of the product range to include sensors.

Since 2013, Angst+Pfister Advanced Technical Solutions (previously LASPAR) with headquarters in Bursa, Turkey has been the new main production location for antivibration and sealing components of the Angst+Pfister Group. It is adjoined by a high-tech research and development centre that in 2016 was recognised by the Turkish Ministry of Science, Industry and Technology.

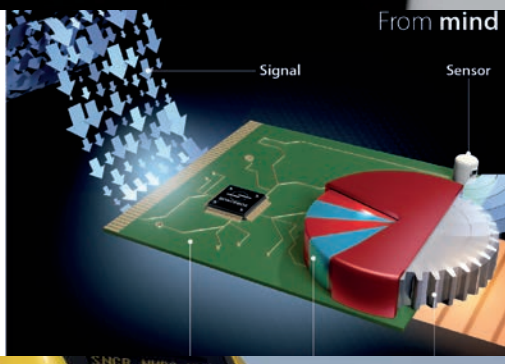
Another important step into the future was taken in 2016 with the conclusion of a strategic alliance with the company TSF S.p.A of Italy, the global leader in the development and manufacture of high-tech compounds, because as experience has demonstrated, the performance of a sealing or antivibration solution is highly dependent on the specific rubber compound. As such, Angst+Pfister entered the new and promising field of high-tech compounding and now produces several high-performance elastomer compounds (PERTEC®) for a range of industries. This area of high-tech sealing solutions was consolidated by Angst+Pfister in 2018 with the additional acquisition of MCM (Italy) and OL Seals (Denmark). This dynamic development will continue to be a focus in the future.

The Angst+Pfister family

Finally, there is an aspect that needs to be emphasised again, and that is one that over all the years has been, and still is, a factor central to success. And this is the international company culture that has allowed Angst+Pfister to become the Angst+Pfister family – and has led to communication that is profitable in every respect, both globally and reaching beyond country and language barriers. “We communicate, listen and bring in different cultural perspectives,” summarises Hans Luginbühl. Collaboration has resulted in a guarantee for the best possible service provision for the customer at the global level.

A small Zurich family business has become an international company – with a collective finger on the pulse of current technology – providing its customers with the best possible performance for their requirements.

100 years of Angst+Pfister



Angst+Pfister Voices

Daniel Franecki

Sales Application Engineer,
Angst+Pfister Germany

«There is always something to discover and every day I am challenged to develop ideas and solutions further. Awesome!»

Daniel joined Angst+Pfister in 2017 and has used his in-depth knowledge of industry products, customer service and salesmanship to develop business in northern Germany. He works on new projects together with existing customers, is responsible for finding new business opportunities and for building long-term customer relationships, which he does with the support of a dedicated team of Product Application Engineers. He greatly enjoys his leadership role, supporting and challenging others to improve performance and customer satisfaction.

"Every day I see products being developed, manufactured and delivered by Angst+Pfister. That is incredible. As a Sales Application Engineer, I work very independently and responsibly in my area keeping the Angst+Pfister core values in mind while looking after customers from a range of industries across all five product centers, and customizing engineering solutions for them."

Michaela Aschauer

Sales Agent for Fluid Handling Technology,
Angst+Pfister Austria

«Smile and the world smiles with you»

Michaela joined Angst+Pfister in 1996. As a Sales Agent, she is the first point of contact for the needs of her customers, provides support, helps with questions and deals with all sales-connected tasks. She enjoys working closely with other colleagues and gaining the appreciation of her customers her work brings.

"Over the last 23 years I have been part of Angst+Pfister's impressive transformation from a trading materials plant to an engineering solutions provider. For example, our logistics capabilities have been optimized to fulfil both our market needs, our engineering activities and, importantly, our production capacity. It is great to look back on the many important and sizable projects that we were able to win in the last few years, as well as to see the potential of current projects. My personal focus during every project is cooperation with my customers and providing support in the implementation of their wishes and needs."

Çağdaş Cengiz

Research & Development Engineer, Angst+Pfister Advanced Technical Solutions, Turkey

«Every day brings new challenges to solve and new opportunities for adding value to this business.»

With a background in structural analysis working with premium automotive brands, Çağdaş started his work at Angst+Pfister Advanced Technical Solutions in Turkey in 2016. His role includes design and mechanical simulation of antivibration products for automotive, railway and industrial applications, as well as developing methods to increase accuracy of virtual simulations to get it right the first time.

"Every day brings new challenges to solve, helping me learn and expand my experience. We are aiming to design the best product in a competitive market by pushing the boundaries of creativity, and combining material know-how with mechanical knowledge."

Giulia van der Werf

Sales Agent for Engineering Plastics Technology, Angst+Pfister Benelux

«A day without learning and laughter is a day wasted.»

Giulia started work as a Sales Agent in 2015 at Angst+Pfister Netherlands where she enjoys the daily cooperation and communication with her colleagues and customers. She loves the technical aspects of orders, offers and engineering solutions in Plastics and Sealing Technology. One of the main things she tries to establish with customers is to be a trusted contact for the customer's organization. Regular challenges keep her active and motivated, for example, filling in for colleagues at Angst+Pfister France in the Internal Sales department or collaborating on product assortments. The Netherlands' team is compact and needs all-rounders with an open mindset as well as communication skills.

"I graduated as an engineer in industrial product design and really enjoy a blend of technical and creative work. That's why I love the diverse and versatile environment at Angst+Pfister! My ambition for the future is to become a Product Application Engineer and help create customer specific engineering solutions."

Kevin Wang

Profit Center Leader Sealing and Plastics Technology, Angst+Pfister Engineering Technology Co., Ltd., China

«Angst+Pfister is truly global, taking care of every employee – no matter where you are. China is far away from the Group headquarters, but we are not alone.»

Kevin's career at Angst+Pfister began in 2017 as a Team Leader in Sealing Technology. Since then he has also taken over the lead of Plastic Technology in China. In this role he is responsible for new business development in the household, gas, coffee machine and robotic sectors. He especially enjoys leading a team of dedicated engineers into new projects, as well as the combination of sales and technical expertise, and creating strong working relationships with customers.

"Sealing is everywhere, each different industry and application makes me excited and curious. The market potential is always huge, and we aim to select projects suited to our engineering expertise – to do the things which the competitor cannot do."

100,000 Times Exactly the Right Product

It doesn't always have to be a specification. For developers and especially for buyers, it's worth taking a look at the extensive range of Angst+Pfister on www.angst-pfister.com – or a visit to the online shop www.apsoparts.com.

APSOseal® HITEC® O-ring

The Angst+Pfister HITEC® O-ring range includes O-rings with approvals for drinking water, food, pharmaceutical and medical technology in the materials NBR, EPDM, VMQ and FKM. The material EPDM 70.10-02 is particularly worthy of note, since this material, in addition to outstanding mechanical properties such as low compression set also has all the approvals in the aforementioned industries - and for a single material too.

APSOseal® FEP-O-SEAL® O-ring

The FEP-O-SEAL® O-ring is the optimal combination of two materials: The core of elastic silicone or FKM ensures the restoring force and the FEP sleeve guarantees the chemical resistance. FEP-O-SEAL® O-rings are ideal for use in the food, pharmaceutical and medical industries: They can be deployed in a variety of applications at temperatures ranging from –60 °C to +200 °C. In addition, they are pressure-resistant and guarantee low compression set coupled with much lower tendency towards cold flow compared to PTFE. They also have FDA and EG1935/2004 compliance, as well as 3A Sanitary Standard and USP Class VI.

APSOseal® Kalrez® perfluoroelastomers (FFKM) O-ring

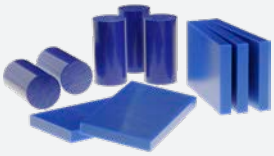
Kalrez® O-rings possess unique operational properties that are unmatched by any other elastomer material. Kalrez® synthetic rubber in its various compounds combines the elasticity and sealing power of a genuine elastomer with the chemical resistance of PTFE. Kalrez® O-rings are resistant against practically all chemicals and can be deployed in continuous operation at temperatures up to +327 °C or for brief periods at temperatures up to +350 °C. Kalrez® O-rings compliant with FDA or USP VI requirements are also available. Angst+Pfister stocks a huge assortment of Kalrez® O-rings and has direct access to special-sized Kalrez® O-rings. Where conventional materials fail, Kalrez® perfluoroelastomers (FFKM) provide the least expensive and most reliable long-term solution from a total cost standpoint.

APSOvib® conical bearings

APSOvib® conical bearings are designed for use in agricultural and construction machinery to absorb impact and isolate engine vibration in cabs.

- Typical applications include the isolation of motors, gearboxes, differential cases, cabins, and others.
- Conical bearings can be used for loads from 2'600 N to 30'000 N.
- They are available from stock in six different sizes, each in different rigidities and breakaway-proof by the use of stop discs.
- The directional stiffness allows a good vibration isolation in the vehicle transverse direction and sufficient rigidity in the direction of travel for the suspension of shock and braking forces.

APSOplast® Visually recognisable plastics according to FDA and EC 1935/2004

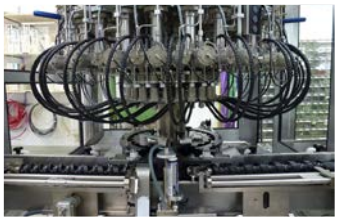


These visually recognisable blue plastics stand out clearly from the colour of processed foods and help with the visual inspection of food. Any fragments of a plastic component can be recognised quickly. The optical recognition is economical and has proven to be successful in a variety of applications in the food industry. Our customers have successfully used blue plastics not only in food processing machines but also in pharmaceutical and medical devices.

These plastics are suitable for direct and indirect food contact according to FDA and EC 1935/2004. They are available as POM-C and PE-UHMW in plates and rods.

APSOfluid® TETRAFLEX® S PTFE hose lines

PTFE (also known as Teflon™) is one of the most versatile plastics on the market: It has almost universal chemical resistance and withstands temperatures from -60°C to + 260°C. Our TETRAFLEX® S PTFE hose assemblies have an inner tube made of this unique material and are therefore suited to a wide variety of applications. Due to the external braiding made of stainless steel, the pipes also withstand high pressure and have good kink resistance. The pipe connections can be individually adapted to the customer's wishes: Normal closing, custom-made, stainless steel or galvanized steel. The selection of TETRAFLEX® S PTFE pipes is also varied: they are available in diameters DN 5 - DN 25, in antistatic versions or with multi-layer braiding for particularly high pressure resistance.



SYNCHROFLEX® GEN III

The combination of a high-strength steel cord tension members and abrasion-resistant polyurethane makes the SYNCHROFLEX® GEN III polyurethane timing belt dimensionally stable and particularly durable. The power transmission of the new GEN III increased by nearly 25% in comparison to the standard version of SYNCHROFLEX®.

The high performance polyurethane used achieves considerably higher benchmark results and the increased hardness of the polyurethane allows a higher number of load-bearing teeth.Thanks to the use of a bifilar tension member arrangement and a higher packing density, SYNCHROFLEX® GEN III timing belts provide the best possible solution for any product down to the smallest detail.

APSOvib® Hinged foot

APSOvib® Hinged feet with glass fiber reinforced polyamide are available from stock with the diameters 40, 50, 65, 83, 103, 123 mm. They are suitable as leveling machine mounts thanks to their high load capacity and the possibility to be oriented +/- 15°. They also have a high corrosion resistance. Depending on the application we offer them with galvanized or stainless steel screws.

Thanks to an anti-gliding rubber pad on the base, the risk to damaging the floor is minimal. This is a specific machine mount for machines, logistic, food and beverage, chemical and pharmaceutical, gastronomy and hotels, domestic appliances, etc. This APSOvib® Hinged foot is an excellent universal leveling machine mount with great value for money!

Services

The Angst+Pfister Group supplies its services to every corner of the globe. We are offering solutions tailored to the customer's specific needs with our local application specialists. We are providing engineering-lead solutions to thousands of original equipment manufacturers in over 50 countries.

Production Platform

Our global production platform spans across 15 countries. In addition to our own state-of-the-art manufacturing, we have reserved capacity with internationally renowned production partners. This allows us to always select the best production location based on our customers' quality, quantity and delivery requirements.

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