

May 2018

PUreview

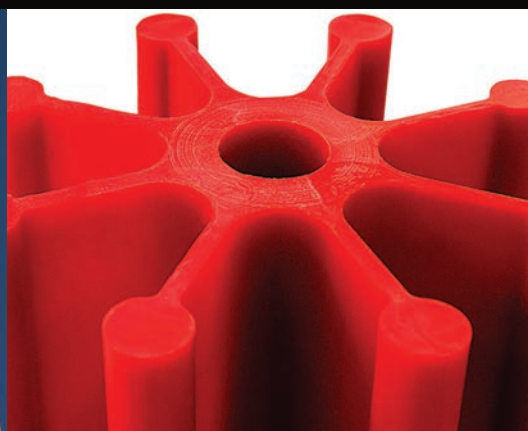
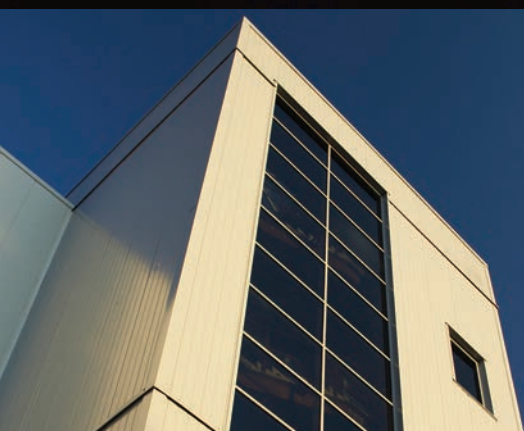
REPORTING THE WORLD OF POLYURETHANES FOR OUR CUSTOMERS

HUNTSMAN

Enriching lives through innovation

Our downstream innovation network

Going further for polyurethane customers worldwide



**Purchase of Demilec adds to spray
foam capabilities**

**Water-blown pipe insulation making city
life more sustainable**

**Setting a new standard in flame retardant
cable protection**

**Showcasing our total innovation network
at UTECH Europe from 29-31 May**





Building on the entrepreneurial legacy of our founder, Jon M. Huntsman

Tony Hankins, President, Huntsman Polyurethanes

If you're a regular reader of *PU review*, you'll be aware that Huntsman Polyurethanes' strategic priority is to strengthen our differentiated downstream capabilities. Over the past decade or so, we've steadily built our global network of downstream enterprises (DSEs), both through organic growth and acquisition, to the point where we now have 30 DSEs located in all major markets, close to our customers.

We're sharply focused on growing downstream, because we see these relatively small, entrepreneurial businesses as being hubs of creative innovation, which help us to deliver real value added solutions to our customers. They are often led by visionary leaders who are able to identify and find value in new market opportunities that others can't see – much like our founder and former Chairman, Jon M. Huntsman, who sadly passed away recently.

I had the great privilege of working closely with Mr. Huntsman since 1999, when Huntsman bought several businesses from ICI, including Polyurethanes. If you ever had the pleasure of meeting Jon, you would know what an inspiration he was. Within our business, and across the wider chemical industry, his knowledge, charisma and human kindness will be missed by many. His passing is also a major loss in the field of cancer research, but we are encouraged in the knowledge that his passion and generosity will continue to thrive through his philanthropy. Jon's legacy also lives on through the work of everyone at Huntsman. He built our Company through ingenuity, determination and legendary deal making, regularly acquiring global businesses that were aligned with his vision and commercial ambitions.

Within Huntsman Polyurethanes we are committed to continuing that work. Just last month, we announced the purchase of Demilec – one of North America's leading spray polyurethane foam (SPF) insulation manufacturers and the latest business to join our global network of DSEs (more information below). The main feature in this issue (page 8-11), gives you an insight into the innovation and creativity of seven of our downstream businesses that are based in Europe. All seven businesses will be together, for the first time, at the upcoming Utech Europe in Maastricht, the Netherlands. If you're at the tradeshow, do please come by and see us.

Huntsman acquires SPF manufacturer Demilec

Huntsman has announced the acquisition of Demilec, one of North America's leading manufacturers and distributors of spray polyurethane foam (SPF) insulation systems for residential and commercial applications.



Demilec, which is considered one of the pioneers of supplying high performance MDI-based SPF systems, offers a full suite of open and closed cell spray foam systems for the residential and commercial markets. Additionally, Demilec also supplies polyurea, intumescent coatings to a variety of industries in North America.

The SPF industry offers attractive growth opportunities for Huntsman Polyurethanes. Our Polyurethanes strategy is to drive our business downstream and SPF offers the largest opportunity to derivatize component polymeric MDI into SPF and polyurea systems.

Demilec has annual revenues of approximately \$170 million (USD) and two manufacturing facilities located in Arlington, Texas, and

Boisbriand, Quebec, Canada. From these sites, Demilec produces PU-based systems, which are marketed directly to applicators, as well as through distributors. Demilec specializes in both closed cell and open cell SPF formulations, with a focus on products with renewable and recyclable content that are eco-friendly, bio-preferred and can reduce energy consumption through highly efficient insulation properties.

Tony Hankins, President of Huntsman Polyurethanes, said: "Demilec has been a pioneer of MDI SPF insulation and coating technologies for more than 30 years, building a strong market reputation with architects, builders and designers. Demilec and the entire SPF industry have delivered strong double-digit growth, by providing products

that offer outstanding insulation performance in a world that is increasingly concerned with improving energy efficiency. The Demilec team will continue to be fundamental to the ongoing success of the business, and as we rapidly build our North American platform, and aggressively expand the business into international markets."

Over the past three years, Huntsman has acquired two additional downstream companies, including IFS Chemicals Limited, a leading United Kingdom-based supplier of specialty polyurethanes systems, and Tecnoelastomeri, a manufacturer and marketer of MDI-based hot-cast elastomer systems and processing machines. |

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In memoriam: Jon M. Huntsman

It is with heavy hearts that the *PU Review* team reports on the death of Jon M. Huntsman, Founder and Chairman Emeritus of Huntsman Corporation. Mr. Huntsman passed away on February 2, 2018, at the age of 80, surrounded by his family, at his home in Salt Lake City, Utah.

Widely regarded as one of his generation's great industrialists, Mr. Huntsman leaves behind an extraordinary legacy. He was a pioneer in the chemical industry, having founded the Huntsman Container Company in 1970, which revolutionized packaging and plastics, and was the initial predecessor to the business we now know as Huntsman Corporation.

In 1974, Mr. Huntsman created the 'clamshell' container for fast-food sandwiches and went on to invent as many as 30 other popular products, including the first plastic plates and bowls. In 1982, Mr. Huntsman formed the Huntsman Chemical Corporation in Salt Lake City. While serving as its Chairman and CEO, he led the Company through constant, rapid growth with a myriad of impeccably timed and well-integrated acquisitions.

Today, Huntsman Corporation and Venator Corporation (a public subsidiary of Huntsman Corporation) represent an \$11 billion (USD) global manufacturer and marketer of chemicals. In December 2017, the Board

of Directors of Huntsman Corporation named Mr. Huntsman, Director and Chairman Emeritus, and elected his son, Peter R. Huntsman, Chairman, President and CEO.

In his heart, Mr. Huntsman was a philanthropist and his life's ambition was much greater than business. His mission was to find a cure for cancer and alleviate its ravaging effects on mankind. In 1995, he contributed \$100 million to establish the Huntsman Cancer Institute in Salt Lake City. A pioneer in genetic research and treatment, the Institute has developed into one of the world's most renowned cancer institutes and hospitals, and is recognized by the National Institute of Health. To date, over \$2 billion has been directed to the Huntsman Cancer Institute and Hospital, a substantial portion of which came directly from Mr. Huntsman and his wife Karen.

Peter Huntsman said: "Dad loved to visit our sites around the world. Many of our employees knew him personally, and he knew many of them by name. All respected him deeply.

He leaves behind a great company and a legacy of optimism, ethical behavior and philanthropy that will serve as his greatest accomplishments."

Peter R. Huntsman
Chairman, President and CEO

They regarded my father as their personal coach, mentor and friend. While never a chemist, he knew more about human chemistry than anyone I have ever met. His passion was building a great company from assets and people that others had seen less value in than he."

"In the end, as sad as I may feel at the loss of this great man, I can only celebrate that my life has been touched by this wonderful soul. I feel blessed that I got the chance to work with my father, at a business that he deeply loved. He leaves behind a great company and a legacy of optimism, ethical behavior and philanthropy that will serve as his greatest accomplishments."

The Huntsman Cancer Foundation, whose sole purpose is to raise funds to support the mission of the Huntsman Cancer Institute, is accepting donations in Mr. Huntsman's memory. |



The Huntsman Cancer Institute
in Salt Lake City, Utah.



Water-blown pipe insulation making city life more sustainable in China

Polyurethane pipe insulation produced by Huntsman is helping to heat the homes of more than two million residents in Taiyuan, China, as part of a huge urban district central heating (DCH) system. *PU Review* explores how DCH schemes work and explains how Huntsman's water-blown polyurethane technology came to play a leading role in an important energy-saving project in the capital of China's Shanxi province.

The human population faces many challenges when it comes to making life on planet earth more sustainable. One of the biggest issues is how to heat private and public buildings in a cost effective, environmentally friendly way. With the world's population growing rapidly and increasingly urbanized, DCH systems are a clever means of generating heat, en masse, for people living and working in densely populated areas. DCH systems use centralized power plants to create heat by burning fossil fuels or biomass materials. This heat is then used to create steam or, more commonly, hot water, which is subsequently circulated to residential and commercial buildings via a network of underground pipes.



DCH systems distribute heat over considerable distances.



Backed by the local government, the Taiyuan DCH Project is made up of 38 kilometers (km) of pipework.

Communal or district heating systems have a number of advantages over individual solutions such as boilers, which produce hot water at the point of need e.g., in a consumer's home or in a public building. Producing heat centrally, at one location, for multiple users, is more energy efficient and makes it easier to control and cut carbon emissions. Mass heat generation can also help reduce fuel costs for consumers.

With DCH systems distributing heat over considerable distances, polyurethane insulation has an important role to play – ensuring that any hot water generated maintains its temperature en route to its final destination. Typically, DCH systems use steel pipes coated with either a spray foam or injectable form of insulation. Historically, this insulation was made using blowing agents, such as HCFC 141b, but with this blowing agent being phased out because of environmental concerns, water-blown systems are becoming the preferred insulation option.

Recognizing that its knowledge of water-blown insulation systems could help the DCH industry, Huntsman decided to set up a project team in China – where numerous DCH projects are in the pipeline. Formed in 2012, the team's first task was to develop a water-blown insulation system that would satisfy the needs of the DCH industry in Asia. Working tirelessly over a number of months, the team created an insulation system that would work with current spray appliance systems; conform to fire retardancy regulations; and be suitable for use alongside large scale DCH pipes – which can be up to 1.4 meters in diameter. To support its work, Huntsman created a special DCH test laboratory where its team could simulate and record spray applications; test prototype insulation systems in sub zero temperatures; and ultimately create a product to pass stringent DCH standards.

Six years on, Huntsman's water-blown DCH insulation systems are proving incredibly popular across China. In 2015, Huntsman

won the insulation tender for the Taiyuan DCH project – China’s biggest urban district heating project. Backed by the local government, the Taiyuan DCH project is made up of 38 kilometers (km) of pipework. Following the success of the Taiyuan DCH project, Huntsman has won several other major projects across China and is in a strong position to capitalize on future anticipated growth.

In 2016, China accounted for more than 10% of global share in the DCH market¹ – a figure that is set to grow. China has a long history of running DCH programs and has the largest district energy system in the world, with more than 200,000 kms of networks providing heat to close to nine billion square meters of building space². The first DCH networks were set up in China in the 1950s, when the country began providing subsidized heating to homes north of the Huai River, where temperatures are regularly sub-zero³. Today, numerous new DCH projects are planned as the Chinese government looks to deliver on its sustainability agenda and actively explores cleaner heating projects.

Beyond China, interest in DCH systems is growing with many countries recognizing the benefits of the technology. In 2014, the Danish government amended the Heating Supply Act, under a mandate to replace conventional electric heating structures with advanced district heating systems in new buildings. In France, there are more than 500 DCH programs in operation. Additionally, in the United States, the district heating market size for 2016 was valued at over \$20 billion (USD). With the United Nations predicting that 66% of the world’s population will be living in urban areas by 2050 – district heating is an important area of the insulation industry to watch and an innovative approach for governments looking to cut carbon emissions, improve air quality and reduce energy demands.⁴ |

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Footnotes:

- 1: <https://www.gminsights.com/industry-analysis/district-heating-market>
- 2: <https://www.iea.org/publications/freepublications/publication/DistrictEnergySystemsInChina.pdf> (page 4)
- 3: <https://qz.com/1093898/chinas-putting-the-brakes-on-coal-for-heating-millions-of-homes-this-winter/>
- 4: <https://www.gminsights.com/industry-analysis/district-heating-market>



Huntsman invests in polyester polyols site

Further investments are underway at Huntsman’s TEROL® polyester polyols plant in Houston, Texas. The 4.5-acre site, which is located near to the Houston Ship Channel, has been producing polyester polyols for more than 35 years.

To increase manufacturing reliability at the site and position the plant for growth, Huntsman is upgrading and expanding the facility’s DCS control system. A 10,000 square foot, three-story building is also being constructed to house the new control hardware alongside an operations control room. Targeted for completion in July 2018, this project will give Huntsman additional capacity for future expansion and automation upgrades. By constructing a new building, Huntsman is also freeing up space on site to create additional offices, meeting and conference rooms, and server storage. The new building will be insulated with spray foam from Demilec, Huntsman’s latest downstream acquisition. |

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Color options now available for smartLite® PF 1560 TPU



Huntsman’s footwear team is pleased to announce that its smartLite® PF 1560 TPU technology is now available – for special projects – in a limited range of colors. smartLite® PF 1560 TPU is an expanded, particle foam technology that can be used to create soft, durable and resilient midsoles. Previously smartLite® PF 1560 TPU was only available as white colored beads. |

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Novel MDI prepolymers developed for footwear applications

Huntsman has created two new prepolymers for the footwear industry that can overcome the storage stability issues associated with some next generation physical blowing agents. SUPRASEC® 2501 and SUPRASEC® 2515 prepolymers can incorporate physical blowing agents, such as HCFO-1233zd (E), with no adverse impact on shelf life stability for at least three months.

HCFO-1233zd (E) is one of a number of relatively new blowing agents with low global warming potential. Developed in response to concerns about the environmental impact of traditional physical blowing agents, HCFO-1233zd (E) has gained widespread acceptance in the polyurethane industry, but has one downside: the systems it is used in can need significant reformulation work to address shelf life issues on the polyol side.

In a bid to solve this problem, Huntsman decided to explore what would happen if you added HCFO-1233zd (E) to the isocyanate side of a system. The results were striking as the photographs opposite show.



Comparing its new prepolymers with control materials, including water-blown systems and systems with and without blowing agents in the polyol side, the team discovered that SUPRASEC® 2501 and SUPRASEC® 2515 prepolymers can enable the creation of elastomeric footwear materials with the following benefits.

Better blend stability

Systems based on the new prepolymers – and incorporating HCFO-1233zd (E) on the isocyanate side – can maintain their reactivity and blowing characteristics after three months. This is a significant improvement on blends with the blowing agent in the polyol, which typically show signs of degradation after only three days of storage.

Better surface quality

In tests that compared soles made using SUPRASEC® 2515 prepolymer with a standard commercial product, the new prepolymer showed very good mold texture definition and the absence of any major defects.

Better mechanical properties

In tests on different density midsole systems, Huntsman proved that there is no negative impact on physical properties when the physical blowing agent is introduced to its new prepolymers. In fact, in some instances, properties such as hardness and resilience showed consistent improvements.

Equivalent blowing behavior

Adding the physical blowing agent to the prepolymer, it is possible to adjust the ratio of physical blowing agent to chemical blowing agent, without affecting the free rise density of the system. Four compositions of the same base system were prepared with varying amounts of HCFO-1233zd (E) in the prepolymer and the corresponding water adjustment in the polyol blend and no differences in blowing characteristics were observed. The prepolymers developed contained an optimal amount of blowing agent to balance different performance characteristics of the system.

Better flexural properties

The use of a physical blowing agent can greatly improve the flexural resistance of an outsole – helping to maintain integrity and prevent the development of micro cracks, which can eventually cause soles to break. Using the Bata Belt test, Huntsman tested two soles with a molded density of 600 kg/m³: one with a standard system and one with the new MDI prepolymer, SUPRASEC® 2501. The latter sample completed the test (50,000 cycles) with no cracks; while the control system developed cracks after about 40,000 cycles.

Better dimensional stability

Using water-blown systems to create high performance footwear systems with a complicated flow pattern – for example work boots – may require extra demold time to maintain dimensional stability. This in turn increases production cycles. Water levels and density can contribute to a longer demold time being required. The higher the water level, the more extra demold time is required. To test dimensional stability, Huntsman prepared two different soling systems. Results showed that the system containing SUPRASEC® 2501 prepolymer – and a next generation physical blowing agent – delivered a 12% reduction in sole volume immediately after demold. This information can be used to implement a cycle time reduction program or to obtain finished soles with less deformation through a similar cycle time.

Following extensive testing, Huntsman is now eagerly promoting these two new prepolymers for the footwear industry. |

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Huntsman PU used to make custom safety shoes for Steitz Secura

German safety shoe company, Steitz Secura, is using a polyurethane technology from Huntsman to pilot a range of specialist safety shoes that can be custom-made to fit an individual's feet, using FitStation powered by HP.



The customized shoes are made using a combination of FitStation's 3D foot scanning, with RSscan pressure plate technology; a DESMA MSI molding machine; and Huntsman's certified PU midsole technology for multi-section injection (MSI), which offers state-of-the-art properties in terms of comfort and durability.

Working together, Huntsman, Steitz Secura, Desma, FitStation and other companies have created a complete solution for the automated manufacture of tailor-made, differentiated safety shoes. The material and machinery package that the companies have assembled reflects several key trends in the footwear industry. It fits with the continued push for automation and digital manufacturing. It also echoes increased demand for customized products – made-to-measure for individualized fit and function.

Hugo Verbeke, Platform Manager Elastomers at Huntsman Polyurethanes, said: "We are delighted to be involved in this exciting project and to work alongside such a prestigious group of companies. Steitz Secura has a reputation for making safety shoes that are hardwearing, protective and comfortable – in equal measure. This project takes that work to the next level – enabling the creation of tailor-made safety shoes that can deliver a new level of personalized comfort and protection."

Huntsman is a long-term supplier to Steitz Secura and has worked with the business for more than 40 years – providing a range of specialist PU-based footwear materials. Huntsman enjoys a similarly lengthy relationship with DESMA; the two companies began working together in the 1970s. |

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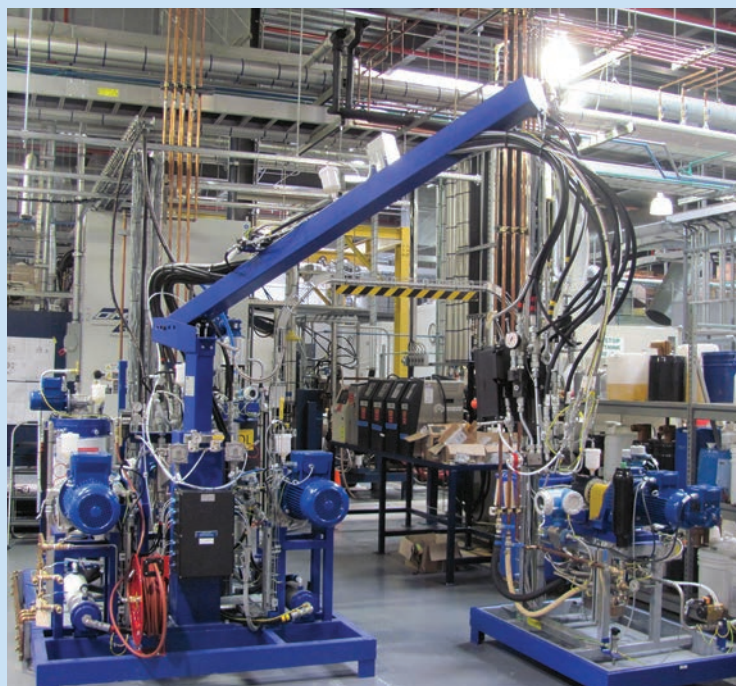
New high-pressure, insulation machine installed at The Woodlands

A state-of-the-art, high-pressure, insulation machine – manufactured by Italian company, OMS Group – was recently installed at the Huntsman Advanced Technology Center in The Woodlands, Texas. The new machine will be used to speed up the product development cycle of insulation formulations within the company's insulated metal panel (IMP) business. It will also help reduce product waste.

Featuring a three-stream mix head, which adds blowing agents to the polyurethane formulation, directly at the mix head, the new machine will give the Huntsman team greater manufacturing flexibility.

Normally, with a two-stream mix head (one for MDI and one for polyol), blowing agents are 'pre-blended' in the polyol. This process takes time and makes it more difficult to adjust formulations. Now, with its new machine, the team will be able to test formulations in one easy step. Huntsman's latest equipment investment is also pentane capable and has the required safety features to use hydrofluorocarbon- (HFC-) free blowing agents. |

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Our downstream innovation network

Going further for polyurethane customers worldwide

With the recent acquisition of Demilec (see page 2), Huntsman now has a global network of 30 systems houses and downstream businesses, producing products for a wide range of industries. At this year's UTECH Europe, seven of our European-based systems houses will be exhibiting together for the first time – showcasing the rich mix of products available in Huntsman Polyurethane's total innovation network. *PU Review* found out more about each of these innovative, entrepreneurial subsidiaries and how they are going further for polyurethane customers worldwide.



HUNTSMAN IFS – ONE OF THE UK'S LEADING FORMULATORS OF MDI-BASED SYSTEMS

Based in Norfolk, England, and primarily working with companies in the UK and Ireland, Huntsman IFS offers a complete in-house polyurethane development service and makes bespoke polyurethane foam and elastomer systems for customers across a variety of sectors.

For the insulation industry, Huntsman IFS produces foam-based products for refrigeration and construction applications and for electric water heaters and shower trays. The business is a key supplier to the automotive industry, developing rigid and flexible foam products for use in car arm rests, sun visors, interior trim components and bumpers. Huntsman IFS also produces products for the marine sector. In this market, typical applications include pipeline protection and insulation systems for subsea industries; buoyancy products for mid-water applications; negative buoyancy systems for concrete coated gas supply lines; plus, closed-cell polyurethane foam systems for the manufacture of small boats and leisure equipment, such as surf and windsurf boards. The business also makes rigid foams for general molding applications, for example, for the production of mirrors and picture frames.



TECNOELASTOMERI

Engineering Urethane Elastomers

Famed for its wide range of high-tech, hot-cast elastomers, Huntsman Tecnoelastomeri sets itself apart from other elastomer producers by also making its own range of elastomer processing machines.



HUNTSMAN TECNOELASTOMERI – A COMPLETE END-TO-END ELASTOMERS SERVICE, COVERING EVERY ASPECT OF ELASTOMER DEVELOPMENT, FROM FIRST IDEA TO FINAL PRODUCT

CASTECH™ machines are a flexible, low maintenance equipment solution for efficiently casting compact polyurethane elastomers and microcellular elastomer foams. Offering the highest levels of accuracy and flexibility, CASTECH™ machines feature a range of interchangeable parts and can be tailor-made to suit customer requirements. As standard, they provide precision dosing with good mix homogeneity, a high output and precise shot casting capabilities. Each machine also comes with its own software package for monitoring performance variables and making adjustments during the manufacturing process.

CASTECH™ machines can be used to process elastomers based on all kinds of isocyanate and chain extender combinations, including Huntsman Tecnoelastomeri's TECNOTHANE™ / DALTOCAST™ range. This advanced portfolio of polyurethane-based, hot-cast, engineering elastomers includes a full range of polyols and chain extenders, that have been blended together in different combinations to create a suite of tried and tested elastomer formulations. These materials are proven to perform, easy to process and provide good chemical resistance and excellent mechanical characteristics. Huntsman

Tecnoelastomeri also has a global Research & Innovation Department. Dedicated to advancing the development and application of polyurethane-based engineering elastomers, associates working in this specialist team study the science behind customer concepts – helping to pinpoint the perfect product. Huntsman Tecnoelastomeri is located between Modena and Bologna in northern Italy.



HUNTSMAN GOMET – SATISFYING THE REQUIREMENTS OF MANY EUROPEAN AND ASIAN AUTOMOTIVE MANUFACTURERS

Located in Azeglio, Italy, Huntsman Gomet manufactures a variety of rubber and thermoplastic spare parts for the automotive aftercare market. Products include protective boots for constant velocity joints; steering gaiters; dust covers; bounce bumpers; and shock absorber service kits (SASKs).



Huntsman Gomet sits alongside Huntsman Polyurethanes' existing automotive business, which makes MDI-based technologies for many of the world's leading automotive original equipment manufacturers. Around 80 people make up the Huntsman Gomet team. Together they manufacture, assemble and distribute around 12 million spare parts per year, from more than 2500 different molds.

Complementing its work in the automotive sector, the team at Huntsman Gomet has also

invented Genibus – a comfortable, ergonomic kneeling mat made out of polyurethane. Designed for use by anyone that has to kneel down for long periods of time, the mat is the ideal accessory for mechanics and automotive engineers who have to complete low-down or ground level tasks. Genibus is also proving popular with plumbers, painters, decorators and tillers; plus gardeners and sports enthusiasts – in particular people taking part in floor-based exercise classes such as yoga.





HUNTSMAN APC (HAPC) – A JOINT VENTURE BETWEEN THE BCI GROUP OF COMPANIES AND HUNTSMAN CORPORATION



HAPC was the first producer of rigid polyurethane systems in the Gulf region. Today, HAPC offers a variety of soft, rigid, and semi-rigid polyurethane systems for the manufacture of different density foams.

In insulation, applications include panel injection, spray foam building insulation and injectable insulation for refrigeration appliances, display units and cool boxes. HAPC also makes structural foam for furniture production.

The success of HAPC is closely linked to the company's marketing strategies and the ability of its 25-strong team to blend together chemicals and create systems that match the changing needs of its customers. Just like other systems houses in Huntsman's total innovation network, HAPC prides itself on using novel blowing agents, which provide an alternative to substances currently being phased out, including HCFC 141b. HAPC is located in Dammam, Saudi Arabia.

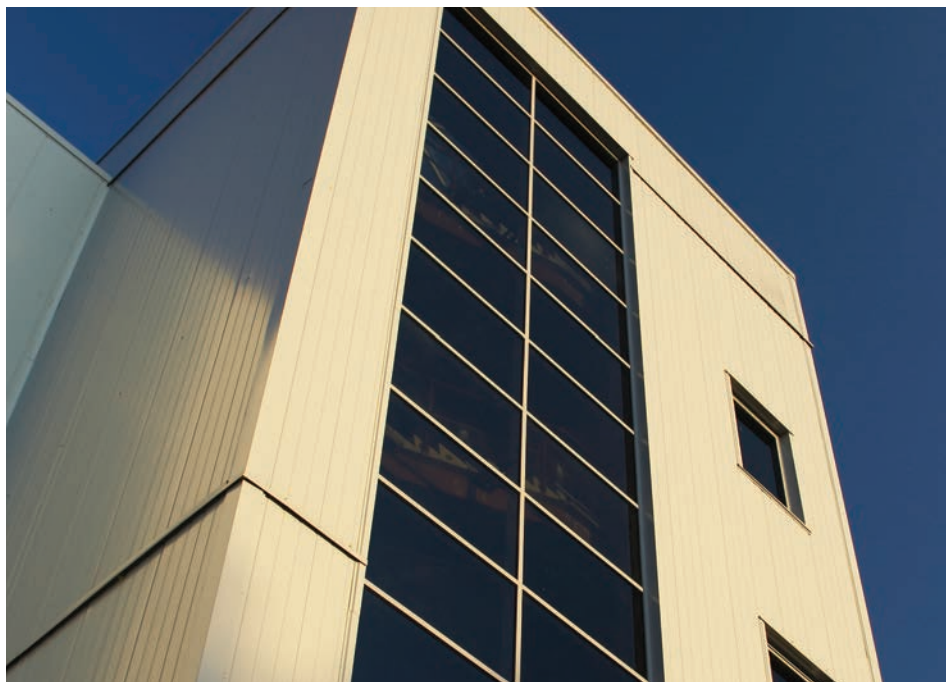


HUNTSMAN-NMG – A LEADING SUPPLIER OF POLYURETHANE SYSTEMS TO MARKETS IN RUSSIA, UKRAINE AND BELARUS

Based in the Kaluga area of Russia, Huntsman-NMG specializes in the development of polyurethane systems for construction coatings, sport surface and playground coatings; footwear; and automotive parts – specifically components, acoustic systems and seating applications.

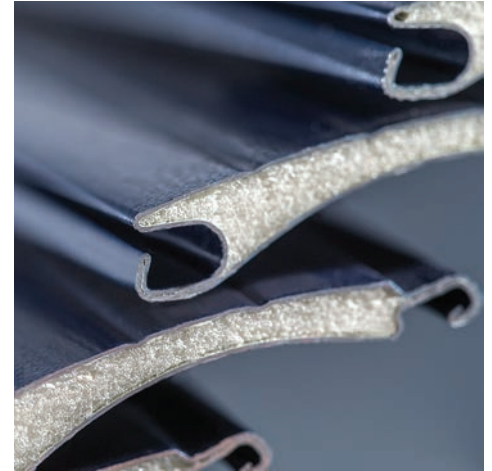
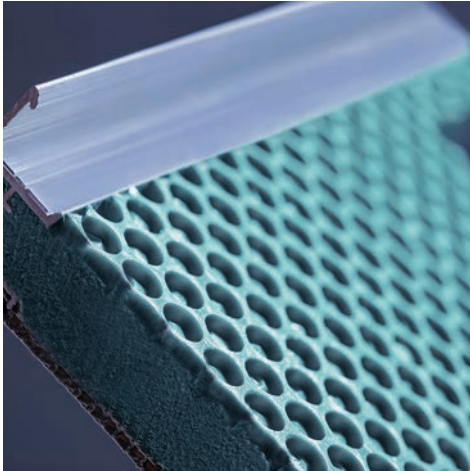
Insulation is also a major market sector for Huntsman-NMG. The business develops polyurethane-based insulation systems for composite panels, spray foam, and technical insulation solutions including pipe-in-pipe and discontinuous panels.

A wholly owned subsidiary of Huntsman Corporation, Huntsman-NMG has a modern production and logistics complex located in Obninsk, near Moscow. Huntsman-NMG also has a network of regional offices in Moscow, Togliatti, Rostov-on-Don, Novosibirsk and Chelyabinsk. In Belarus, LLC Nantico Bel represents the interests of Huntsman-NMG.





HUNTSMAN PUR-SYSTEMS – TAILOR-MADE FLEXIBLE AND RIGID POLYURETHANE SYSTEMS OF THE HIGHEST QUALITY



Located in Georgsmarienhütte, Germany, near to Osnabrück, Huntsman PUR-Systems has broad experience of working with next generation blowing agents. Key areas of expertise include rigid foam insulation systems for shutters, wall and roof panels; refrigeration and container applications; sectional doors; and hot water tanks.

Huntsman PUR-Systems produces CE labeled open and closed-cell spray foam for the insulation of walls and roofs. The business also produces flexible foam products for upholstered parts for furniture, automotive, aviation and railroad applications.

In addition, Huntsman PUR-Systems is a market leader in the manufacture of insulation for window shutters, and has recently branched out into the production of two-component polyurethane-based adhesives for the transportation sector. In 2018, Huntsman PUR-Systems celebrates ten years under the ownership of Huntsman.



HUNTSMAN EMA – PRODUCING POLYURETHANE BLENDS FOR THE TURKISH MARKET AND NEIGHBORING COUNTRIES



At its Istanbul production plant, Huntsman EMA creates innovative polyurethane solutions for applications across insulation, footwear, automotive, furniture, bedding, adhesive, coating and elastomer industries.



Providing Huntsman with its first dedicated polyurethanes manufacturing site in Turkey, Huntsman EMA has 75 ktes of capacity for system blending and 15 ktes of polyester polyols manufacturing; plus space for bulk MDI and base polyols storage.

Insulation for the construction sector is a major revenue stream for Huntsman EMA with the business producing PUR and PIR systems for metal panels used in industrial buildings and cold storage centers; plus spray and rigid foam insulating systems for applications including window shutters, solar systems, imitation wood and pipe insulation.

For the footwear sector, Huntsman EMA provides full systems for work-safety shoes, wellington boots and army boots as well as casual and sports shoes. Another growing business stream at Huntsman EMA is the production of visco elastic, molded and batch block foams for the seating and bedding sector.



Footwear team steps up innovation with new AVALON® products



Huntsman has increased the scope and scale of its AVALON® portfolio of footwear materials with two new developments: AVALON® 55 AHG TPU and AVALON® AB DI TPU.

AVALON® AB DI TPU is a brand new material family with a fast cycle time, which is easy to demold and can help footwear manufacturers improve productivity, when creating injection-molded parts. Designed to improve the cycle time and simplify the production of thick walled parts, AVALON® AB DI TPU offers significant demold improvements, when compared to standard injection molding materials.

Test results show that cooling time is significantly reduced with AVALON® AB DI materials reaching demold hardness in half the time or better, compared to a conventional TPU. AVALON® AB DI TPU was developed following discussions between Huntsman and a major footwear component supplier. The customer wanted to increase productivity when molding footwear soles, such as soccer plates. Use of AVALON® AB DI TPU enabled the customer to increase the production capacity of its injection molding machines, while maintaining the properties of the TPU.

AVALON® 55 AHG TPU is a brand new, soft soling material that offers improved slip-resistance on both wet and dry surfaces. With a nominal Shore hardness of 55A, AVALON® 55 AHG TPU can be used to make soft, thin, high definition, high grip parts, in a variety of colors. With slip resistance properties that surpass vulcanized rubber and other TPU materials with a comparable Shore hardness – depending on sole design – AVALON® 55 AHG TPU is well suited to the production of outsoles for a variety of footwear applications.

The material is a particularly attractive proposition for the manufacture of safety shoes and boots thanks to its oil and petrol resistance, and its adherence to electro-static requirements. Importantly, it also passes ISO 13287 – the international benchmark for testing slip resistance in protective and personal equipment. AVALON® 55 AHG TPU displays excellent processing on both injection and carousel casting machines and is suitable for the production of dual density footwear due to its compatibility with DALTOPED® polyurethane midsole systems. With improved abrasion and hydrolysis resistance, combined with excellent slip performance, AVALON® 55 AHG TPU is also suitable for the production of sports and casual shoes.

Craig Roberts, Global Footwear Marketing Manager at Huntsman, said: “Where injection molding companies are looking to increase capacity and productivity, our range of AVALON® AB DI TPUs offers an attractive alternative to our existing range of AVALON® footwear TPUs. The range is also aligned with the current trends for simplification and automation in the footwear industry. We're also pleased to announce the development of AVALON® 55 AHG TPU, which represents a big step forward in the performance of our high-grip TPU materials. When it comes to dry and wet slip resistance, this product is strides ahead of anything we've developed before. In independent tests, the material exceeds slip requirements on various substrates including the challenging combination of steel with glycerine.” |

When it comes to dry and wet slip resistance, this product is strides ahead of anything we've developed before.

Craig Roberts, Global Footwear Marketing Manager at Huntsman

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Huntsman Tecnoelastomeri launches new CASTECH™ machine

Huntsman Tecnoelastomeri has launched the CASTECH™ HP3000 polyurethane machine – the latest model in its established range of CASTECH™ machines. A flexible, low maintenance, equipment solution, CASTECH™ machines enable the precision metering and mixing of hot-cast elastomers and microcellular elastomer foams from all kinds of isocyanate and chain extender combinations.

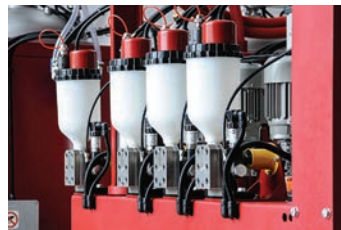
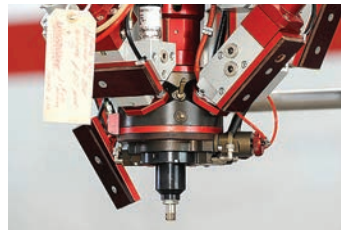
Featuring a range of interchangeable parts, CASTECH™ machines can be tailor-made to suit individual customer's manufacturing requirements. As standard, each CASTECH™ machine provides:

- Precision dosing with good mix homogeneity
- A high output and precise shot casting capabilities
- A long size, flexible arm, which makes it easy to cast parts of different shapes and sizes.

Each machine also comes with its own software package for monitoring performance variables and making adjustments during the manufacturing process.

The CASTECH™ HP3000 polyurethane machine takes this functionality one step further offering:

- A high-speed motor capable of speeds of up to 10,000 rpm
- An output range of 150 to 60,000 grams per minute, depending on circuit / pump size
- New injectors designed with higher output in mind, but also capable of handling lower outputs
- A dynamic mixer, which can be standard or large in size, for perfect mixing quality
- A mixing head compatible with the latest high performance polyurethane systems
- A 19-inch touch screen to display machine status
- An in-built software system for monitoring temperature, pressure levels and mixer speeds
- A cleaning system that manages solvent, pressurized air, mixer RPM and cleaning cycles, and has a programmable pre-wash to help reduce solvent consumption.



Johan Van Tongelen, Global Business Director, Huntsman Tecnoelastomeri, said: "Designed to ease equipment integration and deliver the highest levels of dosing and mixing precision, our CASTECH™ machines are among the most advanced equipment options available for the efficient manufacture of elastomers. With additional features available – including the option to add up to six additional injectors to the mixing chamber – the CASTECH™ HP3000 polyurethane machine takes our offer to the next level, giving us extra flexibility when it comes to creating elastomer processing machines that exactly match our customers requirements."

Huntsman Tecnoelastomeri is one of the world's leading manufacturers of high-tech elastomers and elastomer casting equipment. The business offers a bespoke, end-to-end elastomers service that offers everything you'll ever need when it comes to selecting and processing hot-cast engineering elastomers. Alongside its CASTECH™ machines, Huntsman Tecnoelastomeri provides a wide range of off-the-shelf and custom made hot-cast engineering elastomers – available under the TECNOTHANE™ / DALTOCAST™ brand names. These innovative materials are used to create durable wheels, seals, rollers, pads and other technical parts for industrial, manufacturing and transportation applications. The business also provides a 360° scientific support service for customers that need help evaluating or working with elastomers. |

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Odor Analysis Facility opens at APAC Analytical and Testing Center

Huntsman has recently commissioned a new Odor Analysis Center (IRB approved) in Shanghai, China, as part of its ongoing work on the development of ultra-low odor / emission polyurethane solutions for automotive applications.

The new building is Huntsman's first odor analysis facility, and is part of the company's APAC Analytical and Testing Center (ATC), which is helping to drive the company's innovation efforts across Asia-Pacific.

Since it was built in 2010, the Huntsman APAC ATC has grown into a world-class analytical center with industry-leading testing capabilities in many areas, including VOC, emissions and aldehyde testing. The best facility of its kind for emission and aldehyde analysis in the industry in Asia, the center has many unique capabilities, which cannot be found at other Huntsman sites or any other laboratory in the world.

Among major rivals in Asia, the center has the only 1000-liter chamber for aldehyde / VOC

analysis; and it uses the Tedlar Bag Method, only available at the Shanghai ATC and within Huntsman. The center has also developed the world's first analytical method for determining various aldehydes present in ISO / variants.

Using the equipment and expertise available at its APAC ATC, Huntsman is helping the automotive industry improve in-car air quality by reducing the level of critical acetaldehyde emissions in variants from four parts per million (ppm) to just 0.6 ppm. The Huntsman team has also helped reduce emission levels from polyols from between seven and nine ppm, down to less than one ppm. Identifying which key odorants contribute to the distinctive smell of polyurethane foam is a global challenge. With extensive skills and expertise in odor analysis, the team at

Huntsman's ATC is committed to pinpointing the top three key odorants in polyurethane foam within six months, using a team of panelists that have been screened and trained for this critical work.

As well as delivering major breakthroughs to benefit the global automotive industry, Huntsman's APAC ATC has also gained recognition from the academic community for its competence in challenging unknown analysis. The center has published 15 external peer-reviewed scientific journal articles, making it an undisputed leader in this field in the Asia-Pacific region. |

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Toyota Boshoku award recognizes Huntsman's help in reducing total manufacturing costs

Huntsman Polyurethanes' automotive team has received a Bronze Supplier Award from Toyota Boshoku Europe. The Cost category award was handed to Huntsman at a Supplier Awards Event, in Brussels.

Huntsman's award recognizes the company's efforts to reduce the total cost of manufacturing in automotive seating applications and increase industry competitiveness for its customers.

Working in close partnership, Toyota Boshoku and Huntsman Polyurethanes' global automotive team have enabled a significant reduction in manufacturing repair / rejection rates and an increase in line efficiency at Toyota Boshoku's European manufacturing sites. Huntsman Polyurethanes' automotive team also worked hand in hand with Toyota Boshoku to develop a training program for the component manufacturer's European production team. This exercise was designed to optimize quality and reduce failure rates, and ultimately deliver differentiated value and a significant total cost reduction for Toyota Boshoku.

Niki Revesz, European Sales Director at Huntsman Polyurethanes, said: "This award is another success story for our global automotive team and reinforces our position as a benchmark supplier to the automotive seating industry."

Toyota Boshoku is a leading Japanese automotive component manufacturer, and member of the Toyota Group of companies. |

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Mr. Hirokazu Kamen, President Toyota Boshoku Europe, and Mr. Harvey Haworth, European Sales Manager Automotive at Huntsman Polyurethanes.

Setting a new standard in flame retardant cable protection

Delivering a major breakthrough in the physical and mechanical performance of flame retardant (FR) cabling materials, Huntsman has developed IROGRAN® FR TPU – a unique family of halogen-free, flame retardant (HFFR) cable jacketing materials that can outperform benchmark products, when it comes to strength, durability and environmental performance.



Providing substantially improved reaction to fire properties alongside unprecedented strength and fatigue resistance in both flexion and torsion, Huntsman's IROGRAN® FR TPU grades set a new standard for flame retardant cable protection. Launched at Wire 2018 in Dusseldorf, Germany, in mid-April, Huntsman's IROGRAN® FR TPU range initially includes three new products:

IROGRAN® A 90 P 5014 FR TPU

A baseline material for the most common FR applications

IROGRAN® A 91 P 5015 FR TPU

Suitable for more demanding FR applications

IROGRAN® A 92 P 5016 FR TPU

A flagship grade for the most demanding FR applications.



Made using novel formulation and production processes, Huntsman's IROGRAN® FR TPU products have passed rigorous industry and in-house tests and have been trialed by leading wire and cable producers. Test results showed that:

IROGRAN® A 90 P 5014 FR TPU performs better over time than benchmark products, when it comes to heat resistance. After seven days of heat exposure, this novel HFFR material will typically retain 80% of its original tensile strength. That's up to 14% better than competitive materials tested under identical conditions.

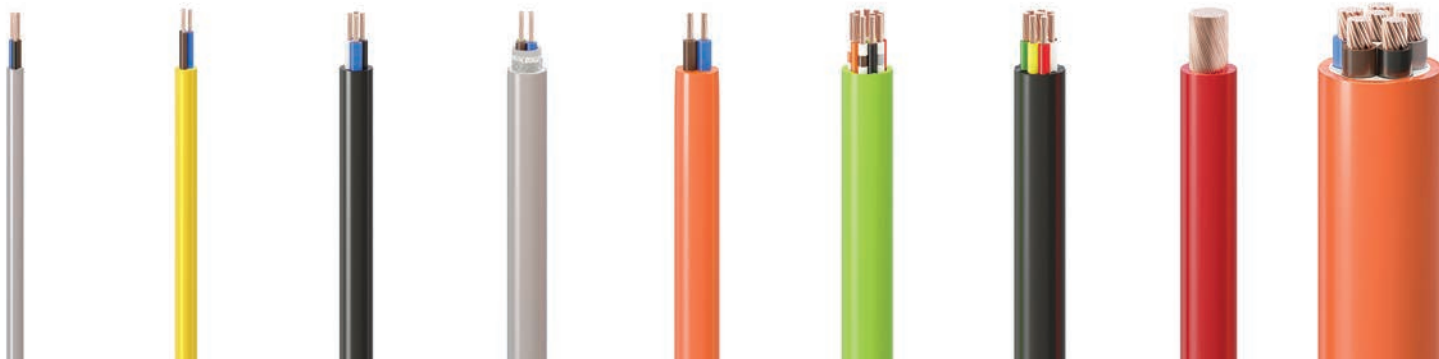
The initial tensile strength of IROGRAN® A 92 P 5016 FR TPU is significantly greater than benchmark cable jacketing materials with the material performing better over time, when it comes to oil resistance. When exposed to oil at 100°C over 42 days, IROGRAN® A 92 P 5016 FR TPU samples were up to 45% stronger than comparable products put through the same process.

Huntsman's IROGRAN® FR TPU products are designed for use in automation, transportation, energy and consumer electronics applications, where flame retardancy is essential, and the physical failure of wire and cable jacketing systems is not an option. Non-halogenated, plasticizer-free and fully recyclable, the new materials also offer:

- **Advanced abrasion, fatigue and stain resistance**
- **Excellent environmental resilience to chemicals, water, oil and solvents**
- **A wide processing window**
- **Consistent dimensional stability**
- **Pleasant haptics with a matt finish for easy uncoiling.**

Franz Michel, Sales Development Manager TPU EAIME at Huntsman, said: "Adding flame-retardants to wire and cable materials will typically influence elongation at break and strength, as well as abrasion and fatigue resistance. Our IROGRAN® FR TPU products are different. With a state-of-the-art reaction to fire, they offer significantly improved oil and heat resistance compared to competitive materials. These are incredibly valuable properties in an increasingly automated world, which demands more from wire and cable products." |

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New partnership with T. Michel Formenbau

The thermoplastic polyurethanes (TPU) team at Huntsman has formed a special partnership with T. Michel Formenbau GmbH & Co. KG – a leading producer of molds and tools for the plastics processing industry based in Germany.

The alliance is designed to benefit plastic product manufacturers wanting to explore the use of expanded TPU (eTPU). Together, Huntsman and T. Michel Formenbau will offer a complete end-to-end material selection and steam-mold service – providing advice on the best materials to use for specific applications, plus mold design, production and testing. The two companies will also work together on research projects, exploring eTPU and steam-molding improvements that could help plastic processors wanting to use this lightweight technology in different application areas.

Under the terms of the agreement, Huntsman will also use T. Michel Formenbau's technical center in Lautert, Germany, to test and demonstrate the processing performance of its own eTPU products. On site, Huntsman will assess new products to ensure their compatibility with the very latest steam-molding techniques. It will also conduct steam-molding trials and demonstrations for customers wanting to evaluate existing materials, such as smartLite® PF 1560 TPU. This lightweight, particle foam technology is widely used in sports shoes, but has broader potential across a variety of industrial markets.

Huntsman chose to work with T. Michel Formenbau because of the extensive range of molding equipment available at its technical center. T. Michel Formenbau specializes in the development of EPS (expanded



polystyrene) / EPP (expanded polypropylene) foam molding tools; PUR foam molding tools; injection molding tools; deep drawing tools; and injectors for particle foams.

The business has also invested in the latest laser equipment, enabling it to create molds that deliver special surface textures. Olaf Michel, Global Technology Manager at Huntsman Polyurethanes, said: "As a global company, we have extensive testing equipment available in-house – but we also know it's important to collaborate with external companies. In the case of T. Michel Formenbau, it's invaluable to tap into their knowledge, use their equipment, and get feedback on our materials. We first made contact with the business in 2015, and quickly realized the potential for a longer-term relationship. Initially, our work together focused on testing our eTPU materials for the footwear sector. Moving forward, we'll continue that work, but we'll also be actively exploring how eTPU can be used across a broader range of applications."

T. Michel Formenbau GmbH & Co. KG was founded in 2000 and employs around 50 people. The business creates bespoke molds for plastic processors – offering them an end-to-end tooling service that covers product development, process development, mold manufacturing, laser texture, filling injectors, measuring probes and sampling. The company's work spans all types of precision mold making – from the smallest, intricate tooling designs to large-scale molds for major engineering projects. With the help of two new laser-texturing machines, T. Michel Formenbau can also give its customers a wide range of options when it comes to surface design. |

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Forthcoming events and technical presentations

UTECH Europe, Maastricht, The Netherlands (29-31 May)

UTECH Asia / PU China 2018, Shanghai, China (1-3 August)

North West Materials Show, Portland, Oregon (15-16 August)

SPE Automotive Composites Conference & Exhibition (ACCE), Novi, Michigan (5-7 September)

China (Shanghai) International Furniture Machinery & Woodworking Machinery Fair, Shanghai, China (10-13 September)

DESMA House Fair, Achim, Germany (19-20 September)

Wire China, Shanghai, China (26-29 September)

CPI 2018 Polyurethanes Technical Conference, Atlanta, Georgia (1-3 October)

IWCS, Providence, Rhode Island (14-17 October)

Foam Expo Europe, Hannover, Germany (16-18 October)

Feiplar Composites & Feipur 2018, São Paulo, Brazil (6-8 November)

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Designed and produced by: Chris Pearson creative communications.