

THE CAVUS
TECHNOLOGY



PROJECT

R.A.C.E.

REACTION
APPLICATION FOR
COMPOSITE
EVOLUTION



THE PROJECT R.A.C.E. FACTBOOK

- _ THE PROJECT
- _ THE SHOW
- _ THE FACTS
- _ THE FUTURE
- _ THE PARTNERS

THE PROJECT

8
PARTNERS

ONE
VISION

28
WEEKS

THE
CAVUS
TECHNOLOGY

POWER:
· 127 KW / 173 HP

DISPLACEMENT:
· 1300 CCM

THE KTM 1290 SUPER DUKE R IS A HIGH-PERFORMANCE
MOTORCYCLE AND THEREFORE THE IDEAL APPLICATION
FOR ULTRA-LIGHTWEIGHT
HIGH-PERFORMANCE
COMPONENTS

CARBON COMPONENTS ARE ALREADY
WIDELY USED IN MOTORSPORT. THE R.A.C.E.
PROJECT NOW MADE AN IMPORTANT DEVELOPMENT
STEP IN THE INDUSTRIALIZATION OF THE CAVUS
TECHNOLOGY FROM KTM TECHNOLOGIES, WHICH WILL ALLOW
EVEN COMPLEX FIBRE COMPOSITE HOLLOW PARTS TO BE
PRODUCED WITH THE AUTOMATED HIGH-PRESSURE RTM PROCESS. SUCH
A STRUCTURAL COMPONENT IS THE SUPER DUKE R'S LICENSE PLATE HOLDER.

ENGINE:
· 2 CYLINDER,
4 STROKE

TRANSMISSION:
· 6-SPEED

CONCEPT OF PROJECT R.A.C.E.

PHOTO BY R. SCHEDL

SERIAL PRODUCTION
MOTORCYCLE

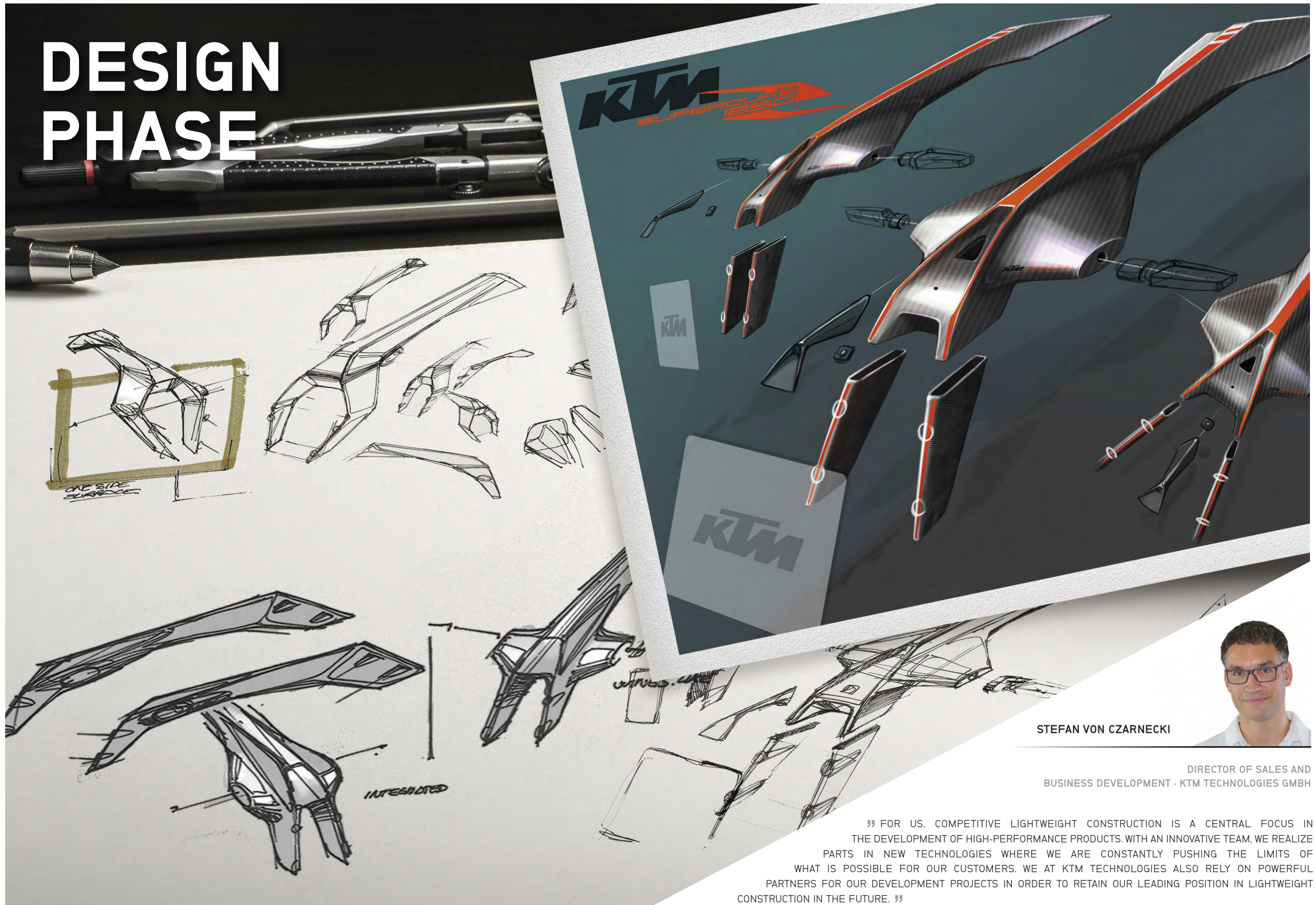


INNOVATIVE PRODUCTION PROCESS:
THE CAVUS TECHNOLOGY



STRUCTURAL
HOLLOW
LIGHTWEIGHT
COMPONENT:
· LICENSE PLATE
HOLDER

DESIGN PHASE



STEFAN VON CZARNECKI



DIRECTOR OF SALES AND
BUSINESS DEVELOPMENT · KTM TECHNOLOGIES GMBH

” FOR US, COMPETITIVE LIGHTWEIGHT CONSTRUCTION IS A CENTRAL FOCUS IN THE DEVELOPMENT OF HIGH-PERFORMANCE PRODUCTS. WITH AN INNOVATIVE TEAM, WE REALIZE PARTS IN NEW TECHNOLOGIES WHERE WE ARE CONSTANTLY PUSHING THE LIMITS OF WHAT IS POSSIBLE FOR OUR CUSTOMERS. WE AT KTM TECHNOLOGIES ALSO RELY ON POWERFUL PARTNERS FOR OUR DEVELOPMENT PROJECTS IN ORDER TO RETAIN OUR LEADING POSITION IN LIGHTWEIGHT CONSTRUCTION IN THE FUTURE. ”

CONSTRUCTION AND ANALYSIS

INSIDE-OUT
DESIGN

INTENSE
COLLABORATION
OF DESIGN &
CONSTRUCTION
FROM THE
BEGINNING

STRONG COOPERATION
OF CONSTRUCTION &
ANALYSIS FOR THE BEST
PERFORMANCE

USING VARIOUS ANALYSIS TOOLS:

- FILLING SIMULATION
- STRUCTURAL SIMULATION
- BRAIDING SIMULATION

SAND CORE

MANUFACTURING METHODS:

- RAPID PROTOTYPING
- CORE SHOOTING

- WATER SOLUBLE
- NON-TOXIC
- REUSABLE FILLER MATERIAL

TEMPERATURE RESISTANCE:
· UP TO 330 °C

PRESSURE RESISTANCE:
· UP TO 500 BAR

IVO HERZOG



MANAGING DIRECTOR · H2K MINERALS GMBH

” H2K MINERALS IS ABLE TO PRODUCE PRESSURE-RESISTANT COMPLEX GEOMETRIES USING SAND. THE SAND CORES WILL WITHSTAND AN ENORMOUS INJECTION PRESSURE OF UP TO 500 BAR. THE BINDER USED IS WATER-SOLUBLE. AT THE END OF THE PROCESS, IT CAN BE FLUSHED OUT EASILY IN AN ECO-FRIENDLY MANNER WITH REGULAR WATER AND WITHOUT ANY USE OF SOLVENTS. ”

BRAIDING

FULLY AUTOMATED
PRODUCTION
PROCESS

- LOAD OPTIMIZED
FIBRE ORIENTATION
- HIGH MATERIAL
PERFORMANCE

AUTOMATIC ROBOT
PATH GENERATION
BASED ON BRAIDING
SIMULATION

DR. STEFAN CAROSELLA

HEAD OF COMPOSITE MATERIAL · INSTITUTE OF AIRCRAFT DESIGN (IFB)

” THE CARBON FIBRES ARE WOVEN AROUND THE SAND CORE IN A BRAIDING PROCESS. THE POSITION, ANGLE AND ORIENTATION OF EACH INDIVIDUAL FIBRE IS EXTREMELY IMPORTANT IN ORDER TO PROPERLY ABSORB FORCES THAT ARE ACTING ON THE PART. ”

IFB
flugzeugbau
Design

RESIN

POLYURETHANE
BASED SYSTEMS

HIGH MECHANICAL
PERFORMANCE,
TOUGHNESS &
DUCTILITY

STANDARD & HIGH GLASS
TRANSITION TEMPERATURE
GRADES

HUBERT REITBERGER

AUTOMOTIVE PRODUCT MANAGER -
ADVANCED COMPOSITE RESINS · HUNTSMAN (GERMANY) GMBH

” THE R.A.C.E. PROJECT IS AN EXCELLENT PLATFORM WHERE HIGH-SPEED PU-MATRIX MATERIALS SUCH AS VITROX® CAN DEMONSTRATE THEIR FULL PERFORMANCE. SELF-RELEASING SYSTEMS WITH OUTSTANDING MECHANICAL PROPERTIES COMBINED WITH OPTIMIZED CURING TIMES ARE THE KEY TO MASS PRODUCTION WITH A SHORT CYCLE TIME. ”

TOOL



HP-RTM TOOL WITH HIGH QUALITY CLASS A SURFACES

INTEGRATED PRESSURE & TEMPERATURE SENSORS

INTEGRATED ELECTRICAL HEATING SYSTEM



GAETANO DONIZETTI

SALES MANAGER · PERSICO SPA

” TO WITHSTAND THE CARBON FIBRES, THE AIM IS TO REALIZE A ROBUST AND HIGHLY POLISHED SURFACE. THIS ENABLES THE PRODUCTION OF HIGH-QUALITY COMPONENTS AND SURFACES. FOR THIS, THE ABILITY TO DEMOLD AND THE INJECTION POINTS HAVE TO BE CHOSEN CORRECTLY. ”

SEAL

HIGH ELASTICITY & LIFETIME
WITHIN THE OPERATING
TEMPERATURE RANGE

EASY TO PROCESS

RESISTANT TO NEARLY ALL
ORGANIC & INORGANIC
CHEMICALS

RALF BURGHOFF



TECHNICAL ASSISTANT TO THE MANAGEMENT
MURTFELDT KUNSTSTOFFE GMBH & CO. KG

„ FOR THE FIRST TIME IN THE R.A.C.E. PROJECT, MURTFELDT PLASTICS IS PROUD TO PRESENT A SEALING MATERIAL THAT CAN WITHSTAND INTERNAL MOULD PRESSURES OF UP TO 200 BAR FOR LONG PERIODS AND IS STILL RESISTANT TO DAMAGE FROM RESIDUE MATERIALS OR EVEN CARBON FIBRES. ”

PRESS & AUTOMATION

ERGONOMICALLY OPTIMIZED
WORKING HEIGHT WITHOUT
OPERATOR PLATFORM

HIGH PLATEN STIFFNESS
FOR PARTICULARLY
STRINGENT QUALITY
REQUIREMENTS

FLEXIBLE AUTOMATION &
MACHINE LAYOUT

MATTHIAS MAYR

HEAD OF APPLICATION ENGINEERING & PROJECT MANAGEMENT
CENTER FOR LIGHTWEIGHT COMPOSITE TECHNOLOGIES · ENGEL AUSTRIA GMBH

” ENGEL MACHINES ARE CHARACTERIZED BY HIGHEST PRECISION, ENERGY EFFICIENCY AND RELIABILITY. COMBINED WITH OUR AUTOMATION CAPABILITIES, THEY ARE THE IDEAL BASIS FOR AN EFFECTIVE MASS PRODUCTION IN THE AREA OF HP-RTM PROCESSING. WE HAVE INTEGRATED AN ELAST 400 INTO THE PRODUCTION CELL WHICH IS BEST SUITED FOR BOTH AUTOMATED AND LABORATORY OPERATION. ”

METERING MACHINE

VACUUM ASSISTED
EVACUATION OF THE MOULD
AND DURING SHOT TO ACHIEVE
THE RIGHT FLOW PATH

MOULD-FILLING WITH HIGH
FIBRE CONTENT WITHIN
SECONDS

HP-RTM PROCESSING
SYSTEM FOR ALL COMMON
MATRIX SYSTEMS:
· POLYURETHANE
· EPOXIDE RESIN
· POLYAMIDE 6

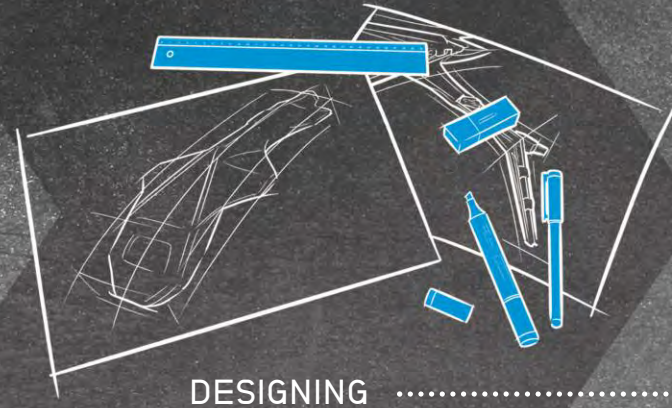
PROVEN HP-RTM MIXHEAD
SYSTEMS WITH INTEGRATED
INJECTION BLOCK FOR
HOMOGENIZED RELEASE
AGENT INJECTION

” THE STREAMLINE MACHINE OFFERS A WIDE RANGE OF SPECIAL FEATURES WHICH SIGNIFICANTLY INFLUENCE THE HP-RTM PROCESS. PRESSURE CONTROL, SENSORS IN THE MIXHEAD OUTLET, HYDRAULICALLY CONTROLLED BACK-PRESSURE FUNCTION AND MOULD FILLING MONITORING – TO COMPENSATE FOR WEIGHT FLUCTUATIONS IN THE PREFORM - ARE ESSENTIAL TO THE PERFECT COMPONENT. ”

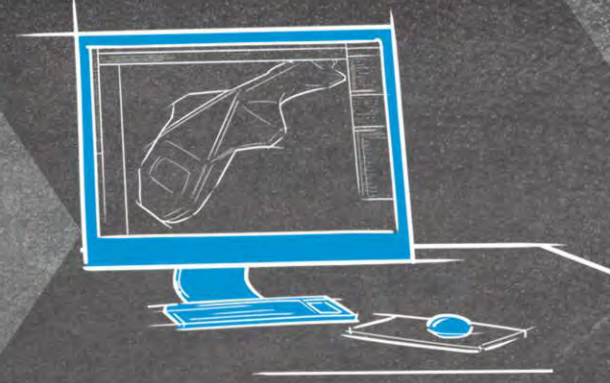
KAROLIN JACOBS

MECHANICAL DESIGN · HENNECKE GMBH

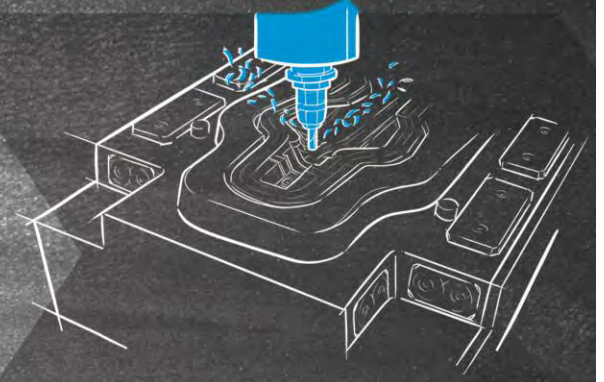
THE WHOLE PROCESS



DESIGNING



SIMULATING

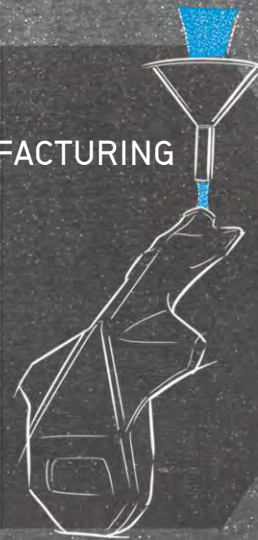


MOULD MILLING

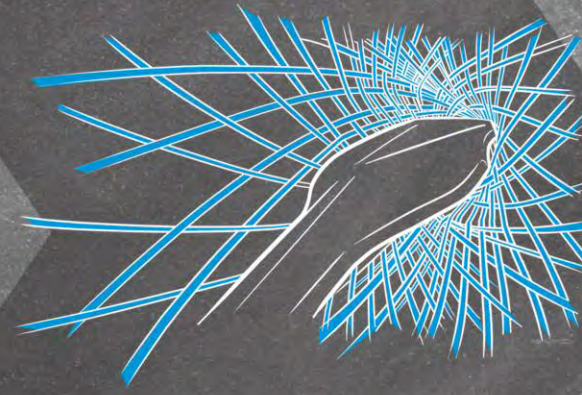
SEALING



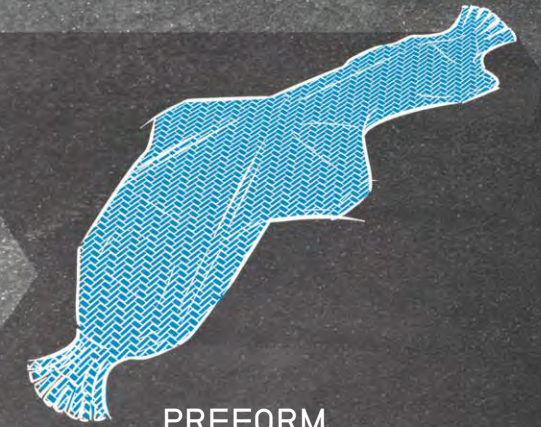
CORE
MANUFACTURING



BRAIDING

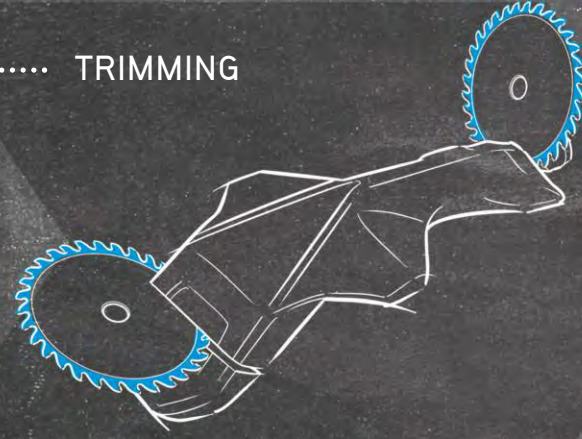
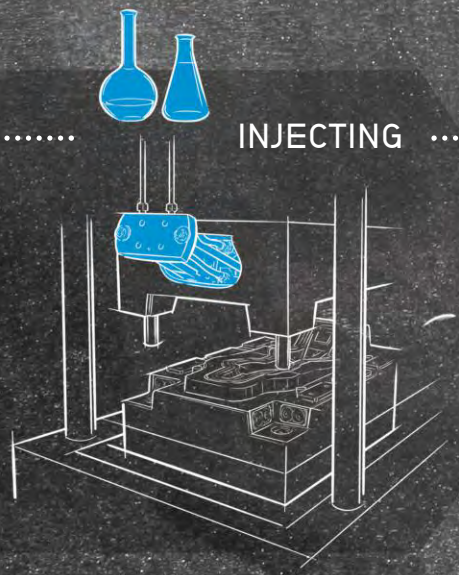


PREFORM
QUALITY CHECKING



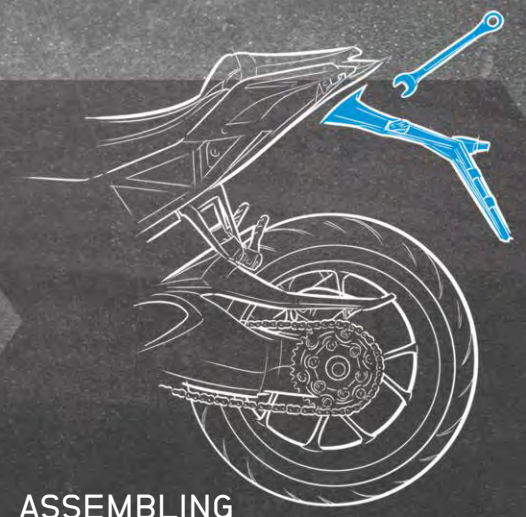
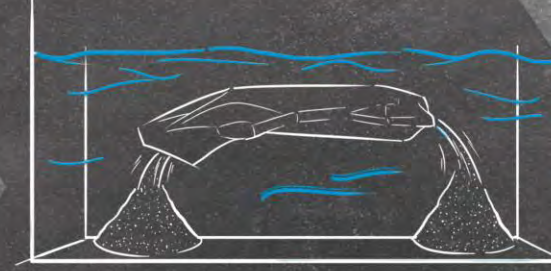
INJECTING

TRIMMING



DISSOLVING

ASSEMBLING



THE SHOW

5

SHOWS A DAY

8

DAYS NONSTOP

3,800

VISITORS

100%

AUTOMATED



ALL ABOUT ADVANCED
MACHINE & SYSTEMS
TECHNOLOGY FOR
PU PROCESSING

PROJECT R.A.C.E.
LIVE PRESENTATION AREA

AS THE WORLD'S BIGGEST TRADE FAIR FOR THE
PLASTICS INDUSTRY, THE K SHOW BRINGS TOGETHER
THE KEY INDUSTRY TRENDS AND AREAS OF FUTURE
DEVELOPMENT. THE 2016 K SHOW WAS THE PERFECT SETTING
FOR HENNECKE TO PRESENT THE PROJECT R.A.C.E.

360 M² EXHIBITION
AREA



Hennecke
Polyurethane Technology

THE CAVUS TECHNOLOGY >>> **PROJECT R.A.C.E.**
Reaction Application for Composite Evolution

METERING MACHINE



ENGEL
elast 400

PRESS &
AUTOMATION

FINISHED
PART

THE CAVUS
TECHNOLOGY

PROJECT R.A.C.E.

PROJECT PARTNERS

MINERALS

ACETECHNOLOGIES

EMAN

ENGEL

Melchert

INDUSTRIE

PERSECO

Hennecke
Polyurethane Technology



THE CAVUS
TECHNOLOGY

PROJECT R.A.C.E.

Hennecke

ENGEL
elast 400

METERING MACHINES

SLABSTOCK LINES

SANDWICH PANEL LINES

TECHNICAL INSULATION LINES

MOULDED FOAM LINES

COMPOSITES & ADVANCED
APPLICATIONS

360° SERVICE

THE FACTS

APPROVED
PROCESSES

125^{SEC}
CYCLE TIME

62[%]
WEIGHT REDUCTION

100^{BAR}
INMOULD PRESSURE

FACTS AND FEATURES OF THE PART

PREFORM

- PREFORM WEIGHT: 98 G
- PREFORM CYCLE TIME: 120 SEC
- NEAR NET-SHAPE BRAIDING

MATRIX

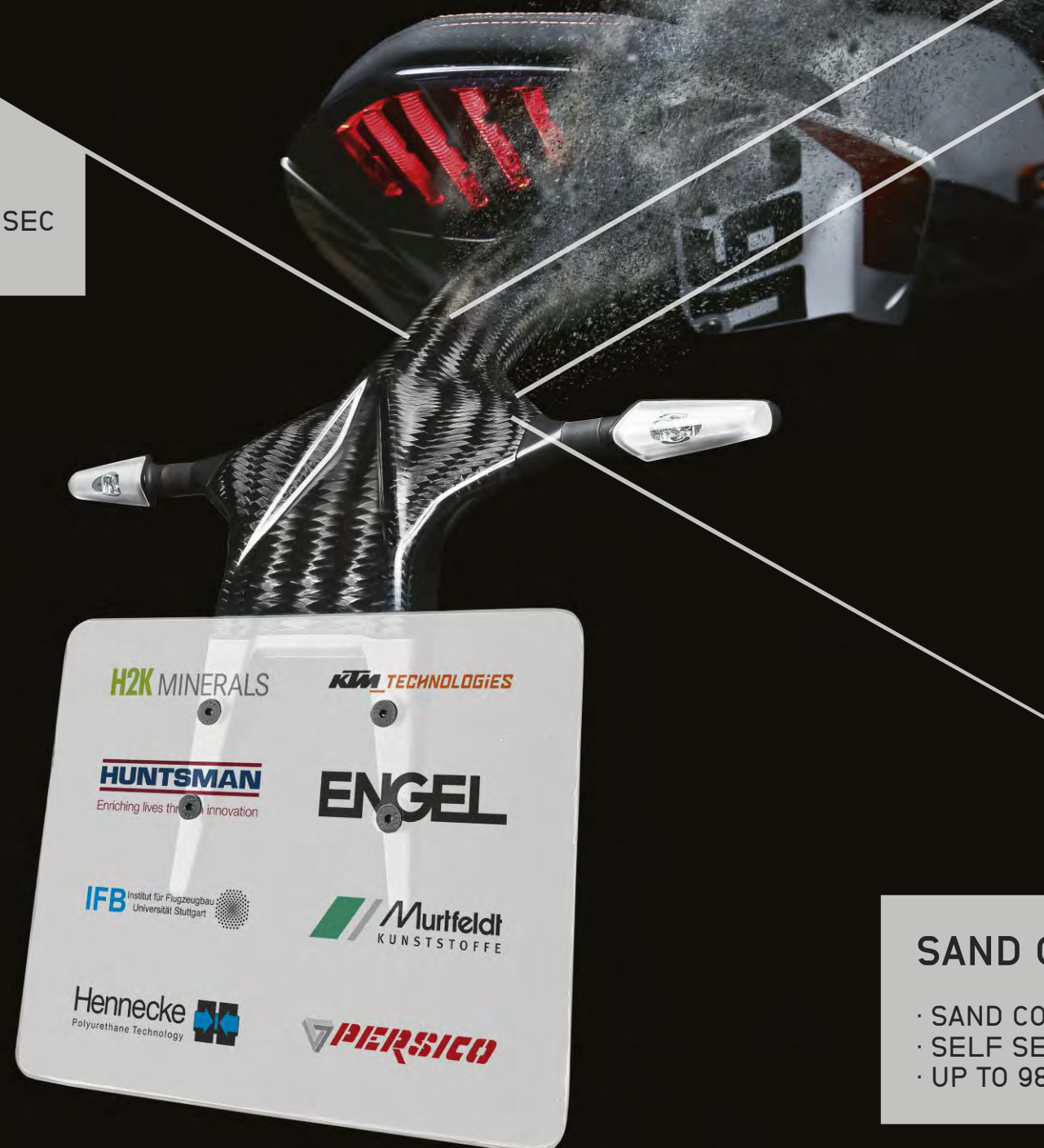
- CYCLE TIME: 125 SEC
- LOW VISCOSITY UNTIL SNAP CURE
- TUNABLE REACTION KICK-OFF

PERFORMANCE PART

- WEIGHT OF FINAL PART: 226 G
- VISIBLE AND STRUCTURAL HOLLOW PART
- FUNCTIONAL INTEGRATION

SAND CORE

- SAND CORE WEIGHT: 1,870 G
- SELF SEPARATING CORE-COMPONENTS
- UP TO 98% CORE MATERIAL CAN BE REUSED



H2K MINERALS

KTM TECHNOLOGIES

HUNTSMAN
Enriching lives through innovation

ENGEL

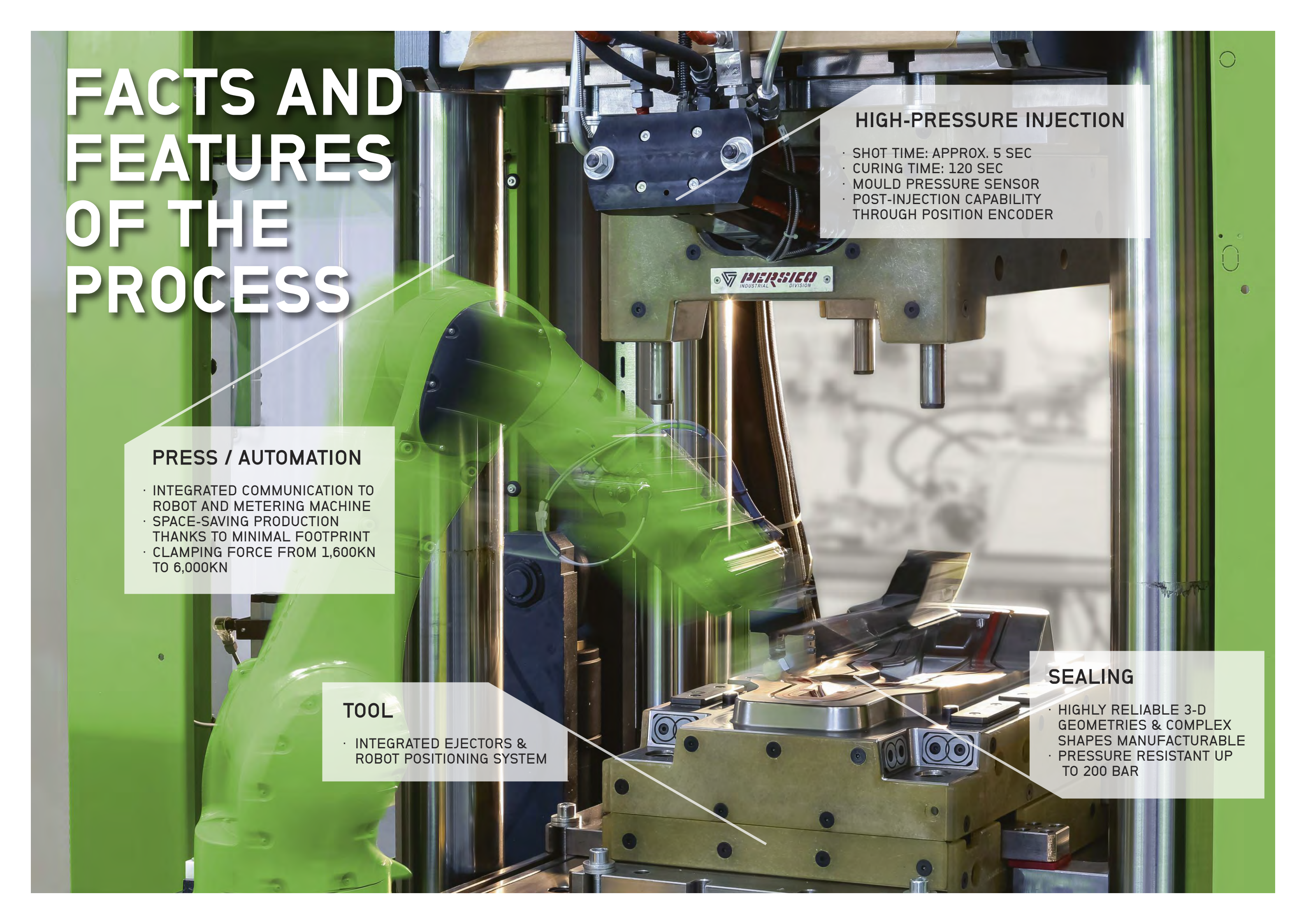
IFB Institut für Flugzeugbau
Universität Stuttgart

Murtfeldt
KUNSTSTOFFE

Hennecke
Polyurethane Technology

PERSICO

FACTS AND FEATURES OF THE PROCESS



HIGH-PRESSURE INJECTION

- SHOT TIME: APPROX. 5 SEC
- CURING TIME: 120 SEC
- MOULD PRESSURE SENSOR
- POST-INJECTION CAPABILITY THROUGH POSITION ENCODER

PRESS / AUTOMATION

- INTEGRATED COMMUNICATION TO ROBOT AND METERING MACHINE
- SPACE-SAVING PRODUCTION THANKS TO MINIMAL FOOTPRINT
- CLAMPING FORCE FROM 1,600KN TO 6,000KN

TOOL

- INTEGRATED EJECTORS & ROBOT POSITIONING SYSTEM

SEALING

- HIGHLY RELIABLE 3-D GEOMETRIES & COMPLEX SHAPES MANUFACTURABLE
- PRESSURE RESISTANT UP TO 200 BAR

**THE
FUTURE**

DISCOVER
APPLICATIONS

NEW
DESIGNS

COST
EFFICIENCY

WEIGHT
REDUCTION

FUTURE POTENTIALS



PHOTO BY R. SCHEDL



WHAT
ABOUT YOUR
PRODUCT IDEA?

FUTURE POTENTIALS



**TEAMWORK
REQUIRED?
CONTACT US!**

THE PARTNERS

8

PARTNERS

4

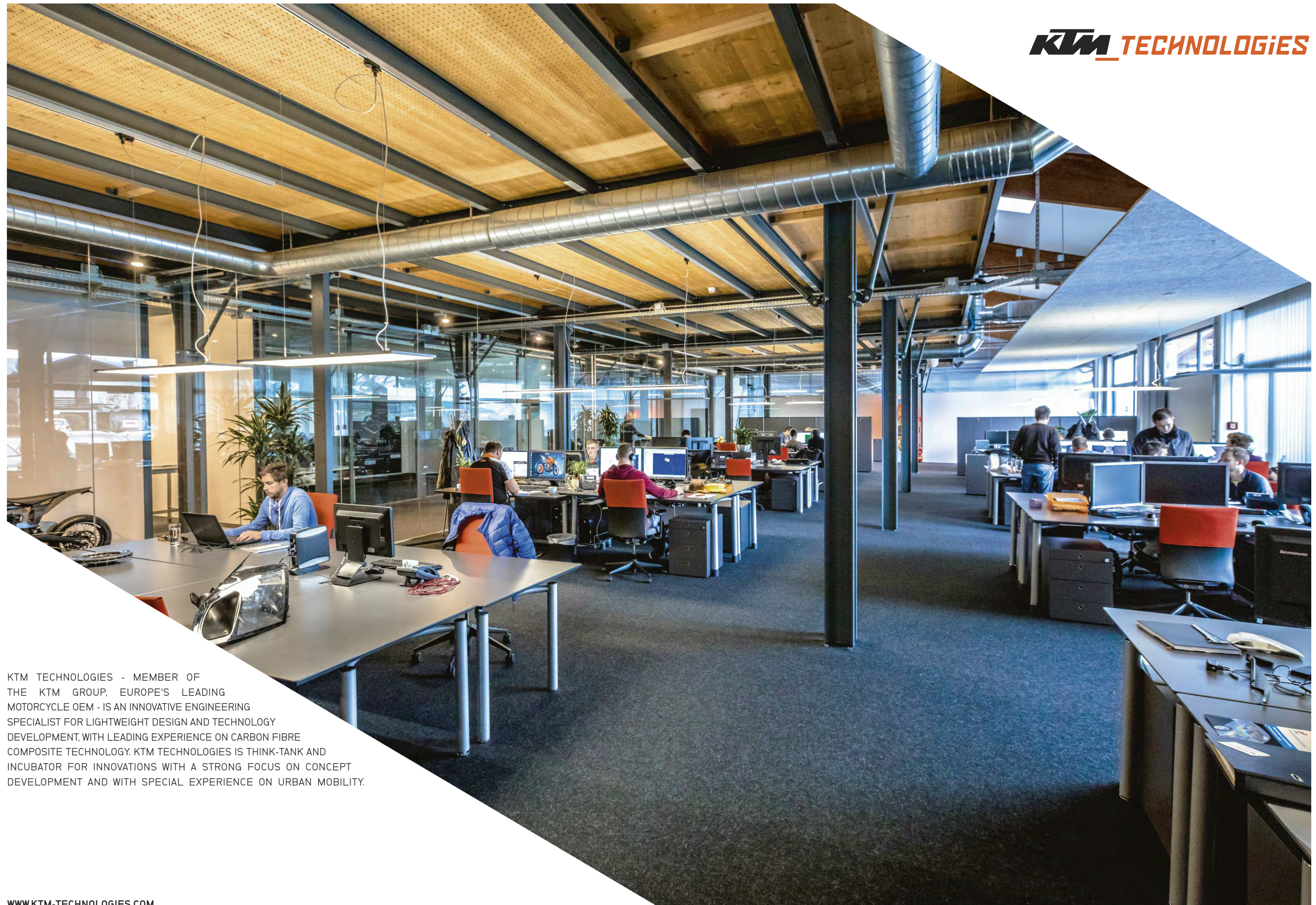
COUNTRIES

21

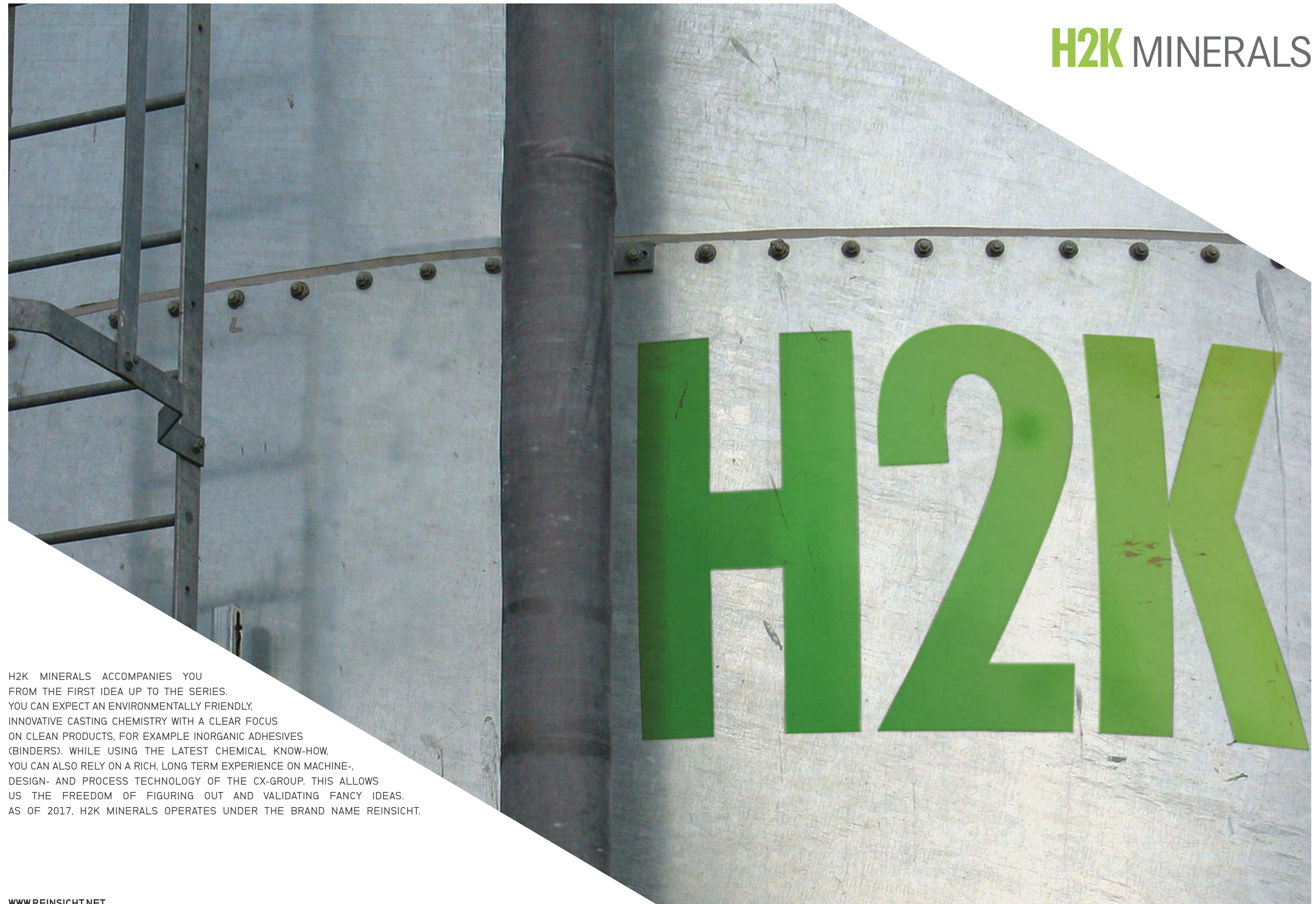
SPECIALISTS

ONE

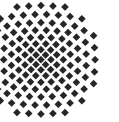
TEAM



KTM TECHNOLOGIES - MEMBER OF THE KTM GROUP, EUROPE'S LEADING MOTORCYCLE OEM - IS AN INNOVATIVE ENGINEERING SPECIALIST FOR LIGHTWEIGHT DESIGN AND TECHNOLOGY DEVELOPMENT, WITH LEADING EXPERIENCE ON CARBON FIBRE COMPOSITE TECHNOLOGY. KTM TECHNOLOGIES IS THINK-TANK AND INCUBATOR FOR INNOVATIONS WITH A STRONG FOCUS ON CONCEPT DEVELOPMENT AND WITH SPECIAL EXPERIENCE ON URBAN MOBILITY.



H2K MINERALS ACCOMPANIES YOU FROM THE FIRST IDEA UP TO THE SERIES. YOU CAN EXPECT AN ENVIRONMENTALLY FRIENDLY, INNOVATIVE CASTING CHEMISTRY WITH A CLEAR FOCUS ON CLEAN PRODUCTS, FOR EXAMPLE INORGANIC ADHESIVES (BINDERS). WHILE USING THE LATEST CHEMICAL KNOW-HOW, YOU CAN ALSO RELY ON A RICH, LONG TERM EXPERIENCE ON MACHINE-, DESIGN- AND PROCESS TECHNOLOGY OF THE CX-GROUP. THIS ALLOWS US THE FREEDOM OF FIGURING OUT AND VALIDATING FANCY IDEAS. AS OF 2017, H2K MINERALS OPERATES UNDER THE BRAND NAME REINSICHT.



THE INSTITUTE OF AIRCRAFT DESIGN (IFB) IS WORKING ON INTERESTING AND RELEVANT TOPICS IN FUNDAMENTAL AND APPLIED RESEARCH AS WELL AS IN EDUCATION IN THE DOMAINS OF AIRCRAFT DESIGN, LIGHTWEIGHT DESIGN, MANUFACTURING TECHNOLOGIES AND WIND ENERGY. WEIGHT SAVING WITH CARBON COMPOSITES IS ONE MAIN TARGET OF THE IFB'S LIGHTWEIGHT DESIGN AND MANUFACTURING TECHNOLOGY RESEARCH AREA. IN ORDER TO ACHIEVE THAT, THE INSTITUTE PROVIDES THE DEVELOPMENT OF FAST ANALYTICAL CALCULATION PROCEDURES WHICH ARE ESPECIALLY USEFUL FOR PRELIMINARY DESIGN. THE RESEARCH AREA'S SECOND FOCUS IS ON THE SIMULATION AND DESIGN OF FIBRE REINFORCED PLASTICS (FRP) THROUGH THE WHOLE (DIGITAL) PROCESS CHAIN. THE IFB IS LOCATED WITHIN THE UNIVERSITY OF STUTTGART CAMPUS IN STUTTGART-VAIHINGEN.



HUNTSMAN

Enriching lives through innovation

HUNTSMAN IS ONE OF THE WORLD'S LARGEST MANUFACTURER AND MARKETER OF DIFFERENTIATED CHEMICALS. HUNTSMAN'S OPERATING COMPANIES MANUFACTURE PRODUCTS FOR A VARIETY OF GLOBAL INDUSTRIES, INCLUDING CHEMICALS, PLASTICS, AUTOMOTIVE, AVIATION, TEXTILES, FOOTWEAR, PAINTS AND COATINGS, CONSTRUCTION, TECHNOLOGY, AGRICULTURE, HEALTH CARE, DETERGENT, PERSONAL CARE, FURNITURE, APPLIANCES AND PACKAGING. ORIGINALLY KNOWN FOR PIONEERING INNOVATIONS IN PACKAGING AND, LATER, FOR RAPID AND INTEGRATED GROWTH IN PETROCHEMICALS, HUNTSMAN HAS APPROXIMATELY 15,000 EMPLOYEES AND OPERATES FROM MULTIPLE LOCATIONS WORLDWIDE.



FOUNDED IN 1976, PERSICO GROUP IS AN ITALIAN PRIVATE COMPANY LOCATED IN NEMBRO, CLOSE TO MILAN, ITALY. IT IS ENGAGED NOT ONLY IN THE AUTOMOTIVE AND MARINE MARKETS BUT ALSO IN OTHERS LIKE AGRICULTURE, TRUCKS, RECREATIVE, AND FURNITURE. IT IS A PROVIDER OF A FULL RANGE OF SERVICES: FROM CONCEPT TO DESIGN, ENGINEERING AND MANUFACTURING OF PROTOTYPES, MODELS, MOULDS, AUTOMATION SYSTEMS, TURNKEY PRODUCTION LINES AND YACHTS. PERSICO IS CUSTOMER-ORIENTED TO FIND TAILOR MADE SOLUTIONS THAT MEET THEIR EXPECTATION BOTH IN NEW PRODUCTION TECHNOLOGIES AND IN NEW MATERIALS. IT HAS SUBSIDIARY PRODUCTION PLANTS AND SALES UNITS IN THE USA AND CHINA TO SERVE ITS CUSTOMERS WORLDWIDE.



MURTFELDT PRODUCTS ARE USED IN ALL SITUATIONS REQUIRING PACKAGING, FILLING, AND TRANSPORT SYSTEMS. THE DORTMUND-BASED COMPANY IS ONE OF THE WORLD'S LEADING MANUFACTURERS OF CHAIN AND BELT GUIDES, CHAIN TENSIONERS, AND GLIDE-ENABLING PLASTICS. MURTFELDT ALSO RESEARCHES AND DEVELOPS RAW MATERIALS AND ADDITIVES IN THE COMPANY'S OWN LABORATORIES, CONSTANTLY COMBINING THEM TO CREATE NEW PRODUCTS. THANKS TO DECADES OF MANUFACTURING COMPETENCE, MURTFELDT IS ABLE TO SUPPLY INDIVIDUAL, COST-OPTIMIZED SOLUTIONS SUCH AS READY-TO-INSTALL MACHINE PARTS AND PROFILES IN ACCORDANCE WITH CUSTOMER DRAWINGS IN ADDITION TO STANDARD PRODUCTS SUCH AS CHAIN GUIDES AND TENSIONERS.

ENGEL



ENGEL IS THE WORLD'S LARGEST MANUFACTURER OF INJECTION MOULDING-MACHINES AND A LEADER IN THE FIELD OF INJECTION MOULDING TECHNOLOGY. ENGEL'S INTEGRATED SYSTEMS SOLUTIONS INCLUDE INJECTION MOULDING MACHINERY, AUTOMATION, PROCESS TECHNOLOGY, SOFTWARE SOLUTIONS, TOOL DESIGN, TRAINING AND SERVICE. WITH 30 BRANCHES, 60 REPRESENTATIVES AND 9 PRODUCTION PLANTS, ENGEL OFFERS ITS CUSTOMERS OPTIMAL SUPPORT WORLDWIDE TO COMPETE AND SUCCEED WITH NEW TECHNOLOGIES AND LEADING-EDGE PRODUCTION SYSTEMS. THE AUSTRIA-BASED COMPANY IS 100% FAMILY OWNED AND HAS 5,800 EMPLOYEES WORLDWIDE.



FOR SEVEN DECADES, HENNECKE GMBH HAS BEEN DEVELOPING AND DESIGNING HIGH-CLASS MACHINE AND SYSTEMS TECHNOLOGY AS WELL AS PROCESS TECHNOLOGY FOR POLYURETHANE PROCESSING. THANKS TO INTENSIVE RESEARCH AND DEVELOPMENT WORK, HENNECKE IS ABLE TO OFFER INNOVATIVE SYSTEMS AND TECHNOLOGIES WITH HIGHLY ECONOMIC AND ECOLOGICAL BENEFITS TAILORED TO MEET INDUSTRY REQUIREMENTS IN A WIDE RANGE OF APPLICATIONS. TODAY, THERE IS HARDLY ANY POLYURETHANE-BASED PRODUCT IDEA THAT CANNOT BE REALIZED BY HENNECKE.



CREDITS

CONCEPT
PROJECT R.A.C.E. TEAM

DESIGN
RE:PUBLIC

PHOTOS
KTM, KTM TECHNOLOGIES, KISKA, HENNECKE, HUNTSMAN, ENGEL, IFB, PERSICO,
MURTFELDT, SHUTTERSTOCK.COM: FUYU LIU, ANDRÉJ SEVKOVSKIJ, RAWPIXEL,
SUWATCHAI PLUEMRUETAI, ANNA VÁCZI, ASHARKYU.

© 2017 ALL RIGHTS ARE RESERVED TO THE RESPECTIVE OWNER. NO PART OF
THIS PUBLICATION MAY BE REPRODUCED, DISTRIBUTED, OR TRANSMITTED IN
ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN PERMISSION OF
THE PUBLISHER.



PROJECT PARTNERS

H2K MINERALS

KTM TECHNOLOGIES

HUNTSMAN
Enriching lives through innovation

ENGEL

IFB Institut für Flugzeugbau
Universität Stuttgart



Murtfeldt
KUNSTSTOFFE

Hennecke
Polyurethane Technology



PERSICO