High performance thermoplastics polymers for aerospace

Varun Kumar
Varun.kumar@evonik.com

Nov 2018

EVONIK
POWER TO CREATE

Our positioning

Evonik is the creative industrial group from Germany and one of the world’s leading specialty chemicals companies.

Evonik in figures 2017

36000 Employees

26.500
Patents

€ 14,4 billion
Sales

€ 458 million
For R&D activities

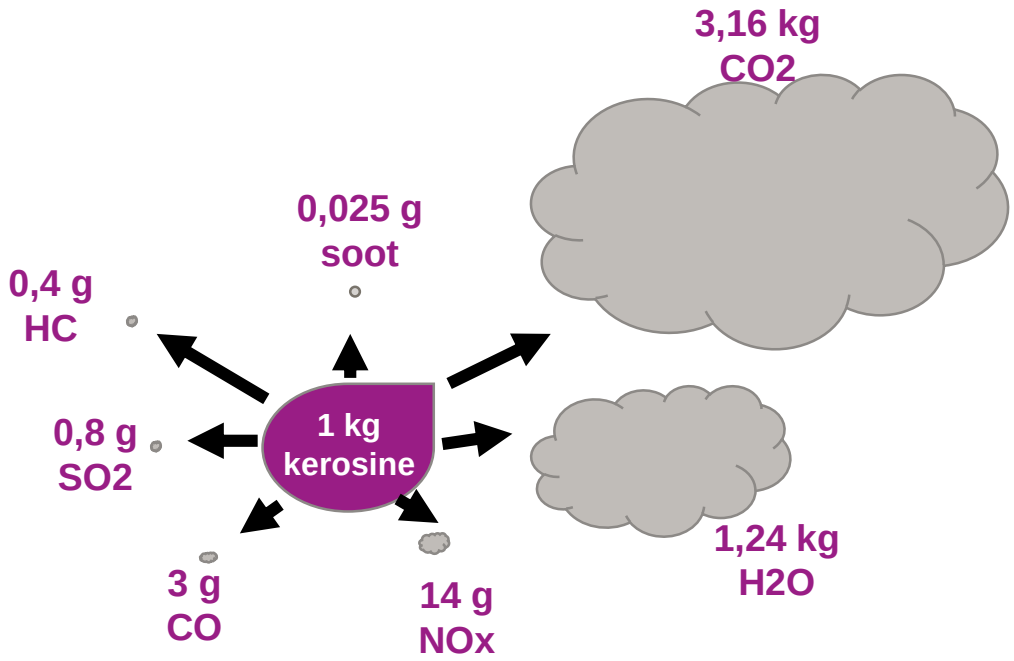
R&D Employees
2800

EVONIK
POWER TO CREATE

Why Aerospace?

Energy and Economic Efficiency
Savings of 1 kg kerosine

Combustion of 1 kg of kerosine releases:



- An Airbus A330 can save appx. 4500 liters of fuel over ist life time by reducing 1 kg of its weight

Source: The International Energy Agency (2007)

International Air Transport Association (IATA) published targets in 2009

- a cap on aviation carbon dioxide emissions from 2020 (carbon neutral growth)
- A reduction in CO2 emissions of 50% by 2050, relative to 2005 levels

OEM

Tier 1/Tier 2

Innovative design

Efficient manufacturing

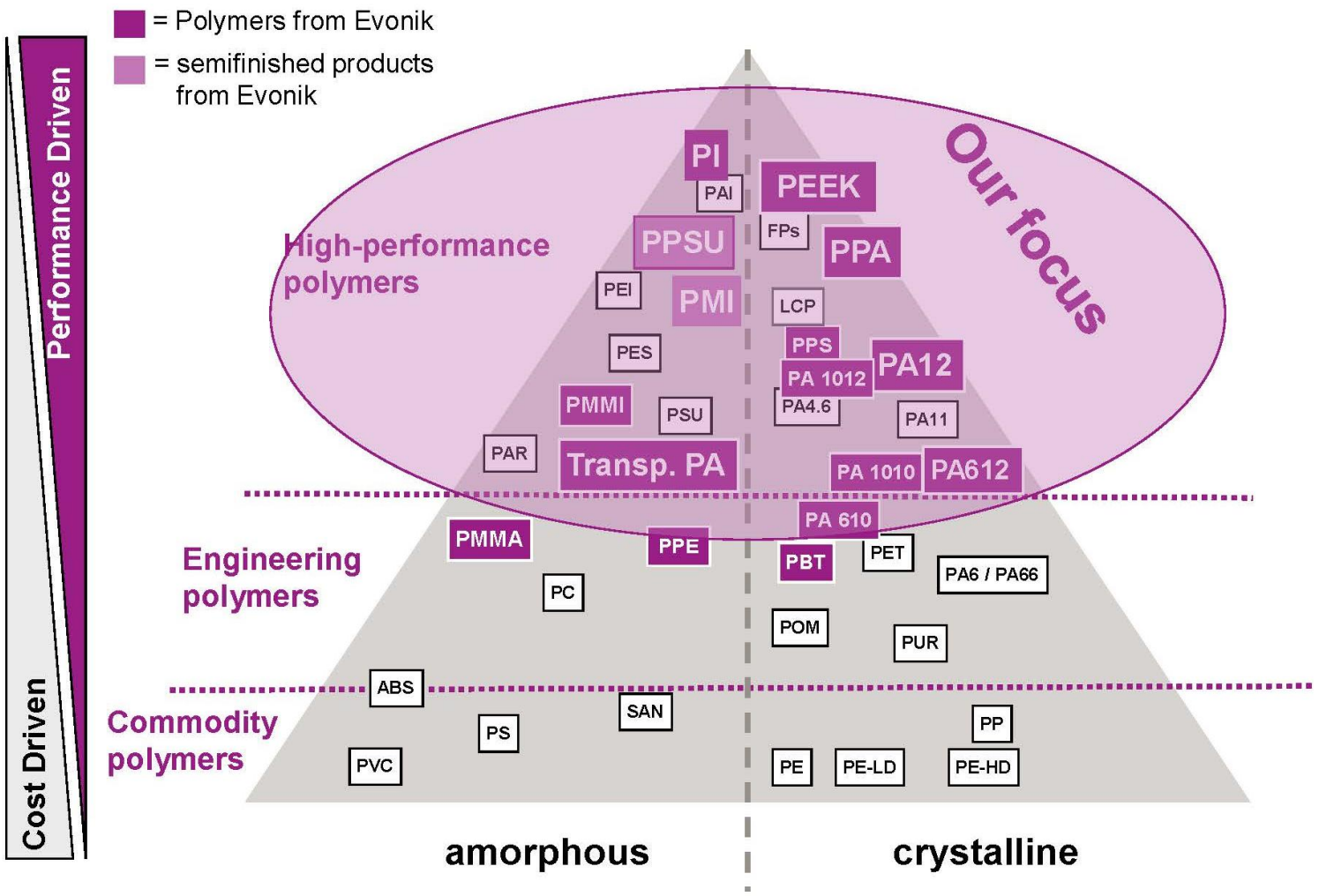
Weight reduction

High performance polymers

EVONIK POWER TO CREATE

High performance polymers
Product portfolio

Product portfolio for high performance polymers



A wide range of high performace thermoplastic materials available

Special tailor-made compounds according to your requirements

High Tg grades available

Specially developed grades for stringent aerospace requirements

EVONIK POWER TO CREATE

High performance polymers for Aerospace

Applications for high performance polymers for aerospace

Interior application

1 Seating and structural support

VESTAKEEP® PEEK can be used for reducing the weight of the structural frame and easily injection molded into complex shapes or geometries.

2 Handles for support

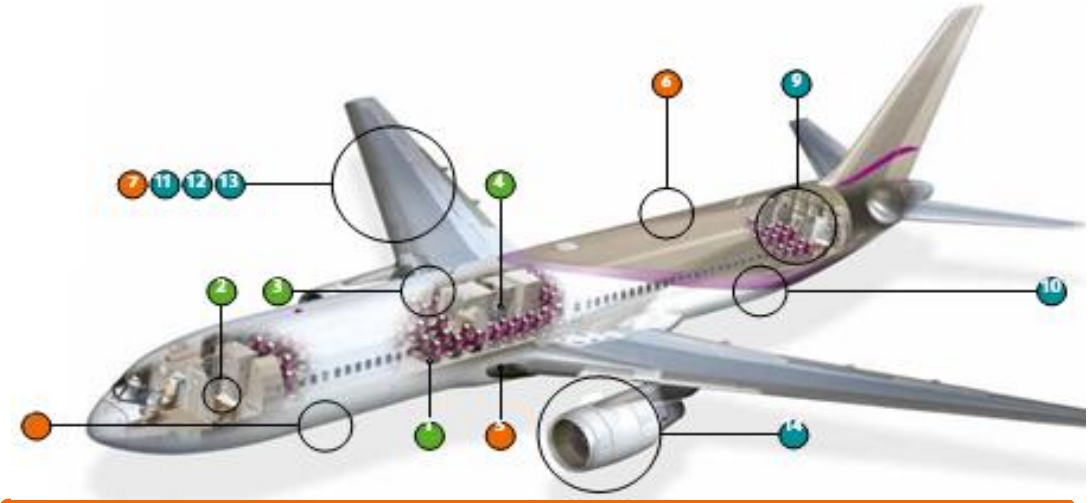
Compared to die-cast parts, injectionmolded VESTAKEEP® PEEK and VESTAMID® PA12 handles offer improved aesthetics and reduced weight.

3 Bracket for luggage compartment retainers

VESTAKEEP® PEEK works well in spaceand weight-saving design concepts that maximize space within the aircraft interior.

4 Galley trolley

VESTAMID® PA12 profiles serve as excellent insulators for galley trolleys to keep food cold for longer periods of time.



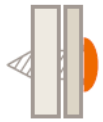
Exterior application

5 Light cover

TROGRAMD® CX is an alternative to glass that can reduce weight and is easy to process into various shapes.

6 Vent grill

Easy-to-assemble, lightweight VESTAKEEP® PEEK has excellent mechanical and thermal properties, making it suitable for replacing metallic parts in ventilation systems.



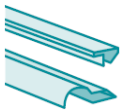
7 Sealing cap

VESTAMID® HTplus PPA presents a cost-effective sealing-cap solution to protect metallic fasteners from corrosion.

8 Thermoplastic composites

A variety of matrix solutions based on VESTAKEEP® PEEK, VESTAMID® PA12, and TROGAMID® CX are available to support emerging welding and joining technology in thermoplastic composites.

Assembly components



9 Extruded profile for cabin

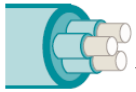
Easy processing makes VESTAMID® PA12 an ideal solution for complex profiles.

10 Tubing and pipes

Tubing from VESTAKEEP® PEEK and VESTAMID® are easy to form and lightweight than metallic tubing.

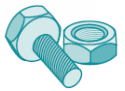
11 Critical assembly components

VESTAKEEP® PEEK has a proven track record as a replacement for metallic components in brackets, clips, and fasteners.



12 Electrical cable insulation

VESTAKEEK® PEEK thin films can be used for cables



13 Nuts and bolts

VESTAKEEP® PEEK nuts and bolts are easy to handle, corrosion free, reliable, and durable.

14 Engine parts

Specially developed high-temperature VESTAKEEP® PEEK grades reduce creep by more than 50% and improve modulus retention at 290°C, making them suitable for replacing metal in components near the engine.

EVONIK
POWER TO CREATE

High performance polymers for aerospace

Polyamide 12 (PA12)	VESTAMID®
Transparent Polyamides	TROGAMID®
Polyphthalamide (PPA)	VESTAMID HT *plus*®
Poly Ether Ether Ketone (PEEK)	VESTAKEEP®
Cross linked PEEK (X-PEEK)	VESTAKEEP XT®

Unique Selling Points

- Crosslinking PEEK XT
- Ductile PEEK
- Flame retarding grades
- ESD grades
- Special additive
- Tribo grades

Providing:

Granules

Stock shapes

Powders

EVONIK
POWER TO CREATE

Main areas of focus for High performance polymers group

Main focus areas

Seating application

Critical assembly components

Profiles and other interior application

Seating application for aircrafts

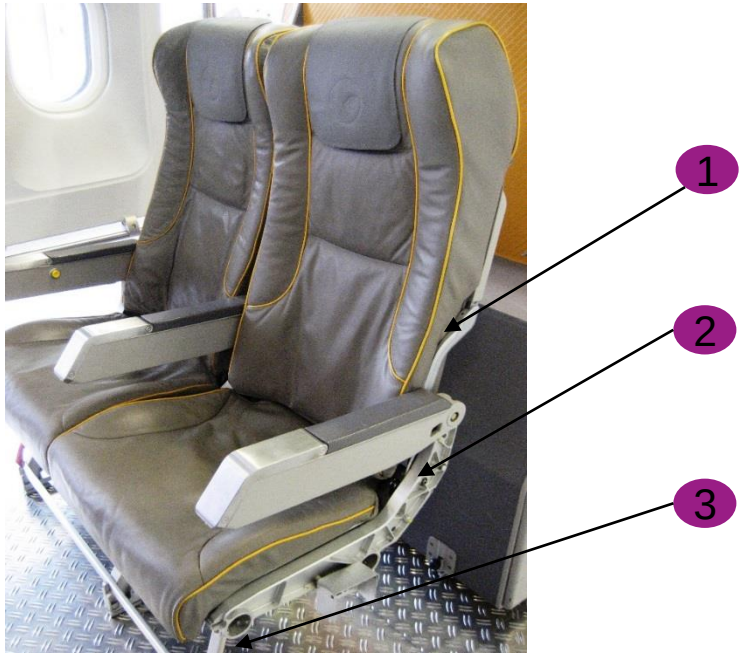
Aircraft seat made of VESTAKEEP®

APPROVED
On-Going Production

This is a sample seat not the actual seat where we sell our material

Boeing 737 Max

What after Seating Applications?



1. Catering Table arm from our VESTAKEEP
2. Structural support for the seat
3. Structural support for the seat

EVONIK
POWER TO CREATE

Critical assembly components

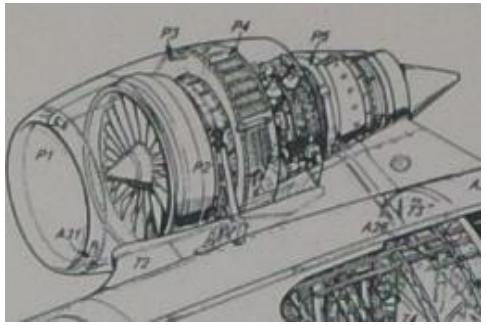
VESTAKEEP ESD grades for brackets

Requirements

- Reduce machining cost
- Electrostatically dissipative
- Corrosion resistance
- Resistance to aggressive aerospace liquids
- Higher energy absorption than competitive material
- Weight reduction

Cross linked VESTAKEEP for ultra high performance

- Suitable for temp more than 260 Deg C
- Shows 50% improved creep compared to standard PEEK



Zone	Air Temp (F)
1	250F-350F (177°C)
2	350F-450F(232°C)
3	450F-550F

Features and benifits

PEEK tubing

PEEK fastners

PEEK connectors

EVONIK POWER TO CREATE

Advantages of VESTAKEEP screws and fasteners

- PEEK screws are upto 70 % lighter than the traditional metallic fastners

Light weight

- Color coating for easier differentiation possible
- High degree of freedom
- Micro Injection molded screws also possible

Better design properties

VESTAKEEP screws

Chemical resistance

- PEEK fastners show good resistance against typical aerospace liquids
- Can be used in CRPF to avoid galvanic corrosion and pitting seen in Aluminium screws
- PEEK screws eliminate the corrosion protection step

- PEEK screws show up to 4 times higher fatigue strength than metals
- PEEK fastners show better damping properties

Mechanical properties

Insulation

- PEEK screws maintain ist electrical properties over wide range of frequency and temperature range
- PEEK screws also have an excellent thermal insulation because of small coefficient of thermal conductivity

EVONIK
POWER TO CREATE

Profiles for interior application

	Density	Tensile Modulus	Charpy - 30/23º C	UL 94 (Internal test)	LOI
	ISO 1183	ISO 527-1	ISO 179/1eU	IEC 60696	ISO 4589
X7167	1,05 g/cm^3	1700 MPa	N/N	V2 at 1,6 mm	25%
X7229	1,06 g/cm^3	1000 MPa	150C/N	V2 at 1,6 mm	25%

X7167 & X7229 Benefits

- Heat stabilized compound based on non-migrating flame retardant, halogens and phosphorus free formulation.
- Wide operating range from -40ºC to 120ºC
- Can be color compounded to match decoration in the interior of the aircraft
- Light weight, flexible, chemical and corrosion resistance.
- Easy processing

ZODIAC AEROSPACE

Approved PA 12Grade: X7167, X7229

AIRBUS

AIMS04-01-004
Issue 4
Page 1 of 6
March 2009

AIMS
Airbus Material Specification

Polyamide 12, flame retardant (PA12-FR)

VESTAMID® X7167

- EVONIK Degussa GmbH -

Individual Product Specificatio

AIRBUS

IPS04-01-004-01
Issue 1
Page 1 of 6
August 2009

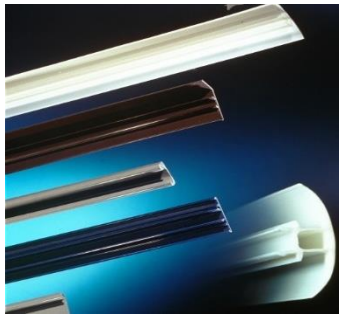
AIMS
Airbus Material Specification

Polyamide 12, flame retardant (PA12-FR)

VESTAMID® X7229

- EVONIK Degussa GmbH -

Individual Product Spec

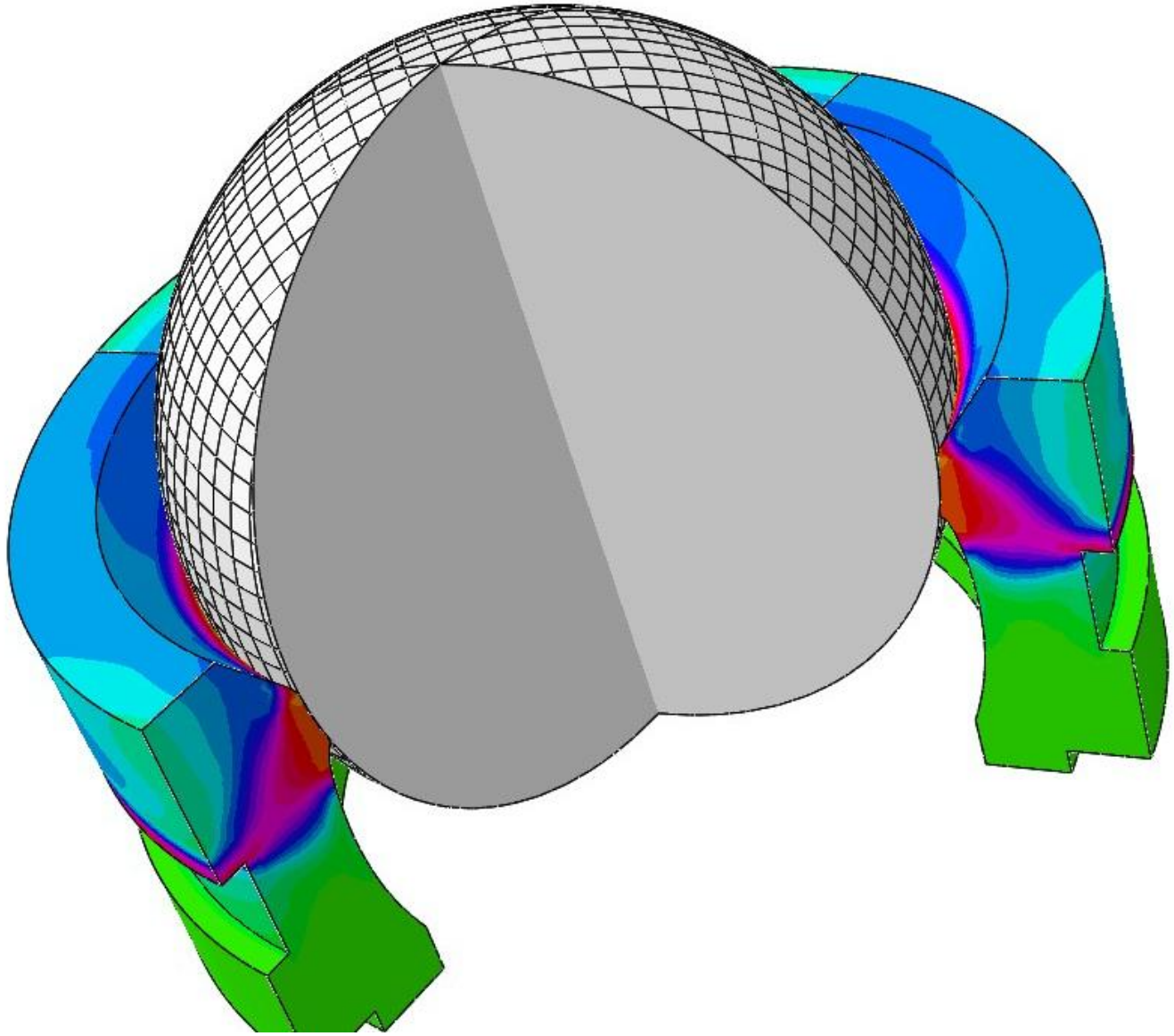


PEXCO AEROSPACE

EVONIK POWER TO CREATE

Simulation capabilities @ Evonik RE-HP

for Analysis in Structural Mechanics and Injection Molding

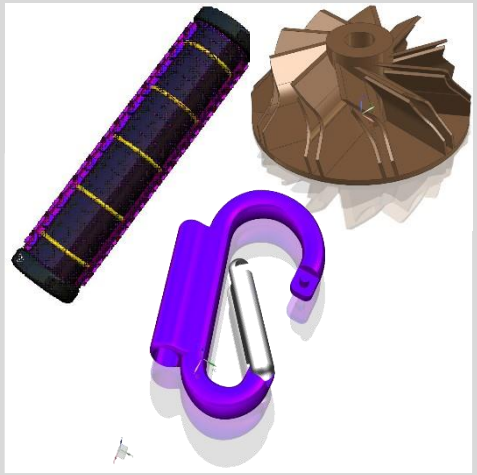


EVONIK
POWER TO CREATE

Software Tools for Computer Aided Engineering & Material Modeling

Computer Aided Design CAD

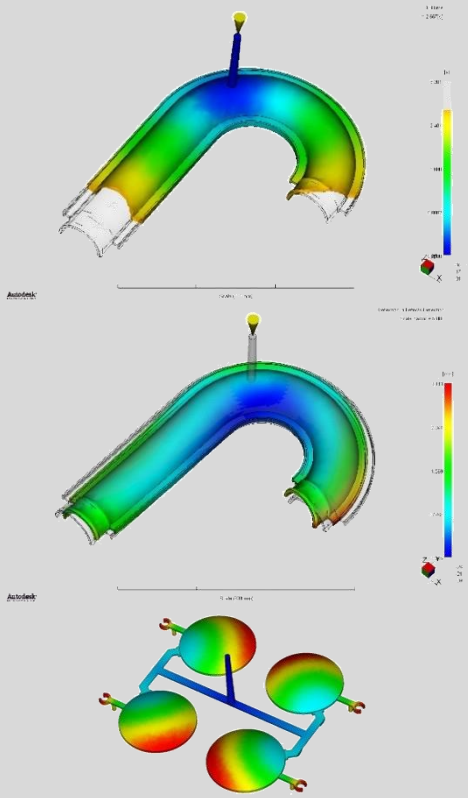
Siemens PLM NX
Data transfer with:
STEP, IGES, STL,
CATIA V4 and V5



Injection Moulding Simulation

Autodesk Moldflow Insight

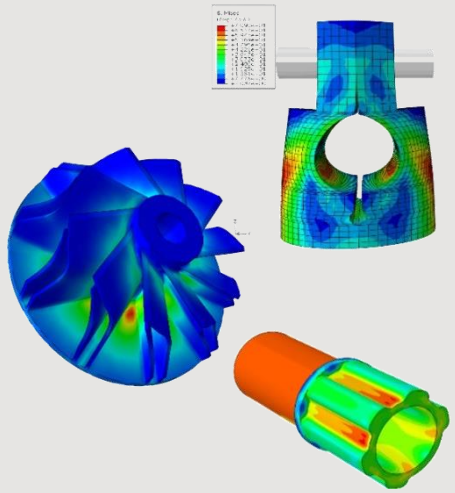
Autodesk Moldflow
INSIGHT 2016



Structural Mechanics:

ABAQUS
SIMULIA

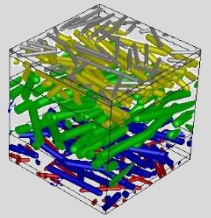
ABAQUS CAE 6.14
ABAQUS
Implicit/Explicit

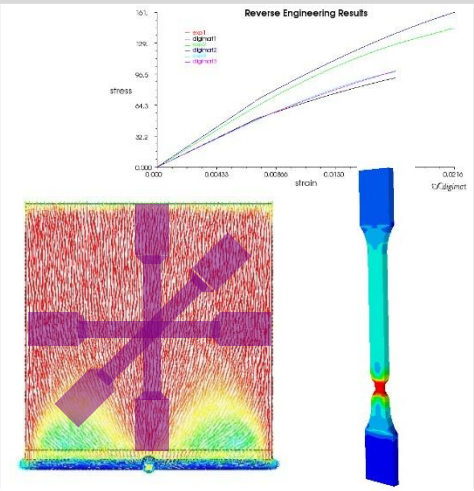


Material Modeling:

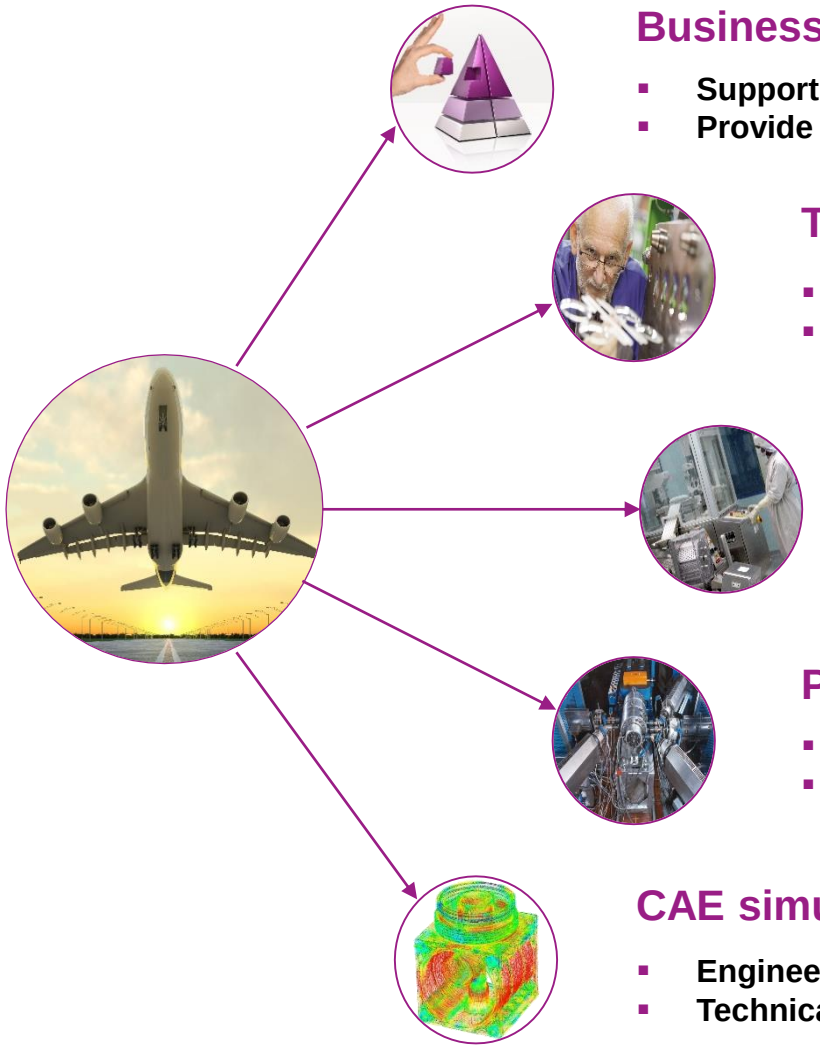
digimat

e-Xstream DIGIMAT
Material Engineering





Technical support over the whole value chain



Business development

- Support to develop new projects and find the right materials
- Provide support framework for aerospace approvals

Technical support

- On site technical support
- Tailor-made products to fulfill challenging requirements

Application technology

- State of art testing lab for various aerospace tests
- Lab scale production of sample parts for testing

Processing technology

- Mixing, compounding, injection molding, extrusion
- Processing recommendations

CAE simulation and modelling

- Engineering service, design improvement recommendations
- Technical and commercial feasability

Evonik - A competant partner for you!


EVONIK
POWER TO CREATE