MAXIMATOR®

Maximum Pressure.

company presentation

(focus on alternative fuels)

3rd Informal Working Group meeting
on GTR13 (HFCV) - Phase2
in Seoul, South Korea
26/27/28JUN2018

company details

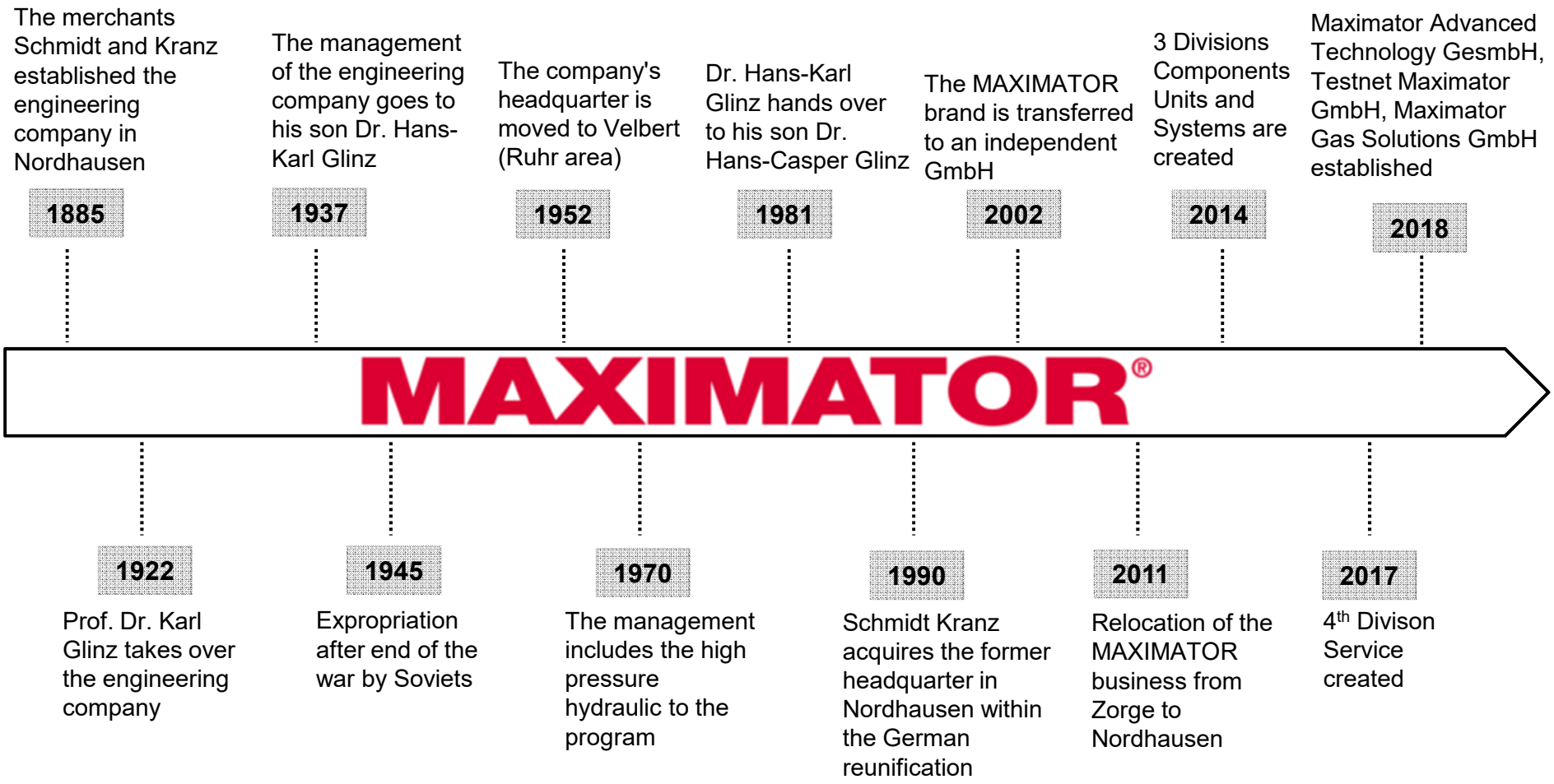
Employees

Nordhausen	approx. 400
International	approx. 350

Turnover

Germany	60	Mio. EUR
International	62	Mio. EUR
Total (cumulative)	100	Mio. EUR

history



SK-Holding

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- Division Components: H2 components (valves, pumps, compressor)
- Division Units: H2 filling stations
- Division Systems: Test stands (prototype and end of line)
- Division Service: Test services (hydraulic)

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Advanced Technology

- Design of H2 Compressor technology
- Design of H2 Components for Hydrogen Filling Stations

TESTNET

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- Test services (hydrogen)
- Testing of H2 filling equipment and components

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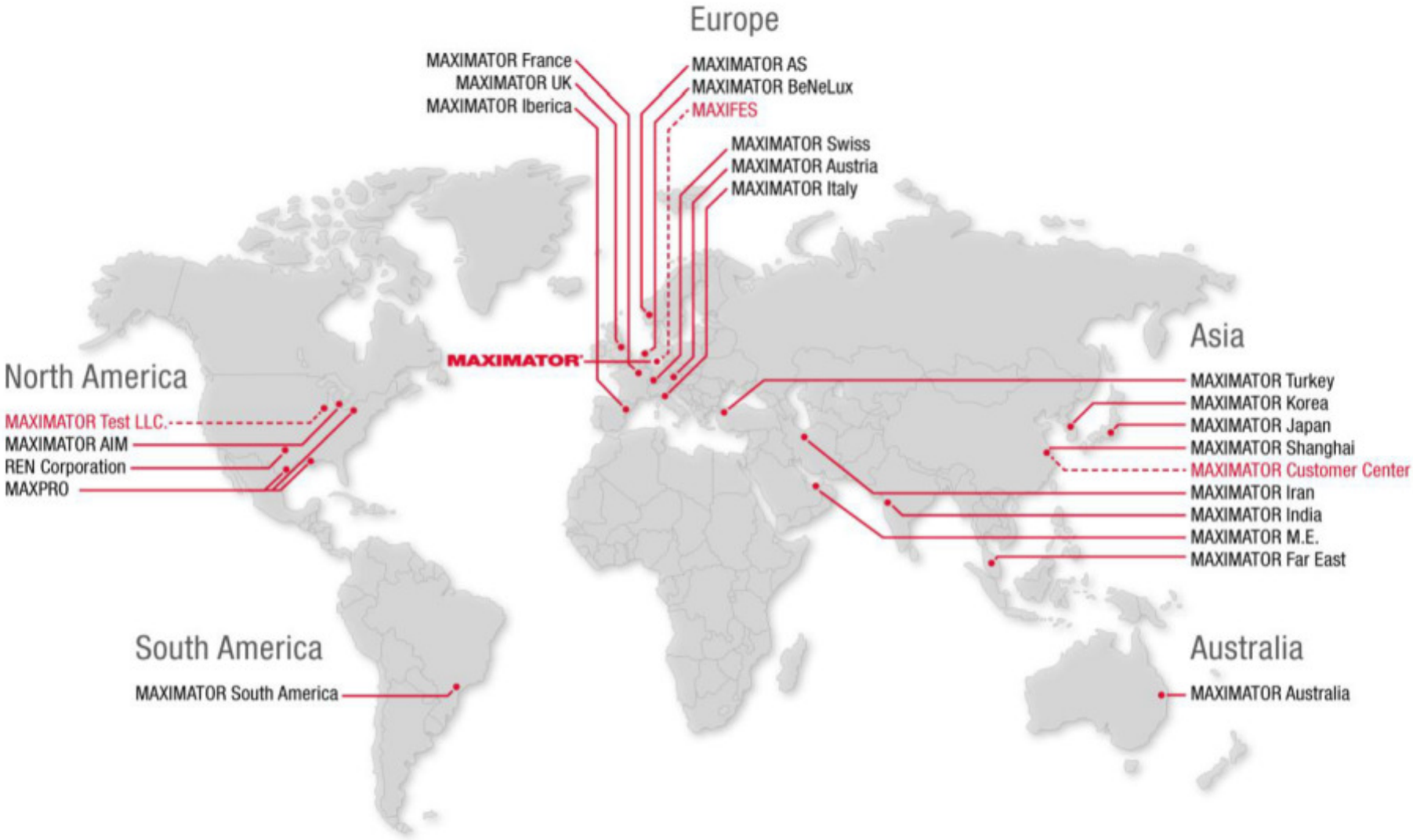
Gas Solutions

- Design of H2 Storage solutions

Maximator family worldwide



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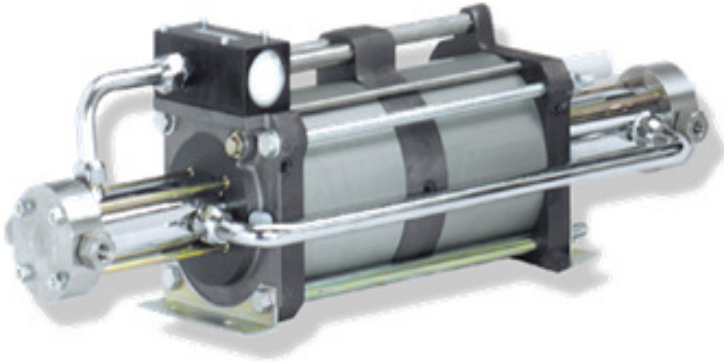
Division Components

H_2 Valve | Standard



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Division Systems

H2 burst and pressure cycle test stand

General	
volume:	up to 300 ccm
fluid:	water or oil
accuracy:	± 2 bar
Burst pressure test	
pressure:	up to 4.000 bar
pressure increase:	1 – 20 bar / s
Pressure cycle test	
pressure:	10 – 1.050 bar
frequency:	up to 10 cycles per minute
curve:	sinus and trapezoid
Regulation:	EC79/2009, EU406/2010, ECE R134 and GTR No. 13

- compact design
- moveable
- filling process included
- for example: hydrogen on tank valves

CNG proof pressure test stand

Pressure	
maximum:	350 bar
fluid:	water
increase and decrease:	controllable, within 10 s
accuracy:	±1 bar
Cylinder	
length:	up to 1400 mm
diameter:	up to 460 mm
volume:	up to 70 liter
Measurement:	circumference, length, expansion volume, temperature, pressure
Regulation:	ECE R110

- flexible fixture
- 2 independent chambers
- very short cycle time through swiveling fixture (45.000 vessels / year & approx. 5 minutes / vessel)
- communication with production system (request / approval of SN)

CNG burst pressure test stand

Pressure	
maximum:	1.000 bar
fluid:	water
pressure increase:	< 3,5 bar / s
Cylinder	
length:	up to 1400 mm
diameter:	up to 460 mm
volume:	up to 70 liter
Measurement:	expansion volume, temperature, pressure
Regulation:	ECE R110

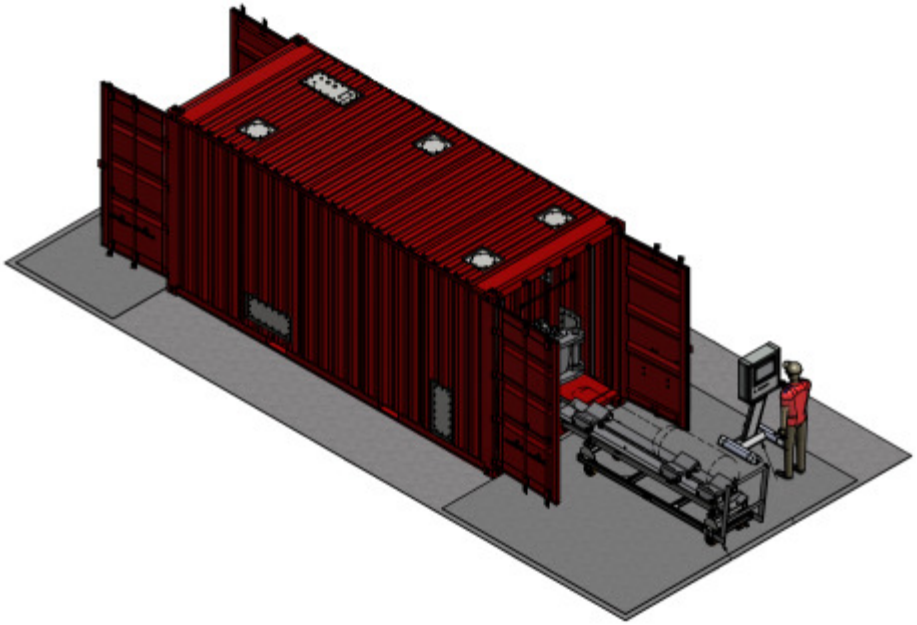
- compact design
- exchangeable sacrificial elements
- manual filling procedure included

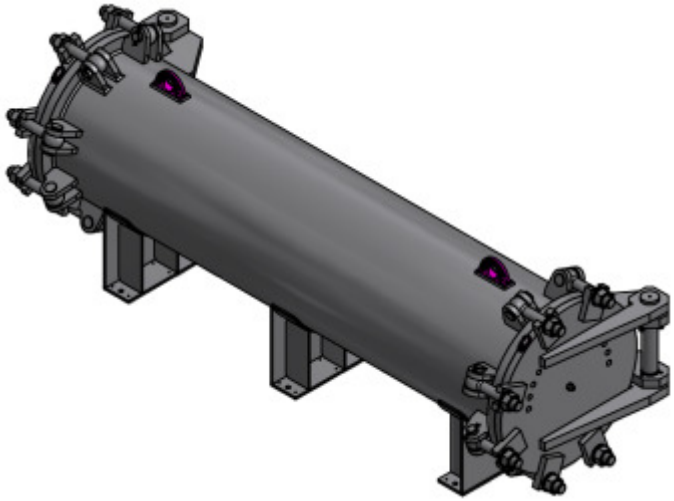
H2 burst pressure test stand

Pressure	
maximum:	4.000 bar
increase:	1 bar / min – 10 bar / s
Cylinder	
length:	up to 4000 mm
diameter:	up to 1000 mm
volume:	up to 500 liter
Measurement:	circumference, length, expansion volume, temperature, pressure
Regulation:	ECE R 110, ECE R 134, EC79, ISO11119-3, EN 12245, UN GTR No. 13

- complete assembled systems (including valves, tubes and fixtures)
- OPTIONAL: (3D) deformation measurement
- OPTIONAL: high speed recording
- OPTIONAL: bending / torsion of cylinder

H2 burst pressure test stand





Pressure	
maximum:	2.500 bar
fluid:	water
pressure increase:	controlled
accuracy:	±2 bar
Cylinder	
length:	up to 3.000 mm
diameter:	up to 500 mm
volume:	up to 200 liter
Measurement:	expansion volume, temperature, pressure
Regulation:	ECE R134, UN GTR No. 13, SAE J2579, EC79 / EU406

- compact design
- manual filling procedure included

CNG pressure cycle test stand

Pressure	
maximum:	300 bar
fluid:	water-glycol-mixture
curve:	sinus
frequency:	max. 10 cycles / min
accuracy:	±2 bar
Cylinder	
length:	up to 1400 mm
diameter:	up to 460 mm
volume:	up to 70 liter
Measurement:	circumference, length, expansion volume, temperature, pressure
Regulation:	ECE R110

- reproducible curves
- manual filling and suction procedure included
- OPTIONAL: additional chambers

H2 extreme temperature pressure cycle test stand (2002)

Pressure	
maximum:	1.200 bar
curve:	sinus
fluid:	heat transfer fluid
frequency:	max. 10 cycles / min
accuracy:	±2 bar
Cylinder	
length:	up to 2000 mm
diameter:	up to 600 mm
volume:	up to 100 liter
Temperature	
maximum:	≥ +85° C / ≥ 95% humidity
minium:	≤ -40° C
Measurement:	expansion volume, temperature (fluid & atmosphere), pressure
Regulation:	ECE R 110, ECE R 134, EC79, ISO11119-3, EN 12245, UN GTR No. 13

H2 extreme temperature pressure cycle test stand (2018)

Pressure	
maximum:	1.050 bar
curve:	sinus
fluid:	heat transfer fluid
frequency:	max. 10 cycles / min
accuracy:	±2 bar
Cylinder	
length:	up to 3000 mm
diameter:	up to 500 mm
volume:	up to 200 liter
Temperature	
maximum:	≥ +85° C / ≥ 95% humidity
minium:	≤ -40° C
Measurement:	expansion volume, temperature (fluid & atmosphere), pressure
Regulation:	ECE R 134, EC79, UN GTR No. 13

H2 leak test stand

Pressure	
maximum:	875 bar
fluid:	N2 (95%) / H2 (5%)
temperature:	Ambient
Specimen	
length:	up to 2500 mm
width:	up to 2500 mm
volume:	up to 150 liter
Measurement:	local tightness (up to 1x10E-08 mbar*l*s^-1), temperature, pressure,
Regulation:	EC79

- test chamber installed into clean room
- controllable pressure increase and decrease (depending on temperature)
- test of single cylinders or complete assembled systems
- OPTIONAL: upgrade to full automated process with robots

H2 cycle test stand

Pressure	
maximum:	1050 bar
fluid:	H2 (100%)
Flow rate	
maximum:	400 lN / min.
Booster type:	4 double-acting stages
Storage:	1200l @ 1000 bar

- complete container according ATEX
- 12m chimney
- HMI to control the pressure curve (remote control included)
- Climate chamber was integrated on-site

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Division Service

Hydraulic burst pressure test

Test	
Pressure:	up 2.000 bar
Curve:	linear
Pressure increase:	controlled
Fluid:	water
Cylinder	
Length:	up to 4.000 mm
Diameter:	up to 1.000 mm
Volume:	up to 500 liter
Measurement:	expansion volume, length, diameter, circumference, temperature, pressure
Options:	High speed recording, Optical 3D deformation measurement

Hydraulic pressure cycle test

Test	
Pressure:	up 1.400 bar
Curve:	sinus
Frequency:	max. 10 cycles / min
Accuracy:	±2 bar
Fluid:	Water-Glycol-Mixture
Cylinder	
Length:	up to 4.000 mm
Diameter:	up to 1.000 mm
Volume:	up to 300 liter
Measurement:	expansion volume, circumference, diameter, length, temperature (fluid & atmosphere), pressure
Options:	bend / torsion stress, optical 3D deformation measurement
Pre-treatment:	Chemical, Thermal, Flaw, Drop, Crash

Extreme temperature pressure cycle test

Test	
Pressure:	up 1.400 bar
Curve:	Sinus
Frequency:	max. 10 cycles / min
Accuracy:	±2 bar
Fluid:	Heat transfer fluid
Cylinder	
Length:	up to 4.000 mm
Diameter:	up to 1.000 mm
Volume:	up to 200 liter
Temperature	Fluid & Atmosphere
maximum:	≥ +85° C (high humidity)
minium:	≤ -40° C
Measurement:	expansion volume, temperatures, pressure
Options:	Optical 3D deformation measurement

Accelerated stress rupture test

Pressure	
Maximum:	MAWP (e.g. 875 bar)
Accuracy:	±2 bar
Duration:	e.g. 1000h (42 days)
Cylinder	
Length:	up to 3.000 mm
Diameter:	up to 800 mm
Volume:	up to 200 liter
Temperature	Atmosphere
Maximum:	≥ +85° C
Measurement:	expansion volume, circumference, diameter, length, temperature (fluid & atmosphere), pressure

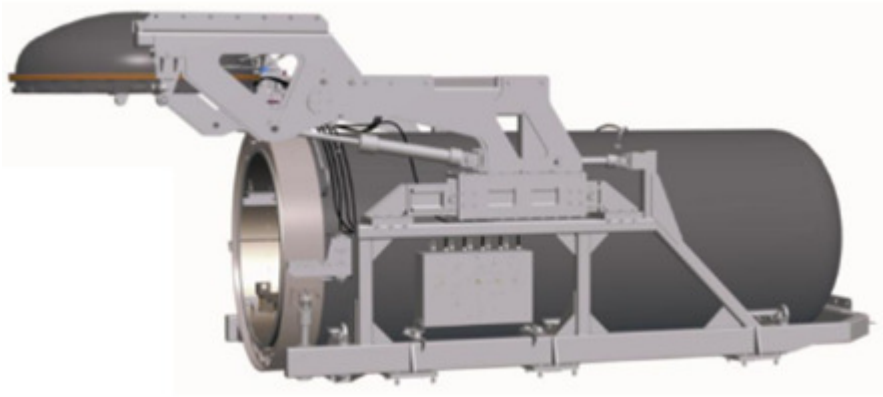
Bonfire & penetration test

Test	
Pressure:	up 1050 bar
Fluid:	H2 or N2
Cylinder	
Length:	up to 4.000 mm
Diameter:	up to 1.000 mm
Volume:	up to 500 liter
Temperature	up to +1000° C
Projectile	≥ 7,62mm

TesTneT Maximator GmbH

established MAY 2018

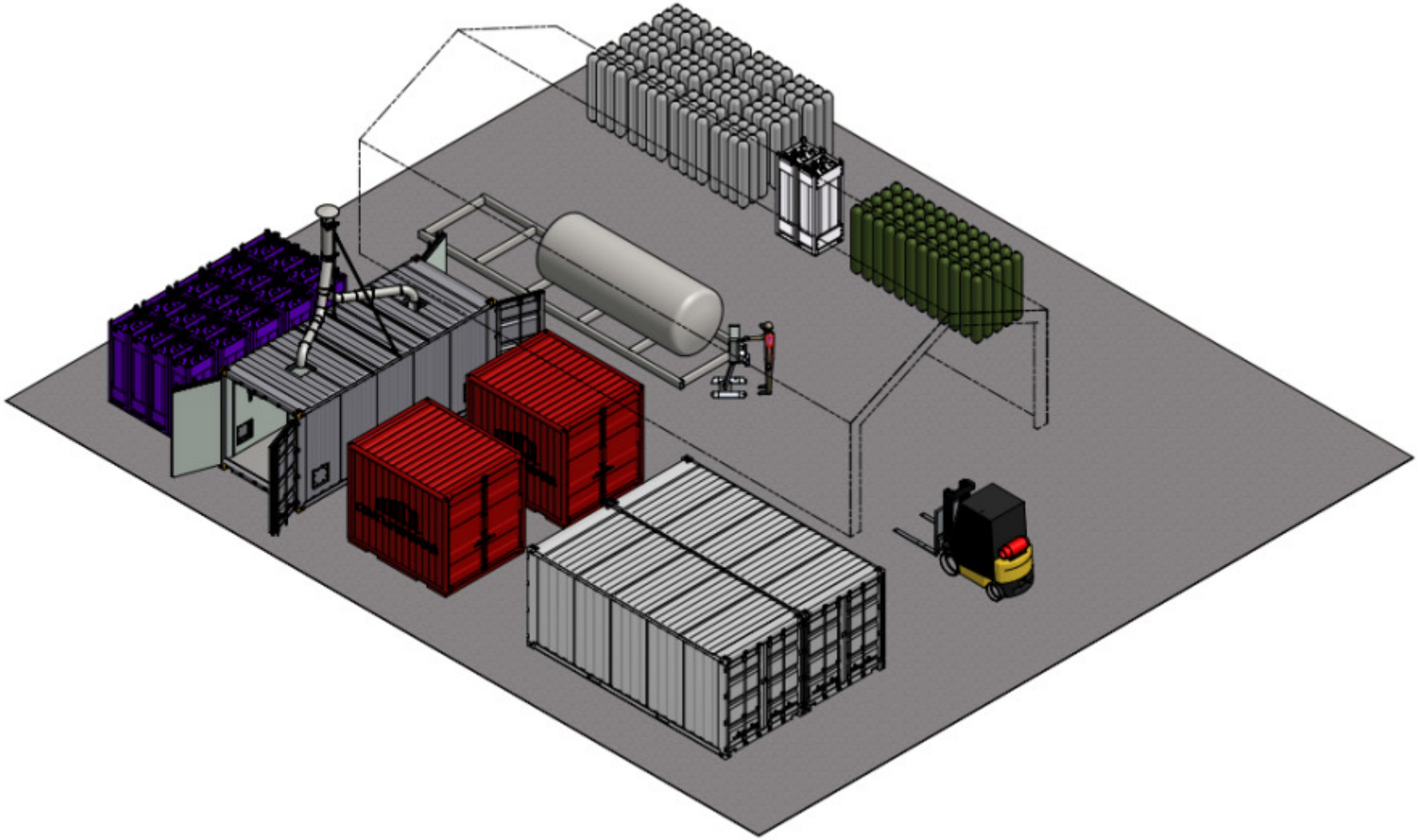
Hydrogen gas cycle test



- Start of operation: Q1/2019
- Location: Munich, Germany
- Certification tests according EC79, SAE, GTR, ECE R134 and so on
- Special tests with possible major leak or rupture (e.g. hydrogen cycle test after crash or with chemical exposure)

Test	
Pressure:	up to 1.050 bar
Frequency:	<1 cycle / h
Fluid:	hydrogen
Cylinder	
Length:	up to 2.500 mm
Diameter:	up to 600 mm
Volume:	up to 150 liter (~6 kg H2)
Temperature	
Atmosphere:	-60 … +120° C
Hydrogen:	-60 … +60° C
Measurement:	length, diameter, circumference, temperatures, pressure
Pre-treatment:	Chemical, Thermal, Flaw, Drop, Crash, Hydraulic Cycling, etc.

Facility layout



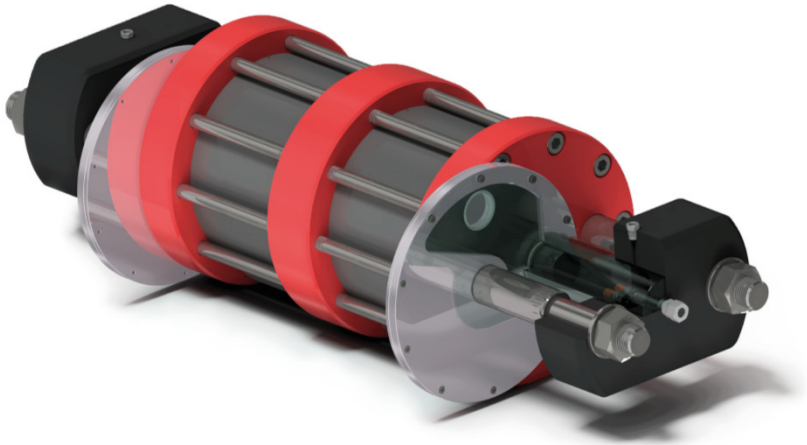
MAXIMATOR®
Advanced Technology

Maximator Advanced Technology

established NOV 2017

The MAT is the Development and Engineering Team of excellence under the direction of Robert Adler

- Employees: 7
- Location: Vienna (Austria)



MAX-Compression

Air driven compressor with nearly 100% efficiency

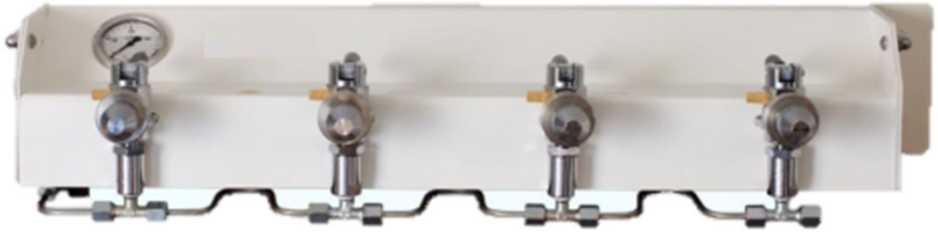
- 2 stage compressor
- Min. inlet pressure: 23 bar
- Max. inlet pressure: 400 bar
- Max. discharge pressure: 950 bar
- Max. capacity: 100 kg/h H2
- Average capacity: 50 kg/h H2
- Stroke speed (one direction): 0,1 - 1 Hz
- Downtime during seal maintenance max. 3 minutes
- ASX technology (protected by patent)

MAXIMATOR®
Gas Solutions

Maximator Gas Solutions

established MAY 2018

Products of Maximator Gas Solutions



Thank you very much for your attention!

Any questions?

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