

VOSS

SAFETY AT EVERY PRESSURE RANGE.

Customized fluid and thermal management systems
for hydrogen and fuel cell technologies.



www.voss.net

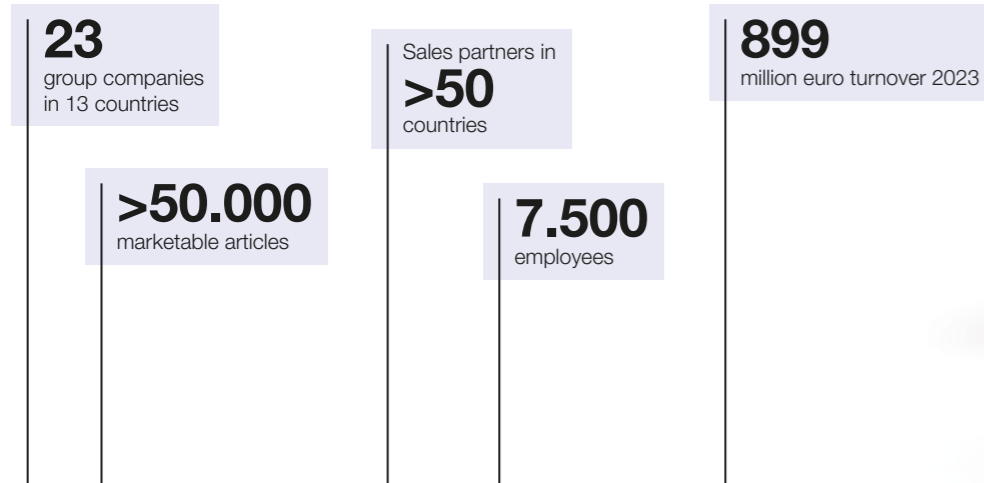
That's who we are

Fluid management for vehicle and machine construction

As a larger medium-sized group of companies, VOSS develops and produces line and connection systems for the automotive industry and mechanical engineering. The success of the VOSS Group is based on great customer proximity, committed employees, innovative products and the demand for permanent top quality for customers with the highest requirements.

With strategic corporate development, a responsible awareness of people, the environment and the region, VOSS has evolved over the past 90 years to an internationally successful group of companies.

VOSS in figures



Competence for high- and low-pressure

Our system competence. Your added value.

Our competences are the development and production of customer-specific system solutions for the fluid management of mobile as well as stationary applications. In doing so, we serve the entire spectrum along the hydrogen value chain. From the high-pressure range, such as in the production, storage or transport of hydrogen, via the low-pressure range in the fuel cell to the thermal management of the cooling circuits, VOSS designs solutions tailored to customized requirements.

Our extensive product portfolio includes installation space-optimized line and connection technology as well as supplementary system components such as valves, sensors or manifolds. Depending on the purpose, these are optimized directly for hydrogen applications. In this way, customers and users benefit from the system competence of the entire VOSS Group. This includes not only our innovative product solutions but also our comprehensive services:

- Vehicle analysis and benchmarking
- Innovative product and system development
- Continuous accompanying simulations and FE analysis
- Rapid prototyping and pre-series production
- Validations and tests during the entire product development process
- Worldwide standardized production and assembly processes
- In-house toolmaking
- Intelligent logistics concepts
- First installation advice & service also after series production
- Extensive theoretical and practical training
- Worldwide availability of our products & services
- Comprehensive certifications and compliance with the highest quality standards

Applications

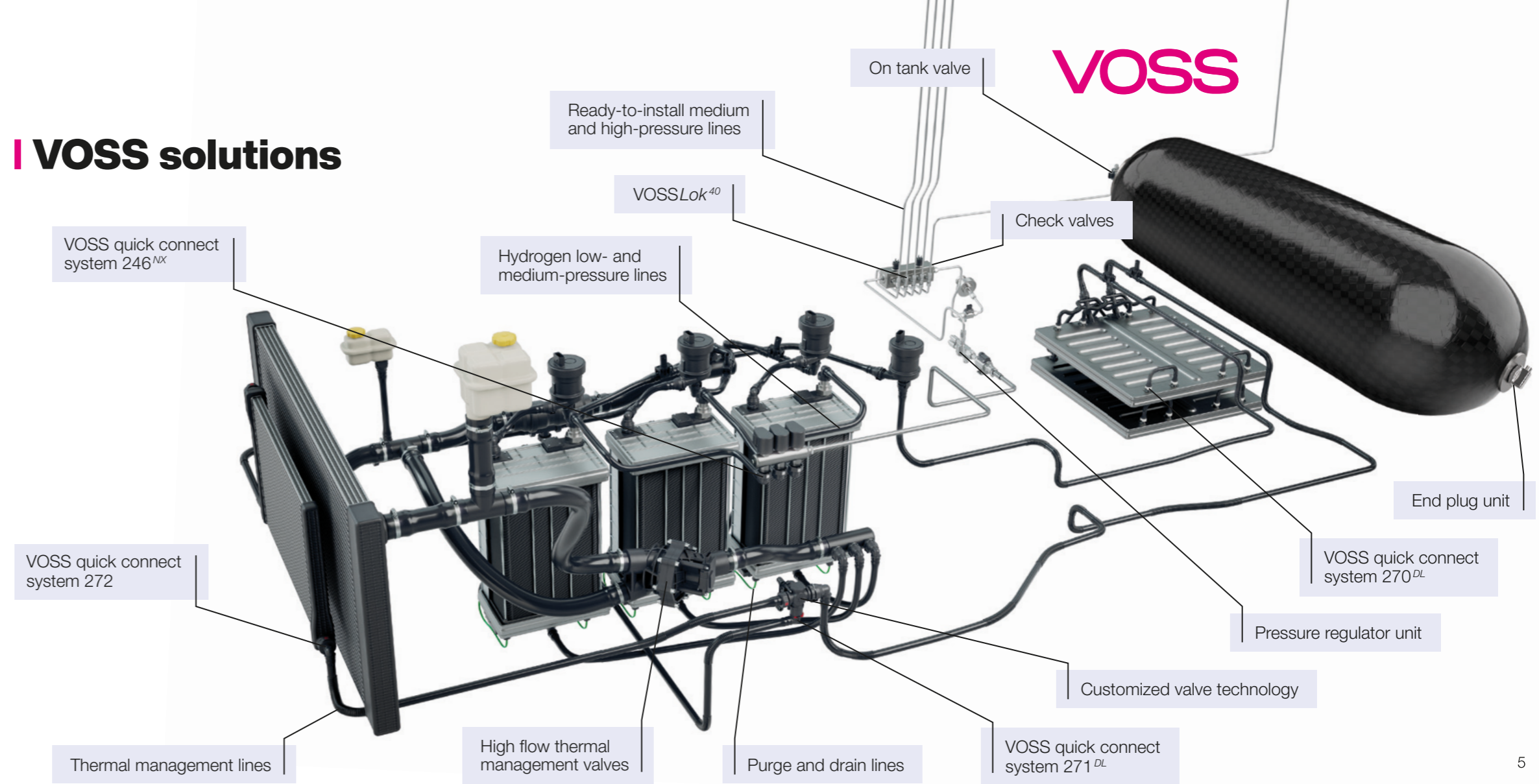
Mobile applications



Stationary applications



VOSS solutions

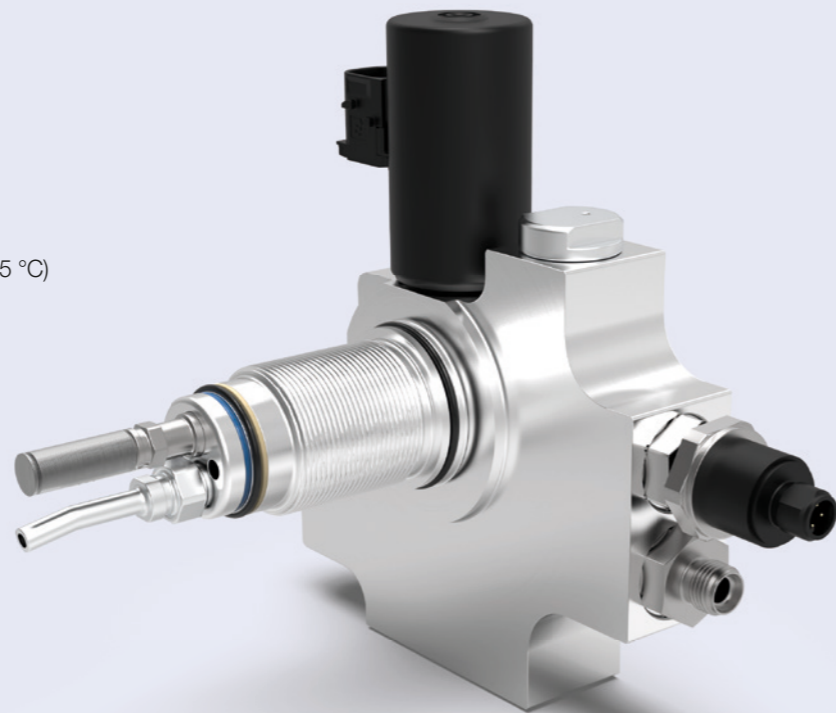


Components for hydrogen applications

On tank valve

Compact interface between vessel and tube system for high flow refueling and withdrawal the hydrogen

- Consisting of various safety-related valve types and a filter system
- For the application of gaseous hydrogen
- Nominal pressure: 700 bar/15 °C (maximum working pressure: 875 bar/85 °C)
- Temperature range: -40 °C to +85 °C
- Supply voltage: 12/24 -4/+5 V
- Mass flow:
 - Fueling: > 120 g/s
 - Defueling: 2-12 g/s adjustable ($p > 20$ bar)
- Weight: ca. 2,200 g
- Dimensions: 206 x 173 x 150 mm (installation height above tank 37 mm)
- Interface for high-pressure connection: 2x VOSSLok⁴⁰ MM06 studs (metallic sealing)
- Other connection systems possible on request



End plug unit

End plug unit for hydrogen tanks with integrated thermal safety relief valve (TPRD) and tube connection for vent line

- Individual alignment for line connection possible
- Nominal pressure: 700 bar/15 °C (maximum working pressure: 875 bar/85 °C)
- Temperature pressure relief device: 110 ±5 °C
- Temperature range: -40 °C to +85 °C
- Weight: ca. 640 g
- Dimensions: 206 x 173 x 150 mm



Components for hydrogen applications

Pressure regulator unit

Installation space-optimized, mechanical pressure regulator for hydrogen applications with integrated pressure relief valve and sensors

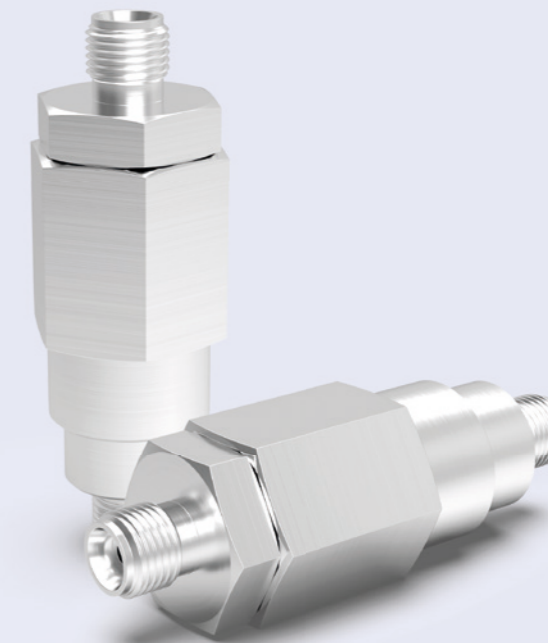
- Realization of different output pressures of the control unit and activation pressures of the pressure relief valve
- Temperature range: -40 °C to +85 °C
- Mass flow: 6 g/s, at p<30 bar
- Weight: ca. 3,000 g
- Dimensions: 88 x 78 x 184 mm
- Low-pressure side with pressure relief valve:
 - Sensor working range: 0-25 bar
 - Nominal pressure: 8-25 bar +/-1.5 bar
 - Port: VOSSLok⁴⁰ MM12 (metallic sealing)
 - Set pressure relief device on venting side PRV: 10-30 +/-1.5 bar
- High-pressure side:
 - Sensor working range: 0-1,000 bar
 - Nominal pressure: 700 bar/15 °C (maximum working pressure 875 bar/85 °C)
 - Port: VOSSLok⁴⁰ MM06 (metallic sealing)



Check valves

Customized check valves for controlled flow in the hydrogen system

- Different sizes and designs available (inline and screw-in version)
- Nominal pressure: 700 bar/15 °C (maximum working pressure: 875 bar/85 °C)
- Temperature range: -40 °C to +85 °C
- Opening pressure < 1 bar (customized on request)
- Weight: ca. 110 g (depending on variant)
- Dimensions: ca. 74 x 24 mm (depending on variant)
- Port: VOSSLok⁴⁰ MM06, also possible in other connection sizes



Components for hydrogen applications

Ready-to-install medium- and high-pressure lines

Customized, ready-to-install tube systems, specially developed for hydrogen systems

- Bended stainless steel tubes with perfectly matched individual components
- Special materials upon request
- End facing machining for different connection systems, e.g. VOSSLok⁴⁰
- Completely pre-assembled modules
- Integration of flex lines upon request
- Different cleanliness standards according to customer requirements
- Upon request, with 100% inspection of tube geometry and tightness



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Connection system - VOSSLok⁴⁰

Tube forming system for a safe and easy handling of connections in hydrogen applications

- Approved according to EC79 / EU No 406/2010
- Additionally approved in several prototypes, field tests, pre-series and also series of renowned OEMs
- Very simple and process-reliable pre-assembly and final assembly
- Reduction of leak paths thanks to high finish quality of the forming
- For metric and imperial tube dimensions
- High precision sealing even with volatile media (e.g. hydrogen) and at very high system pressures (700 bar), but also for low-pressure applications - one system for all requirements
- Fast and more process-reliable forming process
- Also applicable for CNG, LNG, LPG and various other industrial gases



Components for hydrogen applications

High flow thermal management valves

Customized valve solutions for thermal management applications with large volume flows

- 3/2- & 2/2-way proportional valves
- Volume flow: 400 to 650 l/min
- Valve pressure drop: < 150 mbar @ 450 l/min
- For hose connections with inner diameter 50 mm
- Minimal leakage flows
- Max. operating pressure of up to 3.5 bar



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Customized valve technology

Future-oriented valve solutions for thermal management Applications

- Broad spectrum of expertise: mechanically, pressure, thermally and electrically actuated valves
- In-house developed actuators with tailor-made communication protocols
- Integration of VOSS quick connect systems possible
- Modular design concept for individual requirements
- Combination with customer-specific manifolds and connectors
- Minimal leakage flows
- Easy integration into function-integrated system solutions (modules)



Components for hydrogen applications



Hydrogen low- and medium-pressure lines

Tailored line concepts for the distribution of hydrogen

- Unheated lines with innovative VOSS QC system
- Multi-layer tubes made of electrically conductive inner layer, media-resistant EVOH intermediate layer and robust PA outer layer
- Temperature range -40 °C to +90 °C
- Operating pressure 21 bar
- H₂-leak tightness: <10 Ncm³/h

✚ with innovative VOSS QC system made of conductive plastic for maximum safety and tightness in fuel cell systems

- Firmly bonded connection to the plastic multilayer tube
- Autolatch function for automatic latching of the retaining element after successful connection
- System-specific connection contour based on the VOSS QC system 270
- Quick and safe (dis)assembly
- Available in nominal size 14, other sizes on request
- Temperature range -40 °C to +90 °C
- Operating pressure 21 bar

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Purge and drain lines

Ready-to-install line assemblies for deionized water and nitrogen

- Electrically heated lines with VOSS QC system 246^{MX}
- Customized line routing with corrugated plastic tubes preventing heat loss and contamination
- Precision sealing connection of tube and connector by laser welding
- Integration of sensors possible
- Reliable and efficient defrosting performance
- Various operating voltages and strategies, e.g. PWM
- Temperature range -40 °C to +100 °C
- Operating pressure 2.5 bar, higher pressures on request

✚ with VOSS QC system 246^{MX} made of plastic für quick and safe assembly and disassembly

- System-specific 246 connection contour for low height of aggregate connections and adapters
- High positive engagement of release clip to connecting profile allows higher pressures
- Release mechanism can be rotated into eight different positions for easy access
- Nominal sizes 8 and 12 for different tube sizes
- Temperature range -40 °C to +120 °C
- Operating pressure max. 2.5 bar, higher pressures on request
- Optionally available as electrically heated variant
- Reliable and efficient defrosting performance

Components for hydrogen applications

Thermal management lines

Individual solutions for coolant distribution based on line routing and function integration

- Integration of different connection systems, e.g., VOSS QC systems 270, 271, 272 and 246^{MX}, or special solutions according to VDA standard
- Realization of minimum installation space
- Component and installation space optimization through function integration in customer-specific manifolds and connectors
- Integration of temperature sensors possible



- Leak-tight and maintenance-free media-bearing systems along the entire service life of the vehicle
- Minimized pressure losses
- Hydraulic balancing through defined cross-section changes
- Various combinations of hose and tube, plain and corrugated tube, or straight and preformed lines possible
- Customized flexibility by different corrugated tube wave shapes

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VOSS quick connect system 271^{DL}

Robust plastic plugs for the fir-tree connection of plastic tubes

- Suitable for components with recessed ports, or with material for profiled bores
- Quick and safe assembly
- Double Lock (DL) for additional safety and active confirmation of the correctly connected QC system
- Very low system height
- Release mechanism can be supplied in two different positions for easy access
- Nominal sizes S6, S10, S14, S18
- Temperature range -40 °C to +85 °C
- Operating pressure max. 2 bar



Components for hydrogen applications

VOSS quick connect system 270^{DL}

Robust plastic couplings for the fire-free connection of plastic tubes

- Particularly suitable for connections to filigree cooling plates and similar components
- Quick and safe assembly
- Double Lock (DL) for additional safety and active confirmation of the correctly connected QC system
- Very low system height
- Release mechanism can be supplied in two different positions for easy access
- Nominal sizes S6, S10, S14
- Temperature range -40 °C to +85 °C
- Operating pressure max. 2 bar



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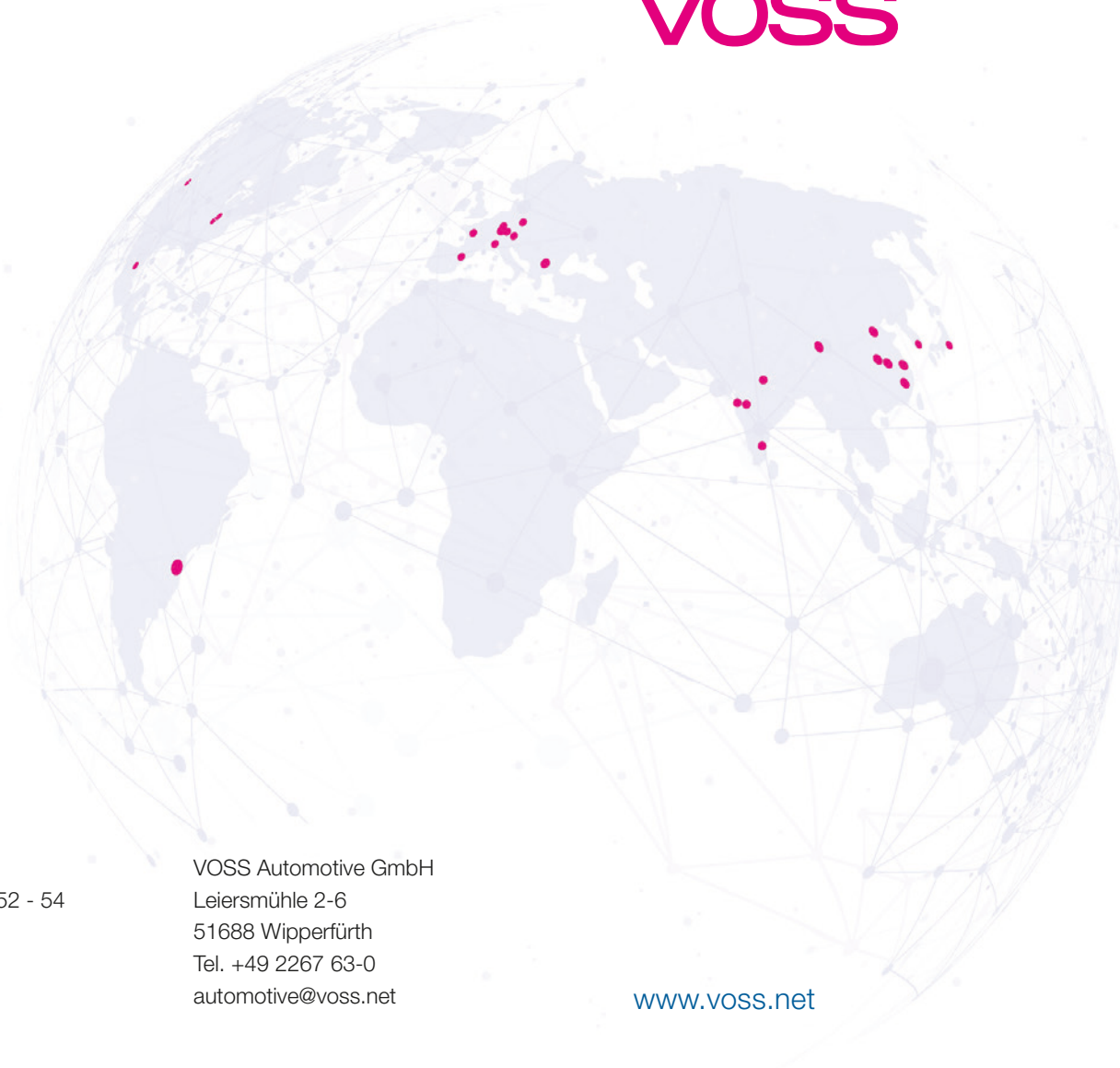
VOSS quick connect system 272

Function-optimized QC systems for thermal management solutions

- System-specific connection contour according to VOSS QC system 270
- Fast and 100% secure installation thanks to autolatch function (automatic engagement of the retaining element after successful insertion)
- Pressure-locked retaining element (no release of the connector possible under pressure)
- Reduced insertion force due to optimized installation of the O-ring
- Minimum installation height
- Retaining element available in four different positions for easy access
- Optionally available with visible locking indicators
- Nominal sizes S6, S10, S14, larger sizes available on request
- Temperature range -40 °C to +85 °C
- Operating pressure max. 2 bar



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