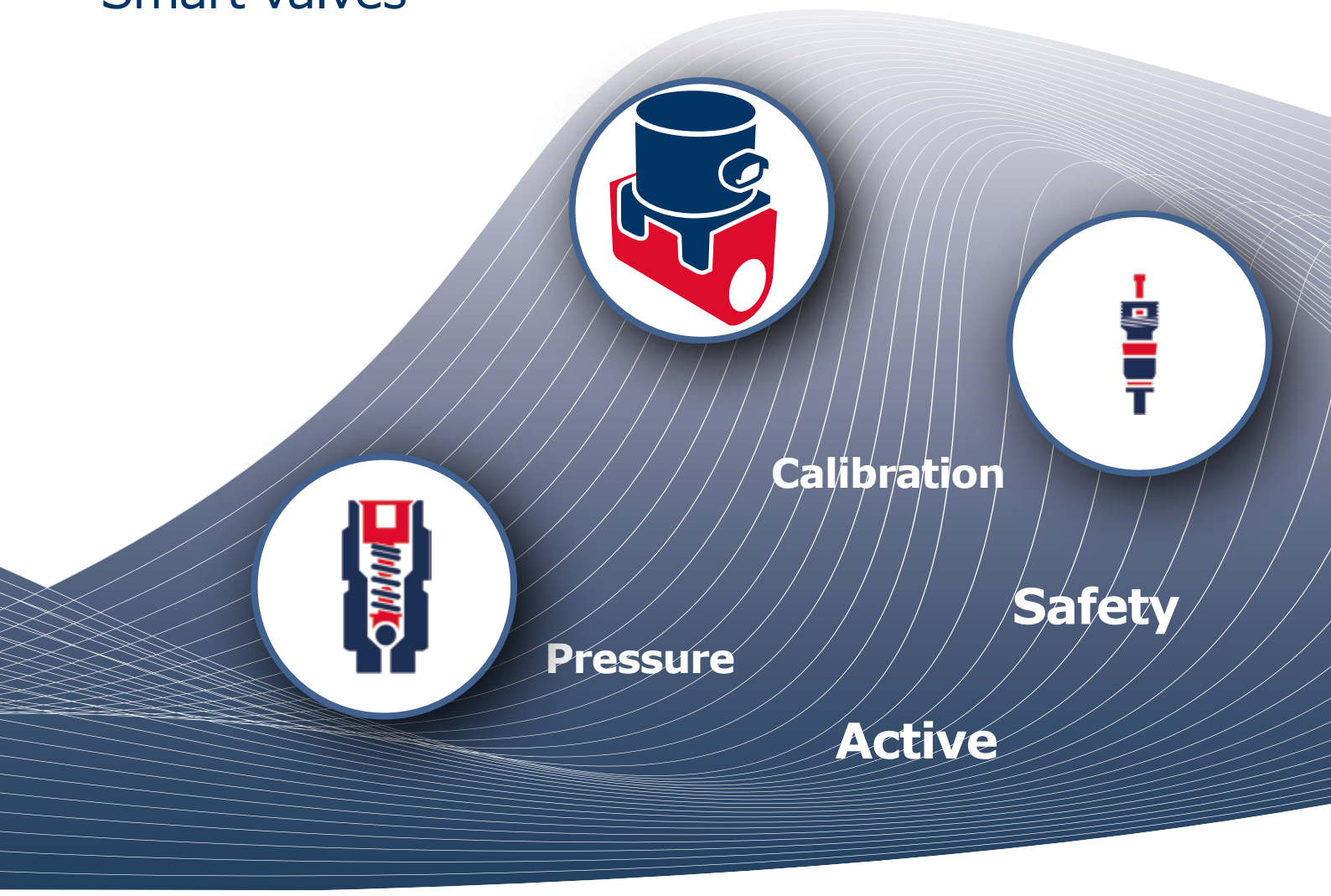
SCHRADER PACIFIC®
Advanced Valves

FLUID CONTROL

Highly engineered valves
Smart valves



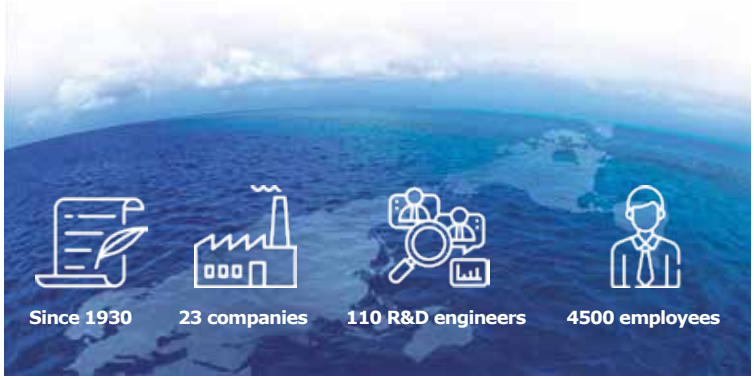
Reliable and innovative.

Pacific Industrial Co Ltd, our parent company

Schrader s.a.s parent company named Pacific Industrial Co LTd develops and produces stamping and molding products, fluid control products, electronic control devices, and Tire Pressure Monitoring Systems (TPMS) for automobiles.

The headquarter is located in Ogaki, Japan.

Pacific Industrial's company as a glance:

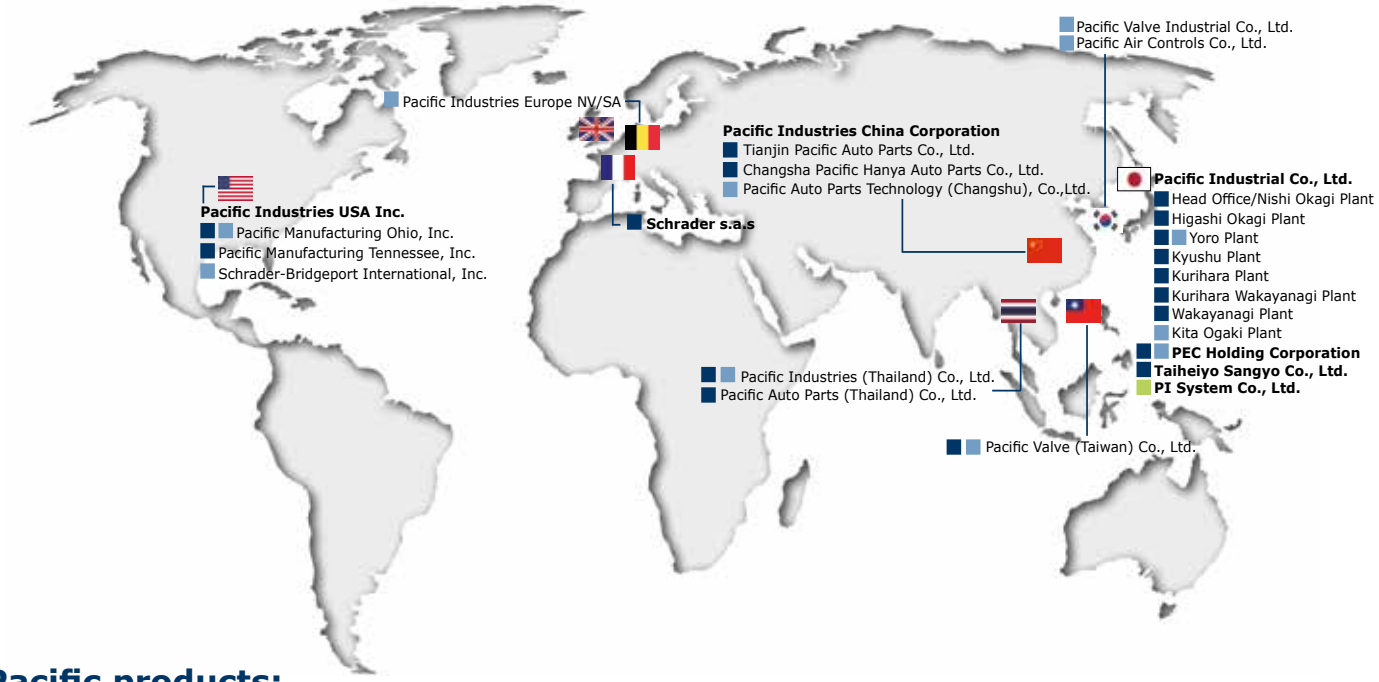


Global Footprint:

Stamping & molding Product Business

Valve Product Business

Information / Service Business



Pacific products:

Molding products

Stamping

Fluid control devices

TPMS

Schrader s.a.s know-how

Schrader s.a.s designs and manufactures highly engineered valves that improve safety, system efficiency and comfort for millions of people every day. Schrader s.a.s boasts extensive know-how in fluid management, fluid mechanics and mechatronics.

The Schrader s.a.s fluid control devices are used in the automotive, aeronautics, industrial, heavy vehicles, air conditioning, medical, telecommunications and energy transport circuits industries.

Schrader s.a.s means fluid control and pressure management for a large range of fluids such as air, nitrogen, oxygen, air-conditioning gases, water, fuels, oils, hydrogen, ammonia…and for any pressure level.

Thanks to our knowledge in fluid behavior, in mechanics, as well as our expertise in mechatronics, we develop and industrialize any new fluid control solutions for any application.

The Schrader s.a.s engineers have expertise in micromechanics and are able to design micro-valves.

Many valves are available on shelf and Schrader s.a.s does custom engineering and design for fluid control systems.

Fluid control devices:

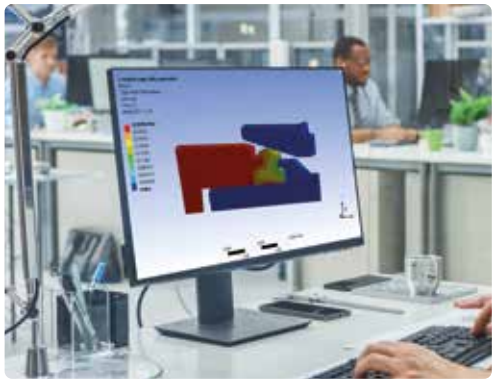
- Shut Off valves
- Check valves
- Pressure regulators
- Safety valves
- Connectors
- Smart Valves
- Dosing valves

Engineering and R&D Excellence: Mechanics, Fluidics and Mechatronics

To design the fluid control devices, Schrader s.a.s can build on:

- Specific and strong knowledge in mechanics, fluidics, material, surface and thermal treatment and electronics
- Capacity of prototyping and numerical simulation (mechanics, fluidics, magnetics and plastic molding)
- An organization in project mode to have best management and best efficiency
- A large laboratory for environment, mechanical and functional validation testing with ability to develop laws for reliability.

Schrader s.a.s R&D is equipped with all the tools needed to dimension and secure conceptions through simulations.



All this work is mainly performed during our development deliverables in phases 0 and 1.

Ansys product suite is used:

- CFD (Fluidic simulations)
- Mechanical (Mechanic and Thermal simulations)
- Maxwell (Electromagnetic simulations)

Schrader s.a.s R&D is equipped with the Simulink & Simscape suite to prototype virtually any concept in the design phases:
Ex: Combination of Fluidic / Mechanical / Electromagnetic / Electrical / Thermal physics

Schrader s.a.s laboratory:

Schrader s.a.s owns all the testing means requested to validate the new fluid control devices: tests benches for mechanical, environmental, tightness, cleanliness validations.

Schrader s.a.s also has the capacity to develop some specific benches.

Manufacturing Excellence

Schrader s.a.s can employ the most cost-effective process solution for each product:

- Wide variety of Machining technologies available (CNC, multispindle, high speed special machining machines)
- Rubber Over-molding
- Plastic Molding
- Cleaning machine
- Special Assembly lines with integrated control systems:

  - Leak Control
  - Pressure Calibration
  - Opening Pressure Control
  - Flow control
  - Camera control
  - Assembly in clean room

Quality policy:

As a supplier of smart valves for safety applications, Schrader s.a.s has to ensure the best quality level for its customers:

- Zero defect policy
- Highest quality solutions via high automation
- Proven track record
- Trusted partner

Our certificates:

ISO 9001, ISO 14001, ISO 45001, IATF 16949

SHUT-OFF VALVES

Features:

Shut-Off Valves allow permanent or temporary access into a pressurized circuit or tank.

The Shut-Off range is able to satisfy a great majority of life cases.

Technical specification:

- **Opening Pressure**: 0.99 to 700 bar
- **Temperature range**: -40°C to +180°C
- **Flow rate**: 6 m^3/h - 35 m^3/h under 7 bar
- **Tightness**: 0.206 cm^3/min under 6 bar
  example: less than 1 gr CO2 /year in an AC system
- **Assembly**: screwed or pushed
  (highly recommended for a plastic body)
- **Fluid**: gaseous or liquid

Strengths:

Well known products by Schrader s.a.s

- **Robustness** regarding the specification submitted
- **Large range** of part numbers for different applications
- **Cost efficient**
- **100% air leak control**

Examples of applications:

- Air conditioning system filling port, including vacuum stage
- Fuel module coupling port
- Engine purge valves
- Engine service valves
- Pressure accumulator
- Gas springs
- Medical: oxygen cylinder and respirator

For more details, please refer to our documentation PU162 V4

CHECK VALVES

Features:

A **check valve** is added on the circuit to avoid **any back flow**.

Check valves are delivered as a:
- **Cartridge** directly fitted in a hose or pushed in a (plastic, aluminum…) cavity
- **Hose to Hose** device

A complete line of check valves is available with different sizes, materials, designs and technologies depending on customer environments.

Technical specification:

- **Opening pressure**: according to the dynamic requirement
- **Temperature range**: -40°C to +200 °C
- **Flow rate**: designed according to the specification
- **Tightness**: Schrader s.a.s has developped a specific software which allows to design the right tigthness according to the life conditions
- **Dimensions**: according to the drop pressure requested
- **Fluid**: gaseous or liquid

Strengths:

Thanks to Schrader s.a.s technology, one poppet and one spring are sufficient to satisfy most of the specifications.
Included high frequency flow change till 20 Hz during millions of cycles.

Examples of applications:

- Fuel circuit (gasoline or diesel)
- Air conditioning system
- Hydraulic circuit
- Medical devices
- All types of pump…

PRESSURE REGULATORS

PRESSURE REGULATOR WITH LOW PRESSURE DROP:

The **Pressure Regulator** maintains a stable pressure for any fluid. A stable pressure improves significantly the system efficiency. Thanks to an **innovative** technology, Schrader s.a.s Pressure Regulators are able to ensure a very small variation in pressure for a large flow range with few components.

The innovation consists of a specific spring developed by Schrader s.a.s which allows to have a double guiding of the piston into the body without any additional component. This is thanks to a cylindrical conical spring. This guiding is essential to have a good pressure regulation and a good sealing. The regulated pressure is calibrated by welding or screwing a cap. The cylindrical conical spring allows also to have higher flow through the valve. The value analysis is optimum, the functionalities are guaranteed with few simple components and consequently the cleanliness is improved.

Advantages:

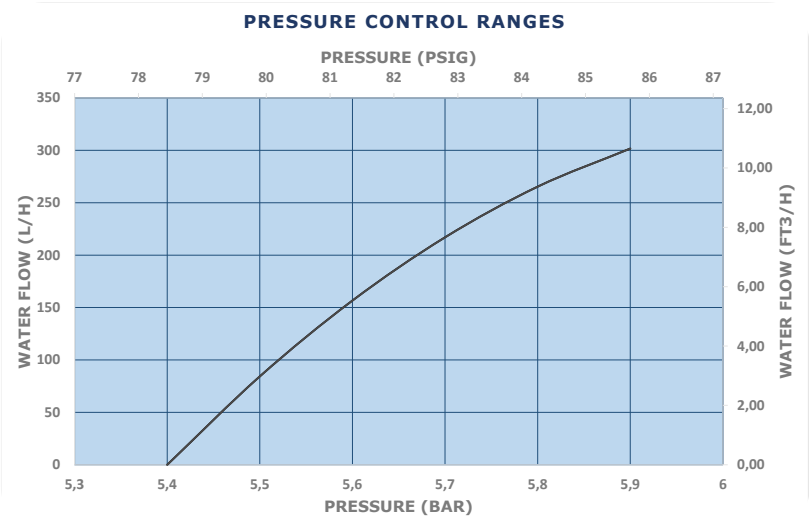
- **A design with few components:** cost advantages and high reduction of risk of pollution
- **Stable pressure** for a wide flow range
- **Large flow regulated**
- **100% control** of the calibrated pressure during the assembly process
- **100% control** of the leak rate

Technical data:

- **Pressure opening:** 5.4 ±0.25 bar
- **Leak rate when closed:** < 3 cm^3 at 1 bar

Schrader s.a.s is able to adapt the design to meet a large range of specification for regulated pressure and flow.

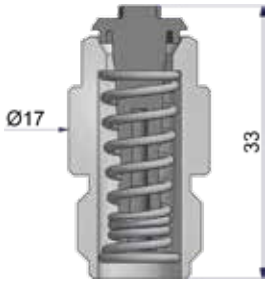
Graphs:



The design is perfectly adapted to liquid applications. Another design is proposed for gas applications.

Material of constructions and dimensions:

Body	Aluminium or stainless steel
Piston	Polymer
Spring	Stainless steel

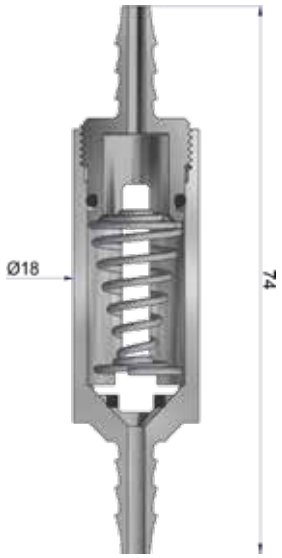


PRESSURE REGULATOR WITH A HIGH LEVEL OF TIGHTNESS:

for gas application for example

To achieve a high level of gas tightness which could be expressed for example in grams per year, Schrader s.a.s proposes also a design with a square seal on the piston. The technology of cylindrical conical comes in different technology of regulators.

The special square seal mounted on the piston ensures an accurate closing pressure and high performances of tightness. This design is ideal for gas applications.



Body and ports	Aluminium or stainless steel
Piston	Aluminium or stainless steel
Spring	Stainless steel
Seal	Rubber: FPM*

* The rubber choice can be changed in accordance with the environment

MEMBRANE PRESSURE REGULATOR INDEPENDENT OF THE OUTLET PRESSURE VARIATION:

Schrader s.a.s proposes also a pressure regulation with a membrane technology which has the benefit to regulate the pressure independently of the variation of the outlet pressure.

Advantages:

- **High stability of pressure regulation** with low pressure drop thanks to a special design
- **Dedicated elastomer membrane** which guarantees a long life time and high stability after ageing and pressure cycling
- **High ability to calibrate the opening pressure** thanks to a special combination of screwed cap and spring
- **Possibility to achieve high flow at a low pressure** (> 40 L/h at 0.9 bar)

Safety solutions: PRESSURE RELIEF VALVE

Features:

Schrader s.a.s Pressure Relief Valves protect circuits from overpressure.
The exhaust of the gas is fast and the PRV indicates the opening thanks to a flag.

Technical specification:

- **Opening pressure**: e.g. 120 to 160 bar ±10 bar
- **Hysteresis**: e.g. 15%
- **Temperature range**: -30°C to +180°C
- **Flow rate**: based on specification
- **Air tightness**: for example with R744 gas, less than 1 g/year in an AC system
- **Dimensions**: M12 or M14
- **Height**: 28 mm
- **Fluid**: air-conditioning gas (R134a, R1234yf, CO2), fuel (gasoline - diesel), gaseous or liquid

All these charateristics can be adjusted to customer needs.

Strengths:

- **Low hysteresis**
- **Very low permeability**: for example with R744 gas, less than 1 g/year in an AC system
- **Several opening and closing**: reusable product compared to a burst disc and not fatigue sentitive
- 100% calibrated and controlled during assembly
- **High temperature** resistance

Examples of applications:

- High Pressure Rail Engine
- Air-conditioning circuit and Air-conditioning compressor

QUICK CONNECTORS:

Features:

Connectors must be:
- **Safe**: appropriate position controlled by a Poka Yoke
- **Easy to fit** by the OEM and/or by Tier 1
- **Disconnection** with a tool or not
- **Cost efficient**
- The connectors exist with **additional functionalities:**
  - Shut off
  - Active functions
  - Sensors
  - Access valve

Technical specification:
- **Pressure range** (for metal design): -1 to 700 bar
- **Temperature range**: -40°C to +160°C (180°C)
- **Fluid**: gaseous or liquid

Strengths:
Schrader s.a.s uses innovative metal clip which allows to achieve all the functionalities with only one component. Moreover, the design of the clip ensures the right locking of the connector, the secure self-locking mechanism is very safe and highly stable. A bad lock is impossible with this technology.

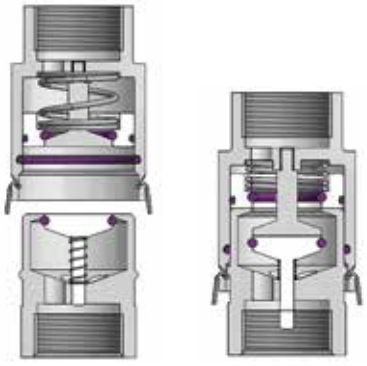
Examples of applications:
- All fluid circuit
- Adblue line
- Fuel line couplers
- Medical devices

NON-SPILL CONNECTOR:

Features:
Non-spill connectors are ideal to use in liquid cooling application. By reducing spillage of liquid to near zero, technicians can confidently connect and disconnect them without risk of drips that can damage or destroy equipments. Different connections are available like fir trees, hose to hose, screw etc... Connection is achieved with a clever stainless steel clip.

Technical specification:
- **Temperature range**: -40°C to +85°C
- **Flow rate**: up to 30 l/min with the current design
- **Operating pressure**: from vacuum to 3 bar
- **Outlet pressure**: 5.6 bar ±1 bar at 30 Hz
- **Dimensions**: according to the requested flow and drop pressure
- **Fluid**: water, coolant

Examples of applications:
- Battery pack cooling
- Ink management
- Electronic cooling



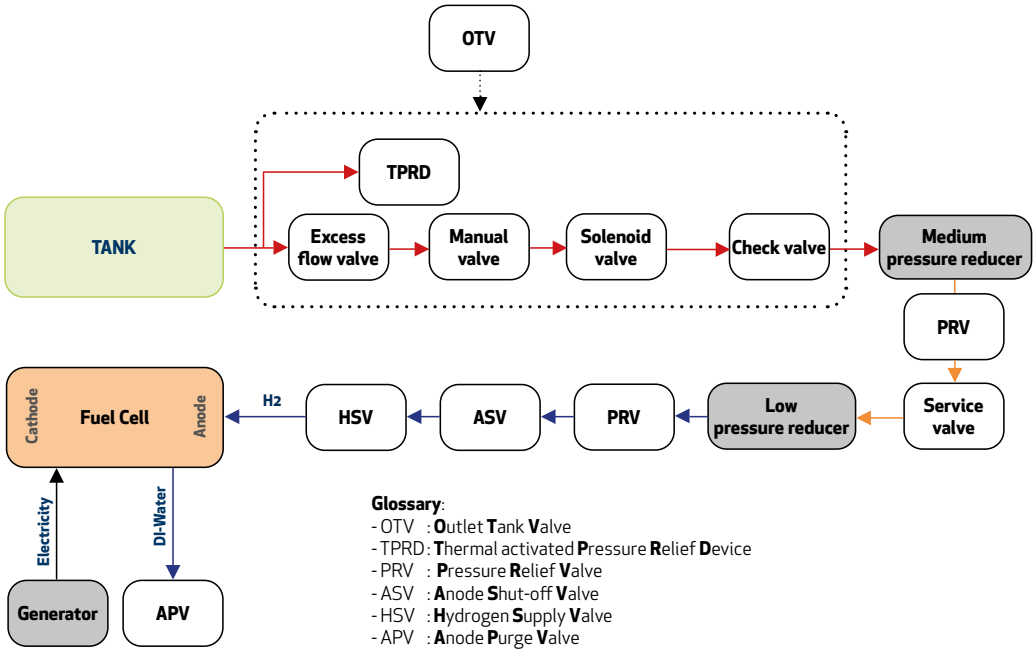
Disconnected Connected

VALVES FOR H2 STORAGE & FUEL CELL

Fluid control solutions for Hydrogen high pressure storage, H2 delivery system, fuel cell system

Based on Schrader s.a.s experience in fluid control especially in sealing, impermeability, connection, pressure calibration and regulation, Schrader s.a.s proposes also many customized designs of devices dedicated to H2 delivery system and fuel cell system such as H2 fittings, Pressure Relief Valve, Service Valve, Purge valve, Supply valve...

FLUID CONTROL DEVICES IN A H2 CIRCUIT & FUEL CELL:



Glossary:
- OTV : **O**utlet **T**ank **V**alve
- TPRD : **T**hermal activated **P**ressure **R**elief **D**evice
- PRV : **P**ressure **R**elief **V**alve
- ASV : **A**node **S**hut-off **V**alve
- HSV : **H**ydrogen **S**upply **V**alve
- APV : **A**node **P**urge **V**alve

VALVES FOR FUEL CELL:

Anode Purge Valve

Drains mix of DI water/H2 from the fuel cell

- **Nominal pressure**: -0.07 bar to 3 bar
- **Maximum sealing pressure**: 4 bar
- **Nominal flow**: 3 kg/h of N2 at 3 bar and 85°C
- **Leakage**: < 10 Ncm^3/h
- **Reaction speed**: < 15 ms
- **Voltage**: 18 to 32 Volt
- **Inlet diameter**: (3x) Ø 1.5
- **Outlet diameter**: Ø 2 mm
- **Max current**: < 1A
- **Drive method**: Direct current

Pressure Relief Valve (PRV)

Exhausts H2 in case of overpressure

- **Operating temperature**: -45°C to +93°C
- **Opening pressure**: 2 ±0.1 bar
- **Exhaust flow**: 7 g/s
- **External leakage**: < 10 Ncm^3/h
- **Inlet interface**: M24x1.5
- **Outlet interface**: Ø 1/2”

Shut off valve

Manages the H2 opening & closing circuit

- **Operating temperature**: -45°C to +93°C
- **Operating pressure**: 20 bar
- **Peak pressure**: 30 bar
- **Flow**: 2.5 g/s at 14 bar
- **External leakage**: < 10 Ncm^3/h
- **Connection interface**: hose to hose
- **Switching time**: < 100 ms
- **Drive method**: Peak and Hold
- **Actuating method**: semi direct

Fluid control devices for the Hydrogen storage

Fittings
Easy and secure connection of all the HP H2 circuit

- **Operating temperature**: -45°C to +93°C
- **Operating pressure**: 700 bar
- **Peak pressure**: 1050 bar
- **External leakage**: < 10 Ncm^3/h
- **Connection interface**: 7-16''-20 UNF
- For tube 3/8''and 1/4''
- **Dismountability**: 25 times
- R134 in progress

Schrader s.a.s designs also specific fluid management valves which are usually integrated in the On Tank Valve.

Excess Flow Valve (EFV) inside the OTV
In case a pipe would break, it will block the potential over flow

- **Maximum operating flow**: 1 g/s
- **Minimum activation flow** 1.5 g/s
- **Minimum working pressure**: 20 bar
- **External leakage**: < 10 Ncm^3/h
- **Connection interface**: integrated in OTV

Check Valve (CV) - inside the OTV
Prevent H2 back flow

- **Operating temperature**: -45°C to +93°C
- **Operating pressure**: 700 bar
- **Peak pressure**: 1050 bar
- Low pressure drop
- **External leakage**: <10 Ncm^3/h
- **Connection interface**: integrated in OTV

Multipoint Thermal activated Pressure Relief Device (TPRD)
Exhaust the H2 through the OTV in case of fire with a remote detection. The fire detection can be moved around the vehicule to trigger the draining from any wished location

- **Operating temperature**: -45°C to +93°C
- **Operating pressure**: 700 bar
- **Peak pressure**: 1050 bar
- **Opening temperature**: 110 ±5°C
- **Exhaust diameter**: 5.8 mm
- **External leakage**: < 10 Ncm^3/h
- **Connection interface**: 5/8''-18 UNF
- Quick activation time
- R134 in progress

Thermal activated Pressure Relief Devices are also available in local version.

ACTIVE VALVES FOR THERMAL MANAGEMENT (EV)

To offer a better fluid management to customers, Schrader s.a.s has the ability to control all the functionalities of the valves electronically: these are the smart valves.

Actuator, motor, sensor and controller are combined to the Schrader s.a.s valves proposing very compact designs = active shut-off valve, safety valves, by-pass valve, dosing valves and expansion valve.

In this context Schrader s.a.s proposes a complete range of valves giving an efficient thermal management of the electric vehicle's batteries. There are 2 product lines: one for the coolant circuit and another one for the gas circuit.

COOLANT VALVES:

Schrader s.a.s designs valves for the coolant regulation of the electric vehicles battery.
The coolant valves are available in different versions : 3 ways, 4 ways and 5 ways and they are designed to combine a maximum of functionalities.

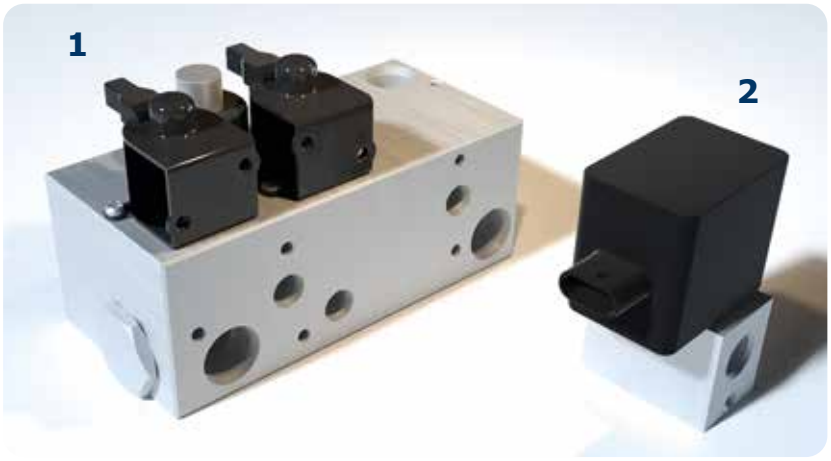
Schrader s.a.s Coolant Valves
1: 4 ways On/Off
2: 5 ways proportional
3: 4 ways proportional
4: 3 ways on/off or 3 ways proportional

Port quantity	3 - 4 - 5
Port size	diam. 16
Mode	Proportional or On/Off
Fluid	50% water-glycol
Voltage	9 to 16 V
Current	< 1 A
Pressure drop	0.2 bar @ 15 l/min
Internal leakage	< 30 cc/min
0 to 100% time response	5 s
Temperature range	-40 to +80°C
Weight	< 500 g
Operating pressure	3 bar
IP rating	IP67
Control type	LIN
Connection	VDA connectors NW16

ACTIVE VALVES FOR THERMAL MANAGEMENT (EV)

AUTOMOTIVE EXPANSION VALVES FOR AIR CONDITIONING CIRCUIT AND HEAT PUMP SYSTEM:

A complete product range is available:
- Expansion valves (EXV): Closed expansion (CE) & Closed expansion open (CEO)
- Bi-directional valves
- Shut-off valves
- Check valves (CV)



Schrader s.a.s Product Range:

1: Multifunction block with 2 shut-off valves, an EXV and a CV

2: Expansion valve (EXV)

	CE / CEO / Expansion valve	Check Valve
Refrigerant	HFC-134a, HFO-1234yf	
Temperature range	-40 to +120°C	
Operating pressure	35.3 bar	
Break-down pressure	> 88.3 bar	
Internal leakage	< 200 cc/min @ 10 bar	
Max. Pressure	24 bar	Operating pressure < 10 kPa
Operation speed	120 pulses per second	
Voltage	9 to 16 V	
Driving mode	Bi-polar, Half-step, CC (0.3 A/Ph)	
Insulation resistance	> 10 mΩ	
Dielectric strength	< 10 mA	

For any questions about **SCHRADER s.a.s.**, please contact:

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