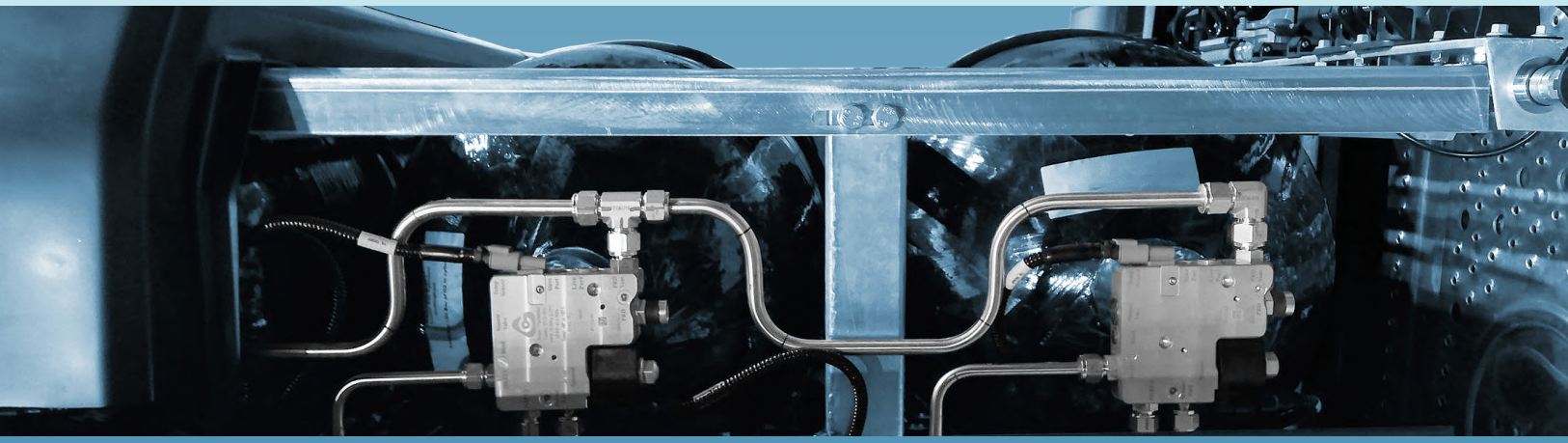
HYDROGEN FOR MOBILITY

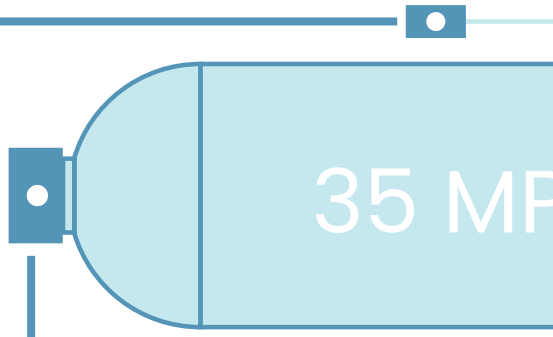


Cylinder Valves for Automotive Hydrogen Applications

cavagna group®

Wherever gas is used, we are there

HP1 - 350 bar Hydrogen REMOTE TPRD



IN/VENT ports:
9/16" - 18 UNF-2B

High-flow TPRD:
vented, glass bulb T=110±10°C

Certifications:
EC79 / R134

HP1 - 350 bar Hydrogen END PLUG TPRD

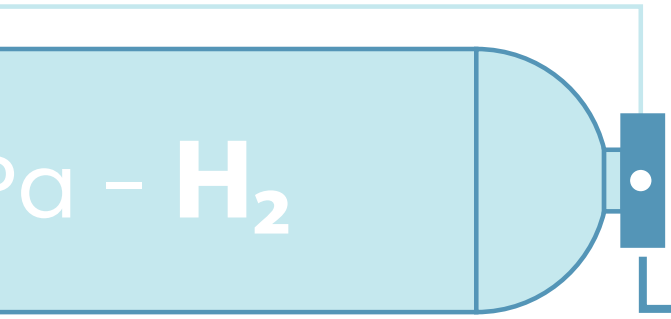
Tank connection:
2" - 12 UN or
1" 1/8 - 12 UNF

Vent Port:
9/16" - 18 UNF-2B

High-flow TPRD:
vented, glass bulb T=110±10°C

Certifications:
EC79 / R134

HS1 - Solenoid Hydrogen Valve



Lightweight aluminum High-flow valve:
CV: 0.86
Fast-filling: full flow at ultra low tank pressure
See graph for flow vs valve dP

High-flow excess flow valve:
No impact on filling flow
Easily calibrated
Auto reset

High-flow TPRD:
vented, glass bulb T=110±10°C

Pressure sensor port option:
SAE/ORB

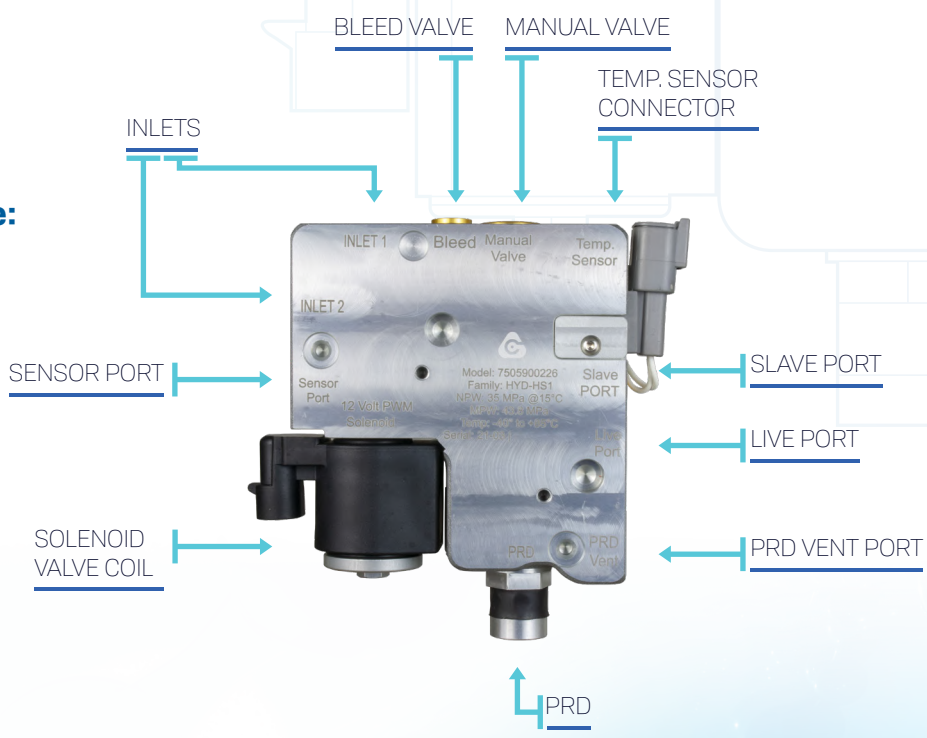
Low-torque/high-flow bleed valve:
Drive vehicle or drain tank
Life > 100 cycles

Live port: for remote PRD:
For optional remote PRD or sensor
IFS format (ø 6 mm or ø 8 mm)

Temperature sensor

Total Mass:
1072g

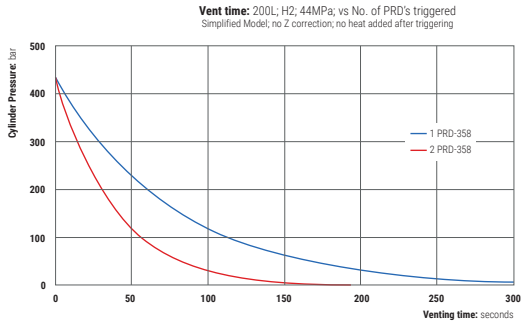
Certifications:
EC79 / R134



HS1 - Solenoid Hydrogen Valve

PRD vent time model

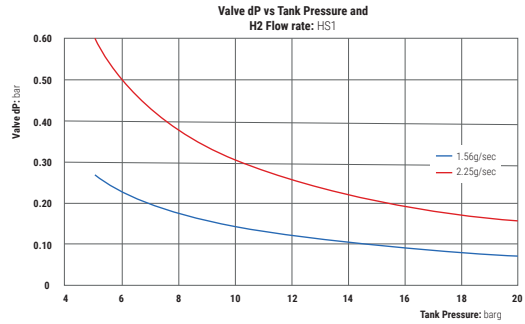
· Vent time directly related to number of PRD's triggered
· PRD meets hypothetical 5 minute goal on 200L tank



Low-pressure valve performance

Valve has capacity for full power performance at ultra-low pressures

· Avoids limp-home modes in low-fuel "emergencies"
· No flow loss at 5 barg (tank pressure)
· Valve has extra capacity in case higher demand fuel cells considered fo future ECEV's



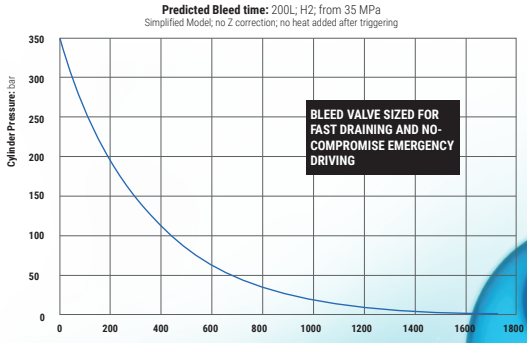
Bleed-valve performance model

Vent mode

· Fastest possible vent time (35 to 0.15 MPa) is 28.8 minutes if valve kept at full flow and outlet is unrestricted

Driving mode

· Solenoid by-passed
· 1.4g/sec available at very low tank pressure (no limp-home mode needed)



Bleed Valve dP at 1.4 g/sec	
Ptank (barg)	**dP** (bar)
5	1.63
10	0.69
15	0.46
20	0.34

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