

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±5°C

Certifications:
ECE R134

HP1 - 350 bar Hydrogen END PLUG TPRD



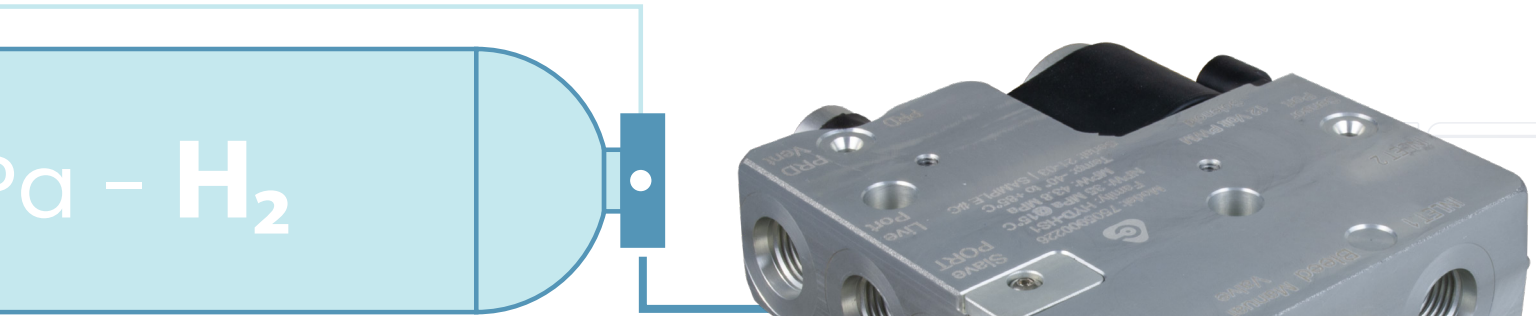
Tank connection:
2" - 12 UN or
1 1/8" - 12 UNF

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

High-flow TPRD:
vented, glass bulb T=110±5°C

Certifications:
ECE 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 $T=110\pm 5^{\circ}\text{C}$

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 ($\varnothing 6\text{ mm}$ or $\varnothing 8\text{ mm}$)

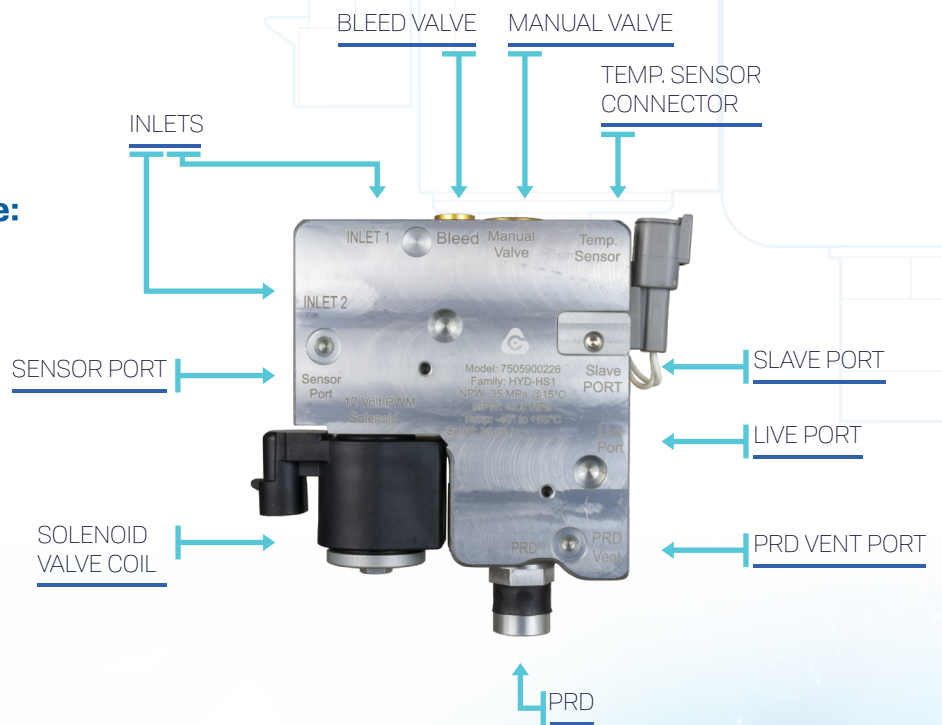
Temperature sensor

Total Mass:

1072g

Certifications:

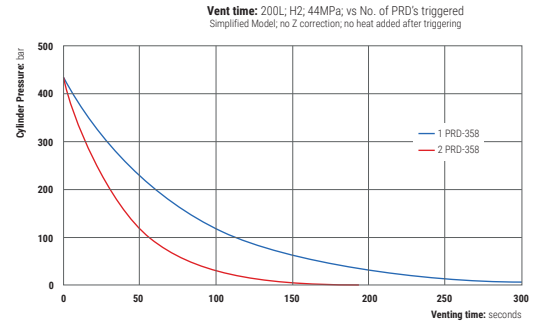
ECE R134



HS1 - Solenoid Hydrogen Valve

PRD vent time model

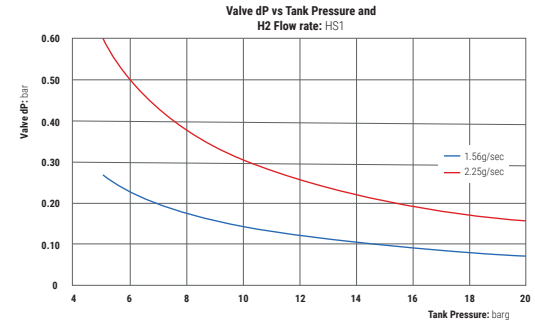
- Vent time directly related to number of PRD's triggered
- PRD meets hypothetical 5 minute goal on 200L tank



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 for future ECEV's



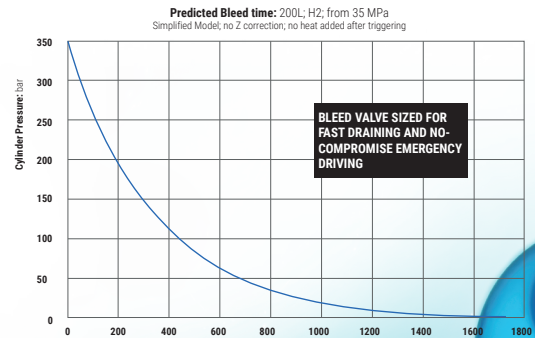
Bleed-valve performance model

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

P _{tank} (barg)	dP (bar)
5	1.63
10	0.69
15	0.46
20	0.34



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