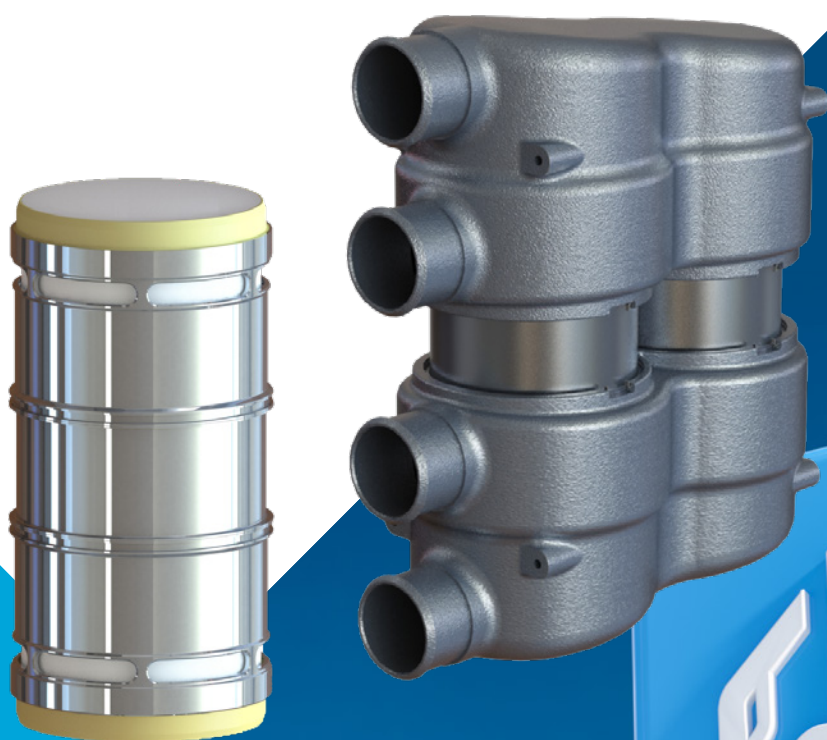


HUMIDIPOWER FUEL CELL HUMIDIFIERS

HOLLOW FIBER HEAT AND MOISTURE
EXCHANGER FOR FUEL CELLS



H₂
Hydrogen



GENERAL INFORMATION

Pentair is currently in development of a new line of humidifiers for hydrogen fuel cells. This humidifier is being carefully designed to handle extreme environmental conditions while still providing optimal humidification needs at low energy demand. The selectable fluid interface and orientation ensures the correct fit for your system.

Modular, scalable design and versatile interfaces with unlimited configurations ensures Pentair's humidifier will satisfy the needs of your fuel cell system design.

Pentair's next generation humidifier comes with several attributes that extend and exceed the traditional humidifier designs.

Target Specifications and Features	Humidipower Fuel Cell Humidifiers
Operating Range* (kW)	30 to 400 and beyond
Inlet Temperature	-30 to 110°C (-22 to 230F)
Connection ports	2" barb (50.8 mm)
Port connection orientation	180 degree increments
Freeze start	Yes
Mounting features	M6x1.0 mm Screw Interface

AVAILABLE OPTIONS

Option 1	Individual hollow fiber membrane modules for customer configurable connections.
Option 2	Complete assembly consisting of: - Two hollow fiber membrane modules - End caps/ports for connections
Option 3	Custom design. Contact us for custom design possibilities. Optimize your humidification and pressure loss or efficiency needs by partnering with Pentair for a custom end-cap design. Options include, but not limited to: multiple modules in parallel, variable bundle lengths, water drainage, sensor integration or bypass ports.



BENEFITS OF PENTAIR FUEL CELL HUMIDIFIERS

Benefit	Objective
Size, shape and weight	Competitive size and weight
Supply chain and scale	Vertically integrated: Pentair has extruded hollow fiber for over 20 years with in-house moisture transfer design team of engineers and also module manufacturing site producing over 40,000 hollow fiber modules per year with capacity to expand and global Pentair footprint.
Efficiency and performance	Pentair's designs enable the ability to provide adequate water transfer from stack exhaust to stack inlet with minimal pressure losses, and low overall product weight
Ease of use, customizable	<ul style="list-style-type: none"> • Easy access to mounting • Regulatory compliance • Highest allowable operating temperature • Versatile configurations and connection/interface capability
Durability	<ul style="list-style-type: none"> • Pentair's robust helically wound hollow fiber bundle design enables consistent performance for years of product life • Freeze-start capability • Aluminum housing design for maintaining product performance at extreme conditions and environmental challenges • Stable materials of construction with minimal impact on proton exchange membrane (stack)
Partnership	<ul style="list-style-type: none"> • ISO 9001 quality management system • Access and familiarity with AS9100 and other ISO standards • In-house engineering experts in hollow fiber moisture transfer and humidifier testing capability • Customer care team aimed at exceeding service expectations
Contributes to sustainability	Pentair's responsibility to provide products and solutions that make life better for people and our planet.



PRELIMINARY SPECIFICATIONS

Fuel Cell Humidifier Module



P/N: 11018A

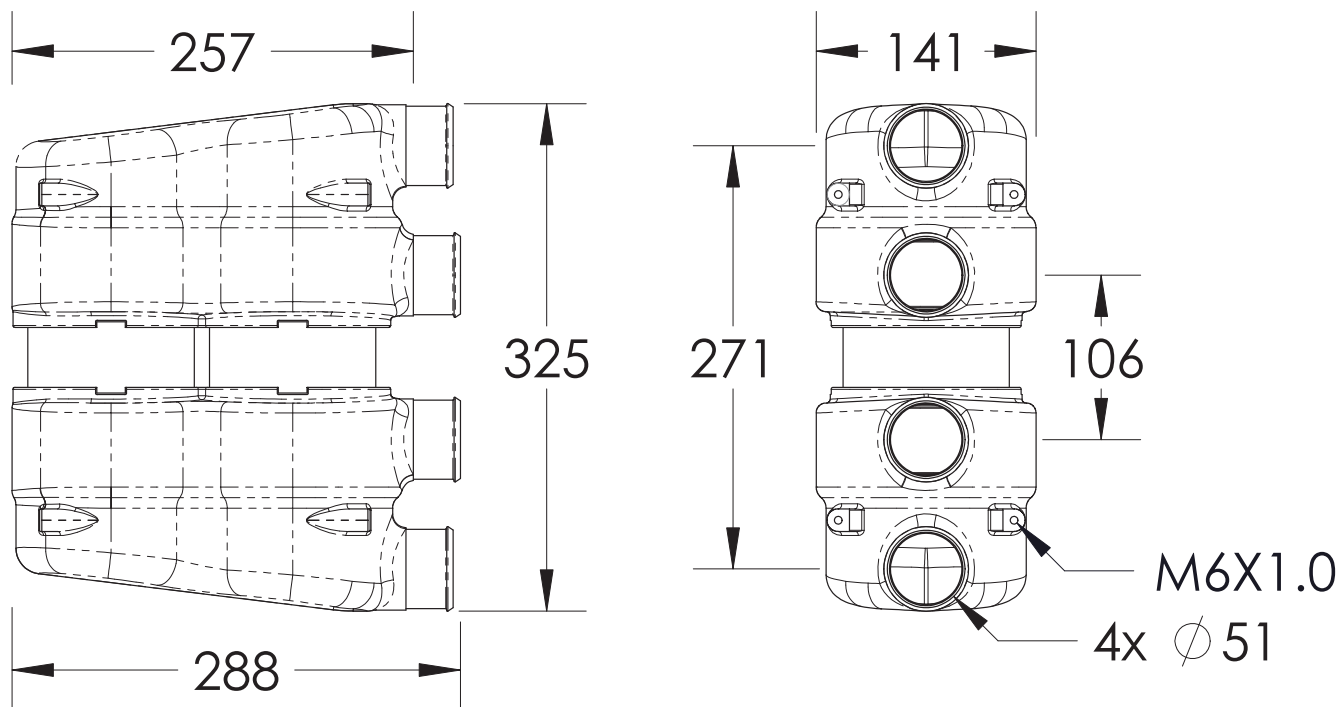
Fuel Cell Humidifier Assembly



P/N: 21018A-UAV
(port orientation shown above)
21018A-XAV (port orientation 180°)

Feature	Pentair's Fuel Cell Humidifier Module	Pentair's Fuel Cell Humidifier Assembly
Size	226mm x 113mm	330mm x 140mm x 260mm
Pressure Drop	Wet - 16 mbar @ 1000 sLPM Dry - 22 mbar @ 1000 sLPM	Wet - 47 mbar @ 3000 sLPM Dry - 40 mbar @ 3000 sLPM
Humidification Performance	55°C Outlet Dew Point @ 2000 slpm	55°C Outlet Dew Point @ 4000 slpm
Operating Temperature Range	-30C - 110C	-30C - 110C
Operating Pressure Range	0 - 3.5 bar(a)	0 - 3.5 bar(a)
Weight	1 Kg	4.7 Kg
Connection	Custom design	2 inch (50.8 mm) Barbed Ports
Mounting	Custom design	M6x1.0 mm Screw Interface
Freeze Start	1500 Cycles	1500 Cycles
Lifetime	25000 Hours	25000 Hours
Housing Material	6061 Aluminum	6061 and A356 Aluminum
Internal Materials	High performance polymers	High performance polymers

DRAWING OF PENTAIR FUEL CELL HUMIDIFIER MODULE

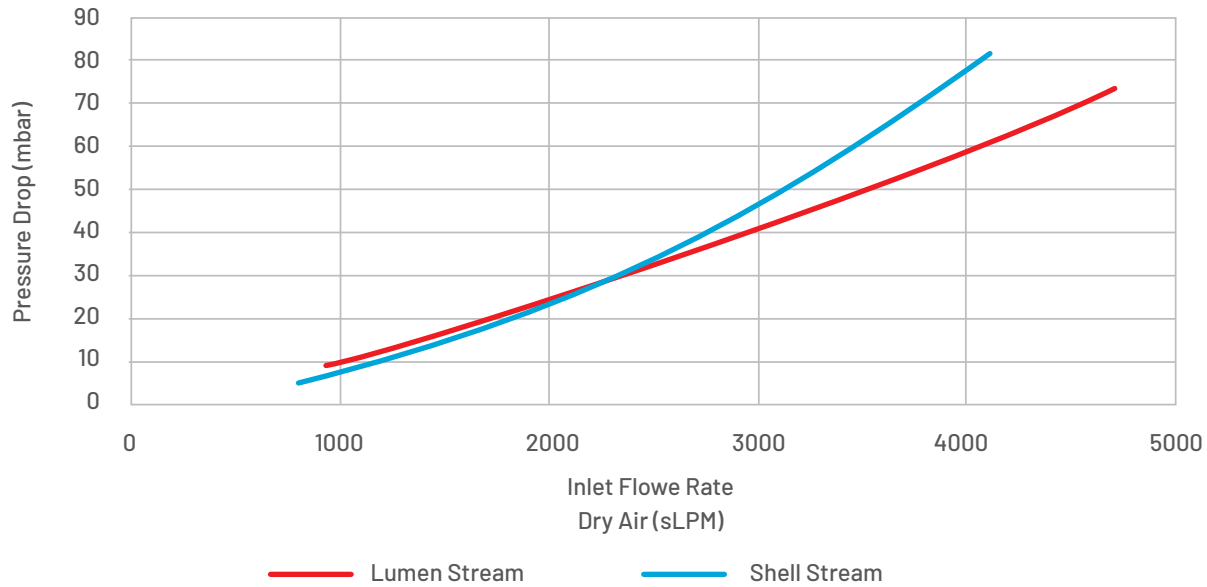


Dimensions (in millimeters)

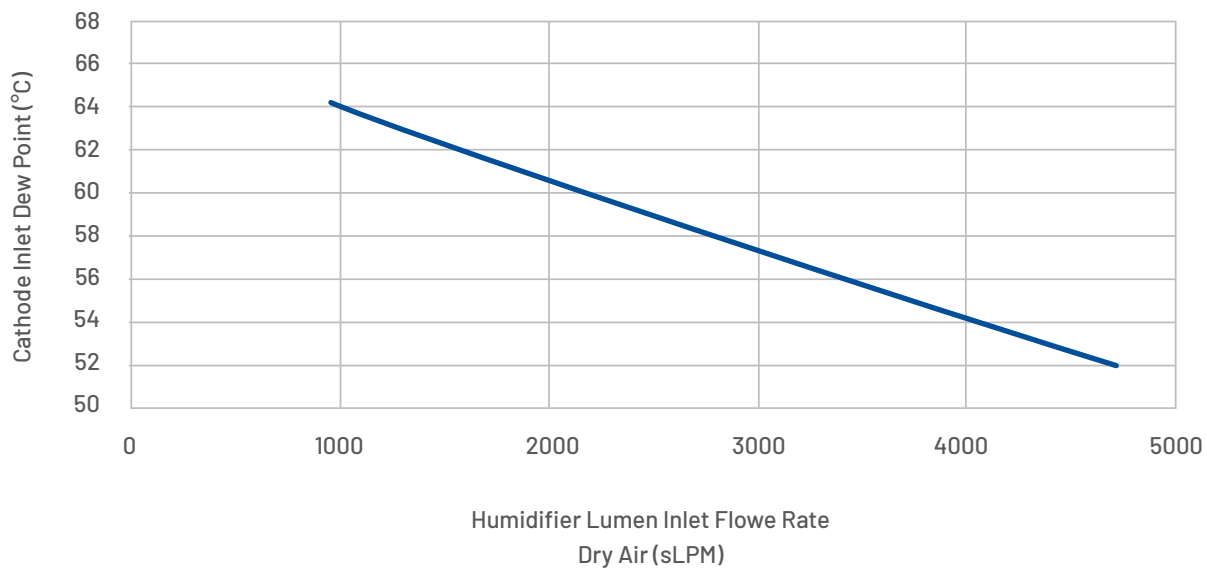


PERFORMANCE CURVES

HUMIDIFIER PRESSURE DROP



HUMIDIFIER OUTLET DEW POINT



The results in these graphs are based on the following lumen and shell inlet conditions:

- ◆ Dry side (Lumen) inlet conditions: 75°C, 6.4% RH, 2.0 bar(a)
- ◆ Wet side (Shell) inlet conditions: 75°C, 90% RH, 1.6 bar(a)



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FUELCELLHUMIDIFIER (09-12-23)