PROXIMAL AIRFLOW WITH DRAINAGE

Managing Rainout in a simpler and cost-effective manner

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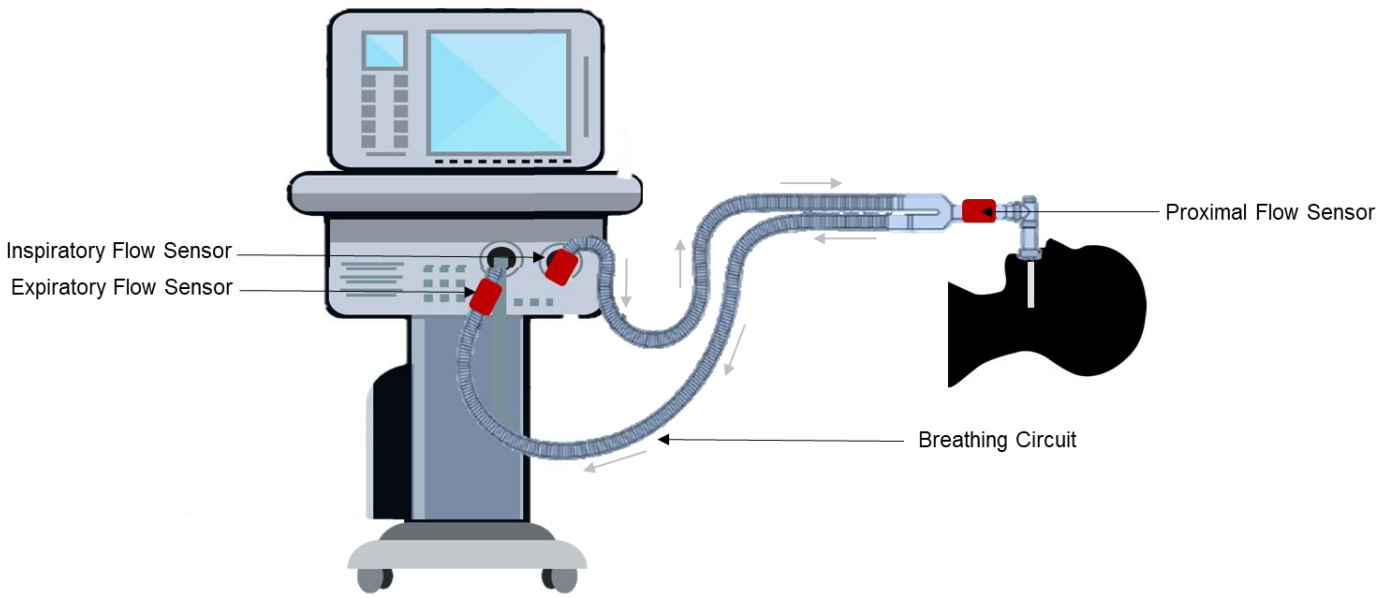
VENTILATOR FLOW SENSORS

Flow Sensors in Vents



HON Current Offering

- Honeywell currently manufactures Proximal Flow sensors in Wismar, Germany under the brand name SpiroQuant
- We offer models compatible with Hamilton Adult Vents, Draeger Oxilog and Draeger Pediatric Vents

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Opportunity Overview

Need – Proximal flow sensors offer **real time, accurate flow data** and are the **clinical guidance** for ventilated patients where data measured by expiratory flow sensors is not sufficient due to time lag or inaccuracies

Gap – The expiratory circuit is unheated as is the Y. Condensation and mucus in these parts flood these sensors (Rainout), causing them to fail and trigger alarms (phenomenon known as Rainout). While water traps exist to protect the Vent in the expiratory path, protections like filters are not sufficient to protect the Proximal Flow sensor from failing due to Rainout. Problems caused:

- Sensor failure triggers alarms that need to be attended by the RTs, reducing operational workflow efficiency
- Sensor cleaning or replacement increases hospital operating costs and negatively impacts sustainability
- Sensor replacement requires the circuit to be broken, which stops patient therapy and puts the patient at risk
- Breaking the circuit also puts patients and clinicians at risk of infections
- Rainout is also generally understood to be a potential cause of infections like Ventilator Associated Pneumonia

Impact – RTs are forced to choose between EITHER following proper clinical guidance in using proximal flow sensors OR avoiding the problems due to Rainout

Solution – Cost effective and easy-to-use solution that either prevents Rainout failure or manages such Failure without compromising sensor life, breaking the circuit or significant increase in clinical effort

UNIQUE VALUE PROP DRIVES OPPORTUNITY

For	**Respiratory Therapists, Pulmonologists, Neonatologists and Intensivists** at hospitals who use invasive ventilation frequently on their adult, pediatric and neonate patients
Who need	a proximal flow sensor for Ventilators that is **robust in handling Rainout** due to condensation and patient secretions and managing the range of problems associated with Rainout
Honeywell's	**Proximal Flow Sensor with Contaminant Drains**
Provides for $X	a **disposable differential pressure proximal flow sensor with a drainage (with and without breathing circuit)** to easily remove contaminants from the sensor without breaking the circuit
unlike	other proximal flow sensors that are **not protected against such secretions, leading to Rainout** and causing other infections like VAP, disrupt therapy and RT workflow, expose patients/RT to infections
We do this by	Adding drains to the sensor that can be easily hooked to available suction devices and remove contaminants periodically without breaking the breathing circuit. Additional traps can be used to increase time to failure
as proven by	Successful tests in-lab with RTs at our hospital partner and strong intent to use by the hospital partner along with all OEM partners we have shared the solution with till date

SUMMARY OF SUCCESSFULLY TESTED CONCEPTS

SQ with Drains

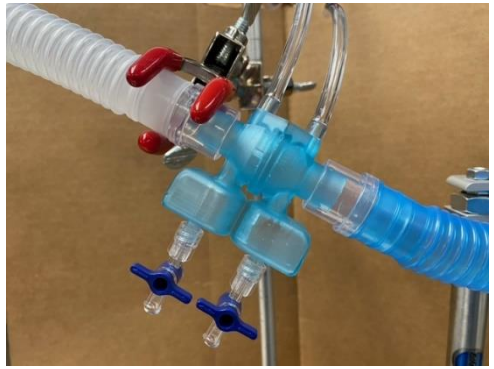
Positives

- Can drain all contaminants in sensor w/o breaking breathing circuit.
- Meets all existing SQ specs.
- Does not increase dead space / internal volume – Preferred for Neonates

Negatives

- All contaminants reach sensor (but can be removed)
- Does not improve “time to failure’

SQ with Basins/Drains



Positives

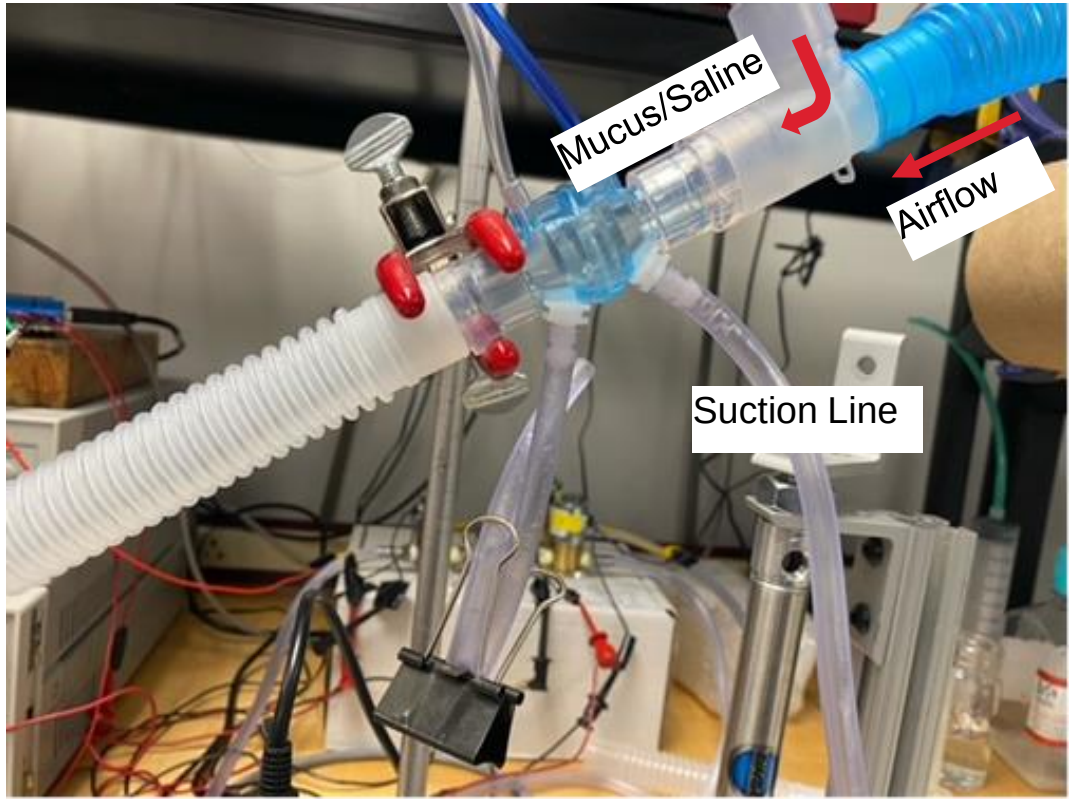
- Meets all existing SQ specs
- Increases time to failure – Optimal for larger patients
- Can “return to tolerance” after failure and drain all contaminants w/o breaking the breathing circuit

Negatives

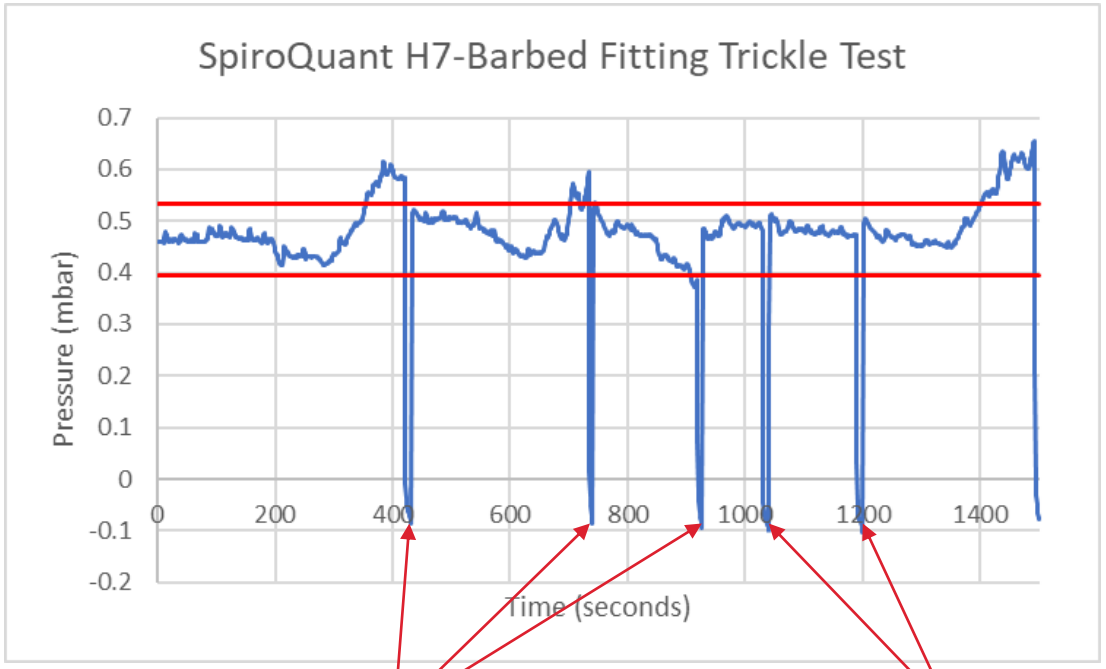
- Increases size/volume

CONCEPTS WITH DRAIN TESTING

- Sensor tipped at 45°
- Airflow set to 15 SLPM
- 50% Mucus / 50% Saline trickled into the flow upstream from sensor at rate of 10 ml/hr
- Suction pump attached to fittings. Pump cycled at varying frequency to drain fluids



CONCEPTS WITH DRAIN - RESULTS



Suctioning to remove fluids pulls sensor back within limits.

More frequent suctioning keeps sensor within limits

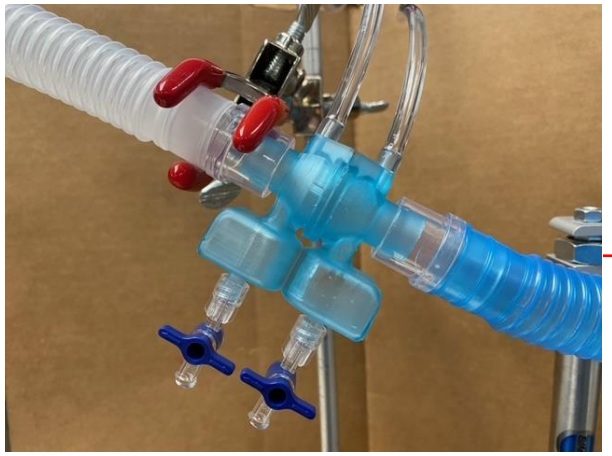
Positives

- Effective at draining fluids (<5 seconds) using readily available hospital equipment.
- Maintains existing sensor specs
- Location can be optimized to drain more effectively.
- Can drain liquids condensed within the sensor.
- No change to dead space / internal volume

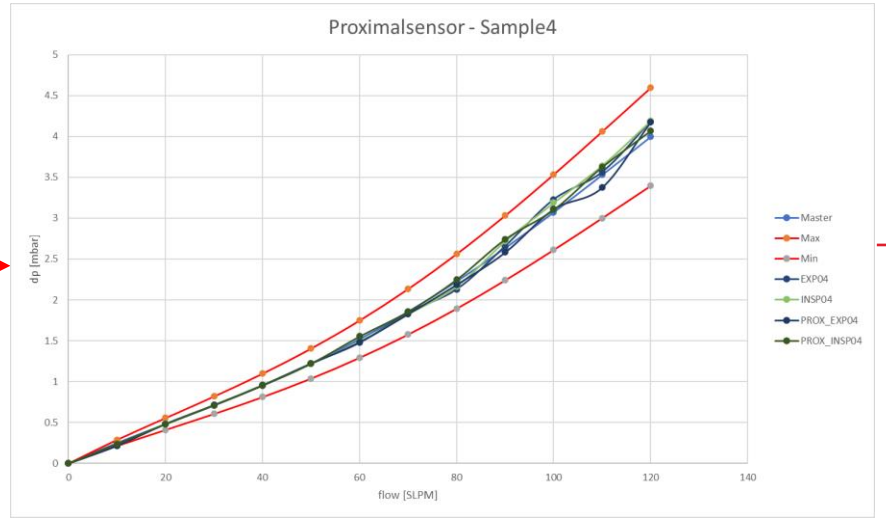
Negatives

- Does not improve Time to Failure from condensation. (Can be restored after suctioning)

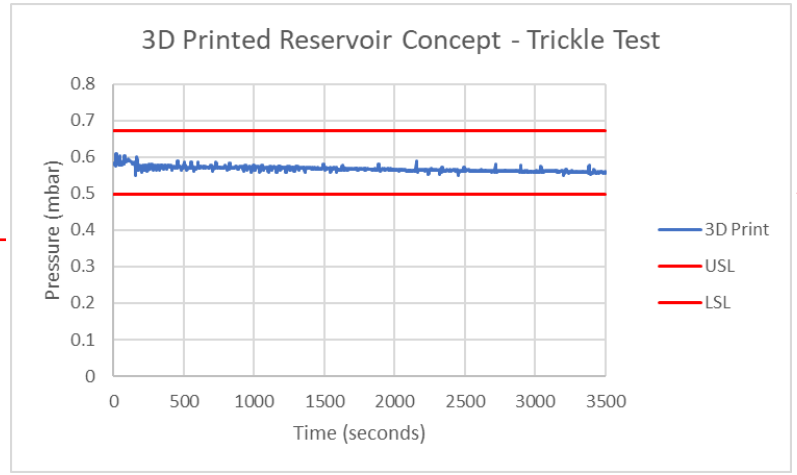
CONCEPTS WITH BASIN AND DRAINS



Mounted existing orifice into 3D Printed housings with collection basins and drain fittings



Characterized POC unit for Transfer Function. Decent correlation for initial prototype!



- Ran trickle test: 15 SLPM of airflow with **20 ml/hr** of mucus/saline for nearly 1 hour.
- Everything was trapped in the upstream basin.
- Sensor output was unchanged!

Fluids easily drained with vacuum pump!

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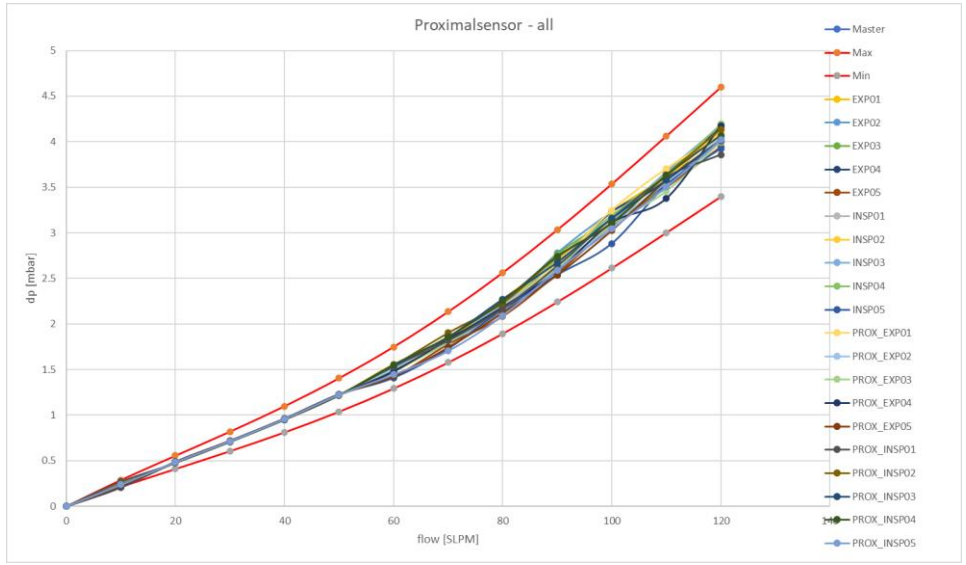
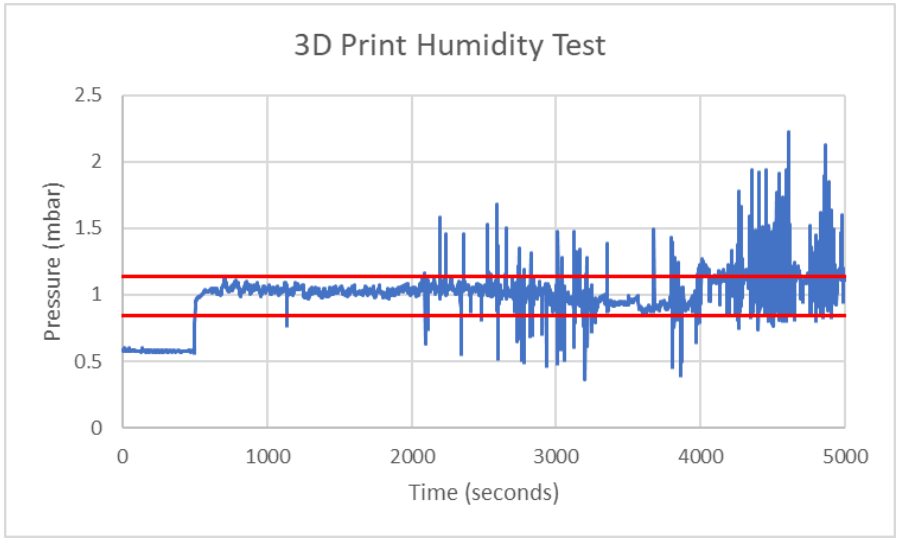
ADDITIONAL BASIN AND DRAINS TESTING

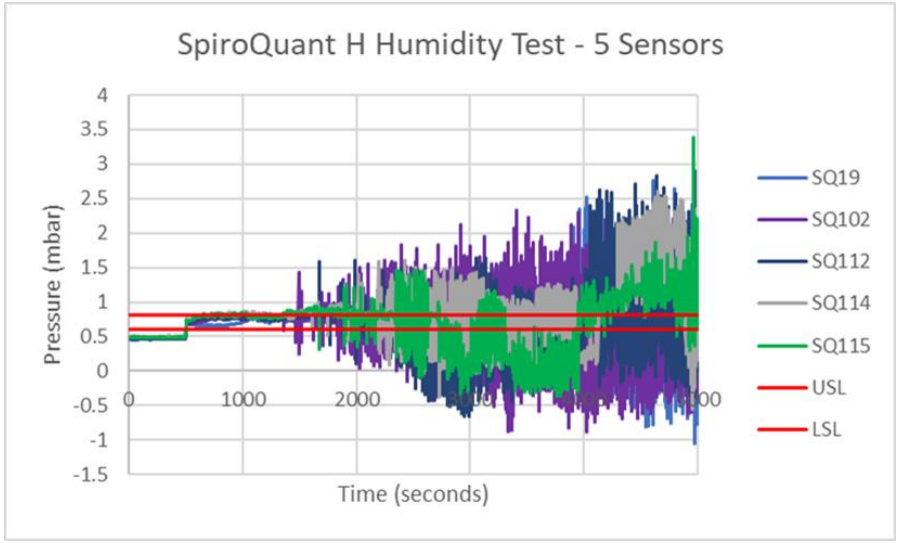
Transfer Function Testing – Multiple Units and Multiple Runs



- Five units tested in forward and reverse flow
- Good unit to unit repeatability

Humidity Testing





Approximate 2X improvement in time to failure over standard SpiroQuant!

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ON VENT / PATIENT SIMULATOR TESTING

Both concepts calibrate and operate successfully on the ventilator and with patient simulators!

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PROJECT STATUS

- Patents for multiple concepts and designs have been filed in 2022 and we continue to file additional patents around further design improvements
- Both concepts presented here have passed HON lab tests across all test parameters
- In-lab hospital tests conducted by Respiratory Therapists of our hospital partner in US were also successful on the 2 concepts
- We continue to improve upon the form factor and are starting to work on the Regulatory actions
- The current concepts are targeted to be compatible with Hamilton Adult Ventilator models
- We are also looking to expand beyond sensors to sensors + breathing circuits
- We are investigating the opportunity beyond sensors compatible with Hamilton Adult Vents

DISCUSSION

- **Overall Review**
  - Do you recognize the challenges of Rainout?
  - Do you see a proximal flow sensor solution that manages Rainout offering significant value to clinicians?
  - Does the proximal flow sensor you use presently require a very specific flow curve output?

- **Concept Review**
  - What do you like about the 2 concepts, what don't you like?
  - What do you think needs to be considered for the solutions to increase the value to you and the clinicians who use your Vents?
  - This solution is expected to increase the cases where clinicians choose to use a Proximal Flow sensor. Do you see that happening?
  - This solution is designed to offer significant cost savings to the hospitals and is expected to be priced higher than the standard sensors. Do you have a recommendation on perceived additional value based?
  - We expect to partner with the OEM to drive post-market surveillance and investigate clinical claims on reduction of infections like VAP. What are your thoughts on conducting the studies and the value of such claims?
  - Other comments, suggestions, or feedback.

Thanks