Test Plan
P2 – High and Low Temperature Characterization
Phase 4, Medical Concentrator Assessment

Draft C

NOTE: This test plan is to be reviewed and adjusted as required by appropriate LabTest Certification personnel to ensure safety. Appropriate LabTest Certification personnel are to determine the equipment set up that ensures safe operation and accurate results.

The PURPOSE of this high-level test plan is to provide LabTest Certification with information that allows them to write detailed Test Procedures and design a test equipment setup that will be safe and accurate.

The below tests are to be performed on O2 concentrator models supplied by DT Global specifically for Performance Testing.

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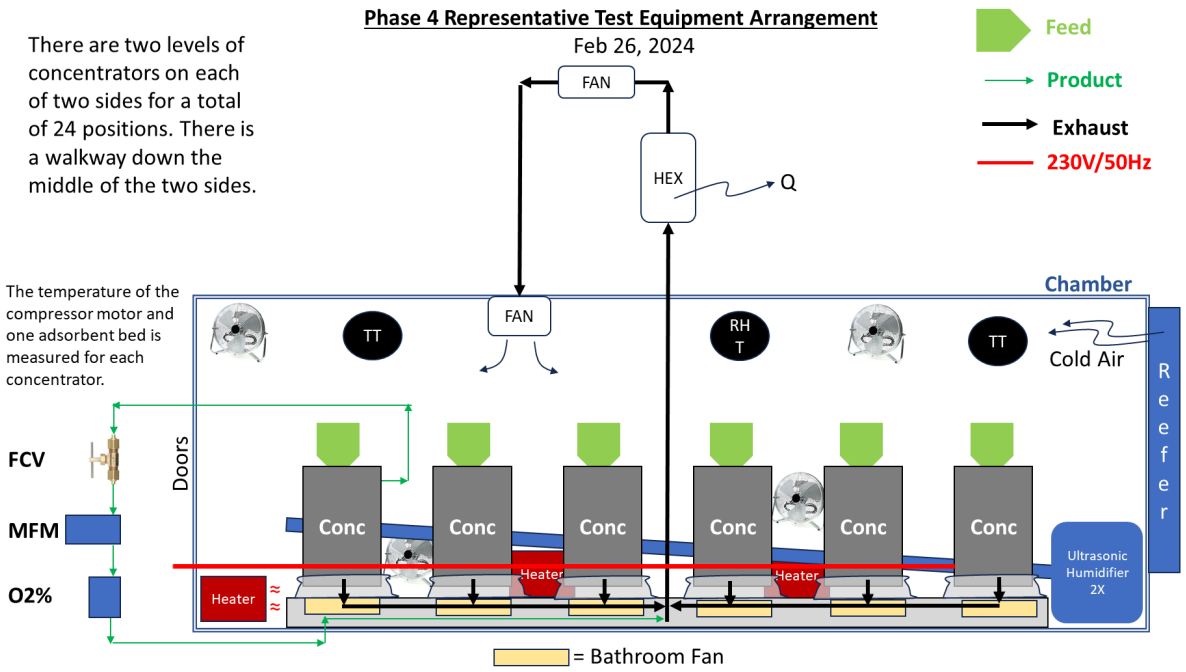
1. Test Name
    - **P2 – High and Low Temperature Characterization**

2. Relationship with Operation in Low Resource Settings (LRS) – for Reference Only
    - High temperature (~40°C), low temperature (~20°C), and average humidity (~50% RH) are typical in LRS.
    - Constant operation of the concentrator, at various flow rates, is typical in LRS.
    - Concentrators typically lose some performance at high temperatures, and may not achieve the required purity specification.

3. Test Objective (Pass/Fail Criteria)
    - To confirm the oxygen concentrator model can produce the required oxygen concentration of >82 vol % at a product flow rates 10 SLPM (0°C & 1 atm) when operated at 40°C.
    - To confirm the oxygen concentrator model can produce the required oxygen concentration of >82 vol % at a product flow rates 10 SLPM (0°C & 1 atm) when operated at 20°C.
    - To characterize product O2% at various flow rates and 40/20°C for comparison at the end of performance testing.
    - Units that can't achieve 82 vol % do not meet specification.
    - Units with more degradation between P2 and P6 characterization are less desirable.

4. Test Apparatus
    - Environmental Chamber, power supply, sensors, data logging.
    - Up to twenty (20) Concentrators, typically in pairs (i.e., two units of each model tested).
    - Schematic shown below.
    - The chamber is at varying temperature and constant humidity during the test. The concentrators are on, and the product flows of all test units are varied.



5. Test Procedure

High Temperature Characterization

5.1 Test is intended to continue from end of previous test, without shutting down or starting up chamber and concentrators. Concentrators should be operating with product flow rates at 10.0 slpm (0°C & 101.315 kPa). Continue data logging all measurements at a rate of 0.2 Hz (1 reading/5 seconds).
Set product flow rates at 6.0 slpm (0°C & 101.315 kPa)

5.2 Hold at 6.0 splm (0°C & 101.315 kPa) for 20 minutes.

5.3 Increase product flow to 8.0 slpm.

5.4 Hold at 8.0 splm (0°C & 101.315 kPa) for 20 minutes.

5.5 Increase product flow to 9.0 slpm.

5.6 Hold at 9.0 splm (0°C & 101.315 kPa) for 20 minutes.

5.7 Increase product flow to 10.0 slpm.

5.8 Hold at 10.0 splm (0°C & 101.315 kPa) for 20 minutes.

5.9 Increase product flow to 11.0 slpm.

5.10 Hold at 11.0 splm (0°C & 101.315 kPa) for 20 minutes. Do not hold for longer than 20 min, as this could damage the concentrator.

5.11 Decrease product flow to 6.0 slpm.
Start decreasing temperature from High Temperature Baseline of 40°C and 50% RH to low temperature 20°C and 50% RH. (While the RH will stay the same through this transition the vapour pressure of water in the chamber will be decreasing.)

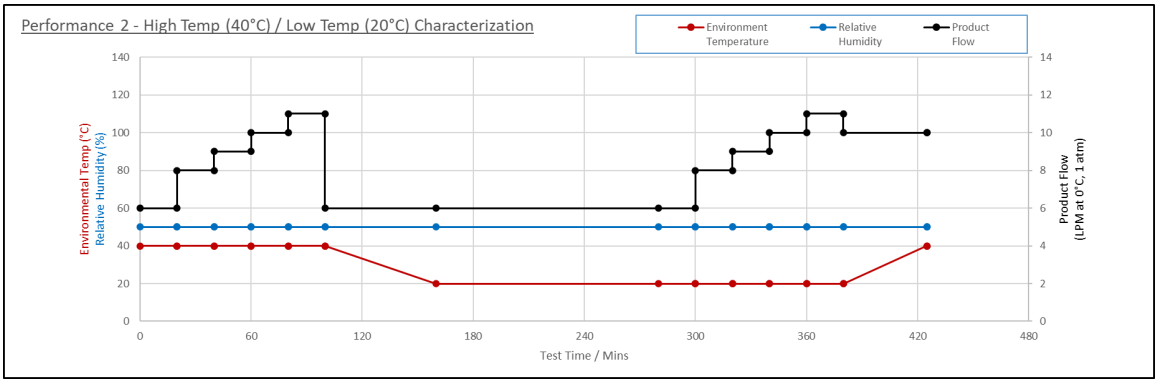
5.12 Decrease temperature to low temperature of 20°C and 50% RH.

5.13 Hold at low temperature of 20°C and 50% RH to stabilize chamber and concentrators for 120 minutes.

Low Temperature Characterization

5.14 Hold at 6.0 splm (0°C & 101.315 kPa) for 20 minutes.
5.15 Increase product flow to 8.0 slpm.
5.16 Hold at 8.0 splm (0°C & 101.315 kPa) for 20 minutes.
5.17 Increase product flow to 9.0 slpm.
5.18 Hold at 9.0 splm (0°C & 101.315 kPa) for 20 minutes.
5.19 Increase product flow to 10.0 slpm.
5.20 Hold at 10.0 splm (0°C & 101.315 kPa) for 20 minutes.
5.21 Increase product flow to 11.0 slpm.
5.22 Hold at 11.0 splm (0°C & 101.315 kPa) for 20 minutes. Do not hold for longer than 20 min, as this could damage the concentrator.
5.23 Decrease product flow to 10.0 slpm.
Start increasing temperature to High Temperature Baseline of 40°C and 50% RH.
5.24 Hold for 60 minutes to stabilize chamber and concentrators.
5.25 The next test (**Protocol 3 – High Temperature and Humidity, On/Off Cycling**), is run continuously (sequentially) with this test. Do not shut down the test station.
5.26 If the test is interrupted, the test will be restarted as soon as possible, and the team will determine how much of the test should be repeated.

6. Planned Profile of Chamber T & RH and Product Flow vs. Time



7. Data Table

- Chamber temperature and product flow vary, but relative humidity is constant during this test.
- If product O_2 concentration declines to less than 82% during the test, report this to the client.

Stream	Parameter	Test Range	Unit	Input/Output	Logging Rate
Chamber	Temperature	20 or 40	°C	Input	0.2 Hz
Chamber	RH	50	%	Input	0.2 Hz
Chamber	Pressure	Atmospheric	kPa	Input	NA
Feed	O_2 Conc.	21%	Vol %	NA	NA
Feed	Flow	~100 to 150	SLPM	NA	NA
Product	O_2 Conc.	82 to 95	Vol %	Output	0.2 Hz
Product	Flow Rate	6.0 to 11.0	SLPM	Input	0.2 Hz
Exhaust	O_2 Conc.	<21 %	Vol %	NA	NA
Exhaust	Flow Rate	~90 to 140	SLPM	NA	NA
Bed Temp.	Temperature	Est. 40 to 80	°C	Output	0.2 Hz
Comp. Temp	Temperature	Est. 60 to 100	°C	Output	0.2 Hz

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