Test Plan
Dust Testing
Phase 4, Medical Concentrator Assessment

Draft A

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 Dust Testing.

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Overview

One concentrator will be placed in an IP dust chamber, which will create a continuous and even dust cloud. The dust to be used is standard MIL-E 810G Blowing Dust, which approximately matches the dust profile measured by RICE in Malawi. This dust has hard particles, in the size range that affects compressor life.

The test will run for about 7 hr total (3 hr operating in dust). The concentrator will be operating so that dust is blowing into the cabinet through the cabinet filter, and into the compressor feed filter.

Oxygen separation performance, as well as compressor temperatures will be measured throughout the test. Plugging of the feed filters is expected to reduce oxygen concentration. Plugging of the cabinet filter is expected to increase cabinet and compressor temperature. Dust in the compressor seals and bearings is expected to increase compressor temperature. All these effects reduce concentrator life and can make them unsafe to operate.

After the test, the concentrators will be disassembled and photographed, to see if dust has reached sensitive areas, such as the electronics, compressor seals, and compressor bearings.

Test Setup

Test Apparatus	LabTest IP Dust Chamber (see photos on page 5)
Test Dust	MIL-E 810G Blowing Dust
Mass of Dust	1.5 kg at start of testing. Add 0.1 between cycles of same unit. Remove easily found dust at end of each unit and add 1.0 before starting with next unit.
Concentration of Dust	(A function of mass of dust, and size of chamber)
Units on Test	One at a time

Concentrator Measurements

Thermocouple 1	Motor casing (epoxied)
Thermocouple 2	Compressor head (epoxied)
Thermocouple 3	Bed (center, outside, epoxied)
Mass Flow Meter	Product mass flow (gas must be well filtered before MFM)
Oxygen Concentration	Product oxygen concentration

Chamber Measurements

Thermocouple	Temperature inside chamber
RH	RH inside chamber (before and as needed for safety)

Test Procedure

1. Epoxy thermocouples to units.
2. Place 1.5 kg of dust in the chamber (1.0 kg if not the first test in the series).
3. Weigh each unit before test, accurately.
4. Photograph each unit.
5. Mount and plumb one unit in dust chamber.
6. Turn on concentrator, set product flow between 9.5 to 10 slpm, as measure by MFM.
7. Ensure RH <30% (to avoid clumping of dust).
8. Hold for 5 min.
9. Ensure flow is between 9.5 to 10 slpm, as measure by MFM.
10. Continuously measure oxygen concentration.
11. Switch on dust cloud, and ensure a continuous cloud of dust.
12. Turn on and operate concentrator for 45 minutes, continuously measuring product flow, oxygen concentration, and temperatures.
    a. (Shut down concentrator and end the test, if bed temperature exceeds 80 °C.)
    b. (Shut down concentrator and end the test, if motor temperature exceeds 160 °C).
13. Shutdown concentrator and allow dust cloud to settle for 15 minutes.
14. Ensure dust is settled before opening chamber.
15. Eliminate static electricity before touching test station and units.
16. Open door and continue to cool concentrator for an additional 45 minutes.
17. Add 0.1 kg of dust to replace dust leakage from chamber when opening door (except for last repeat).
18. Repeat 11-17, four times total (7 hr total test, 3 hr operating in dust).
19. Eliminate static electricity before touching test station and units.
20. Do not remove any dust from concentrator, weigh each unit after test, accurately, and subtract original weight to measure total dust mass accumulated.
21. Photograph each unit after test:
    a. Housing external
22. Brush/clean off outside of unit.
23. Weigh each, accurately, and subtract original weight to measure dust mass accumulated in filters and inside concentrator.
24. Photograph each unit after test:
    a. Housing external
    b. Housing filter(s)
    c. Compressor filter
    d. Product filter
    e. Internal electronics
    f. Inlet tubing to compressor
    g. Compressor external, bearings, bottom of compressor piston (if exposed to cabinet)
    h. Motor external, bearings
25. Remove dust from the chamber.

Test Procedure Timing

Minutes of Operation	Chamber Door	Dust	Concentrator	Flow (SLPM)	Purpose
5	Closed	Off	On	10	Bring concentrator up to operating conditions before starting.
45	**Closed**	**On**	**On**	**10**	**First phase of dust testing.**
15	Closed	Off	Off	0	Concentrator off and cooling, dust settling.
45	Open	Off	Off	0	Open chamber door to cool faster.
45	**Closed**	**On**	**On**	**10**	**Second phase of dust testing.**
15	Closed	Off	Off	0	Concentrator off and cooling, dust settling.
45	Open	Off	Off	0	Open chamber door to cool faster.
45	**Closed**	**On**	**On**	**10**	**Third phase of dust testing.**
15	Closed	Off	Off	0	Concentrator off and cooling, dust settling.
45	Open	Off	Off	0	Open chamber door to cool faster.
45	**Closed**	**On**	**On**	**10**	**Fourth phase of dust testing.**
15	Closed	Off	Off	0	Concentrator off and cooling, dust settling.
45	Open	Off	Off	0	Open chamber door to cool faster.

425 min TOTAL
7.1 hr TOTAL

180 min DUST TESTING
3.0 hr DUST TESTING