Maximized Portable Oxygen Generation

MHSRS-26-3636

Conceptual Design of a Portable Oxygen Generation System for Role 1 Military Medical Operations and Aeromedical Evacuation

Background

Large Scale Combat Operations (LSCO) demand lightweight, reliable, and rapidly deployable medical technologies capable of providing respiratory support at the point of injury and throughout aeromedical evacuation. Current portable oxygen generation systems are often constrained by limited flow capacity, operational endurance, or reduced performance at altitude, creating significant logistical and clinical challenges for Role 1 medical care. To address these limitations, Project ALFA proposes a next-generation compact oxygen-generation platform that integrates advanced oxygen generation technologies into a compact, portable platformdesigned to provide sustained medical-grade oxygen in austere and high-altitude operational environments.

Objectives

To develop and evaluate the conceptual design of a compact, portable oxygen generation system targeting delivery of medical-grade oxygen at **16 L/min** and **55 psi** in a portable system weighing approximately **26 lb** for Role 1 military medical care and aeromedical evacuation, while maintaining high performance, modularity, and operational reliability in austere and high-altitude environments.

Methods

A systems engineering approach was employed to develop the conceptual design of the ALFA portable oxygen generation platform. The conceptual design was developed through high-fidelity mathematical modeling, engineering feasibility analyses, and iterative design optimization of advanced oxygen generation technologies. The proposed platform incorporates a system-level integration approach, integrated engineering functions, and supporting engineering solutions intended to enhance portability, reliability, and operational performance in austere and high-altitude environments. The development process included computational modeling, engineering simulations, prototype planning, laboratory performance assessment, and progressive verification activities in accordance with applicable military and medical device standards.

Discussion

The proposed ALFA platform addresses several operational challenges associated with portable oxygen delivery in military environments through a compact engineering design tailored to different mission requirements. The proposed approach is intended to improve portability, maintainability, and operational capability during Role 1 care and aeromedical evacuation. Although experimental validation remains necessary, the conceptual design establishes a foundation for prototype development and future verification under laboratory and operational conditions. If successfully validated, this approach could contribute to improved respiratory support capabilities for military medical personnel operating in austere and high-altitude environments.

Conclusion

The proposed ALFA portable oxygen generation platform demonstrates a feasible conceptual approach for providing medical-grade oxygen in Role 1 military care and aeromedical evacuation environments. Its integrated engineering approach, together with its emphasis on portability, operational resilience, and maintainability, provides a strong foundation for prototype development and future performance validation. Continued engineering refinement and experimental testing will be essential to confirm its operational capabilities and support its transition toward military medical deployment.

Limitations

This work represents a conceptual design and systems engineering effort at an early stage of technology development. Consequently, device performance has partially been validated through physical prototype testing, whereas clinical evaluation and operational field deployment remain untested. Key performance characteristics, including oxygen delivery under austere and high-altitude conditions, long-term reliability, and compliance with military and regulatory standards, remain to be confirmed through prototype fabrication, laboratory testing, and future verification and validation studies.

Next Steps

Future work will focus on transitioning the ALFA platform from conceptual design to functional prototype through detailed engineering, component integration, and iterative optimization. Planned activities include computational modeling refinement, prototype fabrication, laboratory performance testing, environmental and altitude validation, and verification against applicable military and medical device standards. These efforts will support regulatory planning, technology maturation, and progression toward a deployable oxygen generation system for Role 1 military medicine and aeromedical evacuation.

TARGET PERFORMANCE

19 L/min Continuous Oxygen Flow 60 psi Delivery Pressure 20 lb Maximum System Weight

SCAN ME

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