# CHEMICAL OXYGEN GENERATION TO SUPPORT PROLONGED FIELD CARE AND DELAYED EVACUATION

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Breakout: Far-Forward Portable Life Support & Imaging Devices

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**LO 1 — LEARNING OBJECTIVE 1: LIMITATIONS**
Describe the operational limitations of conventional oxygen delivery systems during prolonged field care and delayed evacuation.

**LO 2 — LEARNING OBJECTIVE 2: CHARACTERISTICS**
Analyze the characteristics of chemical oxygen generation as a power-independent oxygen source for austere medical environments.

**LO 3 — LEARNING OBJECTIVE 3: INTEGRATION**
Discuss integration of portable oxygen generation into point-of-injury and Role 1 operations to support casualty stabilization during delayed evacuation.



## WHEN EVACUATION IS DELAYED, HOW DOES OXYGEN REACH THE CASUALTY?

A portable, power-independent oxygen generation capability was evaluated for austere environments where compressed gas and powered concentrators are impractical — supporting oxygen delivery at the point of injury and during prolonged prehospital care.

Reaction is exothermic

$$2NaClO_{3(s)} \rightarrow 3O_{2(g)} + 2NaCl_{2(s)} + \Delta$$

**SUMMARY OF BENCH & OPERATIONAL TEST RESULTS**

| ≥96% | ≥6 L/min | ≥15 min | ≥90 L | 5.4 lb | 0 w |
|---|---|---|---|---|---|
| oxygen purity | average flow | delivery duration | delivery duration | 2.45 kg, handheld | external power |

## 1 INTRODUCTION (LO 1)

**23%** of U.S. combat fatalities were potentially survivable

**87%** of those deaths occurred before reaching a medical treatment facility

- Hypoxia contributes to preventable trauma mortality — particularly in traumatic brain injury, airway compromise, burns, and thoracic injury.
- Compressed cylinders: fragmentation hazard, weight, and refill logistics limit employment at the point of wounding (LO1).
- Powered concentrators: dependent on batteries or generators; purity and flow degrade with altitude, heat, dust, and humidity (LO1).
- Army Futures Command and the Medical CDID identify far-forward oxygen delivery as a critical capability gap.
- Future operations are expected to extend evacuation timelines and reliance on prolonged prehospital care.

### CLINICAL CONTEXT — TCCC GUIDELINES (MAY 2026)

Updated TCCC guidelines raised the prehospital $SpO_2$ target from >90% to ≥92%. Sustaining this target through delayed evacuation requires oxygen sources that can be employed forward of Role 1.

## 2 CAPABILITY DESCRIPTION (LO 2)

Sealed chemical oxygen generation produces medical-grade oxygen through a self-contained, non pressurized reaction. The process requires no external power; passive thermal moderation conditions the gas to ambient breathing temperature before delivery. The system is single-use and maintenance-free in storage.


PICTOGRAM INSTRUCTIONS FOR USE
SIMPLE TWIST ACTUATOR DIAL
TAMPER EVIDENT COVER LATCH
NON-ROLL DESIGN
RUGGED CASING
UNIVERSAL, FLEXIBLE GAS EXIT PORT

**Activation:** open lid → turn dial 2–3 turns → oxygen flows. No valves, regulators, or power sequencing. Standard outlet (BS EN 13544-2) is compatible with existing masks, tubing, and airway equipment — no workflow changes.

**CHARACTERISTICS VS. CONVENTIONAL OXYGEN SOURCES (LO1, LO2):**

| CHARACTERISTIC | CHEM. GEN. | CYLINDER | CONCENTR |
|---|---|---|---|
| Non-pressurized (no blast hazard) | ✓ | ✗ | ✓ |
| No electrical power required | ✓ | ✓ | ✗ |
| Purity maintained in extreme | ✓ | ✓ | LTD |
| Man-portable for dismounted use | ✓ | LTD | ✗ |
| Silent / no electro-optical signature | ✓ | ✓ | ✗ |
| Safe for aircraft & tactical vehicles | ✓ | LTD | ✗ |

**LTD** = possible but commonly constrained by hazard, power, or sustainment limitations.

## 3 METHODS (LO 2)

Bench and operational assessments evaluated oxygen purity, flow stability, activation reliability, environmental durability, and compatibility with standard oxygen delivery equipment. Environmental testing aligned with MIL-STD-810G/H. Ventilator compatibility was assessed in prehospital and Role 1 configurations (Zoll Impact 731, simulated patient settings).

## 4 RESULTS (LO 2)

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| CHARACTERISTIC | METHOD — PARAMETERS | RESULTS |
|---|---|---|
| Vibration | 514.8 — 5–500 Hz, 60 min/axis | ✓ |
| High temperature | 501.5 — 104°F, 20 h | ✓ |
| Humidity + heat | 507.5 — 95% RH | ✓ |
| Low temperature | 502.5 — 0.4°F, 20 h | ✓ |
| Altitude | 500.5 — 10k / 15k / 20k ft | ✓ |
| Blown sand | 510.6 — 19 m/s, 140°F, 3 h | ✓ |
| Blown rain | 506.6 — 4 in/h, 40 mph wind | ✓ |
| Drop | 516.6 — 3 ft operational drop | ✓ |
| Mechanical shock | 516.7 — 40 g ground / 20 g flight | ✓ |

### REGULATORY & TRANSPORT STATUS

FDA 510(k) cleared. Certified for global transport (UN 3356): commercial & military airlift, ground, maritime.

## 5 ROLES OF CARE (LO 3)

POINT OF INJURY ▶ PROLONGED CASUALTY CARE ▶ ROLE 1 / CASEVAC

Power-independent generation enables oxygen delivery at the point of injury and during prolonged casualty care when evacuation is delayed. It may support stabilization of casualties with respiratory compromise and integrates with existing airway equipment without workflow changes (LO3).

## 6 IMPACT / SIGNIFICANCE (LO 3)

- May expand the ability of forward medical personnel to maintain oxygenation during delayed evacuation and prolonged field care.
- Compact, shelf-stable design may support autonomous resupply — including unmanned aerial delivery — enabling distributed oxygen availability in contested environments.

## 7 DEVELOPMENTAL STATUS

- ✓ **Environmental qualification (MIL-STD-810G/H)**
- ✓ **Ventilator compatibility assessment**
- ✓ **Regulatory clearance — FDA 510(k)**
- ✓ **Transport certification (UN 3356)**
- Planned: user evaluations & integration studies

### FURTHER INFORMATION

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Disclaimer: The views expressed in this poster are those of the authors and do not represent the official policy or position of the Department of Defense or the U.S. Government. The technology described is presented for discussion of capability development and operational evaluation and does not constitute endorsement or promotion of any specific product.

Reference: Eastridge BJ, et al. Death on the battlefield (2001–2011): implications for the future of combat casualty care. J Trauma Acute Care Surg. 2012.