



USAARL-TECH-SR--2026-11

UNITED STATES ARMY AEROMEDICAL RESEARCH LABORATORY

**Recommendations for Specification
Development for Helicopter
Live External Attached Loads (LEAL)**

**Danielle Rhodes, Matthew Ballard, Khalid Barazanji, &
B. Joseph McEntire**

Notice

Qualified Requesters

Qualified requesters may obtain copies from the Defense Technical Information Center (DTIC), Fort Belvoir, Virginia 22060. Orders will be expedited if placed through the librarian or other person designated to request documents from DTIC.

Change of Address

Organizations receiving reports from the U.S. Army Aeromedical Research Laboratory on automatic mailing lists should confirm correct address when corresponding about laboratory reports.

Disposition

Destroy this document when it is no longer needed. Do not return it to the originator.

Disclaimer

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation. Citation of trade names in this report does not constitute an official Department of the Army endorsement or approval of the use of such commercial items.

REPORT DOCUMENTATION PAGE

*Form Approved
OMB No. 0704-0188*

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY) 04-02-2026	2. REPORT TYPE Special Report	3. DATES COVERED (From - To) 10/1/2024 - 9/30/2025
--	---	--

4. TITLE AND SUBTITLE Recommendations for Specification Development for Helicopter Live External Attached Loads (LEAL)	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S) Rhodes, D. ^{1,2} , Ballard, M. ² , Barazanji, K. ^{1,2} , & McEntire, B. J. ²	5d. PROJECT NUMBER MIPR 12150268
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Aeromedical Research Laboratory P.O. Box 620577 Fort Rucker, AL 36362	8. PERFORMING ORGANIZATION REPORT NUMBER USAARL-TECH-SR--2026-11
--	--

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Aviation Mission Systems / Medical Evacuation and U.S. Army Combat Capabilities Development Command Aviation and Missile Center System Readiness Directorate 5400 Fowler Rd Huntsville, AL 35898	10. SPONSOR/MONITOR'S ACRONYM(S) AvMC SRD
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

13. SUPPLEMENTARY NOTES
¹Chenega Services & Federal Solutions, LLC, ²U.S. Army Aeromedical Research Laboratory

14. ABSTRACT
A coordinated effort between U.S. Army Combat Capabilities Development Command Aviation and Missile Center System Readiness Directorate (DEVCOM AvMC SRD), U.S. Army Aviation Mission Systems / Medical Evacuation (MEDEVAC), and the U.S. Army Aeromedical Research Laboratory (USAARL) Injury Biomechanics and Protection Group (IBPG) is being pursued to develop a new military specification for helicopter live external attached loads (LEAL). LEAL is a mode of transportation by which humans are carried on a device that is attached via the exterior of Department of Defense rotary-wing aircraft. This mission is intended to be short range, delivering the individuals(s) to safety via the shortest flight practical. USAARL IBPG researched relevant literature, applying subject matter expertise, and contributed to the preparation, editing, and reviewing the draft LEAL specification.

15. SUBJECT TERMS
live external attached loads, LEAL, standards, helicopter rescue, short range rescue, insertion/extraction, civilians, confined spaces rescue, roof-top rescue, water rescue

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON Loraine St. Onge, PhD
a. REPORT UNCLAS	b. ABSTRACT UNCLAS	c. THIS PAGE UNCLAS			19b. TELEPHONE NUMBER (Include area code) 334-255-6906

This page is intentionally blank.

Executive Summary

The U.S. Army Aeromedical Research Laboratory (USAARL) Injury Biomechanics and Protection Group (IBPG) assisted the U.S. Army Aviation Mission Systems/Medical Evacuation (MEDEVAC) and U.S. Army Combat Capabilities Development Command Aviation and Missile Center System Readiness Directorate (DEVCOM AvMC SRD) to develop a new military specification for helicopter live external attached loads (LEAL). Relevant literature was researched, and subject matter expertise was applied to contribute to the preparation, editing, and review of the draft LEAL specification. This assistance included participating in virtual and in-person meetings and correspondence. This report is a summary of actions taken and contributions provided to the LEAL specification by USAARL IBPG.

This page is intentionally blank.

Table of Contents

	Page
Executive Summary	iii
Background	1
Relevant Literature and Standards Reviewed	1
Summary of Recommendations	3

This page is intentionally blank.

Background

A coordinated effort with U.S. Army Aviation Mission Systems/Medical Evacuation (MEDEVAC) and U.S. Army Combat Capabilities Development Command Aviation and Missile Center System Readiness Directorate (DEVCOM AvMC SRD) is being pursued to develop a new military standard for helicopter live external attached loads (LEAL). LEAL is a mode of transportation by which humans are carried on a device that is suspended from a Department of War (DoW) rotary-wing aircraft. This external live load transport mission is for short duration flights, delivering the individuals(s) to safety via the shortest flight practical. LEAL offers many advantages which include:

- a) Time critical insertion/extraction of multiple individuals.
- b) Insertion/extraction from terrain inaccessible to aircraft landing, such as confined spaces, rooftops, and over water.
- c) The ability to reach areas inaccessible by ground transportation.
- d) Faster transit times than conventional ground transportation.
- e) Independence from ground transportation conditions (i.e., congestion, flooding, terrain, fire).
- f) LEAL capabilities can be expanded beyond the transport of live loads to traditional payloads.

The U.S. Army Aeromedical Research Laboratory (USAARL) Injury Biomechanics Protection Group (IBPG) supported AvMC SRD by researching relevant literature and standards, applying subject matter expertise, and contributing to the preparation, editing, and review of the draft LEAL standard.

Relevant Literature and Standards Reviewed

1. Airworthiness standards: Transport category rotorcraft (14 CFR Part 29). *Code of Federal Regulations*, November 7, 2024. <https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-29>
2. American Society of Testing and Materials (ASTM) International. (2020). *Standard practices for seams and stitches* (ASTM D6193-20). ASTM International, West Conshohocken, PA. DOI: 10.1520/D6193-16R20.
3. ASTM International. (2020). *Standard guide for determining safety factors for technical rescue systems* (ASTM F2491-20). ASTM International, West Conshohocken, PA. DOI:10.1520/F2491-20.
4. ASTM International. (2020). *Standard test method for basket type rescue litters* (ASTM F2821-15). ASTM International, West Conshohocken, PA. DOI: 10.1520/F2821-15R20.
5. ASTM International. (2024). *Standard specification for masses used in testing rescue systems and components* (ASTM F2266-24). ASTM International, West Conshohocken, PA. DOI: 10.1520/F2266-24E01.

6. Department of the Army. (2001). *Airworthiness release (AWR) for rescue hoist equipment on UH/HH-60 helicopters* (AWR 980, Memorandum). Aviation and Missile Research, Development, and Engineering Center.
7. Department of the Army. (2013). *Logistics: Type classification, materiel release, fielding, and transfer* (Army Regulation 700-142). Department of the Army.
8. Department of the Interior. (2011). *Part 351: Aviation operations, Chapter 1: Flight operations standards and procedures* (Department Manual 351 [DM351-1]). U.S. Department of the Interior. <https://www.doi.gov/sites/default/files/uploads/351dm1.pdf>
9. Department of Defense (DoD). (1965). *Military specification survivors, sling, rescue equipment helicopter* (MIL-R-8592/3). DoD.
10. DoD. (1978). *Military specification survivors, sling, rescue equipment helicopter* (MIL-R-8592/3, Amendment 1). DoD.
11. DoD. (1992). *Military specification litters, rigid, stokes* (MIL-L-37987A). DoD.
12. DoD. (1992). *Military standard clevises, suspension, air delivery - Type I* (MS70087L). DoD.
13. DoD. (1996). *Military specification MIL-S-85510: Seats, helicopter cabin, crashworthy general specification* (MIL-S-85510 [AS] Notice 1). DoD.
14. DoD. (1996). *Seat system: Crashworthy, non-ejection, aircrew, general specification for* (MIL-S-58095A [AV] Notice 1). DoD.
15. DoD. (1997). *Military standard requirements for the certification of sling loaded military equipment for external transportation by DoD helicopters* (MIL-STD-913A). DoD.
16. DoD. (1999). *Military standard clevises, suspension, air delivery - Type I* (MS70087L, Notice 1). DoD.
17. DoD. (2002). *Military standard requirements for the certification of sling loaded military equipment for external transportation by DoD helicopters* (MIL-STD-913A, Notice of Validation). DoD.
18. DoD. (2004). *Military specification clevises, rigging, air delivery: General specification for* (MIL-DTL-40137F). DoD.
19. DoD. (2005). *Military standard interface standard for lifting and provisions* (MIL-STD-209K). DoD.
20. DoD. (2019). *Military specification survivors, sling, rescue equipment helicopter* (MIL-R-8592/3, Notice of Validation). DoD.

21. Eshelman, R. E., Circek, I. I., & Robertson, A. (2017). *Joint en route care equipment test standard (JECETS)* (Revision 1). U.S. Army Aeromedical Research Laboratory and U.S. Air Force Aeromedical Branch Aeromedical Test Laboratory.
22. North Atlantic Treaty Organization (NATO). (2021). *Standardization agreement: Horse collar/rescue strop type helicopter hoisting gear* (STANAG 3295, Edition 8). NATO Standardization Office.
23. Rotorcraft external load operations (14 CFR Part 133). *Code of Federal Regulations*, November 7, 2024. <https://www.ecfr.gov/current/title-14/chapter-I/subchapter-G/part-133>
24. Society of Automotive Engineers International. (2024). *Castings, classification and inspection of* (SAE AMS2175B). SAE International, Warrendale, PA. <https://doi.org/10.4271/AMS2175B>.

Summary of Recommendations

Overall, the drafted military standard, *Requirements for the development of equipment to support live external attached loads* (MIL-DTL-[TBD]) was reviewed and edited for consistency and clarity in definitions and terms used and to ensure the standard was inclusive for all currently known LEAL type device designs. All relevant military documents and standards were reviewed for applicability and included when necessary.

The weight of the current 95th percentile civilian male is recommended to be used in the live load calculation. This ensures that the weight of the current civilian population is always used for design purposes.

USAARL recommends that the Joint En Route Care Equipment Test Standard (JECETS) be used as the standard for environmental testing of LEAL components. The JECETS utilizes a three-phase test and evaluation approach to test aeromedical equipment. The three phases include a baseline performance assessment, laboratory tests, and an in-flight assessment (IFA). It is recommended that the environmental testing of the personnel-carrying device (Section 4.15) and restraints (Section 5.8.1b) be conducted in accordance with (IAW) JECETS. Furthermore, USAARL recommends that test results/findings be assessed with respect to the safety risk of the aircraft, aircrew, and LEAL occupants. This risk assessment and recommendation for approval or disapproval should be forwarded to SRD for final review and certification.

USAARL subject matter experts (SMEs) developed Section 5.8, titled occupant safety, of the drafted military standard, *Requirements for the development of equipment to support live external attached loads*, to include restraints, occupant orientation, ingress/egress, and identification. Section 5.8 satisfies the general requirement that the personnel-carrying device (PCD) shall have a means to secure live loads as to prevent inadvertent departure from the PCD.

Restraint requirements include:

- Restraints shall be designed in accordance with MIL-R-8592 and tested IAW JECETS.
- Restraints shall be designed to prevent inadvertent departure of the occupant from the PCD.
- Number of restraints: At a minimum, there shall be one restraint per occupant.
- Sizing and interchangeability: Restraints shall be adjustable or interchangeable to accommodate larger and smaller civilian populations (i.e., male/female adults and children) IAW the current anthropometric data (e.g., chest/abdomen circumference, shoulder width).
- Restraint attachments: Restraints shall have hardware to connect to the PCD.
- Restraints shall be easy to don/doff and secure.
- Restraints shall have a method for safe stowage to prevent injury or ingress/egress hazards when not in use.
- Restraint and restraint attachment performance: The minimum strength of the restraint components shall be equal to or greater than the restraint design load (RDL).

Occupant orientation requirements include:

- A PCD designed for ambulatory and non-ambulatory supine occupants must demonstrate restraint safety during transport as deemed by the certifying agency.
- A PCD designed for ambulatory and non-ambulatory seated occupants must demonstrate restraint safety during transport as deemed by the certifying agency.
- A PCD designed for ambulatory and non-ambulatory standing occupants must demonstrate restraint safety during transport as deemed by the certifying agency.

Ingress/egress requirements include:

- The occupied PCD must be stable for safe ingress/egress and during transport as deemed acceptable by the certifying agency.
- The occupant must be capable of ingress/egress from the aircraft if the PCD is a singular wearable device, such as a harness.
- The PCD must have a procedure for ingress/egress depending on occupant position (i.e., supine, seated, standing, or other, such as a child sitting on a parent's lap).

Identification requirements: Restraints shall be labeled in a manner that prevents removal, deformation, or fading that includes:

- Manufacturer's name
- Country of manufacture
- Contact number
- Manufacturer's product identification
- Serial number
- Date of manufacture
- Proof load rating

U.S. ARMY AEROMEDICAL RESEARCH LABORATORY



FORT RUCKER, ALABAMA

Optimizing

**HUMAN PROTECTION
AND PERFORMANCE**
since 1962

All of USAARL's science and technical informational documents are available for download from the Defense Technical Information Center.

<https://discover.dtic.mil/results/?q=USAARL>



U.S. ARMY



T2COM



MRDC