

SUMMARY



SEPTEMBER 2004

Assessment of the LIMOR and Quickstep Ladders

This comparative analysis project was conducted by The U.S. Army Natick Soldier Center.

SAVER SUMMARY OF THE FOLLOWING REPORT:

Arthur D. Little, Inc. *R28 Final Report (January 2002)*, special report prepared at the request of MOUT ACTD TPO. Cambridge, MA, 2002.

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THIS PROJECT WAS FUNDED UNDER GRANT #2003-TK-TX-0002 FROM THE OFFICE OF STATE AND LOCAL GOVERNMENT COORDINATION AND PREPAREDNESS, SYSTEMS SUPPORT DIVISION (OSLGCPC SSD), U.S. DEPARTMENT OF HOMELAND SECURITY.

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The U.S. Army Natick Soldier Center (NATICK) was tasked by the Marine Corps to evaluate ladders that would “provide the soldier/Marine with the capability to get to a second story window with the objective of getting on top of buildings, or to adjacent buildings.” NATICK was gracious enough to share this report with the U.S. Department of Homeland Security, Office for Domestic Preparedness, System Support Division (ODP-SSD). As part of the SAVER programs mission to provide information on technology and equipment that will enable the responder to prepare, prevent, mitigate, and deter acts of terrorism, SAVER has worked with NATICK to produce this summarized version of the entire report.

Commercial Equipment Evaluated

NATICK evaluated the following commercial off-the-shelf (COTS) ladders:

LIMOR Ladder

RAFAEL Armament Development Authority, Ltd., is a company owned by Israel and has offices around the world. RAFAEL



The Lightweight Modular Ladder (LIMOR) in use.

manufactures the Lightweight Modular Ladder (LIMOR), which is a carbon composite modular device that can be assembled up to a total length of 9 meters, by connecting 10 segments in line. All of the segments are identical, except for those at the ends of the ladder. The net weight of the ladder is 20 kg, and can be carried by a single person using a custom made backpack, which weighs 3.8 kg. The ladder is designed to carry three persons climbing on it simultaneously, when it is leaning against a wall and inclined at an angle of up to 30 degrees from the vertical position. The ladder has a “C” shaped cross-section. The open end of the “C” must be facing the wall against which the ladder is leaning. It was the first ladder to come close to the original requirement of “get on top of buildings.”

QuikStep Ladder

The QuikStep ladder, manufactured by Foldable Products International, Inc., combines easy storage, ease of transport, flexibility, strength, and convenience. It comes in extended lengths of 6, 8, 10, 12, and 14 feet. It can be purchased in silver or black. The QuikStep patented design is composed of diecast aircraft grade aluminum. The ladder weighs 38.5 pounds and when folded, can be carried by one individual in a backpack. Its folded dimensions are 26.5 inches by 11.25 inches by 4.5 inches. The ladder unfolds from the carry position to being fully functional in approximately 5 seconds. Its open dimensions are 16.5 inches by 3.25 inches by 168 inches.

Test Plan

The test plan was developed by Natick Labs using portions of ANSI Test A14.2-1990 (Safety for Portable Metal Ladders). The tests performed were the:

- Horizontal Bending Test
- Simulated In-Use Inclined Load Test
- Deflection and Angle of Twist Test
- Rung-to-Side-Rail Shear Strength Test
- Rung Bending Test
- Rung Torque Test
- Side Sway Test
- Static Side Rail Cantilever Bending Test
- Foot Slip Test
- Side Rail Cantilever Dynamic Drop Test
- Ladder Section Twist Test.

Additionally, two test methods were created to more closely resemble ladder use in an operational environment: two-person and three-person dynamic loading. Dynamic loading refers to multiple individuals running up/down the ladder.

For the purpose of testing to the worst-case load scenarios, both ladders were assumed to be extra heavy duty-type IA ladders. The load requirements for extra heavy duty-type IA ladders were applied when testing to the ANSI standard. (Please see the full report for details on the performed tests.)

Results

The QuikStep exceeded the ANSI requirements in ten of the thirteen tests. However, the safety of the user was not in jeopardy as a result of these failed tests. The LIMOR exceeded the ANSI requirements for all but one of the tests. Again failure on the one test did not raise safety concerns. However, these results do indicate that the QuikStep and the LIMOR are safe for use within limitations. Compliance with the safety conditions and limitations is essential for safe use.

Safety Recommendations

Testing for the worst case scenario resulted in a safety factor of 3.3 being applied to the load limit test results to ensure the safety of the



QuikStep Ladder manufactured by Foldable Products International, Inc.

ladders. For example, if failure occurred when the load limit reached 3,300 pounds, the maximum recommended load is 1,000 pounds.

When testing the ladders for use as a bridge that would allow the soldier/Marines to reach an adjacent building, the QuikStep failed at 128 pounds while the LIMOR failed at 257 pounds. Both weights are below the average weight of a soldier/Marine carrying a full fighting load and other mission specific equipment. Therefore, it was recommended that neither ladder be used as a bridge, as the resulting damage to the ladder could cause injury to the soldier/Marine.

In determining the maximum number of soldier/Marines to be on the ladder at any given time—simulated three-person loading—the QuikStep failed at 747 pounds, and the LIMOR failed at 1,023 pounds. The test results indicate that for the QuikStep, a maximum of two soldier/Marines can be on the ladder at any given time. For

the LIMOR, the limit allowed for a maximum of three soldiers/Marines. Furthermore, spotters should stabilize the ladder by supporting it rather than placing pressure on or hanging from it as the additional weight could result in unsafe conditions.

The ladder should be inspected before and after each use in order to identify whether it is bent, disfigured, dented, cracked, or otherwise harboring damaged members or hinges. Any damage renders the ladder unsafe for use.

For safe use, all soldiers/Marines should be formally trained in all areas of using the ladder including scaling the ladder, spotting procedures, and inspection criteria.

For more information on the R28 report, visit the SAVER website at www.dhs-saver.info or contact Mike Samuel at Michael.Samuel@natick.army.mil.



LIMOR Ladder manufactured by RAFAEL Armament Development Authority, Ltd.