



Limpet Test Specification 001:2009 – Summary

The Limpet™ multi-functional height safety system breaks new ground in combining features and functions that, under normal circumstances, are only catered for by single function machines. The Limpet™ is the only device in the world that combines these multiple functions into one machine.

In conjunction with the development of the system Limpet Technology looked at the existing European test standards for devices of this type and concluded that they were far from adequate and that none were devised with a view to testing the combination of multiple functions within one standard.

Limpet Technology set out, in conjunction with industry experts, to write a new standard, under the European PPE Directive, compatible with new multifunctional technology. The resulting standard is designed to specifically test the capabilities of the Limpet™ system but this summary shows the general assumptions made in defining what we believe should be the minimum standards in relation to any piece of height safety equipment. This summary gives a benchmark of the base requirements for equipment of this type.

Legislation

The Limpet Test Specification 001:2009 is intended to meet the requirements of the PPE Regulations 2002 (the UK transposition of the European Directive 89/686.EEC) for the purposes of gaining the CE mark.

Normative References

BS EN 362	Personal protective equipment against falls from a height – Connectors
BS EN 364	Personal protective equipment against falls from a height – Test Methods
BS EN ISO 9227	Corrosion test in artificial atmospheres – Salt spray tests
BS EN ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories

Definitions

Maximum User Mass	140 kg
Minimum User Mass	40 kg
Safety Factor	15 X

Incorporated Legislation and Standards

The following documents were taken into account in preparing the test methods and criteria for Limpet Test Specification 001:2009:

A. Legislation

- The Working at Height Regulations 2005 (WAHR), SI 2005/735
- Lifting Operations and Lifting Equipment Regulations 1998 (LOLER), SI 1998/2307 and ACoP Safe Use of Lifting Equipment
- Provision and Use of Work Equipment Regulations 1998 (PUWER), SI 1998/2306 and ACoP Safe Use of Work Equipment

B. Standards

ANSI Z359.1:2007	Safety requirements for personal fall arrest systems, subsystems and components
AS/NZS 1891.3:1997	Industrial fall-arrest systems and devices
BS EN 341:1993	Personal protective equipment against falls from a height – descender devices

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Fpr EN 341: 2009	Personal protective equipment against falls from a height – descender devices for rescue, final draft version
BS EN 364: 1993	Personal protective equipment against falls from a height – test methods
BS EN 1496: 2006	Personal protective equipment against falls from a height – rescue lifting devices
BS EN 5062: 1985 (withdrawn) BS 8437	Self-locking safety anchorages for industrial use Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace
CSA Z259.1 1995 (withdrawn)	Safety belts and lanyards
CSA Z259.2.1: 1998	Fall arresters, vertical lifelines and rails
CSA Z259.2.2: 1998	Self-retracting devices for personal fall-arrest systems
CSA Z259.2.3: 1999	Descent control devices
ISO 10333-3:2000	Personal fall-arrest systems – Part 3: Self-retracting lifelines
ISO 10333-6	Personal fall-arrest systems – Part 6: System performance tests
ISO 22159: 2007	Personal equipment for protection against falls – descending devices
BS EN 14502 Part 1: 2005	Cranes – equipment for lifting persons: suspended baskets
BS EN 12278:2007	Mountaineering equipment – pulleys – safety requirements and test methods
BS EN 60529: 1992	Degrees of protection provided by enclosures (IP code)
NFPA 1983: 2006	Standard on life safety rope and equipment for emergency services

Tests

In all dynamic performance tests the following test parameters must be met:

Maximum permitted arrest force	6 kN
Maximum permitted deceleration	6 g
Maximum vertical displacement of test mass	100 mm

1. DYNAMIC PERFORMANCE TESTING

- 1.1 Stationary release of 140 kg test mass, climb-assist feature switched off
- 1.2 Stationary release of 40 kg test mass, climb-assist feature switched off
- 1.3 Ascending release of 140 kg test mass, climb-assist feature switched off
- 1.4 Ascending release of 40 kg test mass, climb-assist feature switched off
- 1.5 Descending release of 140 kg test mass, climb-assist feature switched off
- 1.6 Descending release of 40 kg test mass, climb-assist feature switched off
- 1.7 Repeat of tests 1 – 6 under back-up power supply where appropriate.
- 1.8 Stationary release of 140 kg test mass with no power
- 1.9 Stationary release of 40 kg test mass with no power
- 1.10 Ascending release of 140 kg test mass, climb-assist feature switched on
- 1.11 Ascending release of 40 kg test mass, climb-assist feature switched on
- 1.12 Stationary release of 140 kg test mass with lifeline at near 100% extraction
- 1.13 Stationary release of 40 kg test mass with lifeline at near 100% extraction
- 1.14 Ascending release of 140 kg test mass with lifeline at near 100% extraction
- 1.15 Ascending release of 40 kg test mass with lifeline at near 100% extraction
- 1.16 Descending release of 140 kg test mass with lifeline at near 100% extraction
- 1.17 Descending release of 40 kg test mass with lifeline at near 100% extraction

2. DYNAMIC STRENGTH TESTING

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With machine power off, lifeline deployed at least 3.6 m vertically and then fixed, drop 140 kg test mass a minimum of 0.6 m (freefall). Device should hold test mass in suspension.

3. STATIC STRENGTH TESTING

3.1 **Static strength testing of lifeline joint on drum.**

With lifeline fully extended apply tensile load of 15 kN directly in line with lifeline joint. The lifeline, joint, machine and all components shall survive for 3 minutes with the load applied without any rupture or failure.

3.2 **Static strength test with drum in maximum lifeline condition.**

Test carried out as above with tensile load of a minimum of 15 X maximum user load. For the Limpet™ device a load of **22 kN** is used.

3.3 Repeat test 3.1 and 3.2 with power switched off where appropriate.

3.4 **Static strength test of upper and lower pulley.**

4. HEAT CONDITIONING TESTING

Machine heated to 50 °C for 2 hours, removed and then each test carried out within 90 seconds of removal.

4.1 Test normal function of device at this temperature

4.2 Test dynamic release and descent with 140 kg test mass

5. COLD CONDITIONING TESTING

Machine cooled to -30 °C for 2 hours, removed and then each test carried out within 90 seconds of removal.

5.1 Test repeated as for 4.1 and 4.2.

6. WET CONDITIONING TESTING

Spray water at machine and UPS (if appropriate) at rate of 70 litres/hour for 3 hours, remove and carry out tests within 10 minutes of removing.

6.1 Test repeated as for 4.1 and 4.2.

7. DUST CONDITIONING TESTING

Place device and upper or lower pulley in dust conditioning chamber. Introduce 5 kg of dry cement. Agitate cement dust at 5 minute intervals with blasts of air for 2 seconds.

7.1 After one hour fully unwind and wind lifeline coincidentally with dust agitation. Repeat unwinding/ winding sequence at hourly intervals for 5 movement sequences.

8. OIL CONDITIONING TEST

Immerse lifeline in commercial grade diesel oil for 30 minutes drain for 24 hours and load back onto drum.

8.1 Test repeated as for 4.2.

9. RESCUE OPERATION TESTS

9.1 **Descent Test 140 kg.** Lower 140 kg through 100m at constant drum speed pausing at 3 random points. At each point use hoist function raise test mass through at least 0.5 m before continuing lower. Lower to ground.

9.2 **Descent Test 40 kg.** Repeat 9.1 with 40 kg test mass.

9.3 **UPS Capacity Test.** Where appropriate use UPS supply alone and lower 140 kg test mass through 100 m at constant speed.

9.4 **Descent with Wet Lifeline.** Immerse 200 m of lifeline in water for 15 minutes and repeat 9.1.

9.5 **Descent with Wet Lifeline.** Immerse 200 m of lifeline in water for 15 minutes and repeat 9.1

10. DESCENT TESTS

- 10.1 **Endurance Test.** Complete 100 successive descents of 100 m with a 140 kg test mass ensuring that average speed remains the same.
- 10.2 **Residual Strength Test.** Repeat 3.2 on sample used for 10.1.
- 10.3 **Emergency Descent Test.** Lower a test mass of 280 kg through 100m at a constant drum speed.

11. CORROSION TESTS

- 11.1 Subject test specimen to salt spray test in accordance with BS EN ISO 9227. Inspect for corrosion that could affect function.

12. LADDER CLIMBING PERFORMANCE TESTS

This section of the test method is designed to specifically test the fall prevention / arrest performance of devices being used on fixed vertical ladders.

The tests all employ anthropomorphic test dummies (ATD) (71 and 100 kg) and full body harnesses.

Pass and fail criteria are detailed in the full standard.

- 12.1 **Fall- back release test (sternum attachment).** Repeated with both 71 and 100 kg dummies with ladder rung against heels of boots.
- 12.2 **Fall- back release test (dorsal attachment).** As for 12.1.

The following tests have been adapted from HSE '08.

- 12.3 **Crouch-back release test (sternum attachment).**
- 12.4 **Crouch-back release test (dorsal attachment).**
- 12.5 **Climb release test (sternum attachment).** Test with feet on alternate ladder rungs simulating ladder climbing.
- 12.6 **Climb release test (dorsal attachment).** As for 12.5.
- 12.7 **Feet-first release test (sternum attachment).**
- 12.7 **Feet-first release test (dorsal attachment).**

13. SUPPLEMENTARY LADDER CLIMBING TEST IN 'BACKSCRATCHER' LADDER

This testing was carried out using the test methods detailed in 12 above. These tests comprised releasing a 100kg Anthropomorphic Test Dummy (ATD) fitted with a full body harness and measuring the vertical displacement, peak force and peak vertical g-forces experienced by the ATD.

This testing was carried out with the ATD in a 'backscratcher' ladder situation which is typical of that found in many wind turbines. The maximum distance between the closest edge of the ladder rung and the wall was 725mm.

The following tests were completed using the 100 kg dummy.

- 13.1 **Fall- back release test (sternum attachment).**
- 13.2 **Crouch-back release test (sternum attachment).**
- 13.3 **Climb release test (sternum attachment).**
- 13.4 **Feet-first release test (sternum attachment).**

14. CLIMB-ASSIST TESTING

- 14.1 Using 140 kg test mass and at various levels of assistance (in the case of the Limpet™ 50% and 80%) test to see that the level of assistance received by the test mass is within $\pm 5\%$ of the target assistance.
- 14.2 Test to see that the test mass is never hoisted by the assistance.
Fall prevention testing with climb-assist switched on is done as part of the Dynamic Performance testing.

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