LIFESAVING SYSTEMS CORPORATION

Report Number: F-730-495
Revision: A

Airworthy Qualification Report

Collapsible Rescue Basket

P/N: 495





PROPRIETARY & CONFINDENTIAL

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1.0 INTRODUCTION



Rescue baskets are by far the safest and most efficient helicopter rescue device in use. On some missions, the basket has been the only option for a safe rescue. In missions with multiple victims, with minimal or no injuries, the rescue basket is the perfect solution for rapid unaided rescue. In critical mass-casualty situations, two average-sized individuals can be hoisted at once in the rescue basket. The ability to lift two victims in a single hoist evolution speeds the recovery and reduces the time on scene for multi-victim rescues. Additionally, injury concerns, discomfort, and chest compression caused by some rescue strops, especially with larger heavier individuals, are eliminated by using a recue basket.

The McCauley Collapsible Rescue Basket (named for the U.S. Navy Officer who championed it's development) combines the compact storage capabilities of rescue nets with the ruggedness, rigidity, and safety of solid frame rescue baskets. This design is ideal for smaller helicopters where cabin space is limited.

Frame members are constructed of tubular stainless steel with flexible net sides of 1/2" nylon webbing. All components are non-corrosive and require minimal maintenance over the service life of the device. A semi-rigid plastic mesh liner with 1" openings encloses the bottom. Inherent flotation provides positive self-righting and reserve buoyancy. Float covers are printed with safety pictorials and have high intensity retroreflective markings. A heavy-duty stowage case constructed of 1050 denier ballistics nylon and tie-strap are included with the basket.

The Rescue Basket is quickly assembled with ease by simply lifting the bails and top rail up, then rotating the side supports down, securing them in place with simple spring-locks. For easy stowage the bail assemblies roll down into the basket and each side support folds inward. **NSN 1670-01-566-6578**.

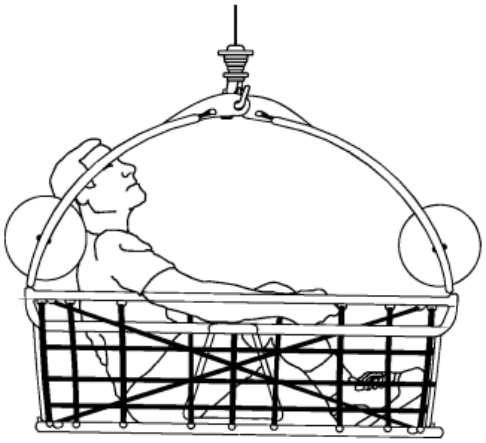
This basket is standard equipment aboard all U.S. Navy H-60 and used by many other rescue agencies worldwide.

The Department of the United States Army has approved the Lifesaving Systems Rescue Basket per the Airworthiness Release (AWR) for Rescue Hoist Equipment on UH/HH-60 Helicopters (AWR 980).

2.0 DESIGN STANDARDS

NFPA 1983: 6.7.1.2 Class III Victim Extrication Device. A device that secures around the waist, around the thighs, or under the buttocks, and over the shoulders or that otherwise encapsulates a body to be used for victim extrication in an upright or horizontal configuration shall be designated as a Class III victim extrication device.

14 CFR § 133.45 specifies limitations for external-load operations as rotorcraft-load combination Class D, the certification requirements for HEC operations are found in 14 CFR § 27.865 or 14 CFR § 29.865, as applicable.



3.0 REFERENCES

NAS 809, National Aircraft Standards Committee, Specification- Aircraft Seats and Berths

SAE ASTM A554-16, Standard Specification for Welded Stainless-Steel Mechanical Tubing

National Fire Protection Association (NFPA) 1983, “Standard on Fire Service Life Safety Rope and System Components,” 2012 edition.

FAR 25.83 Fire Test to Aircraft Material – Horizontal Flammability Test (v)

FAR Part 29 effective Feb 1, 1965 plus amendments 29-1 through 29-16. Airworthiness Standards: Transport Category Rotorcraft

Lifesaving Systems #495-L Load Test Plan & Report, 16-JAN-2013

U.S. Army Aviation Engineering Directorate SER-70534, Appendix E, Rev. 2.

4.0 BASKET DESIGN

- Measurements
  - Stowed: 44½” (L) x 25” (W) x 9½” (H)
  - Assembled: 50” (L) x 25” (W) x 38” (H) (37.5" to inside top of lifting eye)

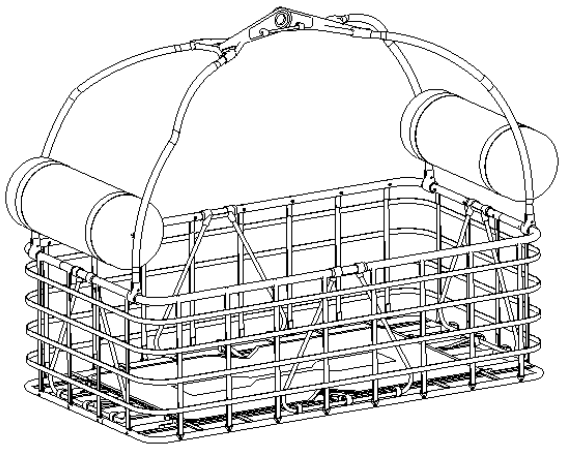
- Weight
  - 37lbs

- Material
  - Frame: 304 Stainless Steel, TIG Welded to AWS D17.1 Standards
  - Flotation: closed cell, marine grade foam with international orange 1050 denier ballistics nylon covers, 3M™ SOLAS-grade retroreflective markings
  - Liner: Semi-rigid plastic net with 1” openings
  - Net sides: ½” nylon webbing

- Service Life
  - On condition (Ultimate – 20 years from DOM)

- Load limits
  - WLL: 600lbs

- Inspection/Maintenance Cycles
  - Acceptance Inspection
  - Pre-Use/Post Flight Inspection
  - Annual load test and Inspection



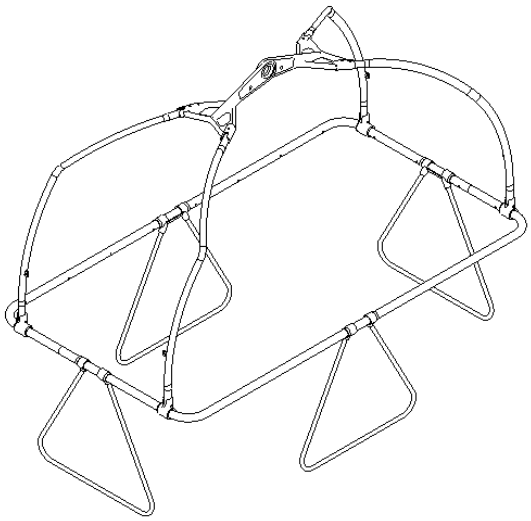
4.1 TOP FRAME STRUCTURE

Tubular:

.75” OD x 0.065” nominal wall

.375” OD x 0.065” nominal wall

Stainless Steel T-304 per ATSM A554-16



Meets Specifications:

Welding shall be performed using the Gas tungsten arc welding (GTAW), also known as TIG (tungsten, inert gas). Welding shall be durable, sound, and in accordance with the applicable recommendation of the Welder’s Handbook, American Welding Society and AWS D17.1.

Acceptable welds shall have no cracks or voids, and thorough fusion shall exist between adjacent layers of weld metal and base metal.

All joints and intersections of frame, ribs, and basket rim shall be welded. After welding, any projections, loose weld spatter or other defects which could possibly result in injury to patient or handler shall be removed.

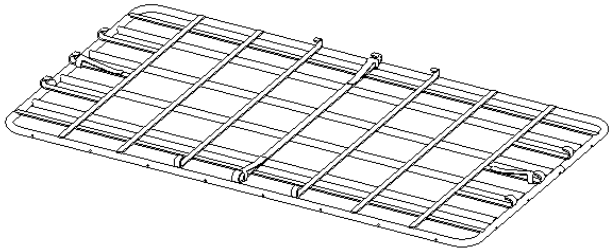
*Note: Supplier certificate of conformance for material is on file at Lifesaving Systems Corp.

4.2 BOTTOM FRAME STRUCTURE

Tubular:

.625” OD x 0.049” nominal wall

Stainless Steel T-304 per ATSM A554-16



Flat Bar:

.125” thick x .625” wide

.125” thick x .500” wide

Stainless Steel T-304 per ATSM A240

Meets Specifications:

Welding shall be performed using the Gas tungsten arc welding (GTAW), also known as TIG (tungsten, inert gas). Welding shall be durable, sound, and in accordance with the applicable recommendation of the Welder’s Handbook, American Welding Society and AWS D17.1.

Acceptable welds shall have no cracks or voids, and thorough fusion shall exist between adjacent layers of weld metal and base metal.

All joints and intersections of frame, ribs, and basket rim shall be welded. After welding, any projections, loose weld spatter or other defects which could possibly result in injury to patient or handler shall be removed.

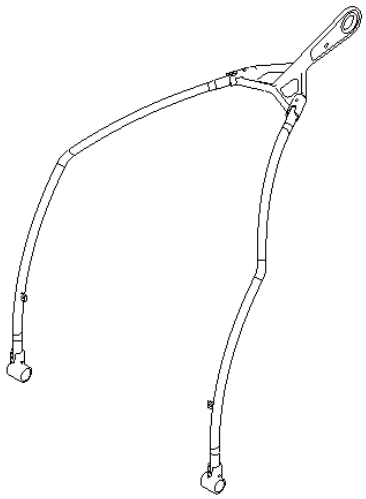
*Note: Supplier certificate of conformance for material is on file at Lifesaving Systems Corp.

4.3 LIFTING BAIL ARMS

Tubular:

.625” OD x 0.049” nominal wall

Stainless Steel T-304 per ATSM A554-16



Bail Eye:

Casting: Stainless Steel 17-4PH per AMS 5355

Heat Treat: Condition H1025 per AMS 5355

Meets Specifications:

NFPA 1983: 6.7.6 Victim extrication devices shall have at least one loadbearing attachment point as identified by manufacturer’s instructions.

NFPA 1983: 6.7.7 Load-bearing hardware components of victim extrication devices shall be constructed of forged, machined, stamped, extruded, or cast metal.

NFPA 1983: 6.7.7.1 Castings shall meet Class I, Grade A requirements of SAE-STD-2175A, Castings Classifications and Inspection of.

Welding shall be performed using the Gas tungsten arc welding (GTAW), also known as TIG (tungsten, inert gas). Welding shall be durable, sound, and in accordance with the applicable recommendation of the Welder’s Handbook, American Welding Society and AWS D17.1.

Acceptable welds shall have no cracks or voids, and thorough fusion shall exist between adjacent layers of weld metal and base metal.

All joints and intersections of frame, ribs, and basket rim shall be welded. After welding, any projections, loose weld spatter or other defects which could possibly result in injury to patient or handler shall be removed.

4.4 BASKET NETTING

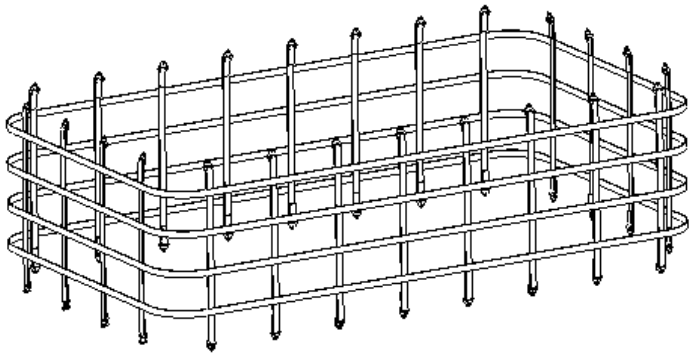
Material: Nylon

Width: ½”

Thickness: .058”

Color: Black

Breaking Strength: 1270lbs (Tensile)



Meets Specifications:

FAR 25.83 Fire Test to Aircraft Material – Horizontal Flammability Test (v)
(15 Sec Horizontal Test, 4in/min)- PASS

NFPA 1983: 6.7.3 Load-bearing textile materials used in the construction of victim extrication devices shall be made from virgin, synthetic, continuous filament fiber.

NFPA 1983: 6.7.4 All webbing ends shall be secured by heat sealing or by another method that prevents unraveling.

*Note: Supplier certificate of conformance for all material is on file at Lifesaving Systems Corp.

4.5 HARDWARE

Link:

Material: Stainless Steel T-304

Thickness: 0.060”

Rivet:

Material: Stainless Steel T-304

5/32"x.300 (.020-.125 GRIP) Stainless Open

Screw and Locknut:

Material: Stainless Steel T-304

Screw Size: #12-24 x 5/8”

Locknut: #12-24

4.6 FLOTATION

Buoyancy: Approximately 50lbs (25lbs each log)





4.6.1 COVER

Material: 1050 denier ballistics nylon

Color: International orange

Markings: 3M™ SOLAS-grade retroreflective

Meets Specification:

FAR 25.83 Fire Test to Aircraft Material – Horizontal Flammability Test (v)
(15 Sec Horizontal Test, 4in/min)- PASS

4.6.2 LOG

7” OD x 18” Closed cell, marine grade foam (Ethafoam 220)

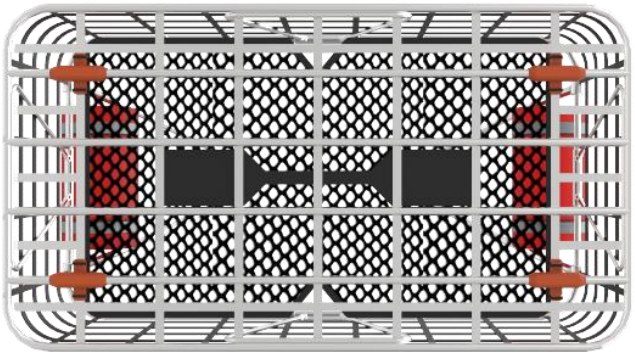
Buoyancy: Approximately 25lbs

4.7 SKID SHOES

Material: Polypropylene

Color: Red/Orange





Meets Specification:

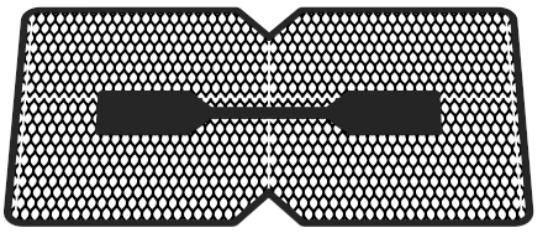
NAS 809: 3.1.1 Protection: All members of the structure shall be protected against deterioration of loss of strength in service due to wreathing, corrosion, abrasion or other causes where the type of material used requires such protection.

4.8 NET LINER

Material: Semi-rigid plastic net (1” Holes)

Dimensions: 19.5” x 33.50” x 1/8”

Color: Black



Meets Specification:

Net lining shall be of a lightweight material that is non-toxic, UV-stabilized, and will not conduct electricity or corrode.

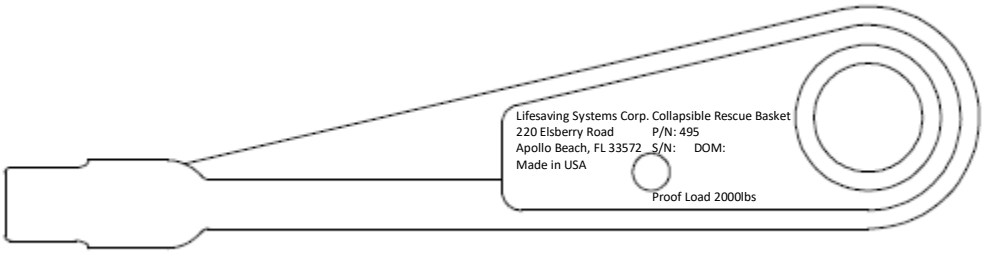
4.9 MARKING

Mark at least one major component permanently and legibly with all the information listed in 14 CFR § 21.607(d). Permanently and legibly mark each article to which this section applies with the following information:

Name and address of the manufacturer.

Name, type, part number, or model designation of the article.

Serial number or the date of manufacture of the article or both.



Laser Engrave Text:

Lifesaving Systems Corp.
220 Elsberry Road
Apollo Beach, FL 33572
Made in USA

Collapsible Rescue Basket
P/N: 495
S/N: #### DOM: MMYY

Proof Load 2000lbs

5.0 TEST REQUIREMENTS

The #495 collapsible rescue basket shall meet the following requirements as set by 14 CFR § 29.305, strength and deformation, during load testing:

(a) The test item must be able to support limit loads without permanent deformation.

(b) The test item must be able to support ultimate loads without failure.

(i) Apply ultimate loads to the structure in a static test for at least three (3) seconds.

(ii) Dynamic tests simulating actual load application.

In addition: The #495 basket must also meet the static load test criteria of 2,700lbs for 5 minutes in accordance with U.S. Army Aviation Engineering Directorate SER-70534, Appendix E, Rev. 2. The 5-minute static load requirement shall supersede the ultimate load requirement of 3 seconds stated in 14 CFR § 29.305.

The #495 collapsible rescue basket shall meet the following requirements as set by 14 CFR § 29.865 - External loads.

(iii) Withstand a limit static load equal to 3.5 multiplied by the maximum external load for which authorization is requested.

(iv) Load applied in the vertical direction.

5.1 TEST ARTICLE/INSPECTION

Static Testing: Testing and inspection were performed at Lifesaving Systems Corporation's (LSC) manufacturing facility located in Apollo Beach, Florida by LSC personnel. U.S. Army AED representatives were present to observe and verify the test results at the time of static loading. The static loading referenced in this report occurred on January 16th, 2013. Full report can be found in Lifesaving Systems #495-L Load Test Plan & Report.

Test Specimen: LSC #495-L Collapsible Rescue Basket w/ Lowered Lifting Eyes
DOM: 01/2011
S/N: 044

Dynamic Testing: Testing and inspection were performed at Lifesaving Systems Corporation's (LSC) manufacturing facility located in Apollo Beach, Florida by LSC personnel.

Test Specimen: LSC #495 Collapsible Rescue Basket
DOM: 06/12
S/N: 137



5.2 TEST FACILITY

LIFESAVING SYSTEMS CORPORATION
220 ELSBERRY ROAD
APOLLO BEACH, FLORIDA 33572

5.3 EQUIPMENT

The primary testing equipment consisted of the following items:

1. Force Application: Physical weights consisting of lead shot in fabric bags and/or lead bars.

2. Force Measurement: 10,000lbs S-beam load cell (transducer) with one (1) each 0-10,000lbs digital gauge.

3. A commercial grade shipping scale will be used to independently verify the weight of each physical specimen added to the basket for force application.

4. Fixtures: Shackles, pins, and custom fixtures as required to suspend the basket with physical weights.

5. Miscellaneous Measurement Instruments: Rulers, tape measures, calipers & 10X magnifying glass as required for supplemental measurement information.

5.4 CALIBRATION

The instruments and equipment are calibrated according to manufacturer's specifications and calibration is traceable to the National Institute of Standards and Technology (NIST). Calibration records are maintained on file at Lifesaving Systems Corp. Refer to the original test reports for previous calibration dates that may be referenced in this report.

6.0 LOAD TESTS

6.1 STATIC LOADS

#495 Collapsible Rescue Basket shall be placed on the ground or other support surface for the addition of physical weights. Once weights have been added according to the target load the basket will be lifted from the ground/support by the basket's lifting eyes and suspended for a minimum of 5 minutes. This will be repeated for each target load specified. The basket shall support a minimum load of 2,700lbs for 5 minutes as specified by US Army AED without failure (bending and deformation allowed).

Success Criteria:

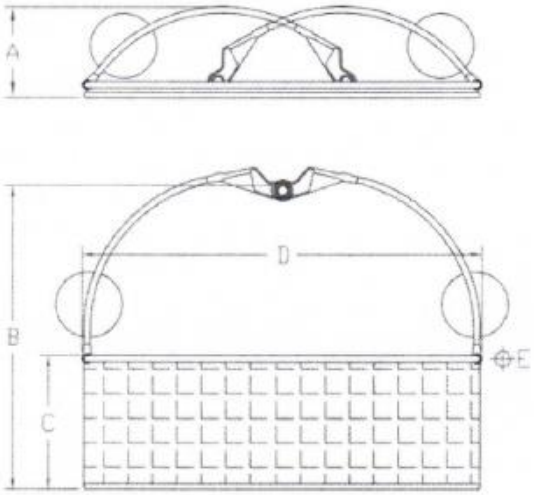
(i) Basket after being subjected to the Working load limit of 600lbs for 5 minutes must exhibit no permanent deformation or other damage (bending, cracks, etc.). Key characteristic dimensions will be recorded before and after the 600lb load test.

(ii) Basket must pass the noted load test criteria of 2,700lbs for 5 minutes in accordance with Army Aviation Engineering Directorate SER-70534, Appendix E, Rev. 2.

6.1.1 WORKING LOAD LIMIT

Target Load (lbs)	Scale Weight (lbs)	Load Cell Weight (lbs)	Success Criteria Pass/Fail	Notes
600	600	637	PASS	Test Load supported for 5 minutes. No permanent deformation

The dimensions as shown in the figure below shall be measured and recorded before and after the 600 lbs (WLL) load test. All measurements obtained in the unloaded condition.



	Dimension Prior to 600 lbs Load Test	Dimension After 600 lbs Load Test
Feature A	10-15/16"	10-15/16"
Feature B	33-1/2"	33-1/2"
Feature C (All four corners)	14-3/4" (all four corners)	14-3/4" (all four corners)
Feature D	44-7/8"	44-7/8"
Feature E*	17-7/8" (side 1) 17-15/16" (side 2)	17-7/8" (side 1) 17-15/16" (side 2)

* Feature E defined as spread between lifting bail arms.

Measurement Comments:

- Basket was marked at two locations (left bail assembly and 1 corner) with tape to ensure before and after dimensions were measured in the same order and manner.
- Feature B dimension measured from bottom of basket (sitting on floor surface) to bottom of lifting eye.



(7) Load Test Fixture w/ Basket



(8) Load Cell Gauge, Reporting 36.8 lbs (basket only)



(9) Load Test - 600 lbs



(10) Load Cell Gauge, Reporting 637 lbs (Basket + 600 lbs load)

6.1.2 ULTIMATE LOADS

Target Load (lbs)	Scale Weight (lbs)	Load Cell Weight (lbs)	Success Criteria Pass/Fail	Notes
1700	1700	1739	PASS	Test Load Supported. Meets FAR 29.305(b) for ultimate loads. No failure other than deformation (permanent)
2700	2700	2741	PASS	Test load supported for 5 minutes. No anomalies or failure of any component including welds, side net, net rivets, side supports, liner and tubular frame. Significant permanent deformation to tubular frame. Meets U.S. Army AED specification.
3300	3300	3351	PASS	Test load supported. No failure of any component including welds, side net, net rivets, side supports, liner and tubular frame. Further permanent deformation to tubular frame. Meets 14 CFR § 29.865 - External loads



(13) Load Cell Gauge, Reporting 1739 lbs (Basket + 1700 lbs load)



(12) Load Test - 1700 lbs



(15) Load Test - 2700 lbs



(16) Load Cell Gauge, Reporting 2741 lbs (Basket + 2700 lbs load)



(17) Load Test - 2700 lbs, Lifting Eye/Bail Detail



(18) Load Test - 2700 lbs, Frame Detail



(19) Basket filled with 3300 lbs (resting on skid supports)



(20) Load Test - 3300 lbs

6.1.3 EXTERNAL LOAD

14 CFR § 29.865 - External loads

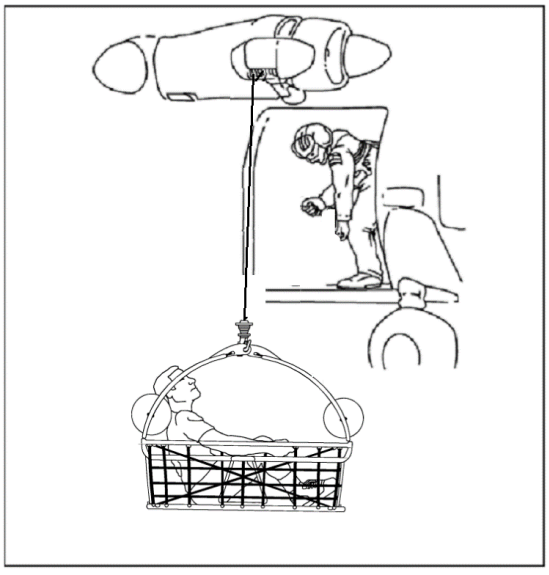
It must be shown by analysis, test, or both that the rotorcraft external load attaching means and corresponding personnel carrying device system for rotorcraft-load combinations to be used for human external cargo applications can withstand a limit static load equal to 3.5 multiplied by the maximum external load for which authorization is requested. The load for any rotorcraft-load combination class, for any external cargo type, must be applied in the vertical direction.

Calculation:

(Working Load Limit) x 3.5 = (600lbs) x (3.5) = 2,100lbs

Ultimate Load = 3,300lbs > 2,100lbs

The #495 collapsible rescue basket exceeds the requirement in 14 CFR § 29.865 - External loads



6.2 DYNAMIC LOADS

FAR § 29.305 - Dynamic tests simulating actual load application.

*Note: The dynamic testing in this report is intended to show the structural strength of the basket.

Impact Force:

A #495 basket shall free fall from 6.56ft (2m) onto a grass surface. This will simulate a typical dynamic force that may be experienced in the field on the basket. The basket shall pass if there is no structural damage that may cause injury to the patient. The impact force shall be calculated for reference to the strength of the basket.

G-Force:

A #495 basket with a 170lb dummy seated inside shall free fall 9.84ft (3m) onto a concrete surface. The "G-force" at impact shall reach a minimum of 30G. The basket shall pass if there is no structural damage that may cause injury to the patient. The "G-force" for the fall shall be calculated for reference to the strength of the basket.

6.2.1 DROP TEST PHOTOGRAPHS



Height: 6.56ft (2m)

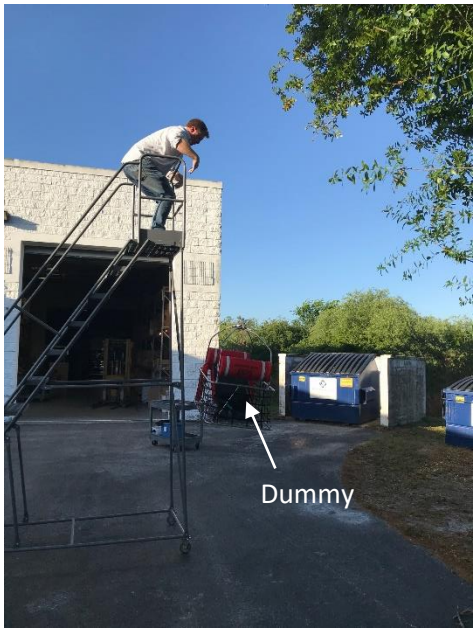


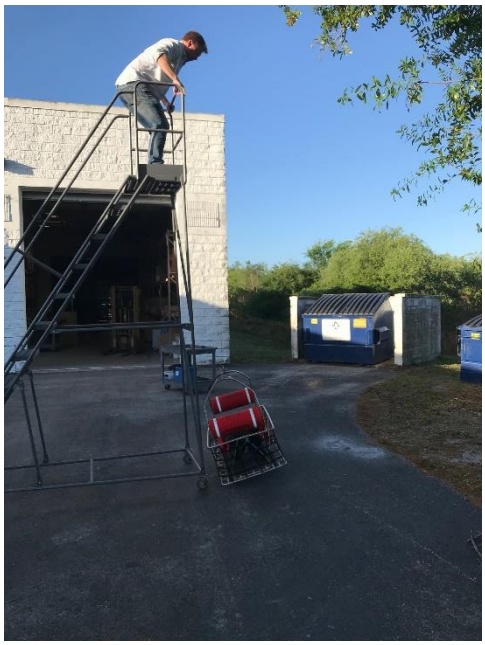
Impact Force Drop



Height: 9.84ft (3m)







No Damage, dummy remained in basket after impact.

6.2.2 DROP TEST CALCULATIONS

Impact Force = F

Velocity just before impact = v

Distance (h) = 2m (6.56ft)

Acceleration Gravity (g) = 9.8$\frac{m}{s^2}$ (32.2$\frac{ft}{s^2}$)

Weight (m) = 17kg (37lb basket)

*Displacement (d) = .01m

Conservation of Energy: $\Delta KE = \Delta PE$

$$1/2mv^2 = mgh$$

$$v^2 = 2gh$$

$$v = \sqrt{2gh}$$

$$v = \sqrt{2 * \left(\frac{9.8m}{s^2}\right) * 2m}$$

$$v = \frac{6.26m}{s} \; or \frac{20.53ft}{s}$$

Impact Force: $\Delta W = \Delta KE$

$$Fd = \frac{1}{2}mv^2$$

$$F = \frac{1}{2}(\frac{mv^2}{d})$$

$$F = \frac{1}{2}(\frac{2mgh}{d})$$

$$F = (\frac{mgh}{d})$$

$$F = \frac{(17kg)\left(9.8\frac{m}{s^2}\right)(2m)}{.01m}$$

$F = 33.32\ kN$ or 7,490lbf

*displacement distance of 0.01m was chosen for this calculation to simulate dropping basket in grass field.

Conservation of Energy: $\Delta KE = \Delta PE$

Height (h) = 9.84ft (3m)

$$1/2mv^2 = mgh$$

$$v^2 = 2gh$$

$$v = \sqrt{2gh}$$

$$v = \sqrt{2 * \left(\frac{32.2ft}{s^2}\right) * 9.84ft}$$

$$v = \frac{25.17ft}{s} \; or \; \frac{7.67m}{s}$$

Coefficient of Restitution: $e = \frac{Vf}{Vi}$ (kinetic energy lost at impact)

$e = 0.59$ (simulated steel ball drop on concrete)

Impulse- Momentum Theorem: $m\Delta V = F\Delta t$

$$vi = \frac{25.17ft}{s}$$

Δt = .01s (impact time)

$$g = \frac{32.2ft}{s}$$

$$m(vi - vf) = ma\Delta t$$

$$vi - vf = a\Delta t \qquad vf = evi$$

$$\frac{vi - evi}{\Delta t} = a \qquad a = (c)g$$

$$\frac{vi(1-e)}{\Delta t} = (c)g$$

$$(c) = \frac{vi(1-e)}{g\Delta t}$$

$$(c) = \frac{25.17\ (1 - 0.59)}{32.2\ (0.01)} = 32G$$