APICAL INDUSTRIES, INC.

REPORT NUMBER AI332-2

STRENGTH, DEFORMATION AND SHOCK ABSORPTION LIMIT
ANALYSIS PLAN AND REPORT

APICAL INFLATABLE EMERGENCY

HELICOPTER FLOAT KIT
EUROCOPTER AS332C, L and L1

FAA PROJECT NUMBER ST8539LA-R

PREPARED BY Mike Lonnecker 10/26/00
Date

CHECKED BY ______________________
Date

REPORT APPROVED BY ______________________
Date

Log of Revisions

Date	Rev.	Page No.	Description	Approval
11/8/00	N/C	All	Initial Release	D.V. Hitzfield

Table of Contents

Table of Figures

References

1. Apical Dwg 20729 & 20730
2. Apical Document II332-1 Installation Instructions
3. Apical Document ICA332-1 Instructions for Continued Airworthiness
4. Apical Document AI332-1 Structural Substantiation Report
5. FAR Part 29
6. Reeves International Specification TX-93012 Certificate of Compliance
7. MIL-HDBK-5F

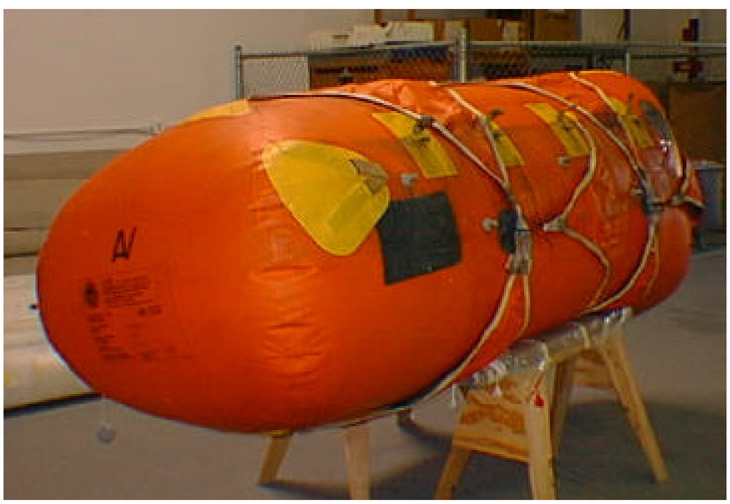
1.0 Scope

The purpose of supplying this Strength, Deformation and Shock Absorption Limit Analysis Plan and Report is to obtain an FAA Supplement Type Certificate for Apical Industries, Inc.'s (Apical) replacement inflatable emergency helicopter floats. The Apical replacement inflatable emergency floats, Nose Float P/N 20729 and Main Floats P/N 20730, are direct replacements for Aerazur's Fwd Float P/N 158820 and Aft Floats P/N 158565 and 158566 for the Eurocopter AS332. The Apical replacement emergency floats are dimensionally and functionally identical to the Aerazur floats. The Apical Floats are installed exactly as the Aerazur floats per Aerazur Maintenance Manual Document No. 25.69.18.

The AS332C, L and L1Models have a current maximum gross weight of 18960 pounds.

Take off after executing an emergency water landing is not permitted.

An egress verification test was conducted during the original float certification



Main Float (Right Hand Looking Outboard)

Nose Float (Only Right Hand Half Shown)

2.0 Introduction

Apical Industries, Incorporated (Apical) currently holds STC's for helicopter inflatable emergency float installations. These inflatable emergency floats are for installation on the Eurocopter AS332. These floats are similar in construction and materials to the other floats for which Apical has obtained certification.

The Eurocopter AS332 Emergency Float System consists of three float bags; one nose float and two symmetrically mounted main floats.

Apical has previously performed drop tests of floats that are similar in design, construction and materials. These previous tests have shown that the internal operating pressures of the floats see negligible increases during the drop testing, suggesting negligible load peaking. Additionally, visual inspection of the hardware shows no permanent deformation. The helicopter airframe and float containers have been structurally substantiated as part of the helicopter type certification. Therefore, it can be implied that the only critical component that requires proof of compliance is the float bag to airframe/container interface structure. Apical will perform analysis that will show the strength of this structure far exceeds the requirements for Strength, Deformation and Shock Absorption Limits in accordance with FAR 29.521, and 29.725 for the limit drop tests.

Test samples of the material used have been prepared and pull tested to determine the ultimate strength of the material used to form the structure of the float bag to container interface. This ultimate strength will then be used in the analysis to determine compliance. The web straps are manufactured to MIL-W- 4088 and have known break strengths as defined in that specification.

The analysis is expected to show a positive margin of safety. This combined with the successful completion of drop testing on several other similar float systems will prove compliance.

3.0 <u>Method of Showing Compliance</u>

3.1 29.305 Strength and Deformation

(a) The float structure must be able to support limit loads without detrimental or permanent deformation. At any load, up to limit loads, the deformation may not interfere with safe operation.

(b) The float structure must be able to support ultimate loads without failure. This must be shown by

(1) Applying ultimate loads to the structure in a static test for at least three seconds; or

(2) Dynamic tests simulating actual load application.

Apical proposes to do an analysis along with the results of previous dynamic (drop) testing to show compliance.

3.2 29.473 Ground Loading Conditions and Assumptions

(a) (b) The proposed analysis and previous drop test results will be used. The design maximum weight with benefit of rotor lift will be used in the analysis.

3.3 29.521 Float Landing Conditions

(a) Upload Condition

(1) Because the floats are installed symmetrically about the rotor centerline, the water reaction passes vertically through the helicopter center of gravity.

(2) The proposed analysis will use a load as specified in (a)(1) above applied simultaneously with an aft component of 0.25 times the vertical component.

3.0 <u>Method of Showing Compliance (Continued)</u>

3.3 29.521 Float Landing Conditions (Continued)

(b) Side Load Condition

(1) A load of 0.75 times the vertical load specified in 29.521(a)(1) above will be divided equally among the floats and used in the analysis.

(2) For each float the load share from (b)(1) above will be combined with a side load of 0.25 times the vertical load proposed by FAR 29.521(b)(1).

.

3.4 29.725 Limit Drop Test

Analysis and similarity to previous limit drop tests is proposed to show compliance with FAR 29.725(a).

3.5 29.727 Reserve Energy Absorption Drop Test

The AS332 airframe has been substantiated during FAA Type Certification for energy absorption for landing.

Analysis and similarity to previous reserve energy drop tests is proposed to show compliance with FAR 29.727(a).

4.0 Analysis

4.1 Float Bags

The AS332 emergency float system is similar to other float systems previously drop tested (See AI355-5 for previous drop test data and results.) to meet the requirements of FAR 29.305, 29.473, 29.521, 29.725 and 29.727. All of the previous tests were completely successful. The AS332 float bags use the same construction and materials as the other floats tested. No appreciable rise in internal pressure was measured in any of the bags in the previous tests. No appreciable rise in internal pressure would be expected if drop tests were performed on the AS332 float bags.

4.2 Airframe/Container

The AS332 airframe and float bag container have been structurally substantiated as a part of helicopter type certification. Further strength investigation of these components is not required.

4.3 Float Bag To Container Interface Structure

The nose float of the AS332 is roughly “U” shaped and fits under the nose of the helicopter (see Fig. 1). The two main floats are cylindrical in shape and are mounted on the ends of the main landing gear pylons (se Fig. 2). All of the floats are mounted directly to their respective containers by fabric panels and webbing. The attachments are designed to take loads in one primary direction. The construction of the attachments and their respective loads is shown in Fig. 1, Fig. 2 and the table below.

Attachment	Materials in each	Load
Nose Float P/N 20729		
2 Pair main girt	Fabric panel & 4 1” web straps	Vertical
2 Pair submain girt	Fabric panel & 2 1” web straps	Vertical
2 Drag tabs	Fabric panel & 2 1” web straps	Longitudinal (aft)
8 Lacing tabs	Fabric panel & 2 1 23/32” straps	Lateral
Main Float (per float) P/N 20730		
2 Main girt	Fabric panel & 8 1” web straps	Vertical
2 Drag tabs	Fabric panel & 2 1” web straps	Longitudinal (aft)
1 Drag tab	Fabric panel & 2 1” web straps	Longitudinal (fwd)
4 Lacing tabs	Fabric panel & 2 1 23/32” straps	Lateral

Note: Fabric used in the panels is Apical P/N 20488-13 with 375 lbs tensile or P/N 20488-2 with 300 lbs tensile.
Web straps are: 1” MIL-W-4088 CL 1 Type XVII, 1 23/32” MIL-W-4088 CL 1 Type VI
Both web straps have 2500 lb break strength

4.0 Analysis (Continued)

4.3 Float Bag To Container Interface Structure (Continued)

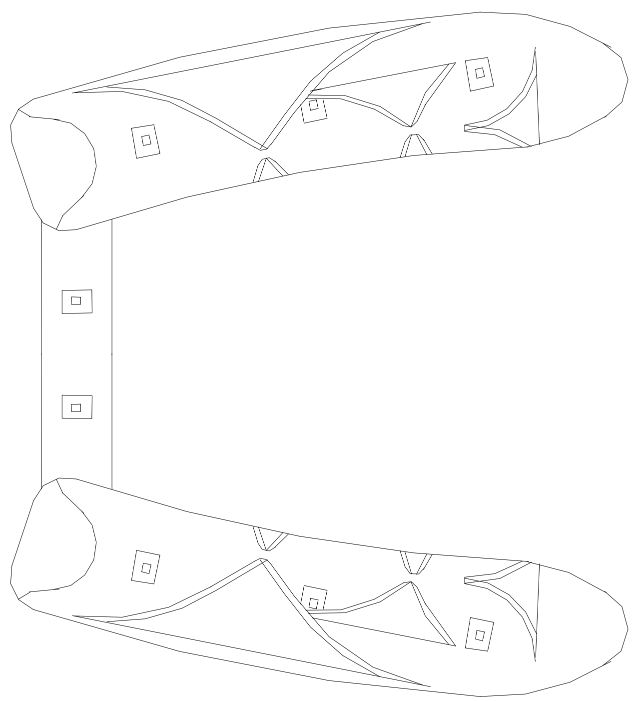


FIG.1 Nose Float With Attachments (Top View)

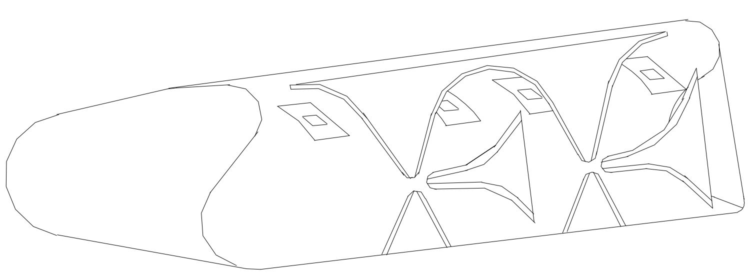


FIG. 2 Main Float With Attachments (Right Hand Looking Outboard)

4.0 Analysis (Continued)

4.3 Float Bag To Container Interface Structure (Continued)

Each attachment assembly must be analyzed at its attachment to the container and the float bag wall for the assembly with the weakest interface. These interfaces can then be summed to give the ultimate strength of the float attachment and then compared directly with the requirements. The strength of the container interfaces is the strength of the webbing that is directly bolted or tied to the container structure. The strength of the attachment to the float wall is the length of the attachment to the wall times the strength of the float wall material.

4.3.1 Attachment Interface Calculations

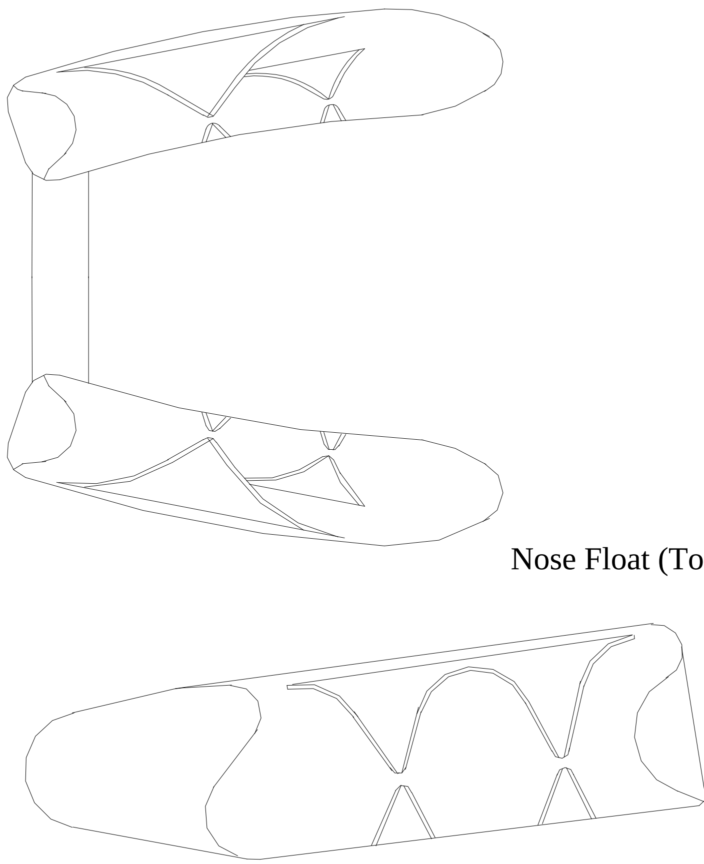
	Container attachment	Float attachment
Nose:		
Main girt.	4 web straps x 2500 lbs = 10000 lbs	60” x 300 lbs/in = 18000lbs
Submain girt	2 web straps x 2500 lbs = 5000 lbs	22.5” x 300lbs/in = 6750 lbs
Drag tab	2 web straps x 2500 lbs = 5000 lbs	20” x 300 lbs/in = 6000 lbs
Lacing tab	2 web straps x 2500 lbs = 5000 lbs	6” x 300 lbs/in = 1800 lbs
Main:		
Main girt	8 web straps x 2500 lbs = 20000 lbs	82.5” x 375 lbs/in = 30937 lbs
Main drag tab	2 web straps x 2500 lbs = 5000 lbs	29”x 375 lbs/in = 10875 lbs
Drag tab	2 web straps x 2500lbs = 5000 lbs	29”x 375 lbs/in = 10875 lbs
Lacing tab	2 web straps x 2500lbs = 5000 lbs	6” x 375 lbs/in = 2250 lbs

Note: The attachment lengths of the girts are the lengths of the bond lines and can be found on drawing no. 20732 for the nose float and 20734 for the main float. The numbers used are conservative versions of the dimensions on the drawings.

4.0 Analysis (Continued)

4.3 Float Bag To Container Interface Structure (Continued)

4.3.2 Ultimate Strength Calculations



Nose Float (Top View)

Main Float (Right Hand Looking Outboard)

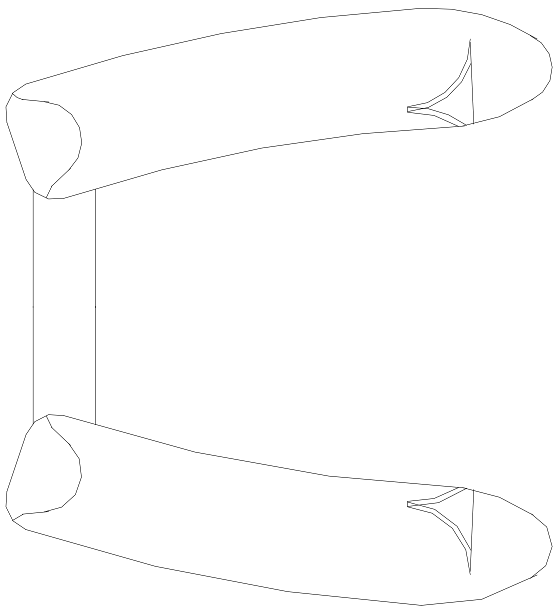
FIG. 3 Main Girts

Up load:
Nose: 4 main girts + 4 submain girts = ultimate strength
4 x 10000 lbs + 4 x 5000 lbs = 60000 lbs
Main: 2 main girts x 2 floats = ultimate strength
2 x 20000 lbs x 2 = 80000 lbs
Total = 140000 lbs

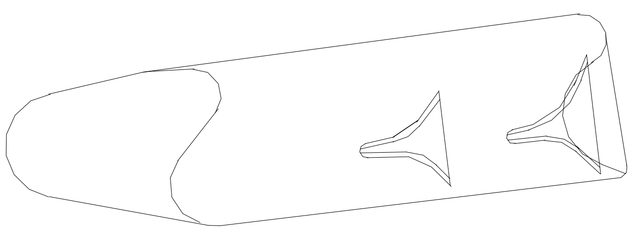
4.0 Analysis (Continued)

4.3 Float Bag To Container Interface Structure (Continued)

4.3.2 Ultimate Strength Calculations (Continued)



Nose float (Top View)



Main Float (Looking Outboard)

FIG.4 Drag Tabs

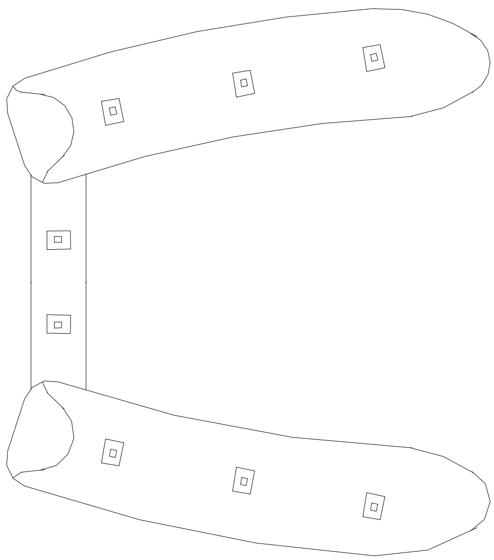
Aft load:

Nose: 2 drag tabs	= ultimate strength
2 x 5000 lbs	= 10000 lbs
Main: 2 drag tabs x 2 floats	= ultimate strength
2 x 5000 lbs x 2	= 20000 lbs
Total	= 30000 lbs

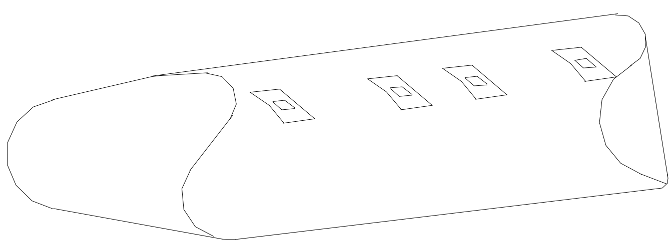
4.0 Analysis (Continued)

4.3 Float Bag To Container Interface Structure (Continued)

4.3.2 Ultimate Strength Calculations (Continued)



Nose Float (Top View)



Main Float (Right Hand Looking Outboard)

FIG.5 Lacing Tabs

Side load:

Nose: 8 lacing tabs		= ultimate strength
8 x 1800 lbs		= 14400 lbs
Main: 4 lacing tabs		= ultimate strength
4 x 2250 x 2 floats		= 18000 lbs
	Total	= 32400 lbs

4.0 Analysis (Continued)

4.3 Float Bag To Container Interface Structure (Continued)

4.3.3 Strength Vs. Load Calculations

Ultimate strength in the upload condition is the sum of the nose and main float girts ultimate strengths in the up load condition or 140000 lbs.
Maximum gross weight for the AS332C, L and L1 is 18960 lbs. Using the load as specified in FAR 29.473, the rotor lift will be 2/3 of the max gross weight of 18960 lbs.

Limit load = (2/3 x 18960) = 12640 lbs 29.473(a)

Margin of safety calculation.

12640 x 4 g = 50560 lbs 29.561(d)

4 g is used as the value for Emergency Landing Load Factor from Part 29.561(d).

$$\frac{140000}{50560} - 1 = 1.77$$

M.S. = 1.77

The ultimate strength for the aft component is the ultimate strength of the drag tabs.

30000 lbs

The limit load of the aft component is .25 times the upload.

.25 x12640 = 3160 lbs 29.521(a))(2)

Margin of safety calculation.

3160 lbs x 4 g = 12640 lbs 29.561(d)

$$\frac{30000\text{lbs}}{12640} - 1 = 1.37$$

M.S. = 1.37

4.0 Analysis (Continued)

4.3 Float Bag To Container Interface Structure (Continued)

4.3.3 Strength Vs. Load Calculations (Continued)

The ultimate strength of the system with side load condition is the smallest of the strengths of the main girts and the lacing tabs.

Upload = .75 x 12640 lbs / 3 floats = 3160 lbs 29.521(b)(1)
Side load = 3160 lbs x .25 = 790 lbs 29.521(b)(2)

Margin of safety calculations.

Total load = 3160 + 790 = 3950 lbs/bag

3950 lbs x 2 g = 7900 lbs 29.521(d)

$$\frac{9000 \text{ lbs}}{7900 \text{ lbs}} - 1 = .14$$

M.S. = .14