# APICAL INDUSTRIES, INC.

REPORT NUMBER AI332-1

STRUCTURAL SUBSTANTIATION REPORT

APICAL INFLATABLE EMERGENCY

HELICOPTER FLOAT KIT
EUROCOPTER AS332C, L and L1

FAA PROJECT NUMBER ST8539LA-R

PREPARED BY Mike Lonnecker 00Oct23
Date

CHECKED BY _____
Date

TEST 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

## 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 AI332-2 Strength, Deformation and Shock Absorption Analysis Plan and 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 Structural Substantiation Report is to obtain an FAA Supplemental Type Certificate for Apical Industries, Inc.'s (Apical) 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 AS332C, L and L1 Models have a current maximum gross weight of 18960 pounds.

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

## 2.0 Introduction

Apical Industries, Incorporated (Apical) currently holds STC's for helicopter inflatable emergency float installations. This report is based on the same techniques used for certifications of these floats. The inflatable emergency floats are for installation on the AS332. These floats are similar in construction and materials to the other floats for which Apical has obtained certification.

Prior STC's are as follows:

| | |
|---|---|
| SH8041NM | Emergency Floats - MDHS 369HS, 369HM, 369HE, 369D, 369E and 500N |
| SR00067LA | Emergency Floats - Bell 206A, 206B, 206L, 206L-1 and 206L-3 |
| SR00269LA | Emergency Floats - Eurocopter BO-105C and BO-105S |
| SR00270LA | Emergency Floats - Eurocopter AS-350B, AS-350B1, AS-350B2, AS-350BA, AS-350C, AS-350D and AS-350D1 |
| SR00471LA | Emergency Floats - MDHS MD600N |

The helicopter airframe has been structurally substantiated as a part of helicopter type certification. The nose float is mounted in and attached to a "U" shaped metal container, supplied by the airframe manufacturer, which is then mounted under the nose of the helicopter. The aft floats are mounted in and attached to a metal container, also supplied by the airframe manufacturer, which is then mounted to the outboard ends of the main landing gear pylons. The float containers were structurally substantiated as part of the AS332 emergency floatation gear optional equipment certification. Further strength investigation of these components is not required. The loads from the buoyant floats enter the containers and thus the airframe via fabric straps bolted directly to the container.

The dynamic peaking loads encountered during water landings are less severe than those seen by impacting a hard surface. Water landing loads are less a shock type of loading and more a gradual impulse loading. Previous testing experience has shown that the internal operating pressures of the floats see negligible increases during the drop testing, suggesting negligible load peaking. Additionally, visual inspection of hardware in previous tests shows no permanent deformation.

## 3.0 Method of Showing Compliance

| | | | |
|---|---|---|---|
| 3.1 | 29.301 | Loads | (a)(b) and (c) In accordance with FAR |
| 3.2 | 29.303 | Factor of Safety | In accordance with FAR |
| 3.3 | 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 will show analytically that the load carrying capability of the float assemblies has such a large margin of safety as to make static or dynamic testing unnecessary in order to comply with this requirement (See Strength, Deformation and Shock Absorption Analysis Plan and Report AI332-2).

| | | | |
|---|---|---|---|
| 3.4 | 29.307 | Proof of Structure | (a) The helicopter airframe and containers have been structurally substantiated as part of helicopter type certification. The float mounting to the airframe will be demonstrated as outlined in (b). |
| | | | (b)(5) Eurocopter has shown compliance for the basic airframe and containers during certification. Apical will demonstrate compliance by analysis (see report AI332-2) in accordance with 29.725 for the airframe/container to float interface. |

## 3.0 Method of Showing Compliance (Continued)

| | | | |
|---|---|---|---|
| 3.5 | 29.473 | Ground Loading Conditions and Assumptions | (a)(b) The proposed analysis (see Report AI332-2) will use loads greater than the effective weight "$W_e$" that is based on rotor lift of 2/3 the maximum design weight and a drop height of 8 inches, both in accordance with FAR 29.725. |
| 3.6 | 29.521 | Float Landing Conditions | |
| | | (a) Upload Conditions | Because floats are installed symmetrically about the rotor centerline, the water reaction passes vertically through the helicopter center of gravity. The proposed analysis (see Report AI332-2) includes loads greater than the aft component of 0.25 times the vertical component "$W_e$." |
| | | (b) Side Load Conditions | The proposed analysis (see Report AI332-2) provides loads greater than the vertical load of 0.75 times the vertical load ($W_e$) specified in 29.521(a) above and a side load of 0.25 times the vertical load proposed by the FAR 29.521(b) that is combined with this vertical load. |

## 3.0 Method of Showing Compliance (Continued)

| | | | | |
|---|---|---|---|---|
| 3.7 | 29.601 | Design | (a) (b) | The Apical float assembly general and detail designs are typical of previously FAA approved float assemblies. Structural substantiation is by analysis in accordance with FAR 29.725 and 29.727 reserve energy absorption. (See Report AI332-2.) The AS332 airframe and containers has been FAA approved and requires no further substantiation. |

**3.0 Method of Showing Compliance (Continued)**

| | | | | |
|---|---|---|---|---|
| 3.8 | 29.603 | Materials | (a) (b) | Suitability of materials and assembly processes are determined from manufacturer's data sheets which comply with FAA specifications TSO C12, TSO C69, TSO C70. See Appendix A. |
| | | | (c) | Cold temperature inflation testing was accomplished on a full size float of representative materials. See Appendix B. |
| 3.9 | 29.605 | Fabrication Methods | (a) | Same as 3.8 above. |
| 3.10 | 29.609 | Protection of Structure | (a)(b) | Compliance with this subpart has been demonstrated by FAA approved similar floats that employ materials and manufacturing processes similar to those employed for manufacture of these Apical floats. This similarity has been shown by comparable tests of materials from the floats being replaced due to wear and weathering. |
| 3.11 | 29.611 | Inspection Provisions | (a) (b) | The Apical ICA332-1 Instructions for Continued Airworthiness provide for periodic tests to identify damage and deterioration. |

**3.0 Method of Showing Compliance (Continued)**

| | | | |
|---|---|---|---|
| 3.12 | 29.613 | Material Strength Properties and Design Values | (a) through (e) Coated fabric strength values are as reported in Appendix A.<br><br>Float attaching hardware is the same as previously approved in the original certification of the optional emergency floatation gear for the AS-332. |
| 3.13 | 29.1301 | Function and Installation | (a) thru (d) The Apical floats are the same in materials and construction as previously certified floats. They are installed and used in the same manner as previously certified floats. They have the same functional requirements.<br>Thus, the performance of the floats and the effect of temperature on the performance of the floats is expected to be the same. |

**SUBJECT: DETERMINATION OF "A" AND "B" STRENGTH VALUES OF REEVES INTERNATIONAL COATED FABRIC TX-93012**

## 1.0 Materials Test Reports

### 1.1 Strength of Coated Fabric

Reeves International has supplied data on all the TX-93012 orders placed with them. Specifically, they have submitted the raw data on which they based the certification of the tensile strength. These data are shown in the spreadsheet attached and are traceable directly to the vendor's records using the purchase order number listed on the spreadsheet.

The raw tensile data were used to compute the mean and standard deviation. The one-sided tolerance-limit factor, as detailed in paragraph 9.2.7.2 of MIL-HDBK-5F, was used. "A" and "B" values were calculated using equations 9.2.7.2(a) and 9.2.7.2(b) and table 9.6.4.1. Certificates of Compliance from Reeves International for each of the purchase orders are attached for reference.

The deviation of strengths over a number of rolls of material is very small. This shows the material strengths are very repeatable.

## 1.0 Materials Test Reports (Continued)

### 1.2 Reeves International TX-93012 Fabric

Strength of Coated Fabric TX-93012
(raw data from Reeves International, reference 3 P.O.'s, test IAW Fed-Std-191A Method 5100)

| P.O. # / DATE | WARP (lb) | FILL (lb) |
|---|---|---|
| 373/98Jan23 | | |
| Average of 5 | 440 | 352 |
| 373/98Feb24 | | |
| Average of 5 | 402 | 333 |
| 447/98Apr14 | | |
| Average of 5 | 429 | 357 |

STATISTICAL BREAKDOWN:

| | | |
|---|---|---|
| MEAN | 423 | 347 |
| STD DEVIATION | 16.0 | 10.3 |
| SAMPLE SIZE | 15 | 15 |
| "A" VALUE ~ | 371.8 | 314.0 |
| "B" VALUE ^ | 393.4 | 327.9 |

~ "A" REFERS TO 99% PROBABILITY AT 95% CONFIDENCE = MEAN - 3.2 * STD DEV
^ "B" REFERS TO 90% PROBABILITY AT 95% CONFIDENCE = MEAN - 1.85 * STD DEV

SEE NON-DISCLOSURE NOTICE ON THE COVER



## 1.0 Materials Test Reports (Continued)

### 1.2 Float Wall Strength Substantiation

TYPICAL CERTIFICATION

CUSTOMER:
APICAL INDUSTRIES INC.
2608 TEMPLE HEIGHTS DRIVE
OCEANSIDE, CA 92056

DATE: June 09, 2000
REEVES SPEC: 3131
PURCHASE ORDER: 800
CONTRACT: 95480
SHIPPED: 06/09/00

| P.O. & SHELL | YARDS | TEST | METHOD (FED STD 191A) | REQUIREMENT | RESULTS |
|---|---|---|---|---|---|
| 05019-01-1 | 199 | | | | |
| 05019-01-2 | 198 | WEIGHT | 5041 | 9.5 - 10.5 | 9.98 |
| 05019-01-3 | 197 | | | | |
| 05019-01-4 | 195 | TEAR | 5136 | 12 x 12 min. | 20 x 16 |
| 05019-01-5 | 192 | | | | |
| 05019-01-6 | 198 | TENSILE | 5100 | 325 x 275 min. | 438 x 343 |
| 05019-01-7 | 97 | | | | |
| | | ADHESION | 5970 | 10.0 min. | 15.0 |
| | | WIDTH | 45" Useable | Pass | Pass |
| TOTAL YARDS: | 1276 | | | | |
| | | AIR RETENTION | 10 psig/5 mins. | No Leaks | Pass |

DATE OF (MANUFACTURE) COATING: June 2000

PRODUCT: Polyether Urethane on Nylon

I CERTIFY THAT THE MATERIAL DESCRIBED ABOVE HAS BEEN PROCESSED, TESTED, AND DOES CONFORM TO THE REQUIREMENTS FOR REEVES SPECIFICATION 3131. (TX-93012)

Vicki Crosswhite
Quality Assurance





## 1.0 Low Temperature Dynamic Condition

### Discussion

Reeves Bro. coated fabric style TX-93012 polyurethane coated nylon is used for the Apical P/N 20729 & 20730 Inflatable Emergency Floats. This material has been tensile tested by Reeves and Apical. The Reeves and Apical testing was conducted at 70º/76º F and 160º F temperatures.

The Apical HF369-102 Emergency Float Assembly substantiation for the MDHC 369 Series (STC SH8041NM) included an inflation test at -25º F, Ref. Test Report TR500-04, Appendix page A-5.

Because the material and manufacturing process used for the Apical P/N 20729 & 20730 for the Eurocopter AS332 helicopter float assemblies are identical with those for the MDHC 369 Series Emergency Inflatable Float Assembly, low temperature testing to satisfy the FAR 29.603(c) requirements is not needed.