U.S. Department
of Transportation
Federal Aviation Administration

Memorandum

Subject: **ACTION**: Request for Review and Concurrence with Equivalent Level of Safety (ELOS) ACE-02-07, for the Iniziative Industriali Italiane (3I), S.p.A Sky Arrow 650 TCS and TCNS Airplanes, to 14 CFR Part 23, § 23.572, Metallic wing, empennage, and associated structures.

Date: MAY 2 0 2002

From: Sky Arrow Project Officer, Project Support Branch, ACE-112

Reply to Attn. of: Doug Rudolph (816) 329-4059

To: Manager, Small Airplane Directorate, ACE-100

This memorandum documents concurrence for the subject ELOS, we request your office review and concur with the proposed ELOS findings to the Structural Strength requirements of 14 CFR Part 23, § 23.572.

Background:
The Sky Arrow 650TCS and TCNS models are increased horsepower versions of the 650 TC and TCN models issued FAA certificate A41CE. The Sky Arrow is a two place tandem, removable T-tail, carbon/kevlar/glass, removable high wing with struts, fixed tri-gear, single reciprocating Rotax engine (pusher propeller) airplane with side stick pilot controls and a maximum weight of 1433 lbs in the Joint Aviation Requirements – Very Light Aircraft (JAR-VLA) Special Class category. The amendment for the new models is based on increasing the max takeoff horsepower from 81 hp to 98 hp at 5800 rpm. All design speeds and maximum weights are unchanged.

When the application for adding Sky Arrow Models 650 TCS and 650 TCNS to the TCDS, Revision 7 was being worked, it was recognized that the previous Models 650 TC and TCN were certified incorrectly to JAR-VLA with night operation. At this time, the FAA does not have justification to require that the previous model 650 TCN be changed from JAR-VLA with night operation to Part 23 certification, but is requiring the new model, 650 TCNS, be certificated to Part 23 because night operation is requested.

Per 14 CFR Part 21, § 21.17(b), an aircraft can be certificated to meet the airworthiness requirements found appropriate by the Administrator, and for Special JAR-VLA it was determined that JAR-VLA requirements would be followed. Per the rules of JAR-VLA, the aircraft must be used in DAY VFR operation only. The Federal Aviation Administration (FAA) has further emphasized this with paragraph 3.a. of FAA Advisory Circular (AC) 21.17-3, which states that aircraft certified to JAR-VLA are limited to day VFR operations only. If night VFR/IFR operation is requested (per AC 23-11, page 4,

paragraph 8), the certification basis is 14 CFR Part 23, using JAR-VLA only for those rules which are shown to be equivalent to Part 23. Per Appendix 2 of AC 23-11, findings of equivalency must also be shown for those fifteen (15) Part 23 rules identified as different than the JAR-VLA, in addition to those considered in Appendix 4 of AC 23-11 for night/Instrument Flight Rules (IFR) operation. According to AC 23-11, the amendment level to use is Amendment 23-42.

According to Ente Nazionale per l'Aviazione Civile (ENAC), the applicant and ENAC are currently working on showing compliance to all but two of the fifteen items listed in Appendix 2 of AC 23-11. The applicant is requesting an ELOS for the two remaining items, § 23.562 and § 23.572. Item § 23.562 will be addressed on another ELOS (or Exemption) and § 23. 572 will be addressed here.

Applicable Regulations: The applicable regulation is § 23.572:

Metallic wing, empennage, and associated structures.

(a) For normal, utility, and acrobatic category airplanes, the strength, detail design, and fabrication of those parts of the airframe structure whose failure would be catastrophic must be evaluated under one of the following unless it is shown that the structure, operating stress level, materials and expected uses are comparable, from a fatigue standpoint, to a similar design that has had extensive satisfactory service experience:

(1) A fatigue strength investigation in which the structure is shown by tests, or by analysis supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected in service; or

(2) A fail safe strength investigation in which it is shown by analysis, tests, or both, that catastrophic failure of the structure is not probable after fatigue failure, or obvious partial failure, of a principal structural element, and that the remaining structure is able to withstand a static ultimate load factor of 75 percent of the critical limit load at V_C. These loads must be multiplied by a factor of 1.15 unless the dynamic effects of failure under static load are otherwise considered.

(3) The damage tolerance evaluation of Sec. 23.573(b).

(b) Each evaluation required by this section must:

(1) Include typical loading spectra (e.g. taxi, ground-air-ground cycles, maneuver, gust);

(2) Account for any significant effects due to the mutual influence of aerodynamic surfaces; and

(3) Consider any significant effects from propeller slipstream loading, and buffet from vortex impingements.

Advisory Circular (AC) 23-11 states for § 23.572: This section requires a life determination for critical structure in the wing and empennage. JAR-VLA provides maximum allowable design stresses that provide critical structure life exceeding the utilization life of this class airplane. This approach to airplane life determination could be considered.

According to associated advisory material for JAR-VLA, ACJ VLA,:
ACJ VLA 572 (a): At least the wing main spar, the horizontal tail and their attachments to the fuselage should be investigated to determine whether or not their stress levels exceed the values given in the table in ACJ VLA(b).

ACJ VLA 572 (b): 1. The use of the following stress levels may be taken as sufficient evidence, in conjunction with good design practices to eliminate stress concentrations, that structural items have adequate safe lives: (from table in ACJ VLA(b))

If Carbon fiber rovings (bundles of filament) in epoxy resin material is used, the allowable normal stress level of maximum limit load is 40 daN/mm^2 .

Applicant's Position: Since the aircraft consist mainly of Carbon Fiber composites, the applicant states that the maximum allowable design stresses are below 40 daN/mm² as required by JAR-VLA to provide critical structural life exceeding the utilization life of this class of aircraft. The applicant also states they have a production quality control for all composites which will minimize inherit flaws introduced at production on the composite units. This quality assurance program will be overseen by ENAC. The applicant also stated that they would provide adequate repair procedures for damage composites in a Composite Structural Repair Manual in accordance with AC 43.13-1B which will be ENAC approved.

FAA Position: The FAA concurs with the applicant and ENAC regarding using AC 23-11 for obtaining an ELOS for this regulation. Per this AC, the applicant can use JAR-VLA regulations and JAR-VLA guidance, ACJ VLA, to obtain an equivalency to this regulation by using a design that has maximum allowable stresses below that which would require fatigue testing per ACJ VLA 572 (b) 2. ENAC will oversee the quality control of the composite assembly to help ensure flaws will not be introduced during production of the major components. The applicant will also provide repair procedures for the composite structure for in service damage. Per Appendix 2 of AC 23-11, along with the use of good design practice, compliance for this regulation requires a life determination for critical structure by limiting the maximum design stresses that provide critical structural life, which exceed the utilization life of this class of airplane.

Damage Tolerance is not required for this aircraft due to the amendment level, amendment 23-42, per AC 23-11.

Recommendation: We concur that the above described features of the Sky Arrow 650 TCS and 650 TCNS models provide an Equivalent Level of Safety (ELOS) as envisioned in the regulation of 14 CFR Part 23, § 23.572 and AC 23-11.

Concurred by:

Manager, Project Support Branch, ACE-112 — Date 5/29/02

Acting Manager, Standards Office, ACE-110 — Date 5/29/02

Manager, Small Airplane Directorate, ACE-100 — Date 5/29/02