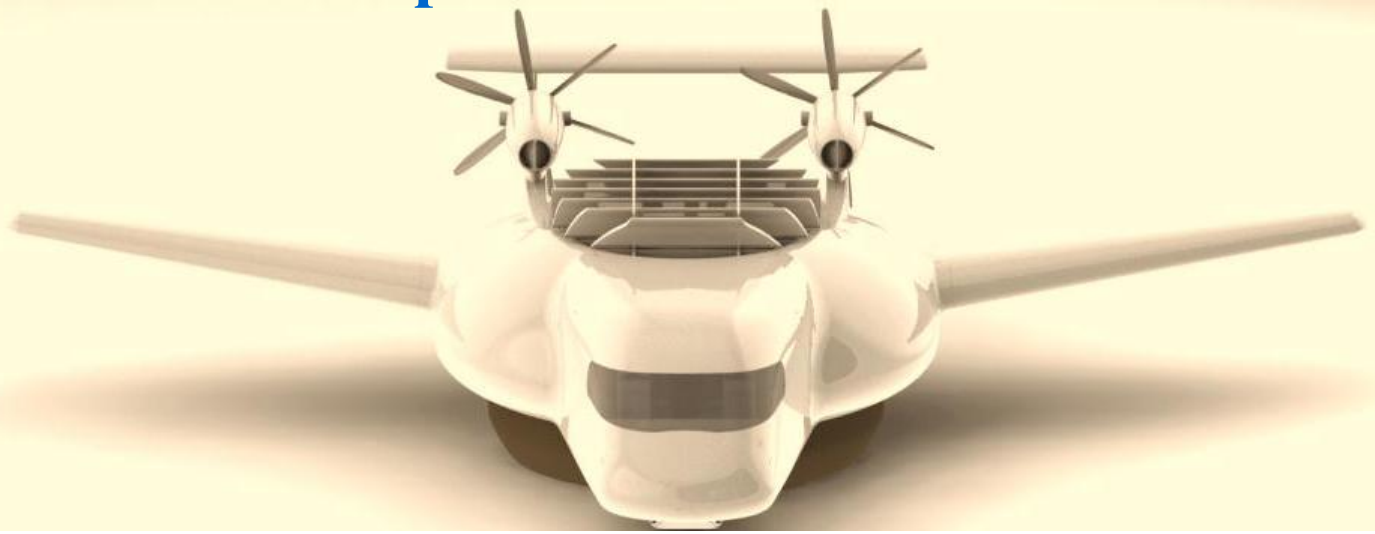
Riga Technical University Institute of Aeronautics

“Special aspects of operating hybrid aerial vehicles in Europe”



Conference on cooperation between European Union and Russian aviation industry «AVIA-INVEST 2014»

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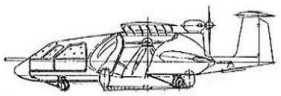
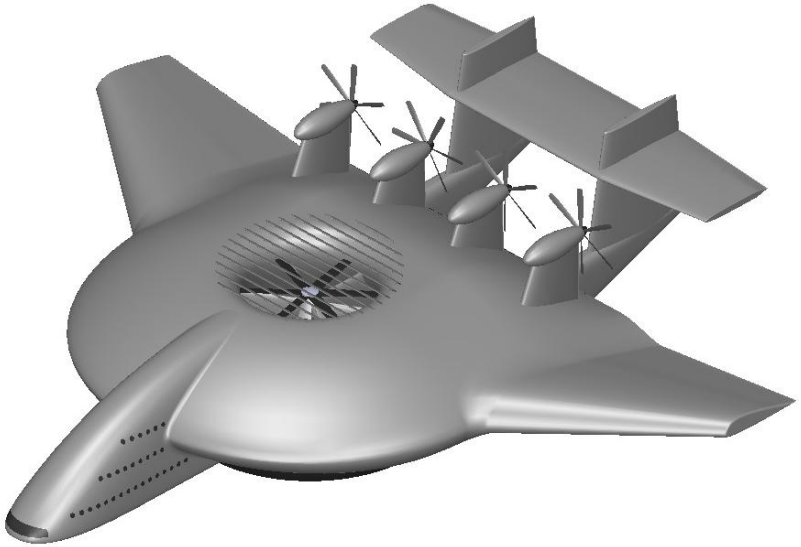
Speaker: Monta Lacane, M.sc.ing., PhD student at Institute of Aeronautics, Riga Technical University, Latvia

Riga, 10-11 April, 2014

ESTOLAS Main Features



- mixed type "flying wing", the main part of which is a disk shaped center plane (receptacle of elevating gas (helium))
- the possibility of off-airfield operation
- operation at European airports in accordance with accepted rules and standards

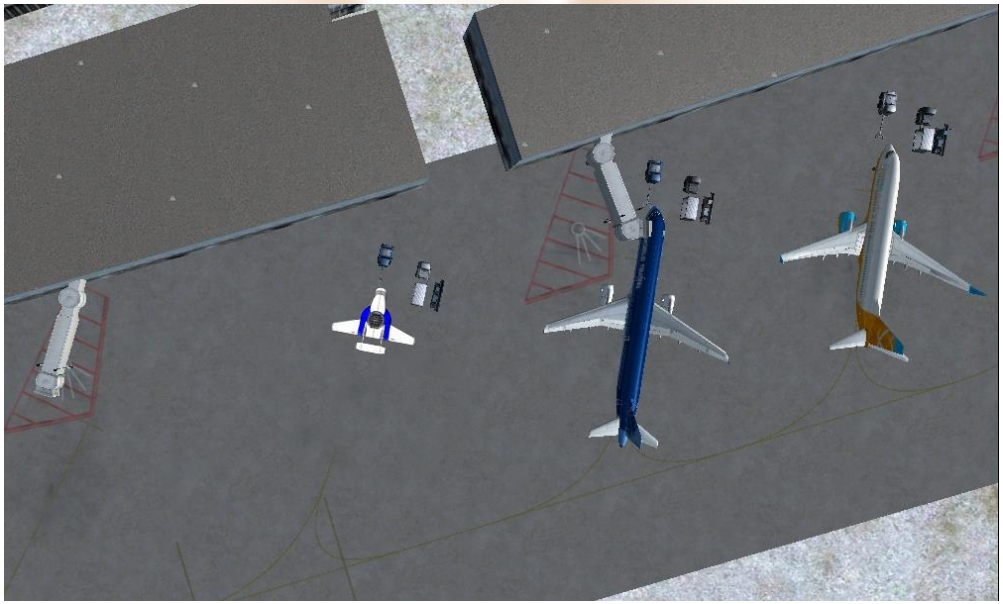


Large-”ESTOLAS” Prototype

Categorization of the Hybrid aircraft: operation at aerodromes

Categorization in accordance with international standards – landing performance class, fire-fighting category, airport categories and other categories.

As an example a middle ESTOLAS will be used.

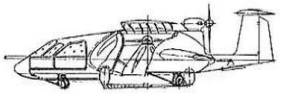


Categorization

RFF	ICAO Rescue Fire-Fighting Category: Determined by fuselage length and fuselage width. (operations to both destination and alternate airfields still permitted, when RFF temporarily up to two states below required by aircraft certification, i.e. 737-800, cat9/7). Requirements for en-route alternates and ETOPs alternates are generally even less restrictive.
ARFF	FAA Airfield Rescue Fire-Fighting Category: as for RFF but determined by fuselage length only.
Approach Category	FAA Standard, also adopted by ICAO. Letter A-D determined by Aircraft Final Approach Speed
Aerodrome Reference Code	Reference Code made up of ICAO code number followed by an ICAO code letter
ICAO Code Number	Number between 1 and 4 determined by runway field length. (Commercial Jet operations as all runways ≥ 1800m are category 4)
ICAO Code Letter	Letter (A-F) determined by maximum allowable Wing Span and Main Gear Outer Track.
FAA Airplane Design Group	Number between I and VI dependent upon aircraft wingspan. Equivalent to ICAO code letter.

Categorization

ICAO guideline documents suggest aerodrome classification should be based on a reference code.



The reference code consists of two elements:

- a number based on runway length;
- a letter corresponding to aircraft wingspan and distance between the main gear outer tracks

CODE ELEMENT 1

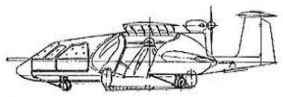
Code number	Runway length
1	< 800 m
2	800—1200 m
3	1200—1800 m
4	> 1800 m

CODE ELEMENT 2

Code letter	Wingspan	Main gear track
A	< 15 m	< 4.5 m
B	15—24 m	4.5—6 m
C	24—36 m	6—9 m
D	36—52 m	9—14 m
E	52—60 m	9—14 m

Categorization

Flight characteristics and detentions of a large-ESTOLAS aircraft

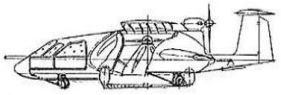


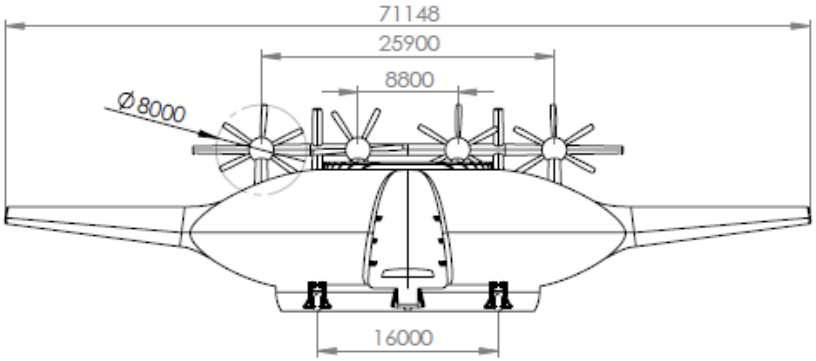
Parameter	Parameter value
Flight, cruising:	180 km/h
flight altitude H	Up to 500 m
Takeoff and landing data:	
takeoff speed V (takeoff), km/h	50...60
landing speed V (landing), km/h	55...60
takeoff run, m	75
landing run, m	60
Requirements for a landing ground (runway)	Natural ground: lake, river, swamp, farm field, etc.
Flight range with full payload 60 tons, km	Up to 1 000 km
Flight range for ferry technical flight (2 pilots on board), km	20 000 km
Dimensions of the aircraft	
Length, L	72
Wing span, I	70.5
Height, H	20

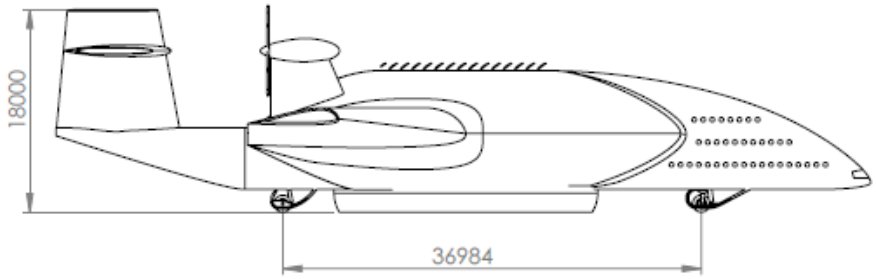
Categorization

The Large ESTOLAS aircraft are referred to category 1E as:

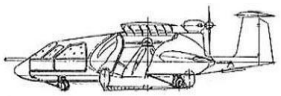
- required runway length is less than 800 meters;
- width between the main gear tracks is 16 meters;
- wingspan is 71.1 meters.







Main Operational Parameters of the Large ESTOLAS aircraft



It is intended for carriage of 45 to 60 tons of cargo.

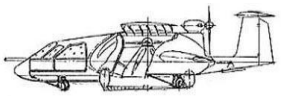
Basic performance predictions for the aircraft:

- two turboprop АИ-20к engines (fuel consumption of ~2000 kg/h) as a basic propulsion system, estimated time of flight in cruising mode with the payload capacity of 45 tones- 7 hours;
- estimated flight range in cruising mode ~1100 km taking into consideration the operation of take-off and landing device engine;

The maximum flight height of 500 meters can be a serious obstacle when operating in mountainous areas and places with obstacles close to the average relative height

Categorization: Large ESTOLAS

RFF Category, ICAO	9
Approach Category, ICAO	A
Aerodrome Reference Code, ICAO	1E



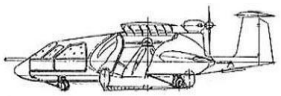
- belong to the highest category according to RFF parameters and Aerodrome Reference Code

- therefore, very high requirements for the airport:

- 24000 liters of water,
- 450 kg of complementary agents,
- minimum 3 special fire-fighting trucks

Such parameters practically exclude operation at small and medium European airports: EVRA 8; ESSA 9

Categorization: Large ESTOLAS

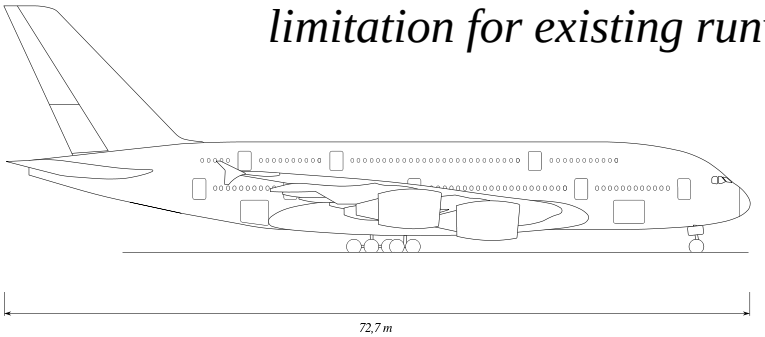


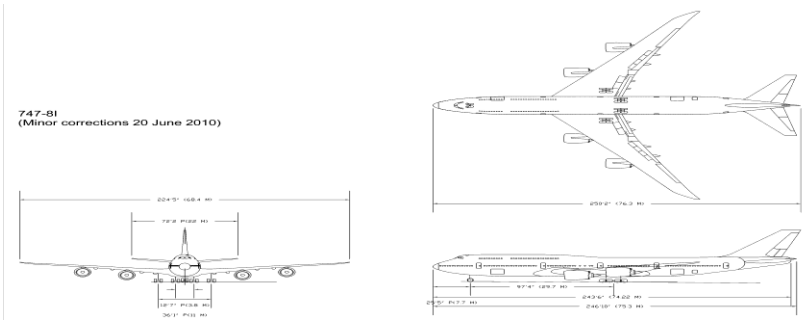
Non-standard category (Aerodrome Reference Code):
- very short runway required;
- a non-standard wheel base exceeding the value of 14 meters.

It will seriously hamper operation even at super large hub airports.

The wheel base for the largest modern operating cargo-and-passenger airliners:
- Airbus A380- 11 meters;
- Boeing B747- 12 meters.

The main gear base for the Large ESTOLAS- 16 meters (considerable limitation for existing runways)

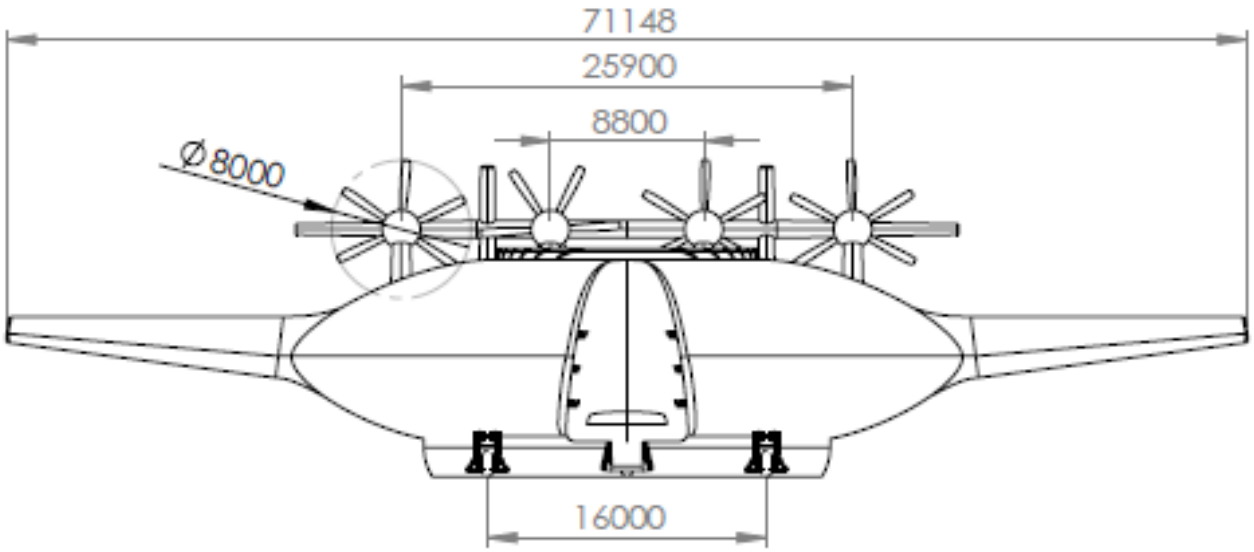




Categorization: Large ESTOLAS

- aircraft drift (from side to side of the runway center line) on the runway during the acceleration and landing run in case of one or several engine failure or during the change in propulsion thrust;

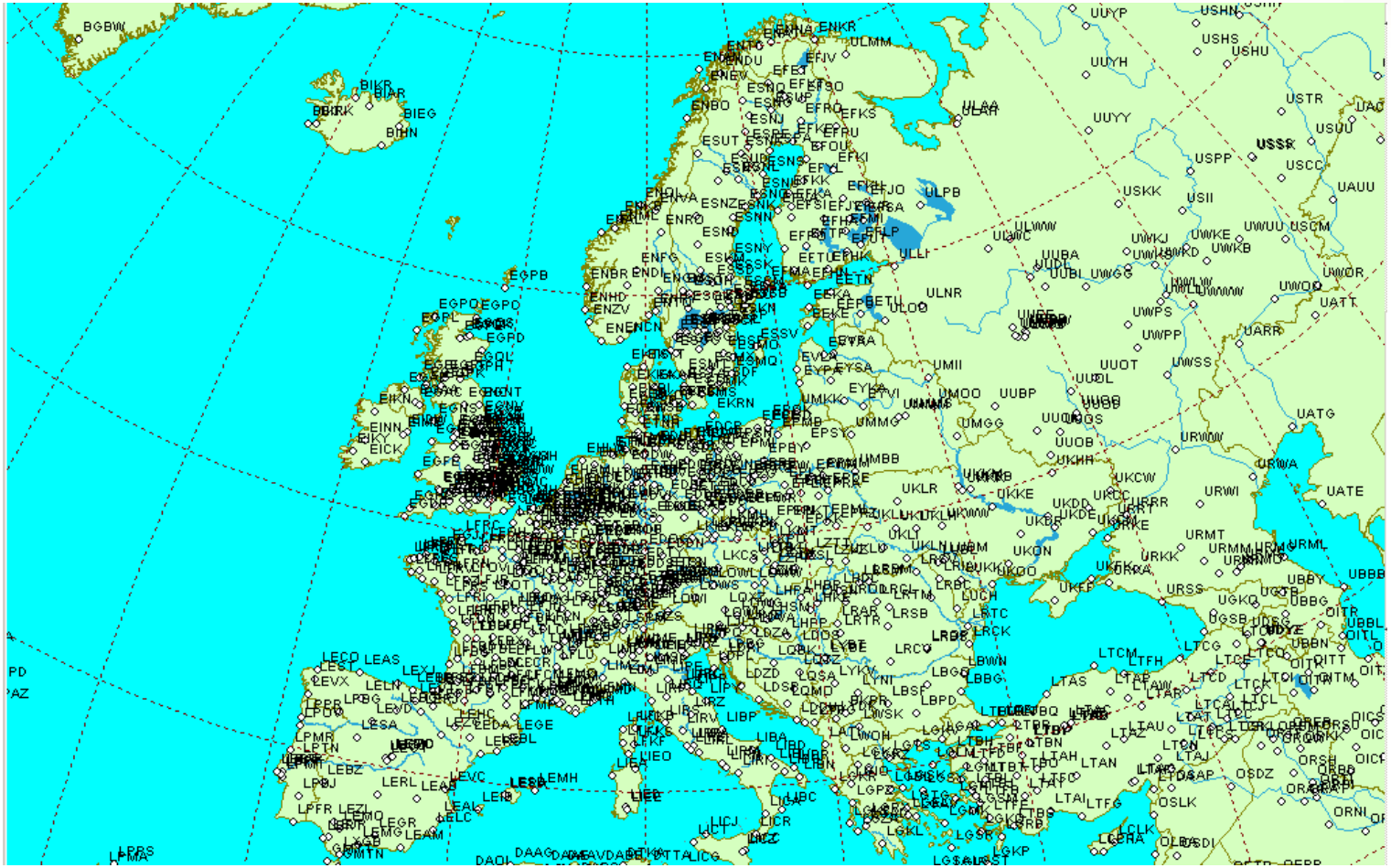
- rotational momentum from the central lift rotor which will noticeably affect the stabilization of the aircraft in case of engine failure.



Hybrid Aircraft Operation

* European airports with runway length of 3000 meters and more.

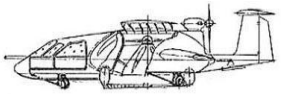
Hybrid Aircraft Operation



* European airports with runway length of 1500 meters and less.

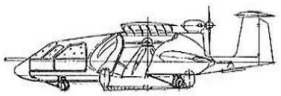
Hybrid Aircraft Operation

Advantages of Large ESTOLAS operation at aerodromes



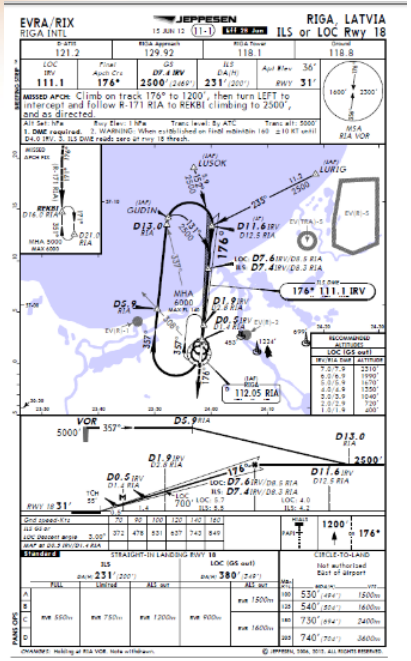
- Super short take-off and landing
- Possibility of transporting large amount of cargo and passengers at the same time
- Short take-off and landing makes it possible to operate on unprepared surfaces of the required size.

Hybrid Aircraft Operation- Navigation



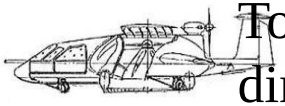
Transportation of cargo and passengers to European airports only with appropriate equipment and in accordance with established procedures, aerodrome specification;

If due to navigation equipment it is impossible to land in accordance with IFR, then flight rules can be changed to VFR (visual), but taking into account weather minima (below 3000ft):
- flight visibility 5km;
- clear of clouds, surface in sight



Hybrid Aircraft Operation

Ground Handling for ESTOLAS Prototypes



To use ESTOLAS aircraft for passengers and cargo transportation, the dimensions and arrangement of cargo doors and cabin doors must comply with technical standards accepted for standard maintenance of aircraft at an airfield.

(height of aircraft cabin doors for passengers and crew, arrangement and design of the cargo hold, method of loading/unloading, etc.

Hybrid Aircraft Operation

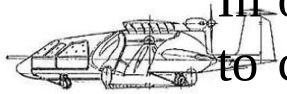
ESTOLAS maintenance requirements

ESTOLAS aircraft maintenance of an aircraft – replacement of parts and units in case of failure, inspection and checks of the aircraft before the flight, repair of damages and failures.

Non-standard design and technical solutions of the ESTOLAS aircraft would make it rather difficult to keep the aircraft at any European airfield.

Maintenance of undercarriage of non-standard design, tanks filled with helium, etc.

Conclusion



In order to operate at European airports of different classes it is necessary to comply with ICAO, European and national requirements. It should be taken into account already at the stage of designing non-standard aviation equipment.

No fundamental limitations to the operation of Small and Medium ESTOLAS aircraft have been detected except the presumably more complex maintenance due to non-standard design.

For the Large ESTOLAS aircraft the requirements for operation at European airports should be considered at the stage of designing: maximum wheel base will become a serious obstacle for the operation at European airports of any type.

Standard helium gas refilling procedures using as simple refilling equipment as possible, preferably located in the territory of an airport.

THANK YOU FOR ATTENTION!