



# *Air Cargo*

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## CHALLENGE 2011

## Regulations

*for the Air Cargo Challenge 2011 in Stuttgart*

*(European edition)*

*Version 1.00*

*6<sup>th</sup> of October 2010*



euroaviastuttgart

studenteninitiative e.v.



AKAMODELL  
STUTT GART E.V.

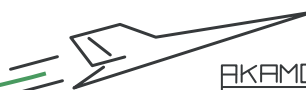
EUROAVIA Stuttgart  
Studenteninitiative e.V.  
Allmandring 5B  
D-70560 Stuttgart

Tel.: +49(0)711-6856 8251  
Fax: +49(0)711-6856 8257  
<http://stuttgart.euroavia.eu>  
[stuttgart@euroavia.de](mailto:stuttgart@euroavia.de)

Akamodell Stuttgart e.V.  
Pffaffenwaldring 35  
D-70550 Stuttgart

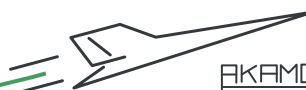
Tel.: +49(0)711-6856 2098  
<http://www.akamodell.de>

Bankverbindung  
BW Bank  
BLZ: 600 501 01  
Konto: 2748470



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## 1 INTRODUCTION

The competition Air Cargo Challenge was created by APAE (Portuguese Association of Aeronautics and Space) in 2003, inspired in the North American DBF (design-build-fly) aircraft university competitions.

Since then, the competition was held every two years and, from 2007, the challenge gained European projection. The 2009 edition was organized by Aeroubi Euroavia Covilhã – Núcleo de Engenharia Aeronáutica da Universidade da Beira Interior (Association of Aeronautical Engineering of University of Beira Interior).

In 2011 the competition is organized by Euroavia Stuttgart and Akamodell Stuttgart (the winner of the competition 2009). This is the first time the competition will be held outside of Portugal.

It is a competition for university students and employees of the engineering or science area and was created to stimulate the interest in the fields of aeronautics. In this competition each team gets the chance to test their skills in a competition with other teams.

Euroavia Stuttgart as well as Akamodell Stuttgart is managed exclusively by students and former students of the University of Stuttgart and works as a non-political and non-profit association that promotes and spreads Aeronautical Engineering. The Air Cargo Challenge offers students the unique opportunity to develop a multidisciplinary and challenging project from its beginning to the realization. By participating at ACC the teams can test their knowledge and, at the same time, get involved with a wide range of challenges that students will find in their future professional career: technical, interpersonal, financial challenges as well as having strict deadlines. To participate in the Air Cargo Challenge competition, the team should design, document, build and fly a radio controlled aircraft with the maximum possible payload. The aircraft must take-off in 60 meters, fly over the airfield at least once and land safely in the place previously defined by the organizing committee. The aircraft must comply with the following competition's regulations which include design restrictions such as limitations of the motor power and weight.

## 2 COMPETITION PURPOSE

### 2.1 AIM

The Air Cargo Challenge Competition gives students and university members the ability to design, build and fly a radio controlled aircraft and to compete with teams from other universities from Europe. Engineering skills are needed to accomplish the task to design an aircraft being successful at this competition.

The team will do its best to guarantee the fulfilment of the main objectives of this competition:

- To develop a dynamic and creative spirit between the academic and scientific communities
- To encourage cultural exchange between European universities
- To promote social interaction between people who share the same interests
- To stimulate interest in the field of aeronautics
- To develop team work
- To give professors and students with the same working field an opportunity to meet
- To share knowledge and techniques between university students and modellers
- To develop and experiment new ideas in a practical manner
- To provide hands-on experience for professors and students who in their academic life have had few opportunities to experiment with their theoretical knowledge
- To give an opportunity to represent institutions and transmit, in an ethical and professional way, their good image

## 2.2 TEAM'S OBJECTIVES

The team should design and build a radio controlled aircraft of limited weight and power, which takes-off in 60 m with the maximum payload possible and flies over the field to return safely to the runway.

The competition is divided in two parts; design and flight:

- In the design part the team will construct a plane considering the requirements and produce a design report to document the design and construction process as well as financial and teamwork approach. This design report is reviewed and graded by the competition jury.
- The flight competition determines the maximum payload that each plane can really carry in a complete regular flight. The flight competition will consist of as many runs as possible. The goal is to have at least 3 runs. The number of runs depends on the number of teams and weather conditions.

Runs will be made even under rainy and windy conditions. The decision if it is possible to fly will be made by the organisation team.

## 3 PARTICIPATION

All Engineering/Science students and Engineers can participate to represent their University as long as the team has the following characteristics:

- A pilot:

Pilots are not required to be students nor be a member from the university but must be accredited model aircraft pilot. The pilot must have insurance for model airplanes being valid also in Germany.

- Three to six members:

One of these takes the leader's responsibilities such as communication with the organization committee. Except for the pilot, all other team members should be professors, students and/or research associates of the higher education institution that they are representing. Teams not representing higher education institutions or from universities outside Europe are accepted if the maximum number of teams is not reached by European universities teams.

### 3.1 PROFESSOR IN CHARGE

A professor in charge is required when the team represents a university or different higher education school. He may also be a team member. A written declaration is required in which the professor states the team is representing the university and approves all team members are students or employees of the university. The aircraft has to be designed and build by students and/or university employees (such as PhD students or engineers working as research assistants) supervised by the professor. In case the Organizing Committee proves some of the team members are not from the university or other irregular actions occurred the team will be disqualified immediately.

The pilot may, but does not need to be member of the university.

## 4 APPLICATIONS

The applications will begin on 1<sup>st</sup> of November and finish on the 13<sup>th</sup> of December 2010 and the application form is available during this period on the competition website: <http://www.acc2011.com>

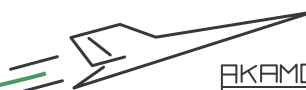
The applications are limited to 35 teams. Each university can have a maximum of two teams. The organization will consider the applications by order of arrival and by their quality in the accomplishment of the competition aims. The application will only be considered as valid after the organization receives the following items:

- Registration form correctly filled out (sent via e-mail)
- Copies of documents proving that all team members are eligible (ex: Student card, etc.)
- Professor in charge statement

All this information must be sent to [info@acc2011.com](mailto:info@acc2011.com)

Applications made after midnight, 13<sup>th</sup> December, will not be accepted. However, the Organizing Committee can eventually postpone the registration deadline or accept applications if the team limit of 35 teams is not achieved by that time. The team will be contacted after 13<sup>th</sup> December by e-mail with the reference of registration accepted. A provisional list of the teams will be published in the official website. Application will then become effective with the bank transfer of the teams application fee (see 4.1).





The transfer has to take place between 13<sup>th</sup> and 18<sup>th</sup> December 2010.

For the reason of payment the team number and the name of the university have to be used.

#### 4.1 APPLICATION FEE

Full Package	total <b>150 €</b>
Lodging for 5 days (4 nights)	
Transport between university and flight field	
3 Lunches	
2 Dinners	
Final Dinner	
Participant package	
Payment Deadlines	
<i>total sum transferred</i>	<i>until</i>
80€	18 <sup>th</sup> of December 2010
120€	4 <sup>th</sup> of April 2011
150€	11 <sup>th</sup> of August 2011
<i>(earliest transfer date is the 13<sup>th</sup> of December 2010)</i>	

**Table 1: Payment Deadlines**

The team's participation is moderated by a fee that obeys the following conditions:

The Euroavia-Stuttgart and Akamodell-Stuttgart are legal associations and will make all efforts in order to provide the teams the greatest comfort and support possible. Accommodation, meals and transportation during the competition in Stuttgart for the duration of the flight competition are provided in the full package application fee. Accommodation and transportation are not included in the basic package application fee. Each member including pilot must pay the application fee.



The team is responsible for keeping the application fee deadlines.

In case you don't need lodging contact the organization committee via e-mail when applying to participate in the competition.

### **Participating in the Competition**

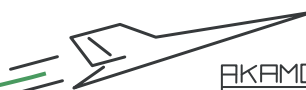
Team members and other representatives of a registered university who are present at the competition are considered to be "participating in the competition" from the time they arrive at the event site until they depart the site at the conclusion of the competition or earlier by withdrawing. If you wish to stay longer, you should contact directly the hotel or inform us so that we can make a reservation at the hotel. The expenses of a longer stay are not included in the registration fee. Payment of the application fee must be made before deadlines of Table 1: Payment Deadlines through bank transfer. The IBAN and BIC/SWIFT will also be written in the Application Form.

BIC SOLADEST

IBAN DE5360050101002748470

The transfer data should be sent by e-mail so that we can finish the registration. The application fee will not be returned in any case, unless the event does not take place.

**Checks will not be accepted! Payment may only be made via Bank Transfer (SEPA-Transfer recommended)!**



## 5 COMPETITION PROGRAM

The program for the flight competition in Stuttgart is the following:

<b>Thursday</b> 11 <sup>th</sup> August	<b>Friday</b> 12 <sup>th</sup> August	<b>Saturday</b> 13 <sup>th</sup> Aug	<b>Sunday</b> 14 <sup>th</sup> August	<b>Monday</b> 15 <sup>th</sup> August
Arrival in Stuttgart	Oral presentations	Flight competition	Flight competition, aircraft exhibition, Final Dinner	Departure

**Table 2: Competition Days**

### 5.1 REGISTRATION OF SEVERAL AIRCRAFT FROM THE SAME UNIVERSITY

The universities may participate with a maximum of two aircraft under the following conditions:

- Each aircraft registered should correspond to only one team
- Each aircraft registered should be different in geometry
- The aircraft registered should show clear design differences between them. By different designs we mean designs that follow different philosophies in their definition.
- Each person can only be registered in one team, except the pilot that can belong to both teams
- Each team can only participate with one aircraft

## 6 INSURANCE AND ACCIDENTS

For the competition the organization committee will have insurance for the duration of the event. Yet the pilots still need to have insurance for model airplanes. (Sorry, we can't change laws we have in Germany...)

We advise all participants to travel with a health insurance and with a European card of medical assistance.

## 7 NOTIFICATIONS, NEWS AND CONTACTS

The organizing committee is available to all interested people.

The contact should be directed through e-mail to

[info@acc2011.com](mailto:info@acc2011.com)

All ads, warnings, news, deadlines changes, or any other subject related to the competition will be available on the official website:

[www.acc2011.com](http://www.acc2011.com)

The competition regulations may be changed by the Organizing Committee in order to fix errors or omissions that are found in the existing regulations. The Organizing Committee may contact the team leaders by e-mail about more or less urgent subjects. All teams are considered to be notified from the moment that all the information is available at the official website of the competition.

The organization committee will provide email support to answer questions regarding the event or technical questions. If necessary or helpful, important information will also be published on the website.

Note: We suggest that you visit the website regularly from the day of the team's application.



**In case you have any questions about ACC feel free to contact us!**

Contacts:

Website: [www.acc2011.com](http://www.acc2011.com)

E-mail: [info@acc2011.com](mailto:info@acc2011.com)

Address:

EUROAVIA Stuttgart

Studenteninitiative e.V.

Allmandring 5B

D-70569 Stuttgart

## 8 AIRCRAFT REQUIREMENTS

### 8.1 AIRCRAFT CONFIGURATION

The aircraft may be of any configuration except rotary wing or lighter-than-air (for example, helicopters, autogyros, dirigibles, balloons are excluded).

- No form of externally assisted take-off is allowed. All energy for take-off must come from the on-board propulsion battery pack(s). The only means of aircraft propulsion is the prescribed electric motor (see 8.2.1).

### 8.2 MOTOR, PROPELLER AND BATTERIES

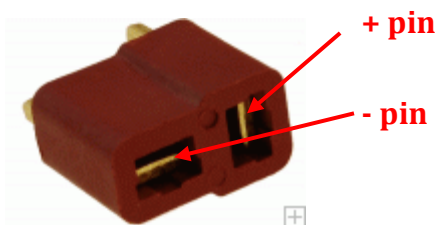
#### 8.2.1 Motor

- The motor must be an Axi Gold 2826/10. The aircraft must be driven by a single motor.

This motor is NOT the same one as for the last two ACC competitions.

- Any ESC can be used. The maximum current is limited to  $I = 40A$  for the competition flights. To ensure no team can be cheating, a current limiter device will be provided by the Organization Committee.

The motor is limited to this one to ensure each team has the equal conditions. An Axi motor has been used for the last 2 competitions. Again an Axi has been chosen due to its reliability, high quality and availability.



Picture 1: connector for the battery



Picture 2: Connector as to be used on the ESC

### 8.2.2 Batteries

All Lithium based batteries (LiPo, LiFe, LiIon) can be used. The teams can choose to use 2 or 3 cells in series. The minimum required capacity is 2500mAh. For parallel battery packs the sum of the capacity must be at least 2500mAh (so eg. 3S2P 1300mAh battery would have 3 cells in series with a total capacity of 2600mAh, which would be fine). The product of max. continuous discharge rate times the capacity has to be at least 40A. For a 3000mAh battery the minimum continuous discharge rate would have to be 13.3C.

The batteries have a minimum capacity to ensure the planes can perform at least one flight pattern. However, each team can choose to use batteries with larger capacities (in case a re-flight is necessary or for other reasons).

Each team is responsible to have their batteries charged before each flight. In case the plane is not able to perform a full flight running out of batteries the flight will not get any points, but counts as one of the three flights of the competition.

It is recommended to bring more than just one battery. Voltage, capacity and max. charge/discharge rate have to be clearly identified on battery. The cells/packs have to keep their factory look and may not be altered.

At the airfield electric power (230V) will be available in order to enable the teams to charge their batteries. In case a teams needs 12V DC they need to bring their own AC/DC converter.

### 8.2.3 Propellers

Single & Multiple propellers, shrouded propellers and ducted fans are allowed. However, the use of metal propellers is forbidden. A spinner or security screw must also be used. The team has to mention a maximum of three types of propellers in the report which they choose to use in the flight competition. Only those propellers will be allowed in the flight competition. After the initial checking of the flight competition, all the changes in the type of propeller have to be reported to the judges. The propellers must be a commercial and tested product with the safety precautions respected (e.g., r.p.m. limit not exceeded).

#### 8.2.4 Transmission

Transmission gears, chains and propeller shafts are allowed as long as the rotation ratio between the motor and the propeller is 1:1.

### 8.3 AIRCRAFT'S RESTRICTIONS

To give the teams a maximum of possible varieties of the aircraft design no other restrictions than the takeoff weight (without payload) are given. This restriction was also chosen to correspond to the significance of lightweight construction in the field of aeronautics, since the weight of the plane is small in relation to the payload and turned out to be a minor factor in the previous versions of the competition.

**The maximum ready to takeoff weight has to be 1800g** (including motor, radio components and batteries). The only additional weight allowed is the current limiter and payload.

There will be a penalty for a weight exceeding 1800g. Every surplus gram will result in 10 penalty grams. The penalty will be subtracted from the payload achieved during flight. However, there is no bonus for aircraft lighter than 1800g.

#### Control restrictions:

No autopilot or control assistance systems (gyroscope, any artificial stabilizing systems) may be used.

Mixing abilities in the transmitter/receiver may be used, as long as they do not use any input of sensors.

However sensors may be used for safety reasons (controlling voltage of RX battery, temperature of battery, motor etc.).

**The aircraft must be able to perform the stability test** made during the technical inspection or before flights during the flight competition.

The wing will be supported both-sided at 2/3 of half of the wingspan and may not break with the payload used during the flight.



If a team decides to fly with more payload than being tested before (during the technical inspection) the test will be performed on the flight field with the payload used during the competition flight.

## **8.4 CARGO BAY**

The volume of the bay will be checked during the dimensional inspection and design analysis. The cargo bay may be larger than required to allow the payload positioning and adjustment of the centre of gravity, but always keeping the exact spacing of 80mm between the two 8mm diameter supports. The cargo bay should be shown clearly in one of the drawings, including dimensions and the corresponding volume should be included in the data chart of the 3-view drawing. The cargo bay may have any shape as long as it carries the payload support with the prescribed design (see attachment). During the technical verifications, juries will use an orthogonal volume of 160x80x80mm (see attachment) made of foam that will be introduced in the cargo bay in order to simulate the cargo plates and ensure that every team respected the minimum cargo volume as stated in the regulations.

## **8.5 PAYLOAD**

### **8.5.1 Payload and load support**

The payload consists of an amount of steel plates which have the corresponding weight. The payload plates are mounted through two 8mm diameter supports (bolts or screws with 80mm distance) in or on the plane. The payload has to be mounted in or to the plane and should not be able to move under normal loads (taxiing, flight, landing etc).

### **8.5.2 Payload distribution**

The payload may not have any effect on the structural stability of the aircraft and must be fixed in the cargo bay to prevent it from moving during flight. The payload has to be mounted in the cargo bay as one block and should not have much influence on the center of gravity of the plane. Therefore the cargo bay should be in the center of gravity of the plane.

## 9 TRANSPORTATION BOX

Each team has to use a transportation box for the aircraft. The box is limited in size and must not exceed 1100x500x400mm (outside dimensions, see attachment). All parts of the aircraft (wing, tail, fuselage, landing gear, motor, propeller, batteries...) must fit into this box at one time. The transmitter is not regarded as a part of the aircraft. The box is used during the transfer between the hostel and the airfield and is also well suited to travel as luggage in an airplane.

It is also recommended that each transportation box has handles on both ends. (outer dimensions include the handlebars).

The dimensions are based on the size restrictions for sport baggage as handled by Lufthansa. Further information is provided in the appendix.

## 10 AIRCRAFT IDENTIFICATION

Each aircraft must have unique identification symbols. This identification should be the team number and the name of the university. Other logos, for example from sponsors, are also allowed.

### 10.1 TEAM NUMBER

The fuselage and wings of each aircraft must be identified with the team number in clear figures with at least 10cm height. The numbers of each team will be decided in a draw. The team number should be shown at least:

- On both of the wings (top and bottom);
- In both sides of the fuselage or vertical stabilizer.

### 10.2 UNIVERSITY NAME

The University name (if applicable) should be visible on the wings or the fuselage. The University initials can be used if they are unique and recognizable.

## 11 RADIO REQUIREMENTS

### 11.1 RADIO CONTROL

The radio control is used to fly and operate the aircraft. Any gyroscope/ auto-pilot assistance is not allowed. The servos have to be capable of withstanding the aerodynamic loads the aircraft is going to be subjected to during the flight. The flight will occur independent on weather conditions, either sunny, rainy or windy. Therefore the teams should be prepared to protect their radio equipment. All radios should comply with the frequencies for aircraft models in Germany. An independent RX battery pack is mandatory, with a minimum capacity of 700 mAh.

Note: a list of allowed channels in Germany can be found at

[http://www.rc-network.de/magazin/artikel\\_05/art\\_05-027/laender/GER.pdf](http://www.rc-network.de/magazin/artikel_05/art_05-027/laender/GER.pdf)

In Germany the 35MHz band and 2.4GHz Systems are allowed.

We highly recommend the use of a 2.4GHz system, since it reduces the risk of multiple teams having the same frequency channel. It also enables the teams to keep their transmitter all the time. This is helpful to adjust the transmitter settings during the competition.

If a 35MHz system is used, the channel number has to be mounted on the transmitter in large letters.

## 12 EVALUATION

The evaluation of the designs will be made in four disciplines:

1. Preliminary Report
2. Report (Technical Report and Drawings)
3. Oral Presentation
4. Flight Competition.

The report has to be sent in as a hardback and must additionally be emailed as a PDF file. The slide show for the oral presentation should be made with Microsoft PowerPoint since it will be available on the PC being provided. The teams may also use slides in PDF format.

### 12.1 PRELIMINARY REPORT

A preliminary report must be delivered till the 1st April 2011, so that the organizing committee can get an overview of the ongoing competition. The preliminary report consists of a written document that should not exceed one A4 page and eight additional pictures. The text should give a summary of the status of the project, making reference to what is already developed, what is not yet developed, the difficulties encountered, etc. The pictures should be an evidence of the aircraft's building condition and can also be about the experience of the team in the development of the project. The report should be sent by e-mail as a PDF file and is not scored. There is, however, a penalty for teams who do not deliver the report.

### 12.2 REPORT

The design report and the drawings must be delivered until 3<sup>rd</sup> June 2011 without delay penalty. By the 10<sup>th</sup> June 2011 the maximum penalty will be given. The date being checked by the organization committee will be the post time stamp. The report may have 30 pages maximum (without attachments). It must be printed in A4 format and font Times New Roman with size 12. The report has to be a hardback so that there are not any separate sheets. It should be correctly identified with the name and number of



the team and the University has to appear on the front page. Each team has to send four complete copies of the report and also email it as a PDF file. The report will be evaluated in terms of its technical content, methods, creativity, clear organization and objectivity. A copy of the registration form signed by all the members and the professor in charge of the project should be attached to the reports. In the report a maximum of three different propellers has to be listed. Only these propellers may be used during the competition.

### 12.3 DRAWINGS

Each copy of the report must include a set of four detailed drawings of the aircraft. These drawings consist of A3 size sheets, printed in one side, properly folded, and bound with the report so that they can be analyzed without separating them from the rest of the document. One of the drawings must be a 3-view drawing of the aircraft using European projection, that is:

- front view at the top left corner
- top view below
- starboard view on the right (of the front view)

The views must contain the main aircraft dimensions (wingspan, wing chords, length and height, etc.). Below the starboard view, there must be a table containing other dimensional information such as relevant areas and/or volumes. Another drawing must be an isometric perspective view of the aircraft. The remaining three must contain information that each team finds relevant with at least one drawing showing the cargo bay, its location and dimensions. A standard scale for each drawing must be properly chosen. The 3-view and isometric perspective drawings may not display hidden lines. All dimensions must be in SI units except for linear lengths which should be in millimetres and plain angles which should be in degrees. All the drawings must have a label in the right bottom corner containing the University logo, the team's name and number, a short description and other pertinent information. The team should send a separate extra copy of the 3-view drawing to be used during the dimensional inspection prior to the flight competition. This copy has to be send with the report or a penalty of 10 points will

be given. If the aircraft is changed after the report is send in, a new copy with remarks identifying the changes has to be e-mailed to the organization committee.

#### **12.4 CALCULATION OF THE PAYLOAD**

A payload prediction has to be calculated depending on the air density.

A linear approximation should be used. The report has to include the formula and a graph showing the predicted possible payload over air density.

#### **12.5 CHANGES IN THE AIRCRAFT**

Changes made to the aircraft should be presented in written form to the organizing committee at least seven days before the beginning of the flight competition at the latest. The judges will then decide about point deductions based on the amount and relevance of the changes done to the aircraft when compared to the design presented in the report. Relevant changes during the competition will only be allowed when accepted by the judges. The judges' decision concerning the change cannot be questioned by the team.

#### **12.6 ORAL PRESENTATION**

All teams must hold an oral presentation of their project on the first day of the competition. The aim is to share the experience gained during the construction and test phases with the audience. The presentation is scored up to 30 points. There will be penalties for those who arrive late or run out of time. The following items are taken into account:

- Students' explanation
- Clearness
- Honesty
- Elements about difficulties during the Project, commands for a future Project, description of the methods used in the construction, etc...



The oral presentation is limited to 15 minutes. A projector and a computer will be available to teams at the presentation day. The teams should be prepared to answer any questions asked by the judges. The presentations must include evidence (photos or movies) that proves that the aircraft has previously flown. The time for questions by the audience is five minutes following the presentation.

### **12.7 FLIGHT COMPETITION**

The flight Competition will take place in August 2011 near Stuttgart, Germany.

There will be a safety inspection of every aircraft before the flight competition starts.

The safety inspections will include the following:

Physical inspection of the aircraft to ensure structural integrity and to verify compliance with the design report:

1. Verification that all components are adequately secured to the vehicle
2. Verification that the propeller is attached safely
3. Visual inspection of all electronic wiring to ensure adequate wires and connectors are used
4. Radio range check, motor off and motor on
5. Verification all controls move in the proper sense
6. Check general integrity of the payload system

The orientation of the flight course will be adjusted based on the prevailing winds as determined by the Flight Line Judge. The flight will be positioned to maintain the greatest possible safety to personnel, facilities and spectators. The maximum take-off distance is 60 meters. The number of points given to a team will be based on the maximum payload carried in a complete valid flight. In order for a team to participate in the flight competition it must accomplish all the requirements of the competition project and must have previously tested the aircraft. The team should demonstrate at the oral presentation evidence that the aircraft has already successfully flown in the same condition it is going to participate in the competition.



If the organizing committee concludes that this is not the case, the team can be declassified based on a security argument. An aircraft that has never flown before the competition or has no proof of flight will not be allowed to fly during the competition.

### 12.7.1 Pattern flight (fully acceptable flight)

The aircraft should take off from a specific place of the defined 60 meters long runway strip that will be shown at the competition day, perform at least a complete turn of 360° and a landing. The initial position of the aircraft is located at the departure line (main gear on the line). The aircraft has to take off (be in the air) within 60m, otherwise the flight attempt is invalid. The aircraft must remain in one piece during a flight attempt. There is no limit of how many turns the aircraft can do before landing, as long as it respects the safety area defined for the flight competition. Repairs are only allowed to broken parts. Changes are only allowed if the judges give their permission.

Note: Any change to the original design will suffer penalties decided by the judges, except if it is made under their permission.

### 12.7.2 Landing

60m in front of the departure line will be an extra line. This line will mark the beginning of the runway for the landing. The length of the runway between the 2 markings will be 120m.

A valid landing has to fulfil following conditions:

- Initial touch down within the 120m section
- The aircraft has to stop jumping and just be taxiing on the runway within the 120m

The aircraft may be taxiing outside the 120m area, it does not need to stop within the 120m.

If the initial touchdown is outside the marked area or if the planes is still jumping when leaving the marked area the landing will be valid but will suffer a penalty.





### 12.7.3 Changes and repairs

The aircraft can be repaired during the competition. However, the aircraft should finish the competition with similar elements to the original ones. The servos, propeller, motors and landing gears can be replaced at any time. The Organizing Committee must be informed of all the modifications as well as of changes of the propeller model. The use and addition of covering, tape, glue, small screws or rivets and structural internal components is not considered as a change.

## 13 JUDGES

Each team will design, document, fabricate and demonstrate the aircraft they determine to be capable of achieving the highest score on the contest. A group of professors, engineers and students will be designated to judge the reports, the oral presentations and the flight competitions of each team. The overall team score is a combination of the Design Report and flight scores. The team with the highest overall score will be the winner.

The Judges will also accomplish the technical inspection. Their measurements, checks and decisions overrule the teams' decisions and measurements.

For the measurements the judges will be equipped with appropriate tools to make fair measurements and decisions.

The jury will be formed by members of the Euroavia Stuttgart, Akamodell Stuttgart, a professor of the University of Stuttgart and a representative of the industry.

The members of the jury will be announced on the website prior to the competition date.

## 14 GENERAL SCORE

The general score will be calculated as follows:

Flight Competition Points + Project Competition Points – Penalties

### 14.1 PROJECT SCORE

The Design Project competition will be scored according to the following criteria:

- Detailed drawings = max. 30 points
- Report = max 50 points
- Estimated Payload = max. 10 points
- Oral presentation = max 30 points

### 14.2 FLIGHT COMPETITION

The number of points given to a team will be based on the payload carried in a complete acceptable flight. In order for a team to participate in the flight competition, it must fulfil all the requirements of the competition and must have previously tested the aircraft.

At the oral presentation each team has to show an evidence of flight for their aircraft (video).

In this proof of flight the plane has to be in the same condition as during the competitions. No major changes will be tolerated. This does not affect repairs that have to be made before the competition.

#### 14.2.1 Maximum payload loaded

The flight competition consists of at least 3 scoring runs if weather conditions permit (and an optional previous free test run) in which the teams will try to carry the maximum possible weight. The number of points, at this time, will be based on the maximum payload carried in a fully acceptable flight and it will be calculated as follows: 20 points for each 1.000 kg that the aircraft carries.

Weight fractions up to 50g will not change the score. E.g. 4000g up to 4049g will result in a score of 80 points.

### 14.3 PENALTIES

The reports, drawings, the estimated payload chart and the envelope with the 3-view drawings, should be delivered to the organizing committee on the established date. The organizing committee will not be liable for document loss or mistakes in the addresses. It is suggested that all the reports and drawings are sent by mail or delivered by hand. Only receipts, mail stamps or bills will be accepted as proof of the sending date.

Some of the penalties will be the following:

Subject	Penalty
Preliminary Report missing	30 points
Delay in delivering reports/drawings	10 points per day
Delay or not being present on opening for oral presentations	12 points
Delays during flight competition	2 points per minute
Chart of payload vs. air density is missing	10 points
Replacements of parts without notifying the organisation committee	10 points
Disrespect of regulations	Disqualification
Video for proof of flight is missing	Disqualification
Changes to the original project of the aircraft	Defined for each case
Wrong size of the cargo bay	40 points
Flying outside specified flying area	Disqualification for that run, run gets 0 points
Flying over spectator area	50 points penalty on final score (for all runs)

Unsuitableness regarding the aims of the competition	Min. 30 points up to disqualification
Disrespect/disobedience to judges	Min. 10 points up to disqualification
Any major attitude against organizing or logistic procedures	3 points
Breaking security rules	Up to disqualification
Aircraft parts transported outside the transportation box	Up to disqualification
Unstated protests	35 points
Aircraft heavier than mass limit of 1800g	Reduced cargo load by factor 10 of overweight
Initial touchdown outside the 120m markings or plane is still jumping when leaving the runway markings	20 points penalty on that run

**Table 3: Penalties**



## 15 BONUS

### 15.1 PAYLOAD PREDICTION BONUS

The payload prediction bonus will be determined according to the following formula:

$$\text{Prediction Bonus} = 10 \times \left( 1 - \frac{|\text{predicted payload} - \text{actual payload}|}{\text{predicted payload}} \right)$$

The predicted payload is a constant value obtained from the chart of payload prediction. The actual payload is the value of the payload achieved in the flight competition.

### 15.2 TIME BONUS

At the flight competition, during the preparation of the aircraft for flight, each team has 2 minutes to put the payload in the aircraft and to prepare the aircraft to flight. The shorter the amount of time the team needs to initiate the take-off run the more points can be made.

The relationship is the following:

$$\text{Time Bonus} = 24 \times (1 - t/120s)$$

If the team uses 2 min or more there will be no bonus. There is no penalty if more than 2 minutes are needed. So 1(one) point is lost for each 5s that the team spends to prepare the aircraft for take-off.

## 16 IMPORTANT DEADLINES

To summarize the important deadlines check the following information:

Important Deadlines	
Application	1 <sup>st</sup> Nov. – 13 <sup>th</sup> Dec. 2010
Application Fee	13 <sup>th</sup> Dec. – 18 <sup>th</sup> Dec. 2010
Delivery of preliminary report	1 <sup>st</sup> April 2011
Delivery of design report and drawings	3 <sup>rd</sup> June 2011
Notification about changes in the project	1 <sup>st</sup> Augusts 2011
Oral presentation and proof of flight video	12 <sup>th</sup> August 2011
Flight Competition	13 <sup>th</sup> – 14 <sup>th</sup> August 2011

**Table 4: Deadlines**

## 17 PROCEDURES, FLIGHT ORDER AND LOGISTICS

The organizing committee will create additional documents which are also relevant for the organization of the competition.

These may be for example:

- Procedures,
- flight order
- logistics
- updates to this document or one of the others

## 18 NOTES

### 18.1 OMITTED CASES

The organizing committee should make all efforts in order to provide comfort to all teams during the development of the process and during the competition. It will treat all teams equally. All matters not mentioned in this regulation will be analyzed and decisions will be made regarding the fairness and equality of all teams. The organizing committee has the right to change the regulations at any time. All changes will be released on the website and registered teams will also be notified via e-mail address provided in the application form.

It may also be possible that the organization committee publishes beta versions or drafts of upcoming changes.

### 18.2 PROTESTS

The teams have the right to protest against the decisions made by the organizing committee. The current regulation and the decisions of the judges cannot be the target of any protests. The protests should be presented in writing to the concerned ones and addressed by the team's leader. The organizing committee is available to accept any suggestions or criticisms aiming at improving any detail of the competition. We remind you that unjustified protests will end up in a penalty.

### 18.3 COMPETITION OFFICIALS AND TECHNICAL AND SCIENTIFIC COUNSELLORS

The Organizing Committee includes three groups of people that will take after the score process, checking and management of the competition. The name of these people will be announced at the appropriate time.

### 18.4 TECHNICAL AND SCIENTIFIC COUNSELLORS

#### Scientific Committee:

The **Scientific Committee** is constituted by university professors in the aeronautics field. They cooperate with the Organizing Committee about the regulations, so that this event becomes more interesting from the engineering and science perspectives.



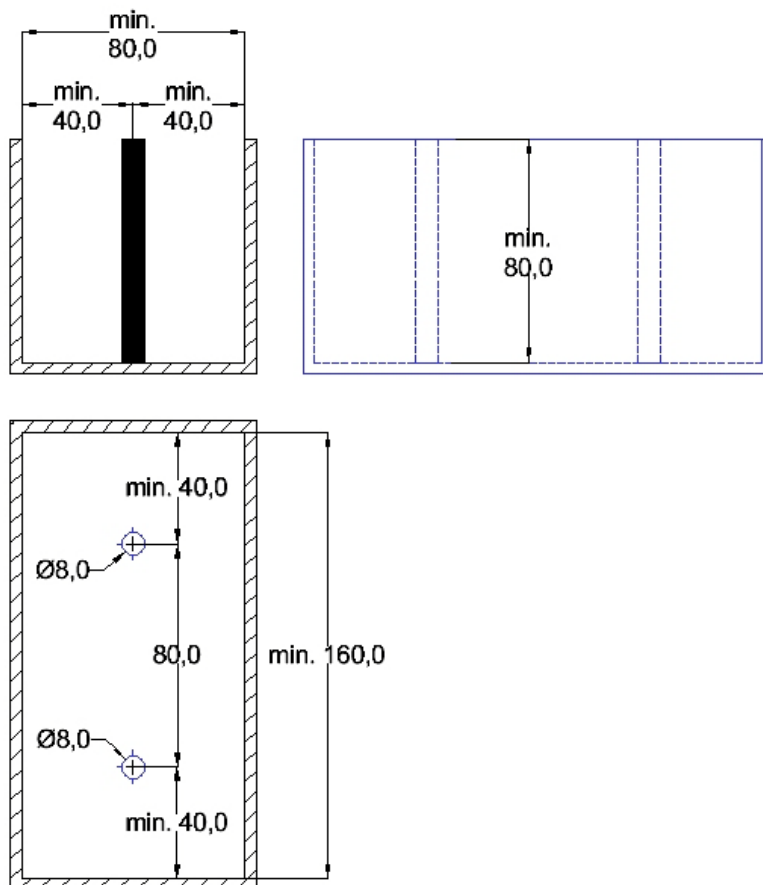
### **Technical Committee:**

It is responsible for the creation of the regulations and it has to assure that all these rules are accomplished during the Air Cargo Challenge. It has to check if the projects respect all the rules and to assure that all the flying competition occurs according to the previous established procedures and rules.



## 19 APPENDIX

### 19.1 CARGO BAY



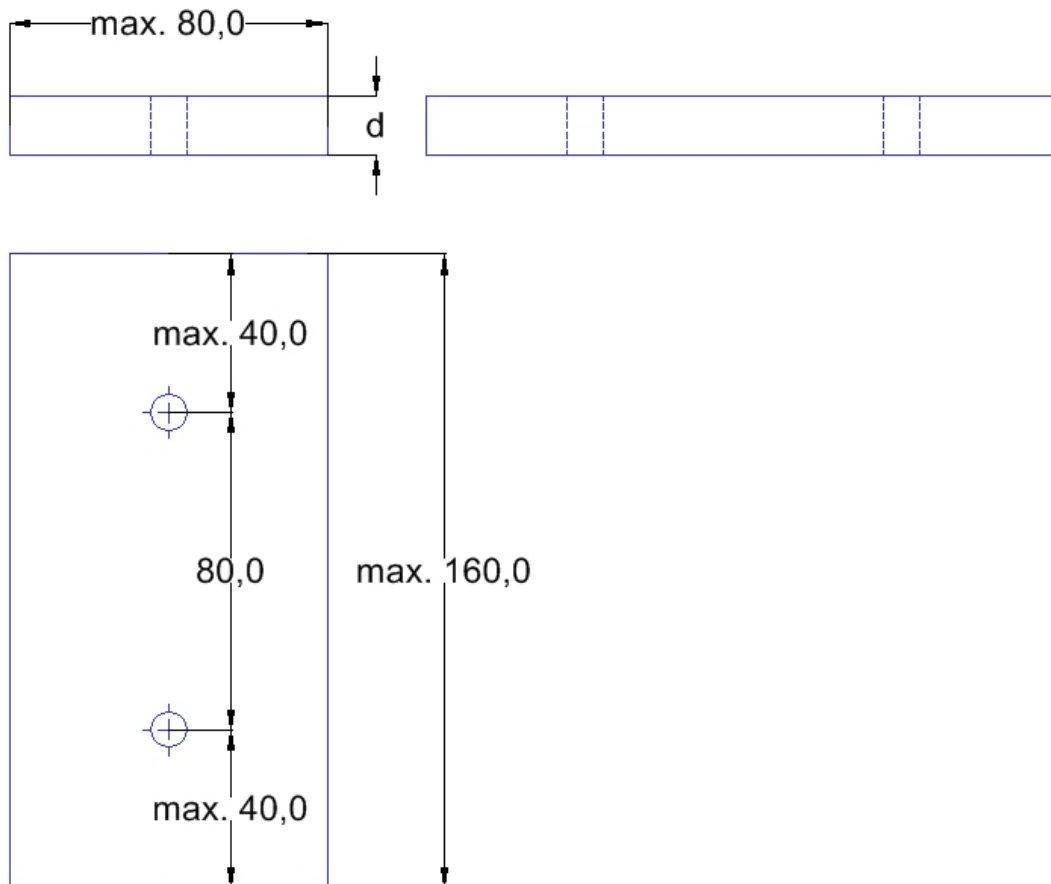
**Picture 3: Dimensions of the cargo bay**

The dimensions given as minimal dimensions may be greater than the given minimal dimensions (we recommend they are).

The maximum dimensions of the metal plates are the minimal dimensions of the cargo bay.

If you decide to use the minimal dimensions for the cargo bay it might be hard to fit the plates into the cargo bay.

## 19.2 WEIGHT PLATES

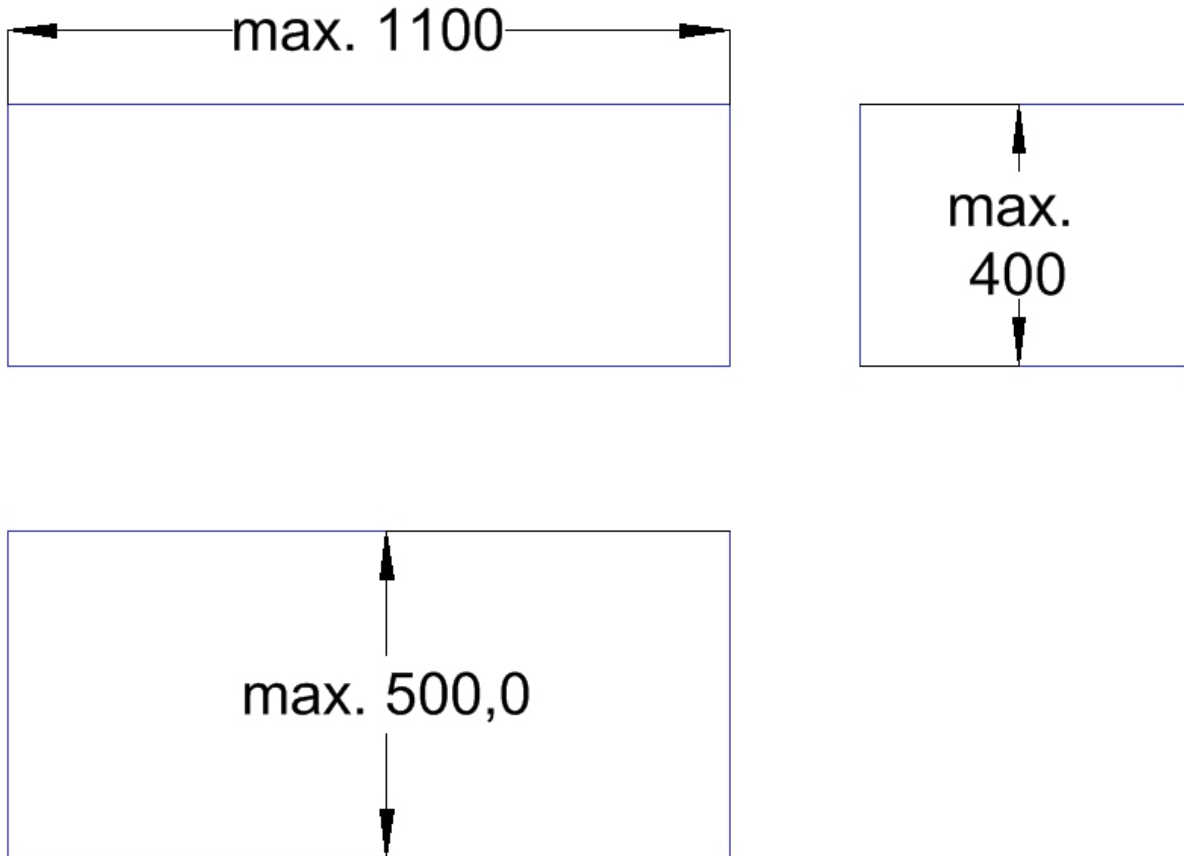


**Picture 4: Dimension of the metal plates**

The bore diameter will be slightly more than 8mm (probably 8.5mm or 9mm). So distance of the bores is 80mm with less than 1mm tolerance.

The plates may be smaller and vary in thickness in order to achieve different weights. This is to be able to have a payload  $\pm 50g$  compared to the payload the teams ask for.

### 19.3 TRANSPORTATION BOX



**Picture 5: Transportation Box**

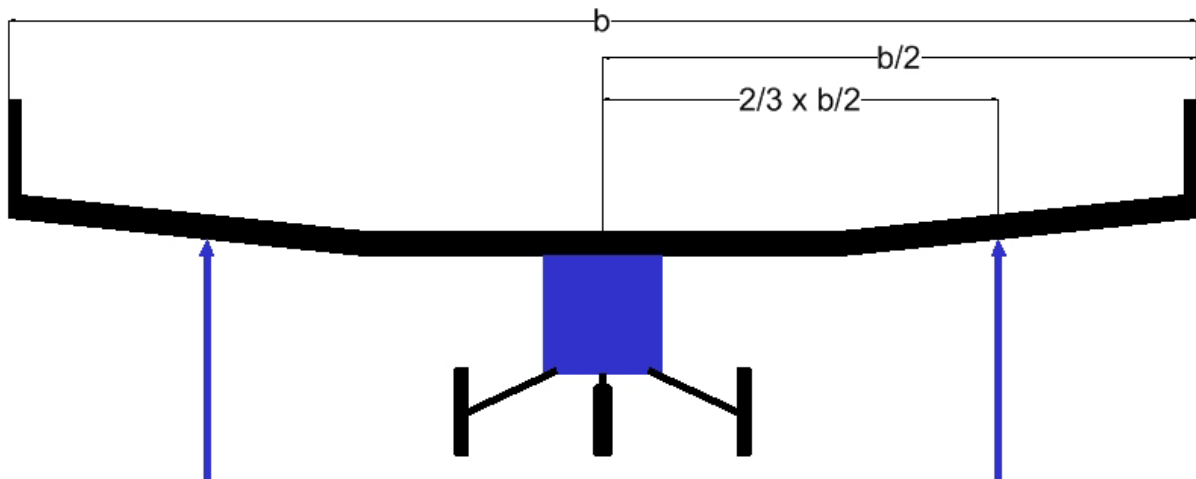
The dimensions of the transportation box are outer dimensions including handlebars. The sum of length, width and height may not exceed 2m. This restriction is due to the size of sport baggage based on the information of Lufthansa<sup>1</sup>.

The weight of the transportation box should be 32kg or less. In case it has more weight it probably is more expensive, since it will not be Medium, but Large sport baggage.

The team should notify the airline that it has oversized baggage to avoid troubles getting the transportation box on board.

<sup>1</sup> <http://www.lufthansa.com/de/en/Excess-and-special-baggage>

## 19.4 STABILITY TEST



**Picture 6: Stability test for technical inspection**

Before the plane may fly with payload a stability test has to be performed. The wing will be supported at 2 points located at  $\frac{2}{3}$  of half of the wingspan.

The plane has to be able to withstand this load without failure. This test is for safety reasons to simulate a load during flight (simulating 1.6g).

We recommend minimum secure g-load of 2.5 for the maximum designed (predicted) payload. This would result in supporting the wings at the wingtip.