



# AirCargoChallenge 2022

# Participation Handbook

Version 01.15

01.07.2022

Changelog:

Date	Change
06.08.2020	Version 1.0
07.08.2020	V01.01: minor changes
25.08.2020	V01.10: changed drawing for flight task , small corrections, clarifications
16.03.2021	V01.11: New dates for ACC2022, changes to CG calculation
01.07.2022	V01.14: Updates to the new flight field, small changes that were already told via E-Mail but forgotten here and some correction V01.15: Updated jury

Changes since version 01.00:

Section	New in Version	Change (green new, red old)
3.8	1.01	Application period 01.09.2020 <del>12-UTC</del> 00 UTC – 01.11.2020 24 UTC; Technical report and drawings 01.05.2020 <del>01</del>
4.4.4	1.01	...metal plate visible from the outside: <del>with</del> your name and postal address <del>on it.</del> (e.g. Owner/Pilot)
4.4.5	1.01	Main Battery: To allow for inspection of the voltage, the battery must have a (female) balancer connector of the single cell voltages with a spacing of 2.45mm pitch of the pins. (e.g. Standard EH or XH connectors)
4.4.6	1.01	We will use a 434MHz, <del>or</del> 868MHz (or 2.4GHz) Radio for this task.
4.5	1.01	All submissions may be published on the internet or other media <del>by the</del> organizing committee.
<del>4.7.6</del> -> 4.6.12	1.01	Context is better in the previous Section
4.9	1.01	Flow-Chart: <del>Report Penalties</del> -> Drawings
6.3	1.01	Removed scale, because the drawing is not A4 in this document
-	-	-
3.4	1.10	<del>Each member, including the pilot, must pay the application fee</del> For each team member, including the pilot, the participation fee must be paid.
3.4	1.10	Receipt of payment is the relevant date.
4.4.3	1.10	<del>four-sided</del> rhombus-shaped
4.4.3	1.10	Standing on the floor by itself ( <del>e.g.</del> in take-off configuration);
4.4.3	1.10	Beware of rule 4.4.1 if you have any moving shape of the aircraft. You must comply with the size restrictions in every position.
4.4.8	1.10	<del>Loosing</del> The loss of the logger will result in zero points for the flight.
4.4.9	1.10	The Payloadbox/Payloadbay has to be fixed at one position.
4.4.9	1.10	The cargo bay has to accommodate at least one bag with 300g.
4.4.11	1.10	OpenVSP
4.4.14	1.10	<del>minimum dimensions;</del>

4.4.15	1.10	Added several aspects to clarify the load test with more than one wing, winglets or swept wings. (added lines are marked)
4.6.6	1.10	New graphic with pink color for the distance flight
-	-	-
	1.11	Removed all old markings of changed sections. (small line on the left of the section)
	1.11	Changed all dates for ACC2022 (not marked individually) Please check the new deadlines. Some moved up one day!
2	1.11	Update to the Corona information, Old text is still here.
4.4.9	1.11	<del>Also note that the payload must not affect the center of gravity (CG) of the aircraft. → The CG shall not change by different amounts of payload.</del> Be aware that the payload might affect the center of gravity (CG) of the aircraft. The stability and controllability have to be calculated for all extreme CG positions. (see 4.4.11)
4.4.11	1.11	A sufficient stability margin for stable flight has to be demonstrated in a calculation for the most extreme (positive and negative) CG positions due to change in payload (for example, but not necessarily, maximal and minimal payload).
3.10	1.12	Added chapter on Competition Program and general information
3.6	1.12	Completely new
3.7	1.12	Added A1/A3
4.6.2 & 6.5	1.14	Updated flight area and pictures
3.10.6	1.14	Added flight field
4.4.4	1.14	Updated e-ID, and no more fireproof sticker
4.6.5	1.14	A1/A3 licence added
0	1.14	Small adaption to the procedure
4.4.5	1.14	No 230V availability at airfield for chargers.
4.5.6	1.15	Added poster usage
3.9	1.15	Added head jury and Speakers incl. short information
3.10.2	1.15	No more busses unfortunately ☹️ But we have a way to do it with public transportation.
		Info: we will probably make another version with minor detail changes. You will get an e-Mail update then as well!

# Introduction

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The Air Cargo Challenge (ACC) is a competition aimed at engineering students. It was created to excite students for aviation and to experience the challenges of an engineering task. Within 10 months, an unmanned aircraft is designed and built to compete against other teams from all over the world. The main task of the aircraft is to transport a payload. The AkaModell Munich successfully competed against 27 other teams in the Air Cargo Challenge 2019. As the winner of the competition, we are organizing the next event in the summer of 2022 in Munich.

## About AkaModell Munich:

We are a club of engineering and aerospace students at the Technical University of Munich, founded in 1999. We do basic research, theoretical development, design, construction and finally flight testing of remote-controlled model aircraft. Our goal is to supplement the education of students at TU Munich by successfully applying our theoretical knowledge to practical problems. In the last 21 years we designed 19 "official" aircrafts. Some of them can be built for private flying and gained a big interest within our group.

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# 1 NOTIFICATION, NEWS AND CONTACT

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All news will be posted on our website [www.acc2022.de](http://www.acc2022.de) .

We suggest visiting the website regularly. This is the binding source for news as well as changes in the regulations and organization.

For press inquiries please contact [info@acc2022.de](mailto:info@acc2022.de) .

Some updates will be announced additionally on our Facebook page ([www.facebook.com/akamodell](http://www.facebook.com/akamodell)).

If you have any questions concerning regulations or organization, please contact [teamcontact@acc2022.de](mailto:teamcontact@acc2022.de).

PLEASE use your team number and team name as first words in the subject line. (e.g. "04 Akamodell Munich - Question about motor")

This contact is for all questions by the teams (organizational, financial, regulations, etc.).

If necessary, the answers will be made public to every team.

There will be two WhatsApp groups:

1. "ACC2022 all Participants": for all participants (unmoderated) to increase the communication between the teams before the competition. You will get the invitation link after your registration. All team members may join. Don't expect us to read all posts!
2. "ACC2022 team leaders": for team leaders only! You may ask questions regarding Organization or Regulations. Please keep this group short and informative. Please use this only for small inquiries, everything else via e-Mail. ([teamcontact@acc2022.de](mailto:teamcontact@acc2022.de))

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 the information is available at the official website of the competition.

## 2 CORONA INFORMATION

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### UPDATE:

Unfortunately we had to postpone the ACC2021 to ACC2022.  
We really hope that this time the date stands.

- All Dates are moved approximately one year back.
- All accepted teams get a “golden ticket” to participate in the ACC2022.
- A new application period starts on Thursday 01.04.2021 00:00 UTC. It ends on Mo 01.11.2021 24:00 UTC or if all available spots are full.

The current situation is very special. The corona virus pandemic costs a lot of lives around the world and we still don't know how long the restrictions will be in place or how they will look like in 2021. Travelling between countries, even inside the EU, is at least difficult. Additionally, the economic crisis puts pressure on a lot of companies. This leads to a difficult search for sponsors.

There are a lot of problems and challenges that still lie ahead of us. We are closely monitoring the situation and will adapt to changes if necessary.

1. Most important: we do not want to endanger any participant by being with us in Munich!
2. The travel restrictions won't be in place forever. Our main concern is for the European countries, but we know that usually there were some teams from all around the globe. There must be a high probability that no team within the EU has problems getting to Munich and back home safely.
3. Our goal is to connect you with other participants. Being in direct contact and exchanging ideas is the main factor for a good ACC. This will not be possible while maintaining save distance between everybody.
4. Finding sponsors is difficult at the moment. To reduce your cost we added some more restraining rules about the aircraft size. This should have a significant financial impact for you.  
It should also reduce the need for a big workshop. A lot of model aircrafts are built on the kitchen table. Let's be creative!

We thought long about delaying the ACC for one year “until the dust settles”. But since we believe in a positive Corona development, we want to go ahead like planned and hope that we will be able to enjoy a great ACC 2021!

But what if it won't be possible?

We do have two dates to decide if we postpone the competition.

First option is the end of 2020. Depending on how many teams applied for the competition, we will decide if it makes sense to postpone the ACC for one year.

The second option is to cancel it in 2021, up to 3 months before the competition. Wherever possible, we organized a cancelation policy to allow this. At the moment we do not think that you would have any financial drawbacks. Only one more year to optimize and build... ;-)

Nevertheless, in case of a very unlikely complete cancelation, we can only pay back money that we are getting back as well.

In case of delaying the competition for one year, **all your registrations would remain valid.** If there were any drop-outs or the team limit was not reached before, there might even be a new additional registration period one year later.

### **3 ORGANIZATION HANDBOOK**

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Section 3 of the handbook will deal with all organizational matters.

The technical parts of the competition will be in Section 4.

Regulations Handbook.

### **3.1 NOMENCLATURE**

Shall = this is a requirement that should be kept. Please consult with us EARLY if you can't realize any of these rules to find a solution.

Must = this is a hard rule. Not keeping it will definitively lead to a penalty or up to disqualification!

## 3.2 PARTICIPATION

A team consists of 4 to 7 people. All team members shall be over 18 years old during the competition.

One team member is the designated pilot. If you don't have a pilot, please contact us before applying.

The pilot may be a "non-student". (e.g. pilot at your local RC-club,...)

Except for the pilot, all other team members shall be students, professors or research associates of the higher education institution that they are representing.

In case the organizing committee finds some of the team members are not from the university or other irregular actions occurred, the team will be disqualified.

Teams not representing higher education institutions or from universities outside Europe may be accepted by the organizers. European teams will have priority.

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 that the team is representing the university and confirms that all team members are students or employees of the university.

## 3.3 APPLICATION

The application period will begin on Thursday 01.04.2021 00:00 UTC. It ends on Mo 01.11.2021 24:00 UTC or if all available spots are full.

The application form can be downloaded during this period on [www.acc2022.de](http://www.acc2022.de).

We have to stop the application, if 30 Teams have applied. If the limit is exceeded, the application will be accepted in a first come first serve manner. Every team is allowed to participate with a maximum of 7 team members. Due to this limitation there are no guests possible in the initial application. If we still have free capacities after November 1<sup>st</sup>, it might be possible to bring guests and additional team members. Otherwise everyone is free to visit the ACC as a visitor. Each university can participate with one team. The application is valid after the organizer receives the following items:

- Application is fully and correctly filled out
- 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 [teamcontact@acc2022.de](mailto:teamcontact@acc2022.de) with the declaration of the team name in the subject line of the e-mail. (e.g. "Team Daedalus – Application")

Applications made before 01.04.2021 00:00 UTC or after 01.11.2021 24:00 UTC, will not be accepted.

The teams will be contacted via e-mail after processing, to confirm successful registration. A provisional list of the teams will be published one week after the application stop.

You will get a bill after the application with important information like IBAN,...

The application will become effective with the first bank transfer of the team application fee.

### 3.4 FINANCIAL

The first transfer has to take place until February 1<sup>st</sup> 2022 with 100€ per team member. Please use your team number and the name of your university as reason of payment. The second transfer has to be made until the 1<sup>st</sup> of April with 150€ per team member. Banking fees have to be covered by the participating team. We can only process received funds.

<b>Transfer</b>	<b>Amount per team member</b>	<b>Deadline</b>
<b>1<sup>st</sup></b>	100€	01.02.2022
<b>2<sup>nd</sup></b>	150€ (additional)	01.04.2022

AkaModell München e.V. will make all efforts in order to provide the teams the greatest comfort and support possible.

Accommodation, meals and transportation during the competition are provided in the application fee.

For each team member, including the pilot, the participation fee must be paid. The fee for the team members does not cover all expenses of the organizing committee. The deficit will be covered by sponsoring. We are still trying to reduce the amount of the second payment through additional sponsors.

In case of a cancelation we will try to give back as much money as possible.

The teams are responsible for fulfilling all application fee deadlines. Receipt of payment is the relevant date.

### 3.5 EUROAVIA

We were asked by Euroavia IB if we could report what local EA groups join the ACC2022. We are happy to help EA to continue the Air Cargo Challenge in the future and will report Euroavia IB what EA groups registered for the competition.

### 3.6 COMPETITION PROGRAM

The competition will take place in Munich on 5.7.2022 - 8.7.2022.

Detailed time schedule: 3.10.7

Day	Mon	Tue	Wed	Thu	Fri	Sat
Date	4.7.22	5.7.22	6.7.22	7.7.22	8.7.22	9.7.22
Location	-	Flugwerft Schleißheim	Flugwerft Schleißheim	Flugwerft Schleißheim	Flugwerft Schleißheim	-
Activity	Arrival	Technical inspection	Flight day #1	Flight day #2	Flight day #3 Final dinner	Departure

Detailed schedule	For bus times refer to 0.					
Morning 9:00	Arrival of teams in Munich Check-in from 15:00	Technical inspection Until 17:00	Test flights	Competition flights Day 2	Competition flights Day 3	Departure until 10:00
Lunch break			Lunch	Lunch	Lunch	
Afternoon 19:00 *			Competition flights Day 1	Competition flights Day 2	Competition flights Day 3	
Evening 22:00 *		-	-	-	Final Dinner with award ceremony	

**\* Please be aware that the afternoon and evening times are a very hard deadline by our location. We have to be out of the location at that time!!! Plan your work on aircraft or other things accordingly to leave in time!**

You may check-in on Monday between 15:00-20:00 at the hostel. For later arrival, please check with us before the competition.

Check-out on Saturday is 9:45 latest!

Since all meals are pretty expensive and we don't know exactly when you will arrive in Munich, we decided that there will be no dinner on Monday!

This means, if you arrive late, have a sightseeing tour, sleep,... you may eat wherever and whenever you want. See section 0 for possible restaurants.

As mentioned in the mail for the first invoice:

You will have breakfast at the hostel, lunch at the venue and a small foodbox for dinner.

### 3.7 INSURANCE AND ACCIDENTS

The pilot needs to have insurance for model airplanes by German law. It must cover at least 1.000.000 €. Every pilot is responsible for his aircraft during flight. The pilot is required to complete a proof of competency certificate A1/A3. Please refer to the mail from May 6<sup>th</sup>.

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

### 3.8 DEADLINES

The important deadlines for the participation are summarized in the table below.

Application period	01.04.2021 00 UTC – 01.11.2021 24 UTC
First bank transfer	01.02.2022
Second bank transfer	01.04.2022
Preliminary report	01.03.2022
Technical report and drawings	01.05.2022
Video presentation and proof of flight video	20.06.2022
Competition	05.07.2022

#### ***3-1 Important Deadlines***

### 3.9 JURY

The jury consist of university professors, industry representatives and members of AkaModell Munich. They will score the reports and videos submitted by the teams.

#### Head Jury:

#### Prof. Dr.-Ing. Mirko Hornung



Professor Hornung's research is in the area of aircraft design, integration, and evaluation. His focus is on conceptual aircraft design and the theoretical and experimental evaluation of overall system technologies in the operational context.

Professor Hornung received his doctorate in aeronautical engineering from the University of the Bundeswehr (Federal Armed Forces) in Neubiberg. His thesis on reusable space transport systems was awarded a research prize in 2003. From 2003 to 2009 he worked in the Military Air Systems Division of the Airbus Group (formerly EADS) on propulsion systems integration, program management and business development. In his last position he was responsible for the conceptual design of future manned and unmanned military aircraft. In a joint effort he acts as the executive director research and technology of Bauhaus Luftfahrt, an international think tank on the long term developments in aviation.

(Source: <https://www.professoren.tum.de/en/hornung-mirko>)

#### Prof. Dr.-Ing. Florian Holzapfel

Prof. Holzapfel's (b. 1974) research field is flight system dynamics. His key interests are flight control, trajectory optimization, sensor technology, data fusion and navigation, modeling, simulation and parameter estimation, avionics and safety critical systems. Prof. Holzapfel takes a holistic approach to teaching and fosters close cooperation with a number of small and medium-sized aerospace companies, mainly in Bavaria.



After studying aerospace engineering at TUM and working in flight control, Prof. Holzapfel returned to the Chair of Aeronautical Engineering and Control at TUM to complete his doctorate under Prof. Gottfried Sachs (2004). After that, he spent several years working in the industry (IABG, Ottobrunn) before accepting an invitation from TUM in 2007. Prof. Holzapfel is Associate Fellow of the AIAA and a member of the DGLR.

(Source: <https://www.professoren.tum.de/en/holzapfel-florian>)

## Opening speech:

### MdB Michael Kießling



Member of the German Bundestag

Mr Kießling was born in Rüti, Switzerland in 1973. After school he was trained as assistant nurse in “Bundeswehrkrankenhaus Amberg” and made his way through seargeant and officier training at “Sanitätsakademie München”.

In 1998 he finished his studies in civil engineering and started working in different positions for Nemetschek AG. He participated in an apprenticeship MBA program to get a deeper insight into business management.

In 2014 he started his political career as major of the city “Denklingen”, and was elected as representative of his electoral district in the German Bundestag in 2017.

He represents electoral district 224 “Starnberg, Landsberg am Lech und Germering”.

(Translated from: <https://www.kiessling-michael.de/ueber-mich>)

### Prof. Dr.-Ing. Klaus Drechsler

Prof. Drechsler’s research fields are in the areas of materials science, structural mechanics, manufacturing technology and fiber-reinforced materials (carbon composites).

Prof. Drechsler (b. 1960) studied aeronautic and aerospace engineering at the University of Stuttgart. He also completed his doctorate there in 1991 on the topic, "On the design and calculation of bonded fiber materials with three-dimensional textile reinforcement". Following a period as an assistant at the university’s Institute for Aircraft Design, he joined the central laboratory of Messerschmitt-Bölkow-Blohm in Ottobrunn. There, he held the position of senior scientist and head of department for the Plastics division at DaimlerChrysler and EADS. In 2002, he accepted the positions of Director and Chair of the Institute for Aircraft Design of the University of Stuttgart. Since 2009, he has headed the Chair of Carbon Composites at TUM. He is also director of the Fraunhofer Research Institution for Casting, Composite and Processing Technology IGCV in Augsburg.



(Source: <https://www.professoren.tum.de/en/drechsler-klaus>)

**Field Jury:**

Our professors supported us all the way during the preparations, creation of the regulations and lately with several problems finding a new event location. We want to thank them for their incredible help. Without it, Air Cargo Challenge would not be possible in Munich!

Since our competition takes place during the lecture period and several big conferences take place, our head jury can't be at the competition all the time.

Together we found a field jury, grading reports and videos. They will define the penalties for technical deviations on Tuesday evening, and be available at the field or easily reachable in case of a protest or to help us organizers make difficult decisions.

To keep them as unbiased as possible we chose people not directly involved in making the regulations or communication with the teams. Most of them participated in ACC, know model aircrafts inside out and bring a sense of reality from their industry experience.

## **3.10 LOCATION & PROGRAM**

### **3.10.1 Hostel**

#### **Address:**

a&o München  
Hackerbrücke  
Arnulfstr. 102  
80636 München  
+49 89 45 23 59 - 58 00

**Check in: from 15:00 pm**

**Check out: until 9:45 am**

Breakfast 7.00 – 11.00 (Mo-Fr)

#### **How to go to the Hostel with public transportation:**

##### **From the S-Bahn station Hackerbrücke:**

On foot: Walk up the Grasserstraße to the crossing Wredelstraße / Arnulfstraße. Turn left into Arnulfstraße. After 600 meters you will see the a&o Hostel München Hackerbrücke on the right side.

By tram: Walk up the Grasserstraße to the crossing Wredestraße / Arnulfstraße, cross the Arnulfstraße. Then turn left. There is the tram station Hackerbrücke. The lines 16 direction Romanplatz and 17 direction Amalienburgstraße take you in only 2 stations to the stop Marsstraße. You will see the a&o hostel in the direction of travel on the right.

##### **From the Central Station (Hauptbahnhof):**

You can get from the Central Station by tram, metro or S-Bahn to the a&o München Hackerbrücke. The fastest and easiest way is the tram.

Leave the Central Station via the main exit. Across the street is the tram station. The lines 16 direction Romanplatz and 17 direction Amalienburgstraße take you in only 5 stations to the stop Marsstraße. You will see the a&o hostel in the direction of travel on the right.

##### **From the Central Bus Station (ZOB):**

The ZOB Munich is located directly at the S-Bahn station Hackerbrücke. Turn right onto Grasserstraße. Walk up the Grasserstraße to the crossing Wredestraße / Arnulfstraße. Cross the Arnulfstraße and turn left into it. Walk 600 meters. The a&o is on the right side. Alternatively, you can also take 2 tram lines 16 and 17 to Marsstraße

##### **From Munich Airport:**

Take the S1 towards Munich East (“Ostbahnhof”) for 12 stations and get off at station Donnersbergerbrücke. Take the exit for Erika-Mann-Straße. Turn right into this one. Crossing the Arnulfpark runs Helmholtzstraße, which takes you to Arnulfstraße. You can already see the a&o Hostel across the street. Tickets: 3.10.4

### 3.10.2 Transportation on Tuesday to Flugwerft Schleißheim

Unfortunately, the bus company left us hanging and we don't get the busses on Tuesday.

We arrange a transporter to pick up all your aircraft boxes and possible repair/tool/transmitter/charger boxes Tuesday morning around 7:30 to 8:00 in front of the hostel. (maximum around the volume of the aircraft box additionally)

We transport it to Flugwerft Schleißheim and from there directly to the flight field for Wednesday.

You will then travel to Schleißheim with the Subway (We have some people accompanying you, but please be attentive when to exit yourself as well):

1. Use the Tram 17 to "Sendlinger Tor". Change to the S1 direction "Flughafen München".  
Exit at "Oberschleißheim"  
Walk to the "Flugwerft Schleißheim" or take the Bus 292 direction "garching-Forschungszentrum" until "Mittenheimer Straße"
2. Walk to the station „Donnersberger Brücke”.  
Take the S1 direction "Flughafen München".  
Exit at "Oberschleißheim"  
Walk to the "Flugwerft Schleißheim" or take the Bus 292 direction "garching-Forschungszentrum" until "Mittenheimer Straße"

▼ 1 From 10:08 Until 11:02 (00:54 hrs.) ▶ Single trip 5.30 € or 3 strips	
10:08	From München, A&O Hostel (Arnulfstraße 102) 
	▶ Walk to Origin (approx. 7mins - 209m)
<b>Live</b>	 <b>Tram 17 Sendlinger Tor U</b>
10:15	From Marsstraße 
10:20	To Hauptbahnhof Nord
	▶ Change (approx. 3min walk)
<b>Live</b>	 <b>S-Bahn S1 Flughafen München</b>
10:23	From München, Hauptbahnhof (S, U, Bus, Tram)  Gleis 2
10:44	To Oberschleißheim Gleis 3
	▶ Notification
	▶ Change (approx. 5min walk)
<b>Live</b>	 <b>MVV-Regionalbus 292 Garching, Forschungszentrum (U)</b>
10:51	From Oberschleißheim  
10:53	To Oberschleißheim, Mittenh. Str. 
	▶ Walk to Destination (approx. 9mins - 564m)
11:02	To Oberschleißheim, Flugwerft Schleißheim 

For more detailed information use the journey planner yourself:

<https://efa.mvv-muenchen.de/>

### 3.10.3 Transportation to the competition Flight Field

To go to the Competition Flight Field we use public transport. For all information there is a Journeyplanner for public transport in Munich that will give you the most important information:

<https://efa.mvv-muenchen.de/index.html#trip@origdest>

Of course you can also use google maps or local apps like MVV, MVG or DB.

The Journeyplanner will look like this:



The screenshot shows the MVV Journeyplanner interface. It features a search bar with the origin 'München, Arnulfstraße 102' and the destination 'Garching (b München), Garching, Forschungszentrum'. The date is set to 'Wed, 06.07.22' and the time is '09:00'. There are 'Dep.' and 'Arr.' buttons and a 'Submit' button.

Please fill in the blanks with:

From: München, Arnulfstraße 102

To: Garching (b München), Garching, Forschungszentrum, the day and your departure/ arrival time.

Basically, you have 2 options:

1. Drive with the Tram 17 to “Sendlinger Tor” and take the U6 toward “Garching-Forschungszentrum”. You need to exit at the final destination, so you basically can’t miss it.
2. Walk to station “Donnersbergerbrücke”, take any Subway S1-S8 (direction Ostbahnhof/Marienplatz/City center) and drive to “Marienplatz” (4<sup>th</sup> stop). Change to the Subway U6 toward “Garching-Forschungszentrum”. You need to exit at the final destination, so you basically can’t miss it.

▼ 1 From 08:05 Until 08:49 (00:44 hrs.)		› Single trip 7.00 € or 4 strips
<b>Live</b>  <b>Tram 17 Sendlinger Tor U</b>		
08:05	From Marsstraße 	
08:15	To Sendlinger Tor	
▶ Change (approx. 4min walk)		
<b>Live</b>  <b>U-Bahn U6 Garching, Forschungszentrum</b>		
08:22	From Sendlinger Tor 	
	U3/6 Gleis 1	
08:49	To Garching, Forschungszentrum  	
	Gleis 2	

Figure 1: As an example here is a trip from your hostel to University on Wednesday with an arrival at 9 o'clock. Using the Tram-option

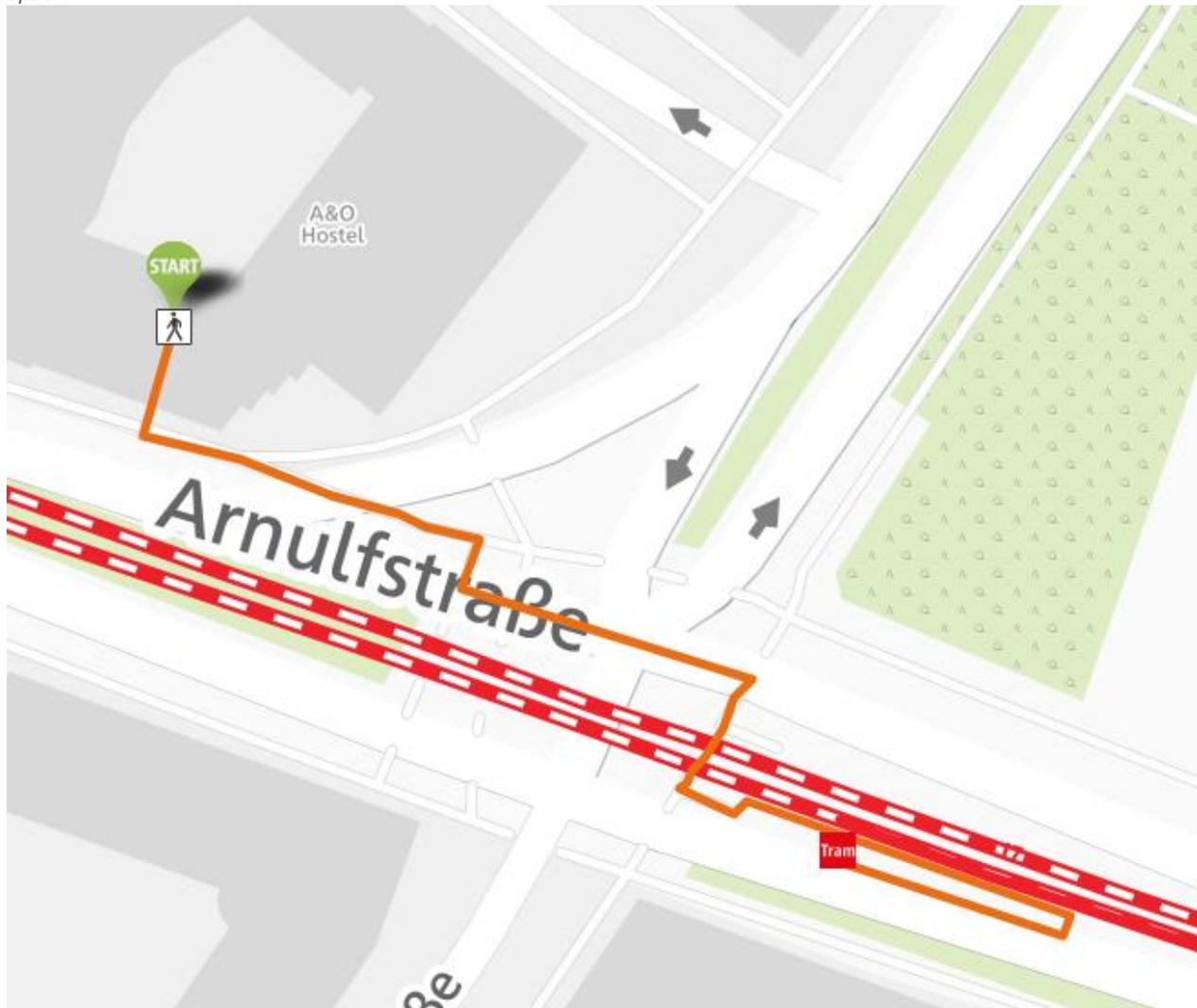


Figure 2: walk from Hostel to the tram station

When you arrive in Garching-Forschungszentrum, Figure 3 shows the way to the airfield in orange.

If you come by car, exit the Autobahn A9 at Garching-Nord and drive to the big blue parking lot.

From there the walk is basically the same as for coming with the subway.

Details for possible parking of one car/team close to the airfield during the technical inspections/teamleader meeting.

Flugwerft Schleißheim: <https://goo.gl/maps/spi2xb5MuujWuijDA>

Flight field: <https://goo.gl/maps/2Qcwq8SxgHzmWPI46>

Parkinglot (at Campus): <https://goo.gl/maps/ZiubjvKteJdWbPoc7>

Final dinner: <https://goo.gl/maps/1akZnQBonsQc9tqg6>



Figure 3: Location of airfield and walking route

### 3.10.4 Public Transport

If you want to travel in Munich you have the possibility for a 9€ ticket for a whole month. We strongly recommend to use this opportunity, even if you come by car. If you want to travel only twice in Munich it might be the cheapest possibility. With this ticket you can use all local public transportation like U-bahn (subway), Tram-Bahn (tramway), S-Bahn and Bus (MVV/ MVG) in entire Germany. If you want to stay in Germany before or after the competition you can also use some regional trains but we would like you to ask us or google if necessary, which ones you can use.



This is how it looks on the ticket machine: (look for similar words on different machines, this screenshots are for MVG, but it doesn't matter where you buy the ticket in Germany)



Here you can find a network map. You can use every shown connection with the 9€ ticket. Use Google Maps or similar apps to see to which station you have to travel.

[https://www.mvv-muenchen.de/fileadmin/mediapool/03-Plaene Bahnhoeefe/Netzplaene/MVV Netzplan S U R T X.pdf](https://www.mvv-muenchen.de/fileadmin/mediapool/03-Plaene_Bahnhoeefe/Netzplaene/MVV_Netzplan_S_U_R_T_X.pdf)

### 3.10.5 Competition location: Flugwerft Schleißheim

The entire competition will take place at “[Flugwerft Schleißheim](https://goo.gl/maps/5vruVK1sYQ7uhYrLA)” by “Deutsches Museum” (<https://goo.gl/maps/5vruVK1sYQ7uhYrLA>). You can have a look at lots of interesting exhibits and several unique and trendsetting aircraft.

**Additional guests and spectators** are more than welcome to come as well. If they want to enter the area, they need a museum ticket. Food is e.g. available in the neighbouring beer garden (<https://goo.gl/maps/DTX54itqF5gFLzb69>) or Pizzeria (<https://goo.gl/maps/MsycvhC16e67CPrv5>).

The flight competition will take place in a different location and is unfortunately non-public. (The guests you told us are on the invite list)

Please make sure to take the necessary **protections against the weather**. Especially high strength sun screen (SPF 30-50), a good hat and a rain coat for possible thunder storms in the evening.

**Restrooms** are available at Flugwerft Schleißheim.

**Lunch and dinner** will be served in a separate room. Only official participants and official guests are eligible for the meals! (Wristbands)

In case of an **emergency**, please contact us, the staff at Flugwerft Schleißheim or in severe cases call the emergency number **112** from any (mobile) phone.

We are currently finalizing the preparations to give you access to **12V supply voltage** to charge your flight batteries. The plus and minus poles should be accessible via 4mm banana plugs or clamps that open around a rod with 10-13mm diameter. There will be a power limit and charging will only be possible at max ~50W/team, which should not pose any problems.



### 3.10.7 Time schedule

This is a preliminary time schedule, please follow the signal channel and e-Mail for last minutes updates

Date	Time	Description
4.7.2022	15:00 - 19:00	Check-in, get your welcome packages. Double-check everything you get immediately!
5.7.2022	7:00	Breakfast
	Around 8:00 will be updated	Departure to Flugwerft Schleißheim
	9:00	GDPR return, Wristbands, Start building up aircrafts for technical inspection
	10:00	Official opening ceremony with MdB Kießling and Prof. Drechsler (Room: Lilienthalsaal)
	11:00	Meeting Teamleaders and Pilots ONLY (Room: Lilienthalsaal)
	13:00	Lunch (Inspections ongoing)
	16:00	Short 2 <sup>nd</sup> Teamleader Only meeting (Room: Lilienthalsaal)
	17:00	Everybody out of the Museum!
	Evening	Free time e.g. for visiting the TUNIX festival!
6.7.2022	7:00	Breakfast
	Around 8:00 will be updated	Departure to Garching-Forschungszentrum
	9:00	Building up at airfield
	10:00	Pilots briefing
	Until 13:00	Test flights (planned, depending on weather forecast, 1x/Team!)
	At least until 19:00	Flying (depending on weather)
7.7.2022	7:00	Breakfast
	Around 8:00 will be updated	Departure to Garching-Forschungszentrum
	9:00	Building up at airfield
	At least until 19:00	Flying (depending on weather)
8.7.2022	7:00	Breakfast
	Around 8:00 will be updated	Departure to Garching-Forschungszentrum
	9:00	Building up at airfield
	Until 15:00	Flying (depending on weather)
	15:00-18:00	Changing venue, help during disassembly is much appreciated
	18:00	Begin final dinner
	23:00	End of ceremony
9.7.2022	Until 9:45 (10:00 sharp!)	Check-out. Don't be late!

### 3.10.8 Wristbands, Tshirts, ...

Every team gets a welcome package with their T-Shirts and a list to sign for GDPR and photo usage. When we get the signed list back (on Tuesday in front of Flugwerft!) you get the matching amount of wristbands and the money to compensate for the 9€-Ticket you had to buy individually. Please check the amount of wristbands, money and T-Shirts immediately after you get it. We cannot do any later complaints.

The T-Shirts and wristbands are already pre-sorted and should match even your latest submission in the team list.

It is not allowed to share wristbands. They have to be firmly attached to the participant. Take care of your wristband! This wristband is the entrance to the museum/competition site (payed by us), busses, meals and access to the final dinner. **We will not be able to replace lost wristbands!!!**

### 3.10.9 What to do in Munich

#### 3.10.9.1 Money / Paying in stores & restaurants

Be aware, that it is possible (mostly in small stores and street food) that you can only pay with cash (€), if you are not sure whether you can pay with credit card just ask the people.

#### 3.10.9.2 Parks

- Englischer Garten
  - Take a cold bath in the “Eisbach”
  - Watch surfers on the “Eisbachwelle”  
<https://www.muenchen.de/sehenswuerdigkeiten/orte/1285585.html>)
  - Visit the Monopteros  
<https://www.muenchen.de/sehenswuerdigkeiten/orte/119359.html>
- Olympiapark
  - Good view over the park on the “Olympiaberg”  
<https://www.muenchen.de/sehenswuerdigkeiten/orte/120221.html>
  - Tollwood (summer festival)  
How to get there: <https://www.tollwood.de/en/besuchereinformationen/anfahrt/>  
You can eat and drink and some performances are free (no entrance ticket necessary, only some performances need tickets)  
Further information: <https://www.tollwood.de/en/>
- Schlosspark Nymphenburg  
<https://www.muenchen.de/sehenswuerdigkeiten/orte/120404.html>

#### 3.10.9.3 Other sites

- Viktualienmarkt
- Hofbräuhaus

#### 3.10.9.4 Lakes

There are a lot of lakes and rivers in and around Munich. You can get a bath in basically all of them.

- Isar (bathing: [Flaucher](#))
- Eisbach (Englischer Garten 3.10.9.2)

The big lakes to the south of Munich. Reachable via public transportation:

- Ammersee
- Starnberger see

Bathing lakes in Munich or to the north:

<https://www.mucbook.de/badeseen-guide-ohne-auto-muenchen/>

<https://www.mux.de/info/muenchner-badeseen-mit-der-s-bahn/>

### **3.10.9.5 Beer garden**

In general you can bring your own food but you have to buy drinks at a beer garden. Usually you can also buy some food if you want to.

- Hirschgarten
- Taxisgarten
- Biergarten am chinesischen Turm

### **3.10.9.6 Events**

- Tollwood (described in section parks)
- TUNIX (student festival)  
near the Subway station “Königsplatz”  
On the main campus of TUM  
Student summer festival with much better beer prices 😊  
Hopefully you can find information on this website soon (unfortunately only in german):  
<https://www.tunix.de/>

### **3.10.9.7 Museum/ Exhibitions**

- Deutsches Museum main site (technical museum):  
Museumsinsel 1, 80538 Munich, 09:00 – 17:00  
<https://www.deutsches-museum.de/en>
- Deutsches Museum Verkehrszentrum (Cars, trains,...)  
Am Bavariapark 5, 80339 München, 09:00 – 17:00  
<https://www.deutsches-museum.de/en/verkehrszentrum/visit>
- Lenbachhaus (mostly art of the 19<sup>th</sup> century)  
Luisenstraße 33, 80333 Munich, 10:00 – 18:00  
<https://www.lenbachhaus.de/en/>
- Haus der Kunst (different more modern exhibitions like fog sculptures from Fujiko Nakaya)  
For more information about the different exhibitions:  
<https://hausderkunst.de/en/?locale=en>  
Prinzregentenstraße 1, 80538 Munich, 10:00 – 22:00
- Alte Pinakothek (art exhibition 14<sup>th</sup> – 18<sup>th</sup> century, some parts of the 19<sup>th</sup> century exhibition)  
Barer Straße 27, Eingang Theresienstraße, 80333 München, 10:00-18:00 (Tuesday and Wednesday until 20:30)  
<https://www.pinakothek.de/en/visit/alte-pinakothek>
- Pinakothek der Moderne (exhibition of art after the 19<sup>th</sup> century)  
Barer Straße 40, 80333 München, 10:00-18:00 (Thursday until 20:00)  
<https://www.pinakothek.de/en/visit/sammlung-moderne-kunst-der-pinakothek-der-moderne>

- Museum Brandhorst (contemporary art)  
Türkenstraße 19, 80333 München, 10:00-18:00 (Thursday until 20:00)  
<https://www.pinakothek.de/en/visit/museum-brandhorst>
- Sammlung Schack (mostly 19<sup>th</sup> century art exhibition)  
Prinzregentenstraße 9, 80538 München, 10:00-18:00  
<https://www.pinakothek.de/en>
- BMW Welt & Museum  
Am Olympiapark 1, 80809 München, 07:30-00:00 (Welt), 10:00-18:00 (Museum)  
<https://www.bmw-welt.com/en.html>

### **3.10.9.8 Clubs/ Bars**

Clubbing (as everything else) in Munich can be expensive, be aware. You can find clubs in all tastes.

You find a lot of clubs near [Karlsplatz/Stachus](#) and at [Ostbahnhof](#).

Bars are everywhere, but some distinct locations are around the universities TUM and LMU ([Schellingstrasse / Türkenstrasse](#)) and [Glockenbachviertel](#)

### **3.10.9.9 Restaurants**

You can find everything from fast-food up to several restaurants with multiple points in the Guide Michelin. If it's nice weather, consider a beergarden as well! You can usually pay with cash and credit card. Some "cheaper" locations are located close to the universities, too. A traditional Bavarian breakfast is the "Weißwurstfrühstück", consisting of [Weißwurst](#), a soft brezel, sweet mustard and a wheat beer. Traditionally they are only eaten till noon.

### **3.10.9.10 Drinking water**

The tap water in Germany is highly controlled and regulated. Quality and taste are extremely high, often higher than bottled water. If a tap does not provide drinking water it has to be marked as such: "Kein Trinkwasser" = No drinking water.

### **3.10.9.11 Forgot something?**

The usual opening hours for supermarkets are Mo-Sat 08:00 – 20:00. Small stores may close earlier, especially on Saturday.

- Normal shopping close to the hostel:
  - Supermarket:
    - Cheap: Netto, Weiglstraße 5, 80636 München
    - Cheap: Lidl, Hackerbrücke 4, 80335 München
    - Little bit further away but higher quality: google for Edeka, Rewe
  - Still hungry? (there are of cause many restaurants, but more for hunger emergencies 😊)
    - Subway, Arnulfstraße 43, 80636 München
  - Drugstore ("Drogerie"):

- DM, Hackerbrücke 4, 80335 München
  - Pharmacy (“Apotheke”):
    - Wappen Apotheke: Nymphenburger Str. 73, 80636 München
    - Elvira Apotheke: Nymphenburger Str. 81, 80636 München
- At night and on Sundays:
  - Supermarket: Edeka Ernst Arnulfstraße 2, 80335 München  
Mon-Fr: 07:00 – 23:00  
Sa+Sun: 08:00 – 23:00
  - Drugstore: DM, Orleanspl. 10-12, 81667 München  
06:30 – 23:00 (every day)
  - Pharmacy: <https://www.aponet.de/apotheke/notdienstsuche/80636/%20/5>  
(unfortunately in german)  
insert 80636 and click on “Suchen” (=search)  
Pick one of the pharmacies (maybe the people in the hostel can help if necessary)

## 4 REGULATIONS HANDBOOK

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### 4.1 NOMENCLATURE

Shall = this is a requirement that should be kept. Please consult with us EARLY if you can't realize any of these rules to find a solution.

Must = this is a hard rule. Not keeping it will definitively lead to a penalty or up to disqualification!

We consider the ACC regulations as “open”, meaning that everything that is not forbidden is allowed. Of course this is limited by safety concerns. If you are not sure about something you thought of, you can always contact the organizer to clarify if it is allowed.

The powertrain providing thrust to your aircraft is “closed”, giving only a limited number of options to provide fair and equal conditions for every team.

### 4.2 FLIGHT GOALS

This year the rules for the ACC changed significantly. This has several reasons:

- We wanted smaller aircrafts that are cheaper and faster to build (hopefully)
- Less dependence on the skill of the pilot (no sharp turns)
- Less benefit for vast computing power, more engineering practice
- Automated measurement of flight data
- New challenge for existing teams
- Adaption to real life scenario

Your task is to transport medical emergency goods from one point to another.

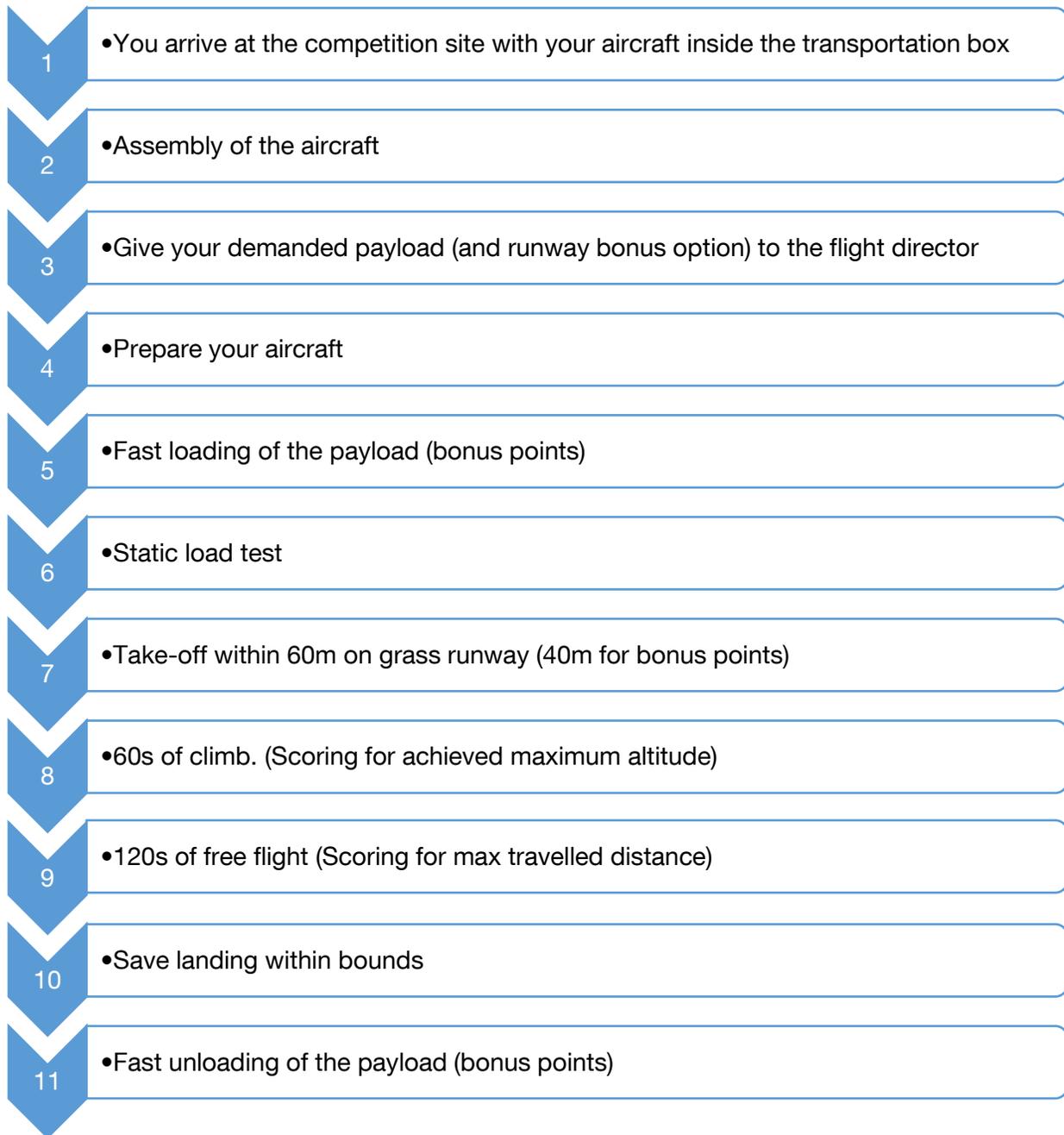
Imagine an avalanche or a flood cutting off a village. You need to transport medical supplies to and from a laboratory fast and environmental friendly. In our case, we use blood bags as payload.

There are several demands for your aircraft:

1. Transport as much as possible...
2. ...and as far as possible within two minutes.
3. After take-off you have to get to a safe altitude as quick as possible to avoid obstacles
4. You only need little space for transport, assembly and take-off

The first three demands are being scored during the competition.

### 4.3 FLOW CHART OF THE FLIGHT COMPETITION



Now that you are familiar with the competition sequence we will get into the details. Let's start with the aircraft.

## **4.4 AIRCRAFT**

### **4.4.1 General**

You are tasked to design an aircraft which is powered by an electric propulsion device and which generates lift by aerodynamic forces acting on surfaces remaining fixed in flight, except control surfaces. Aircraft with variable geometry or area must comply with the specification when the surfaces are in maximum and minimum extended mode. The remotely piloted aircraft must be controlled by the pilot on the ground using radio control. Any variation of geometry or area must be actuated at distance by radio control.

The aircraft must not be rotary wing or lighter-than-air (for example, helicopters, autogyros, dirigibles and 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.

### **4.4.2 Transportation Box**

Each team must use a transportation box for the aircraft. The box is limited in size and must not exceed 1100 x 400 x 250 mm<sup>3</sup> (inside dimensions, 6.1 Transportation box). All parts of the aircraft (wing, tail, fuselage, landing gear, motor, propeller...) must fit into this box at one time. The transmitter is not regarded as a part of the aircraft. The batteries must be transported in a special protective container. (See Section 4.4.5) The Transportation box must be 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 must have handles on both ends.

### **4.4.3 Size restrictions**

The size of the assembled "flight ready" aircraft must fit into a rhombus-shaped box with an edge length of 1.5m each. The angle between the edges is NOT fixed! You may vary them as you want.

The maximum height is 0.5m. (Standing on the floor by itself in take-off configuration, no additional support)

See Section 6.2 Limiting Box in set-up state

Beware of rule 4.4.1 if you have any moving shape of the aircraft. You must comply with the size restrictions in every position.

### **4.4.4 Identification**

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

The team number must be visible on the aircraft:

- In figures with at least 10cm height (if this is not possible, please contact us)
- On both top and bottom of the wing
- On both sides of the fuselage or vertical stabilizer.

The university logo shall be visible on the wings or the fuselage. The university initials can be used if they are unique and recognizable or the logo is too complex.

| By European law you must have the pilots e-ID written on the outside of the aircraft.

#### **4.4.5 Propulsion**

To ensure fair and equal conditions during the competition, certain parts of the powertrain are prescribed for all teams.

Only the prescribed parts are allowed in the powertrain. All parts have to be "commercially, off the shelf", in unmodified condition.

##### **Propeller**

It is allowed to use one propeller on the aircraft. The participants may choose between two variants:

- APC-E 10x6E Manufacturer code: LP10060E or LPB10060E  
<https://www.apcprop.com/product/10x6e/>
- Aeronaut CAMcarbon Light 10"x6" Manufacturer code: 7216/22  
<http://www.aero-naut.de/produkte/flugmodellbau/flugzubehoer/luftschrauben/camcarbon-light-prop/>

The propeller has to be fastened to the power train in a secure way (photograph/drawing in the final report). A common motor spinner or airscrew nut is ok (e.g. the one shipped with the motor).

The propeller must be demountable to allow a test run without propeller during technical inspection.

##### **Transmission**

The rotational speed of the propeller must always be the same as the rotational speed of the motor.

-> e.g. only 1:1 Gears are allowed as long as they keep the motor rpm unchanged toward the propeller.

##### **Motor**

The motor must be an unmodified "AXI 2826/10 GOLD LINE V2" (Please note that the old V1 is no longer included to ensure that all teams can get the same motor).

The aircraft must be driven by a single motor. The motor is fixed to the airframe of the aircraft.

The motor must be easily accessible from all sides to allow for inspection.

You may solder the motor to the ESC or use plugs.

##### **ESC**

You may use your choice of ESC with minimum 30A constant current rating. Only commercial ESC available to everyone are allowed. The ESC is not allowed to increase the voltage of the battery in any way.

### **Main Battery:**

You may use LiPo, Lilo or LiFePo based batteries. You may use up to 3 cells in series. The maximum voltage for the pack is 12.6V (Lilo and LiFePo have a lower maximum Voltage, according to their datasheet). The maximum continuous discharge rate has to be at least 30A. The maximum voltage per cell as specified in the datasheet must not be exceeded.

Voltage, capacity and maximum discharge rate shall be clearly printed on the battery. The cells/packs must keep their factory look and may not be altered except for the plugs. If the required data is not printed on the pack/cells you must provide the datasheet from the manufacturer.

To allow for inspection of the voltage, the battery must have a (female) balancer connector of the single cell voltages with a spacing of 2.45mm pitch of the pins. (e.g. Standard EH or XH connectors)

Be careful with Lithium batteries, they can be dangerous. Also check with your airline on how to transport them. (<https://www.rcgroups.com/forums/showthread.php?209187-Complete-Guide-to-Lithium-Polymer-Batteries-and-LiPo-Failure-Reports>)

The batteries must 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 second start is necessary or for other reasons).

Each team is responsible to have their batteries charged before each flight. It is recommended to bring more than just one battery.

All batteries have to be stored and transported in a LiPo safety bag or container and not mounted in the aircraft. Usually you can buy these safety bags at your LiPo battery dealer. If you notice a damaged LiPo battery, notify the organizational committee immediately!

**At the airfield, electric power 230V will NOT be offered. Refer to the 12-15V option please, we will provide that.**

### **Connectors**

There are no restrictions according connectors. The connector must have a constant current rating of at least 50A. We recommend XT60/XT90 plugs between battery and ESC. This might also allow for cross compatibility with other teams if you encounter a defect. If you deviate from XT60/XT90, the connectors have to pass the technical inspection.

The connection between ESC and motor may be realized by connectors or soldering.

#### **4.4.6 Radio Requirements**

The radio control is used to fly and operate the aircraft. The servos have to be capable to withstand the aerodynamic loads the aircraft is going to be subjected to during the flight. The flight will occur at any given weather conditions as long as the limits given in chapter 4.6.3 are not exceeded, either sunny, rainy or windy. Therefore the teams shall be prepared to protect their radio equipment.

All radios must comply with the frequencies for model aircraft in Germany. An independent RX battery pack is mandatory, with a minimum capacity of 600 mAh (2s LiPo recommended). No power supply from the main propulsion battery (Battery eliminating Circuit, BEC) is allowed. If your ESC has a BEC, you have to disconnect the positive wire to the RC system or use an optocoupler module.

Only 2.4GHz Systems are allowed, since it reduces the risk of multiple teams having the same frequency channel. Please be aware that with some manufacturers your radio must have an EU firmware installed to comply with German radio regulations. (e.g. Taranis EU Firmware)

Please read the manual on how to put the transmitter into range-check mode.

The fail-safe function in the receiver must be activated: at least Motor OFF!

We try to organize a radio link from the aircraft (Automated measuring Equipment) to the ground. If it works, we can see the position of the aircraft and directly show a preliminary score for the flight. We will use a 434MHz, 868MHz (or 2.4GHz) Radio for this task. Please place your RC receiver antennas in some distance to the measuring box to avoid that the RC signal is affected.

#### **4.4.7 Autopilots**

The use of any onboard-sensed data to automatically move the control surfaces or to modify the aircraft geometry is prohibited.

#### **4.4.8 Automated Measuring Equipment**

To make automated measurements of your flights, we developed a small box with all the measurement equipment. It uses a Unilog GPS Logger 3 (<https://www.sm-modellbau.de/GPS-Logger-3>) to get the altitude and GPS Data. This logger is approved and tested by several model aircraft competitions. We conducted our own tests as well and were very satisfied with the stability of the GPS signal and logging accuracy.

The logger will be provided by the organizer and must be mounted in the aircraft by the team. The loss of the logger will result in zero points for the flight.

It is your responsibility to fly in a way that the GPS receiver will point to the sky. Avoid steep bank angles (>40°) and high G-loads (>3-4g).

Loss of GPS-signal will not be a reason to get an additional new flight.

The measurement box shall be placed in the model with an unobstructed view of the sky.

We added two lines in the drawings to indicate an angle of 20° from the horizontal. You should not place any component over this line to ensure a good visibility of the sky.

The box will be handed to you before takeoff and must be given back after landing.

In case there is a problem with our logging equipment, the flight manager will give you a reflight.

You can find the size of the box in the Appendix: 6.3 Automated Measuring Equipment

The box will be screwed into your aircraft with two M3 screws. Every aircraft must have two M3 nuts directly under the box to safely and reliably mount the box. We suggest to use M3 drive-in nuts in the aircraft.

The box will have a maximum weight of 150g.

At the moment (July 2020) we are working on a radio link to get your live position to the ground. This means there will be a 434MHz, 868MHz (or 2.4GHz) transmitter and antenna attached to the box! There should not be any interference with your 2.4GHz RC-Radio, but please place your receiver antennas at some distance to the Measuring Equipment.

#### **4.4.9 Payload**

You are transporting small blood bags. We will fill them with water and some starch to reduce sloshing. We will provide 100g, 200g and 300g bags. The payload will predominantly consist of 300g bags. Only bags that are undamaged after unloading will be counted as transported payload, therefore take care of this precious resource. The total weight of the bags including the bag itself and fluid will be included in the payload calculation.

The payload must be fully enclosed within the aircraft's structure. The Payloadbox/Payloadbay has to be fixed at one position in the aircraft.

We chose small bags to help you deal with sloshing, but you should still think about this problem.

The cargo bay has to accommodate at least one bag with 300g.

Be aware that the payload might affect the center of gravity (CG) of the aircraft. The stability and controllability have to be calculated for all extreme CG positions. (see 4.4.11)

See section 6.4 for measurements of the size of the blood bags.

#### **4.4.10 Maximum take-off weight**

To stay within the regulations of the airfield, a maximum take-off mass of 20 kg must not be exceeded.

#### **4.4.11 Longitudinal Stability of the Aircraft**

To ensure a safe flight of your aircraft, the correct position of the CG is important.

Calculation of the correct CG has to be executed by using corresponding formulas. The chosen calculation method must be described in the preliminary report for review by the organizing committee.

To calculate the derivatives of the airfoils for the CG calculation, only the following methods or calculations by software are allowed:

- Wind tunnel measurements
- XFOIL
- XFLR5

- AVL
- Eppler
- Javafoil
- OpenVSP
- Other methods only after checking with the organizing committee.

A sufficient stability margin for stable flight has to be demonstrated in a calculation for the most extreme (positive and negative) CG positions due to change in payload (for example, but not necessarily, maximal and minimal payload). The value of the intended stability margin must be delivered in the preliminary design report.

#### **4.4.12 Aircraft Production**

The aim of the Air Cargo Challenge is to learn and understand the challenges of the aircraft design process. Therefore, you must not only design the aircraft but you shall manufacture as many components of the airframe as possible by yourself. You will experience problems arising from your design decisions and learn from them. Especially the production of the wings shall be done by the team. Evidence that the manufacturing had been carried out by members of the participating team has to be provided (e.g. time lapse video recording, Photos,...)

Some components are specifically excluded from this rule. Please use reliable commercially available off the shelf parts for:

- RC components (transmitter, receiver, servos)
- Screws, fittings and connectors
- Powertrain (ESC, batteries)

#### **4.4.13 Proof of Flight**

An aircraft that has never flown before the competition and/or has no proof of flight will not be allowed to fly during the competition.

A proof of flight video shall be included in the Video presentation. (see also: 4.5.5)

#### **4.4.14 Technical Inspection**

During the technical inspection all aircrafts will be checked to meet these regulations and the minimum quality for a safe flight.

You will get a maximum of one hour time to build up your aircraft for the technical inspection. It has to be complete and ready for take-off, except for the batteries that are not connected until instructed and the payload that is provided on the flight days.

Inspection will comprise at least the following items:

- Dimensions
- Verification that all components are adequately secured to the vehicle
- Visual inspection of all electronic wiring to ensure adequate wires and connectors are used
- Verification that the propeller is attached safely
- Motor test
- RC-Check, range test with motor off and motor on
- Servo test
- Linkages (correct mechanics, backlash, strength)

- Payload installation (fixation)
- Check of Center of Gravity
- Build quality
- Secure attachment of components

This list is not complete and we reserve the right to ground an aircraft we deem not airworthy.

#### **4.4.15 Static Load Test**

In addition to the technical inspection, there will be a static load test of the aircraft with payload before take-off.

A maximum of 2 team members are allowed to lift the aircraft on its wingtips by hand. (the thumb of the hand has to touch the outermost point of the wingtip) The aircraft has to withstand this load to be allowed for take-off.

The aircraft must be held at the wing with the biggest wingspan for the load test.

Clarification:

Especially for swept wings, multiple wings or wingtips, which do not allow an easy support with the hands, a support structure may be used.

For this support structure, the following rules apply:

The thumb of the hand must touch the outermost point of the support structure, which must not reduce the effective wingspan.

It must not be reach further inside the wing than 20cm from the wing tip.

The support structure may protrude forward or backward to compensate any pitch tendencies due to the wing sweep.

When connecting multiple wings, the structure must not carry any moments in between them.

The support structure must be easily attachable and has to be removed before take-off.

The support structure and its functionality must be presented during scrutineering.

## **4.5 DELIVERABLES**

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

1. Technical Report
2. Drawings
3. Video Presentation
4. Flight Competition.

All submissions must be in English. All submissions may be published on the internet or other media by the organizing committee.

### **4.5.1 Preliminary Report (PR)**

The preliminary report is an update for the organizer. It consists of a written document that does not exceed one A4 page and eight additional pictures. It shall give a summary of the progress of the aircraft design and how you organized your team. It shall also show what is not developed yet and what difficulties you encountered.

Please don't forget to include your stability analysis formula as well as your aimed stability margin in the PR.

There will be no scoring on the Preliminary Report, but there are penalties if you miss to deliver it. Delivery is via e-mail in PDF format.

### **4.5.2 Technical Report (TR)**

The technical report sums up all your thoughts during the design of the aircraft and shows the final aircrafts with its details.

The TR may have up to 30 pages maximum (without attachments).

It must be printed in A4 format with font Calibri (or similar) size 12.

We will provide a template for the front page.

Each team has to send in three (3) complete hardcopies of the report as well as a PDF file via E-Mail. The delivered TR has to be bound in hardback.

To have a better comparability between the different reports, the report shall contain at least the following chapters:

- Introduction
- Project management (financial budget and time schedule)
- Aerodynamic design
- Structural design
- Payload prediction
- Outlook
- Drawings

More content is requested and necessary to get the full score for the Report.

The drawings have to be included in every report.

We accept delayed hardcopies without penalty **if** the identical digital version arrived on time (UTC) AND the hardcopies arrive at most one week later.

### **4.5.3 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 on one side, properly folded, and bound with the report so that they can be analysed 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, used airfoil, etc.

The second drawing must be an isometric perspective view of the aircraft.

The third drawing shows the cargo bay, its location and dimensions, as well as the location of the RC receiver and the measuring equipment.

The fourth drawing must contain information that each team finds relevant.

Summary:

- 3-view drawing
- Isometric drawing
- Cargo bay, RC receiver position, position of measuring equipment
- Free choice

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 shall be in millimetres and plain angles which shall be in degrees. All the drawings must have a label in the right bottom corner containing the team logo or university logo, the team's name and number, a short description and other pertinent information. The team shall send a fourth extra copy of the 3-view drawing without the report to be used during the dimensional inspection prior to the flight competition. This copy has to be sent with the report or a penalty of 10 points will be given. If the aircraft is changed after the technical report is sent in, a new copy with remarks identifying the changes has to be e-mailed to the organization committee.

### **4.5.4 Video Presentation (VP)**

All teams must deliver a video presentation (VP) including a proof of flight video.

The aim is to share the experience your team gained during one year of preparations. The presentation will be scored by our judges and put online by us before the competition to enable the exchange with other teams and the public. There is no specified way to realize the VP. (e.g. you may do a filmed standard presentation or some kind of product video) The team shall be present in the VP.

The video has a time limit of 15 minutes, including an approx. 1 minute proof of flight video.

Scoring will be based on:

- Clearness of information
- Articulation
- Presentation style
- accentuation of distinctive features of the design
- Elements about difficulties during the project, lessons learned for a future project, description of the methods used in the construction, etc. ...
- More needed for the full score

#### 4.5.5 Proof of Flight Video

The proof of flight video must be included in the video presentation.

The video must be filmed from the ground, showing at least one complete take-off (incl. rolling) and sustained cruise flight condition.

#### 4.5.6 Poster

Since there are no on-site presentations, every team will bring a poster (size A0, 841 mm × 1189 mm) with details of their design. These posters shall be easily understandable to give spectators of the event a glimpse of the work you put into this project. The poster shall at least contain the following:

- Header: ACC2022 logo (left side), Team number, Team name, 3-letter country code(right side; [https://en.wikipedia.org/wiki/ISO\\_3166-1\\_alpha-3](https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3))
- Team/University logo
- Basic aircraft parameters (span, wing area,...)
- Image, isometric view or rendering of the entire plane to identify it during the competition.
- Special features of the aircraft

We will place the posters next to the aircraft at Flugwerft Schleißheim and into the mechanical engineering building for the flight days to attract some attention to the news feed and livestream!

#### 4.5.7 Deliverables Scoring

The following points can be achieved:

- Report:  $S_{\text{Report}}$  = max. 200 points
- Drawings:  $S_{\text{Drawings}}$  = max. 50 points
- Video Presentation:  $S_{\text{Video}}$  = max. 100 points

Points are given by our jury.

## 4.6 COMPETITION

### 4.6.1 Flightfield

Medical aid is not always needed at perfectly equipped airfields. Your aircraft needs to withstand harsher environments.

Therefore our take-off and landing field is made of grass. Detailed pictures of the runway will be published in the near future. It will be lawn moved before the competition.

### 4.6.2 Flight area

You can find some pictures of the airfield in the appendix.



Figure 4: Flight Area: RED: No-Fly-Zone; BLUE: Flight area; GREEN: Landing field; BLACK: grass runway

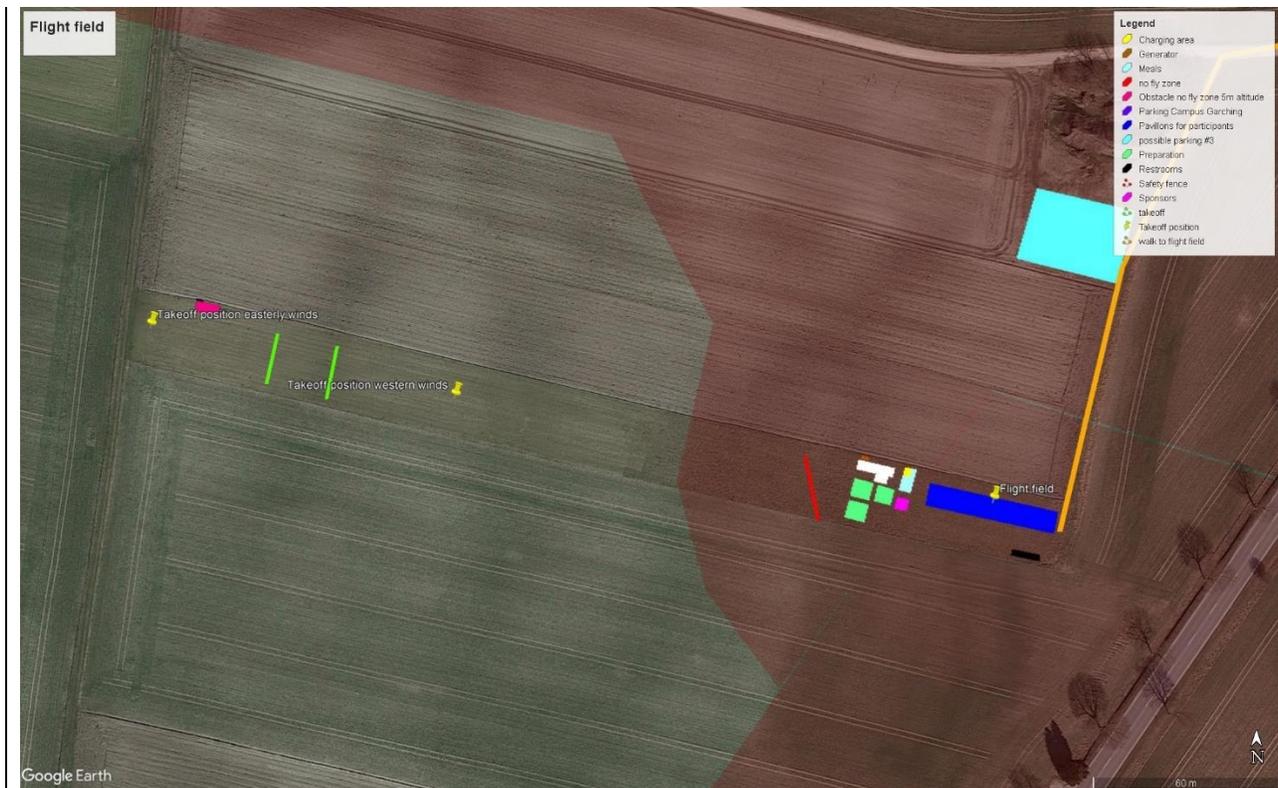


Figure 5: Flight field detail with no-fly zone.

#### 4.6.3 Bad weather

The contest will be interrupted if the wind, measured at approx. 2 metres above the ground at the starting line, is stronger than 9 m/s for at least 20 seconds. (8m/s if the wind is more than 45° from the starting direction)

We will try to avoid rain, but you have to be prepared for high humidity conditions or even light rain.

The flight manager can interrupt the competition earlier if there are safety concerns.

#### 4.6.4 Protest

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 must be presented in writing in English to the judges by the team's leader. The organizing committee is available to accept any suggestions or criticism aiming at improving any aspect of the competition. We remind you that unjustified protests will end in a penalty.

#### 4.6.5 Pilot, Helper and Flight Manager

The pilot is allowed to have one helper with him on the runway. All other team members have to be in the safety area during the flight.

The pilot is required to follow the German laws. This includes, that he must not be under the influence of alcohol, drugs or other substances.

The pilot must show a valid A1/A3 certificate to be eligible to fly at the airfield. His e-ID must be written onto the aircraft. (See also 4.4.4)

There will be a flight manager directly next to the pilot. He is the authority on the field and helps you to stay within the flight area. There will be no take-off attempt without his specific call. The flight manager is also allowed to demand an abort of flight and immediate landing.

#### 4.6.6 Overview of entire flight task

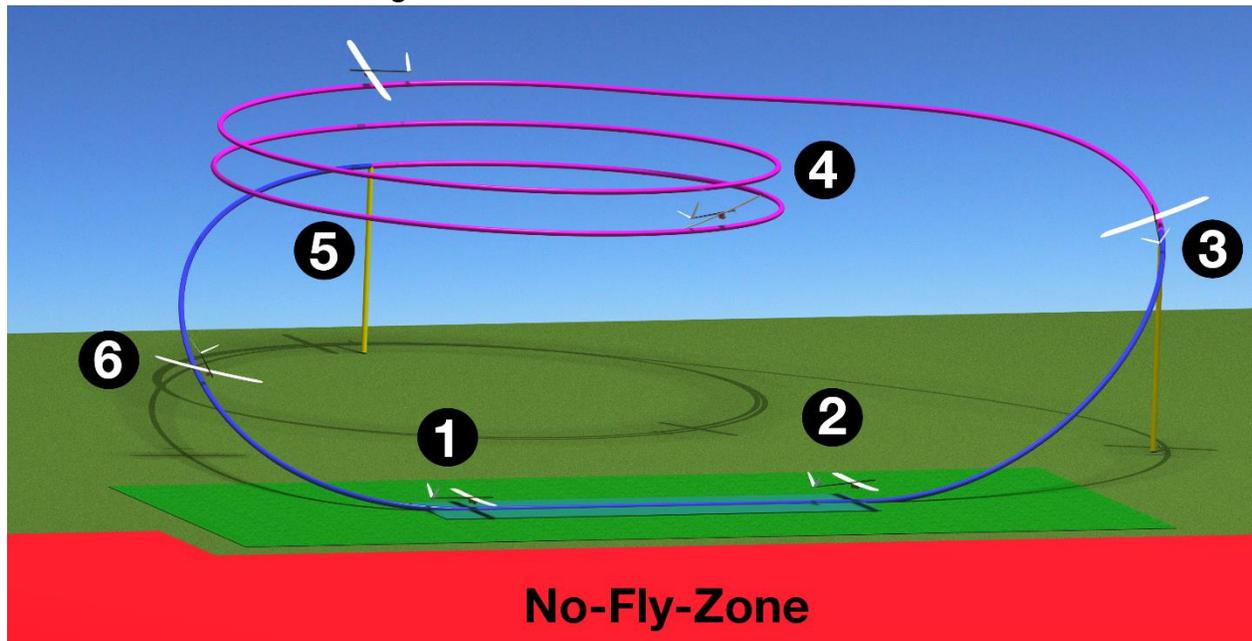


Figure 6: Graphic of entire flight task

1. Take-off
2. Climb
3. After 60 seconds -> Climb assessment over, start of 120 seconds distance flight
4. Fly at will
5. End of distance flight -> Distance assessment over
6. Safe landing -> Payload assessment over

After take-off with your payload you will climb as high as possible within 60 seconds. The measuring equipment will automatically log the reached altitude (yellow rod at number 3 in Figure 6). Now the distance task starts. You have to fly as far as possible within 120 seconds. This distance (pink in Figure 6) is logged as well. After that you have to perform a safe landing.

#### 4.6.7 Take-off

The grass runway has 60m length. (Approximately 15m width, wait for details)

The entire aircraft has to be inside the runway and no team member is allowed to touch the aircraft after line-up.

If you touch anything outside this runway during take-off, there will be a red flag indicating that you violated the take-off distance. In that case you are allowed to return your aircraft to the start line with a maximum of three team members and try again as soon as the helpers are in the safety area.

You have three minutes to complete your take-off.

#### **4.6.8 Restricted areas**

If you land or fly outside the flight area, the flight will be scored with zero points.

As safety for participants and visitors is our highest priority there will be a penalty up to disqualification if any person is endangered by the aircraft. Please inform your pilots that highest priority is the wellbeing of people, not the aircraft.

#### **4.6.9 Flight Pattern**

You may fly at will during your entire flight time.

You must ensure to stay within the flight area. The bounds will be indicated to you by the flight manager during flight and in the pilots briefing before the competition.

#### **4.6.10 Landing**

The landing has to take place in the landing area as shown in the map.

Please note that the grass outside the runway may be much higher.

If you lose any parts during landing (status after landing not equal to the status before take-off) you will get a deduction to your score.

#### **4.6.11 Minimum flight altitude**

The minimum flight altitude for the distance flight is 10m. If you fly below this, the distance will not be counted.

#### **4.6.12 Definition Flight Time**

The flight time starts with your aircraft reaching 5 km/h GPS-speed in the logged data.

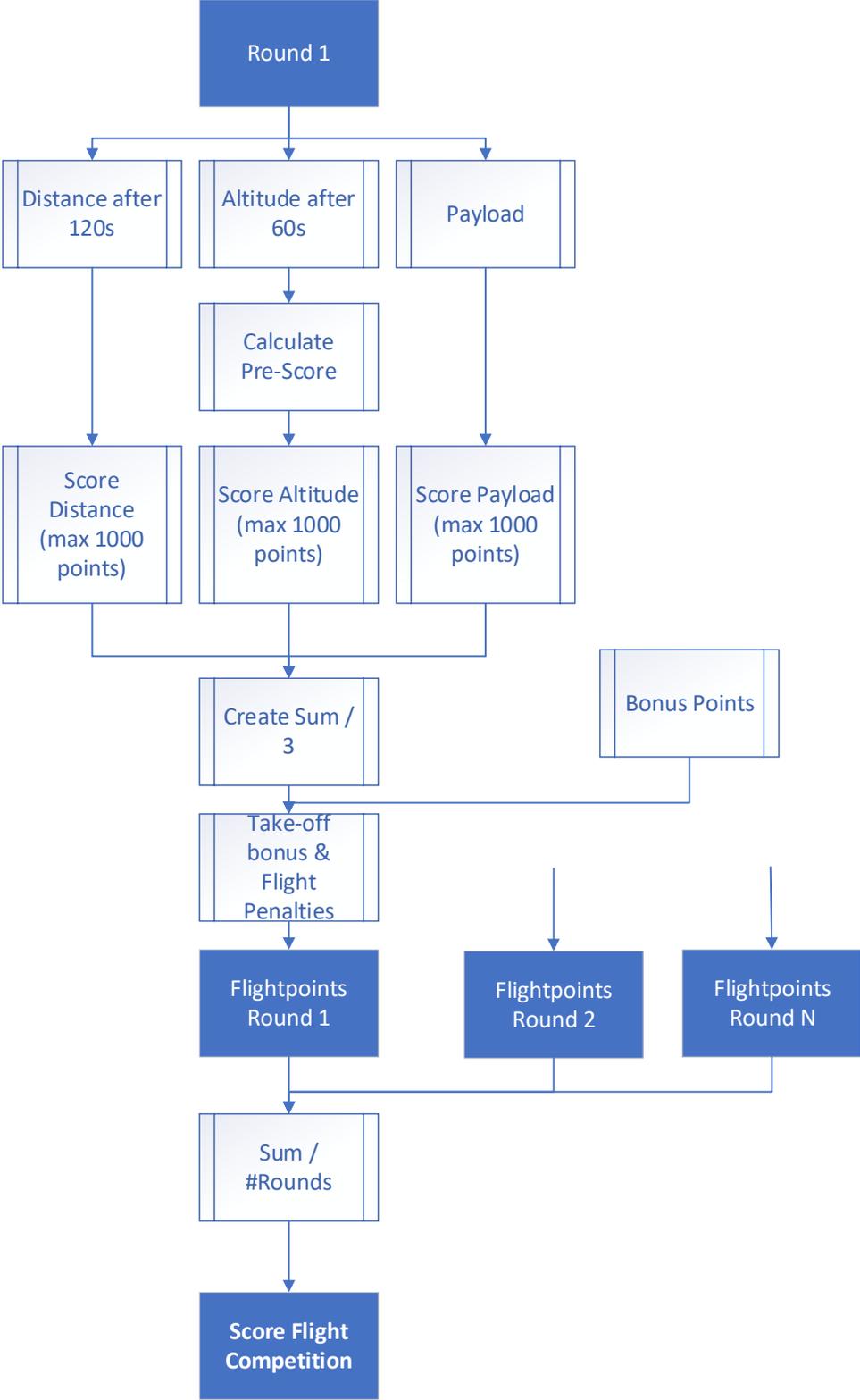
After 60 seconds, the altitude will be recorded and the 120 seconds for the distance flight start.

After the additional 120 seconds are over, the travelled distance during this time is recorded.

This results in a total flight time of 180 seconds plus time for landing. (Keep in mind you may need more than one or two tries for landing)

# 4.7 FLIGHT COMPETITION SCORING

## 4.7.1 Overview



#### 4.7.2 Partial Scores

In reality you don't get a fixed formula to assess your aircraft. You have to do some research of competitors, comparable existing aircrafts or the physical effects that limit the performance of aircrafts.

We will fly several rounds. Every team gets the chance to fly once during each round.

Partial scores will score the flight performance for each round independently for three features:

1. Payload transported during the flight
2. Travelled distance within two minutes
3. Altitude reached 60 seconds after take-off

The team with the best result in each category will get 1000 points. The other teams partially less.

In the end, all achieved points will be added up for the ranking.

#### 4.7.3 Payload Scoring

The "Score Payload" for each flight is determined as follows:

$$S_{payload} = 1000 \times \frac{P_{team}}{P_{max}}$$

$P_{team}$  = Payload transported during your flight

$P_{max}$  = Maximum Payload by any team during this round

#### 4.7.4 Distance Scoring

The "Score Distance" for each flight is determined as follows:

$$S_{distance} = 1000 \times \frac{D_{team}}{D_{max}}$$

$D_{team}$  = Distance travelled during your flight

$D_{max}$  = Maximum distance travelled by any team during this round

#### 4.7.5 Altitude Scoring

We want you to fly in a safe altitude but not violating our flight field restrictions. (Minimum 10m, maximum 120m altitude) This is why this part of the scoring is a little bit different.

At first we will calculate a “Pre-Score”, based on a formula. Based on this Pre-Score we will apply the partial scoring as above.

##### Pre-Score Altitude

$$PS_{altitude} = a * h_{60s}^4 + b * h_{60s}^3 + c * h_{60s}^2 + d * h_{60s} + e$$

$h_{60s}$  = The altitude of your aircraft 60 seconds after take-off

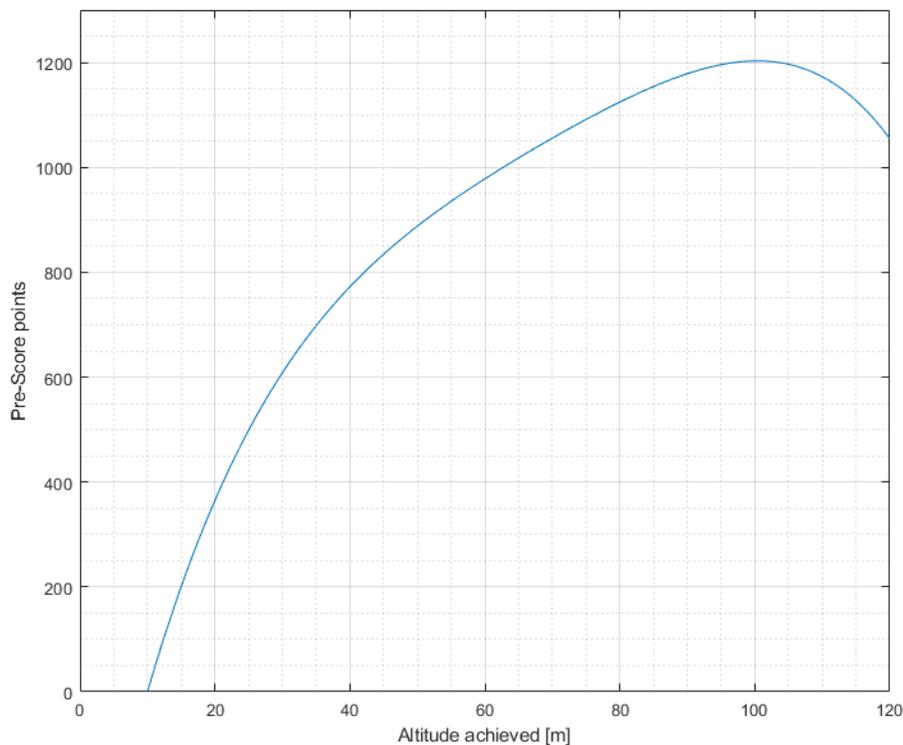
a = -3.92e-5 [Points/m<sup>4</sup>]

b = 1.08e-2 [Points/m<sup>3</sup>]

c = -1.156 [Points/m<sup>2</sup>]

d = 64.2 [Points/m]

e = -537 [Points]



##### Score Altitude

$$S_{altitude} = 1000 \times \frac{PS_{altitude,team}}{PS_{altitude,max}}$$

$PS_{altitude}$  = Pre-Score Altitude achieved during your flight

$PS_{altitude,max}$  = Maximum Pre-Score Altitude achieved by any team during this round

#### 4.7.6 Loading Time

For each flight the team has to put the payload into the aircraft. The shorter the amount of time a team needs for loading the payload, the more points can be gained. The aircraft shall be prepared for take-off completely before the loading. (Except plugging in the main battery) After the payload is mounted, no more changes to the aircraft shall be made. (Except plugging in the main battery)

The relationship is the following:

$$B_{Loading} = \begin{cases} 60 \times \left(1 - \frac{t}{120s}\right) & \text{for } t < 120s; \\ 0 \text{ points} & \text{for } t \geq 120s \end{cases}$$

t = time needed to load the payload

#### 4.7.7 Unloading Time

After the flight, the main battery is disconnected and the aircraft is transported to a safe location on the ground by the team. There will be an additional unloading bonus to get the payload back out of the plane fast.

$$B_{unloading} = \begin{cases} 60 \times \left(1 - \frac{t}{120s}\right) & \text{for } t < 120s; \\ 0 \text{ points} & \text{for } t \geq 120s \end{cases}$$

t = time needed to unload the payload

#### 4.7.8 Payload Prediction Bonus

A payload prediction must be calculated as a function of the air density in the technical report. A linear approximation of the following form must be used:

$$\text{Predicted payload [kg]} = a \times \text{air density} \left[ \frac{\text{kg}}{\text{m}^3} \right] + b$$

The formula and a graph must be included in the technical report. The payload prediction bonus will be determined according to the following formula:

$$B_{Prediction} = 50 \times \left( 1 - \left| \frac{\text{achieved payload}}{\text{predicted payload}} - 1 \right| \right)$$

No negative bonus points will be given.

Both achieved payload and predicted payload have to be positive.

The predicted payload is the value obtained from the chart of payload prediction. The actual payload is the payload achieved for the flight.

#### 4.7.9 Take-off Bonus

If your team decides to only use 40 meters instead of the available 60 meters of runway you will get an additional 10% bonus to your flight points.

You have to announce this option together with your payload before the round starts. All rules apply for 40m instead of 60m, e.g. if you can't start within 40m the flight is invalid and you may try again if the remaining time allows it.

$$B_{take-off} = \begin{cases} 0 & \text{for violating runway limit} \\ 1 & \text{for 60m runway} \\ 1.1 & \text{for 40m runway option} \end{cases}$$

#### 4.7.10 Flight Penalties

If any part of the aircraft gets lost during the flight attempt, the flight will be scored with zero points due to safety concerns. "Lost" means that a part has no more physical connection to the aircraft.

If you are flying below 10m (except for take-off and landing) or over 120m altitude during the flight you will receive zero points for the round.

$$P_{flight} = \begin{cases} 1 \\ 0 & \text{if any parts are lost or flight altitude was under 10m or over 120m} \end{cases}$$

#### 4.7.11 Score for one Round

Using the results from 4.7.3 - 0 we now calculate the total points for the team for one round

$$S_{Round,N} = \left( \frac{S_{payload} + S_{distance} + S_{altitude}}{3} + (B_{Loading} + B_{Unloading} + B_{Prediction}) \right) * B_{take-off} * P_{flight}$$

$S_{payload}$	= Partial score Payload during the flight (4.7.3)
$S_{distance}$	= Partial score Distance during the flight (4.7.4)
$S_{altitude}$	= Partial score Altitude during the flight (4.7.5)
$B_{Loading}$	= Bonus Points for Loading Time (4.7.6)
$B_{Unloading}$	= Bonus Points for Unloading Time (4.7.7)
$B_{Prediction}$	= Bonus Points for Payload Prediction (4.7.8)
$B_{take-off}$	= Bonus Points for short take-off (4.7.9)
$P_{flight}$	= Penalty factor if parts are lost or altitude is too low (4.7.10)

(Therefore the total points of one round can never be higher than 1287 points.)

#### 4.7.12 Score for the Flight Competition

$$S_{FC} = \frac{\sum_{N=1}^R S_{Round,N}}{R}$$

$S_{Round,N}$	= Score of the team for Round N (4.7.11)
$R$	= Number of rounds minus omitted rounds

(Therefore the total points of the flight competition can never be higher than 1287 points.)

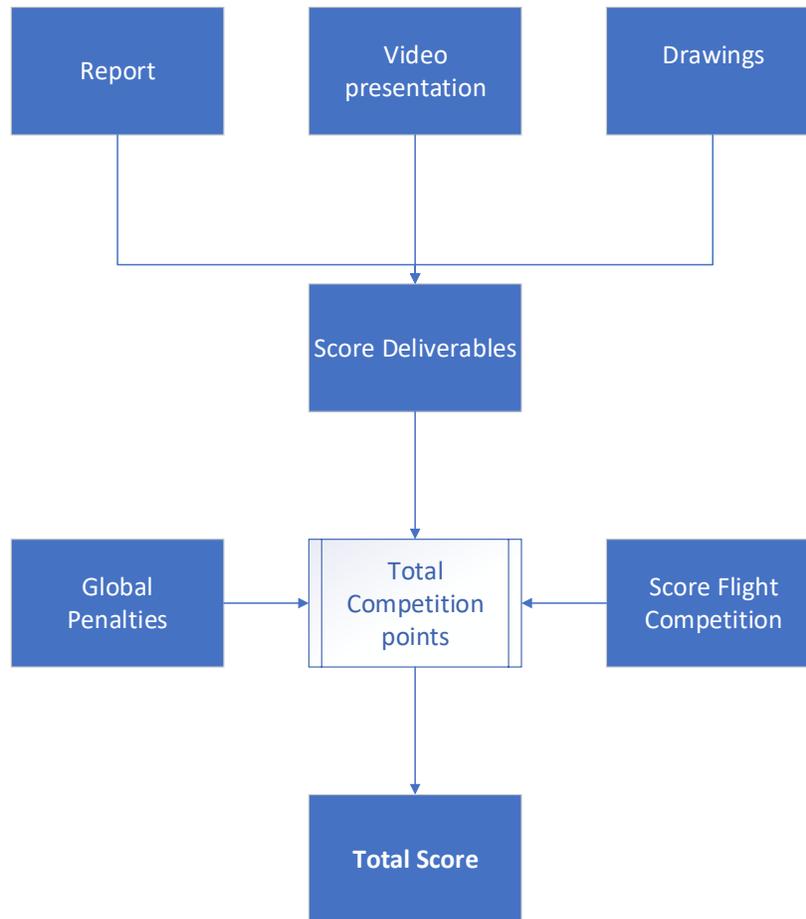
In case there are more than 3 rounds, the teams' round with the lowest score will be omitted.  
In case there are more than 6 rounds, the teams' two rounds with the lowest score will be omitted.

## 4.8 GLOBAL PENALTIES

These Points will be deducted from your final competition score.

Delay in delivering Preliminary report	30 points per day, max. 100 points
Poster missing	100 points
Delay in delivering technical report/drawings	30 points + 30 points per day
Delay or not being present at technical inspection. (e.g. over 60 min set-up-time)	50 points
Delays during competition	5 points per minute
Chart or equation of payload vs. air density is missing	no payload prediction bonus
Replacement of parts without notifying the organisation committee	50 points
Extra version of drawings is missing	50 points
Disregard of regulations	Disqualification
Video for proof of flight, delay	10 points per day
Changes of the aircraft to the technical report	Defined for each case
Flying over spectator area	200 points penalty + Flight with 0 Points 2 <sup>nd</sup> offender: disqualification
Flying outside the Flight area	200 points penalty + Flight with 0 Points 2 <sup>nd</sup> offender: disqualification
Disregard of flight manager/Jury/Organizing committee	200 points penalty up to disqualification
Unjustified protest (the jury does not agree with your protest)	First time: 20 points Next times: 100 points

## 4.9 TOTAL SCORE / FINAL RANKING



All given points will go into the final ranking

$$S_{total} = S_{FC} + S_{Report} + S_{Drawings} + S_{Video} - \sum Global Penalties$$

$S_{FC}$  = Score of the team during the flight competition (4.7.12)

$S_{Report}$  = Score of the Final Report (4.5.7)

$S_{Drawings}$  = Score of the Drawings (4.5.7)

$S_{Video}$  = Score of the Video Presentation (4.5.7)

Global Penalties = Sum of all global Penalties (4.8)

(A maximum of 1637 points can be achieved in the entire competition theoretically.)

The final ranking is based on this score.

## 5 FINAL REMARKS

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We hope you enjoyed the new regulations. If you have any questions, feel free to contact us!

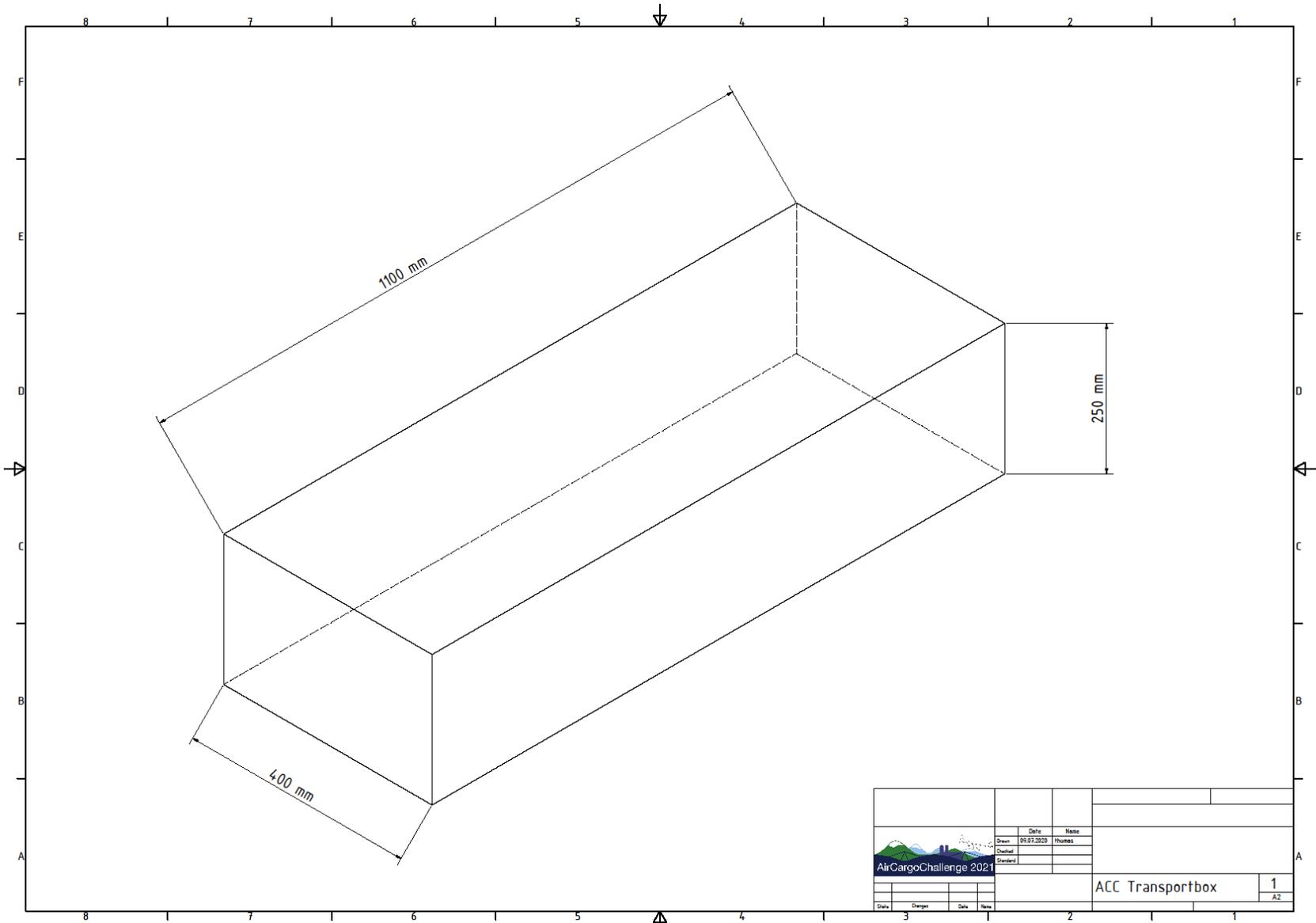
For now we wish you good luck, stay safe and let's have a great time in Munich in the summer of 2022!

-Your AkaModell Munich team

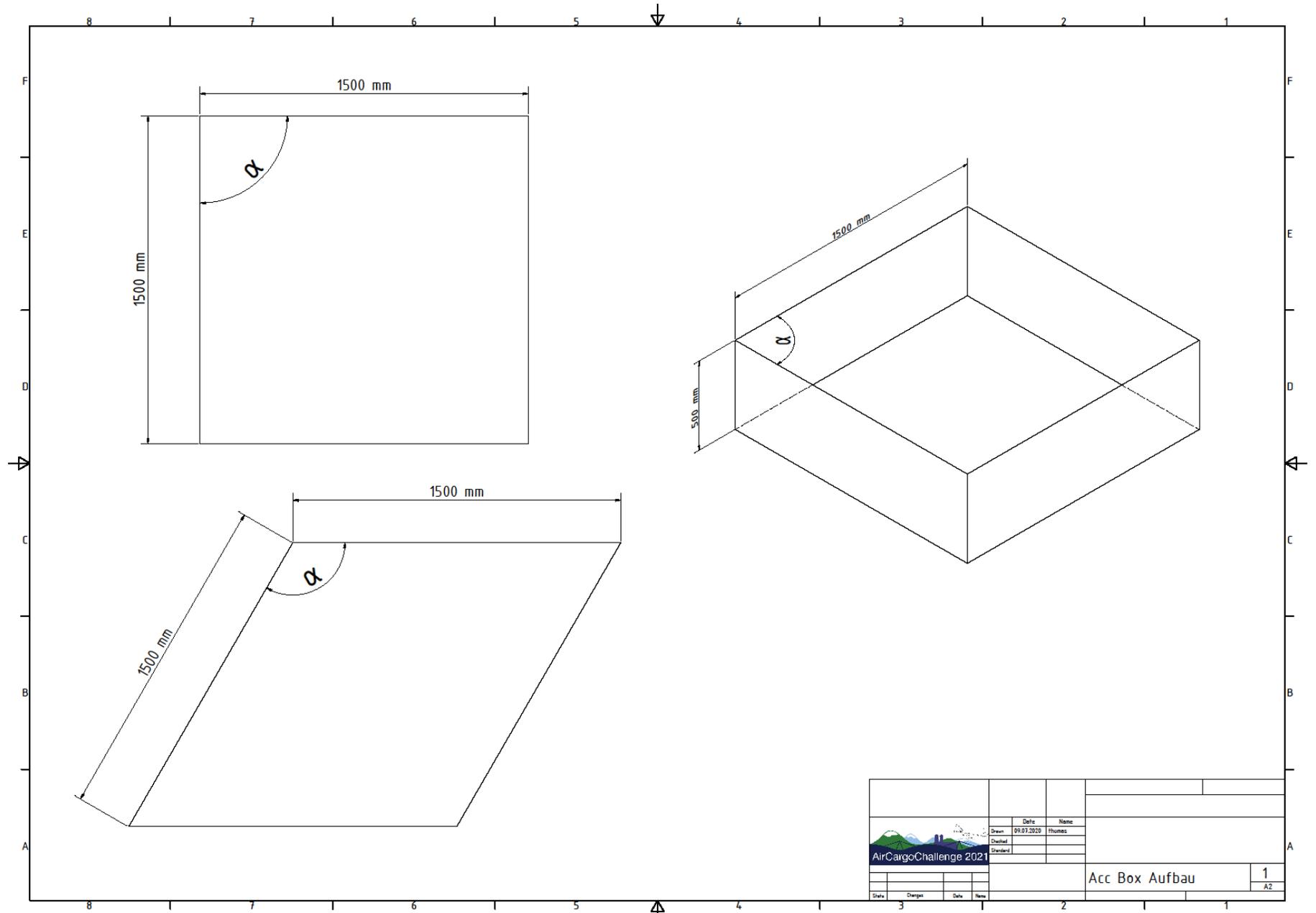


# 6 APPENDIX

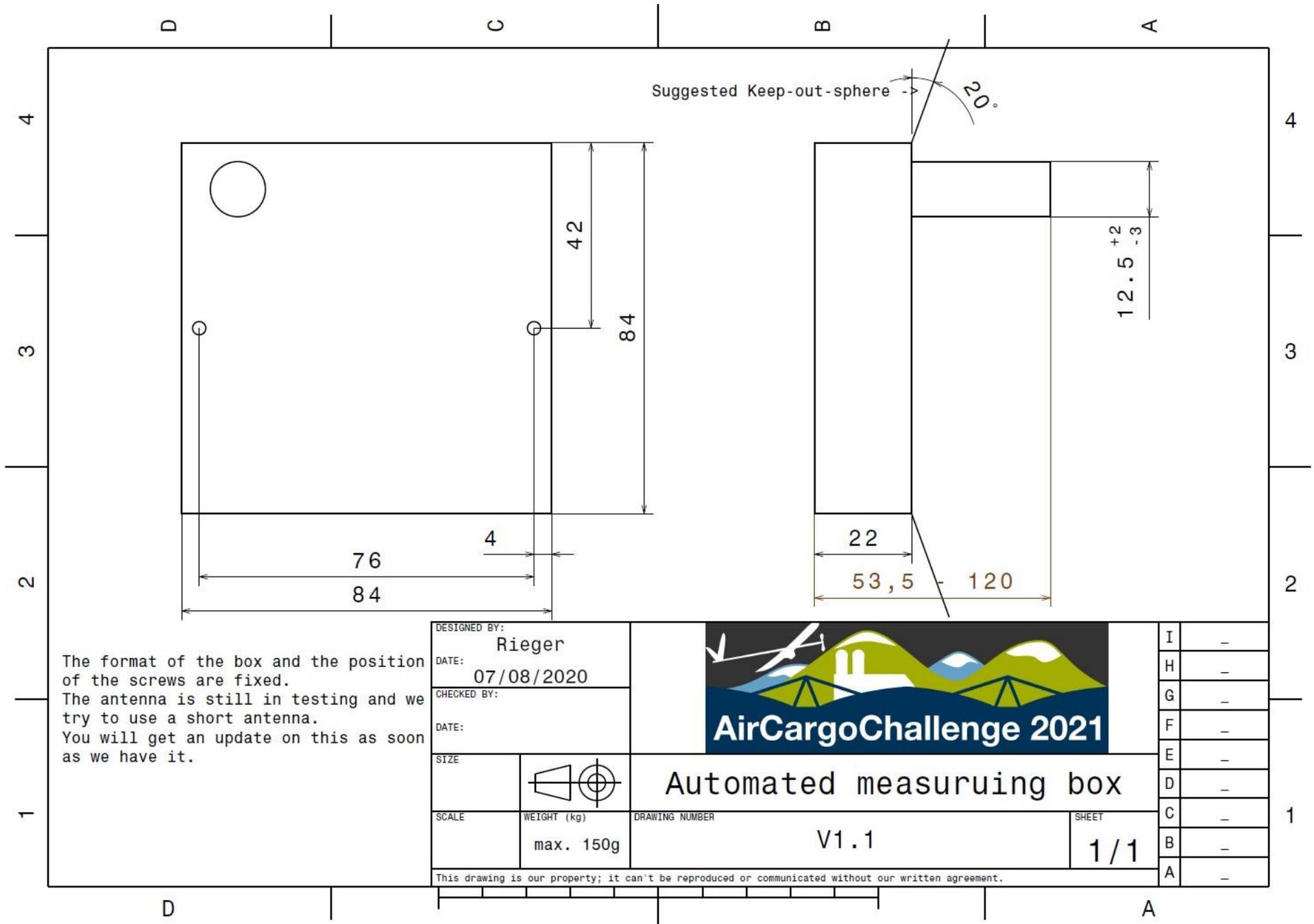
## 6.1 TRANSPORTATION BOX



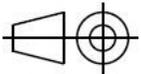
## 6.2 LIMITING BOX IN SET-UP STATE



### 6.3 AUTOMATED MEASURING EQUIPMENT

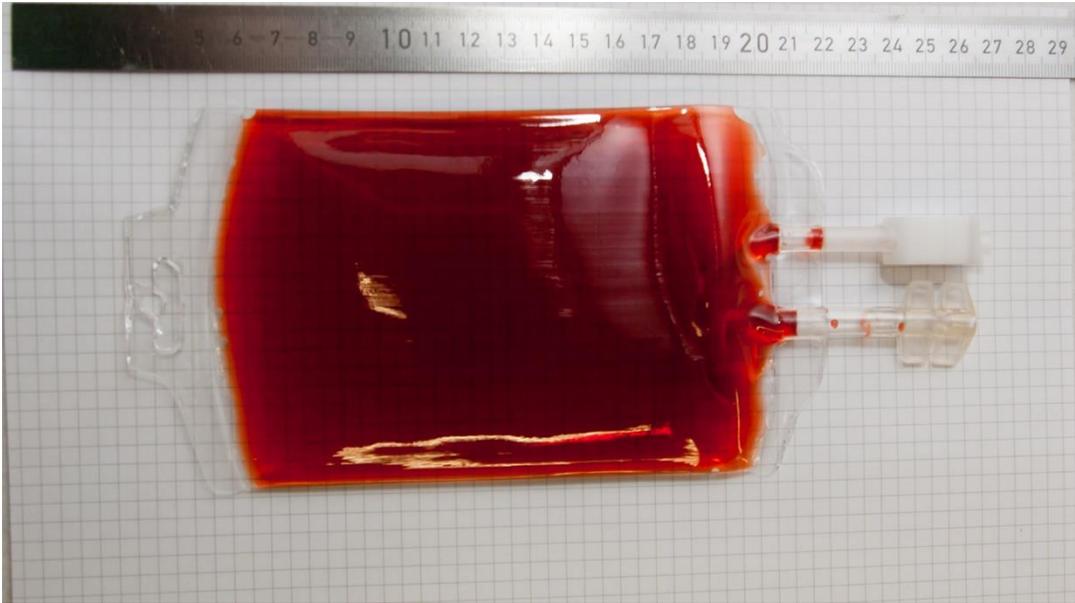


The format of the box and the position of the screws are fixed. The antenna is still in testing and we try to use a short antenna. You will get an update on this as soon as we have it.

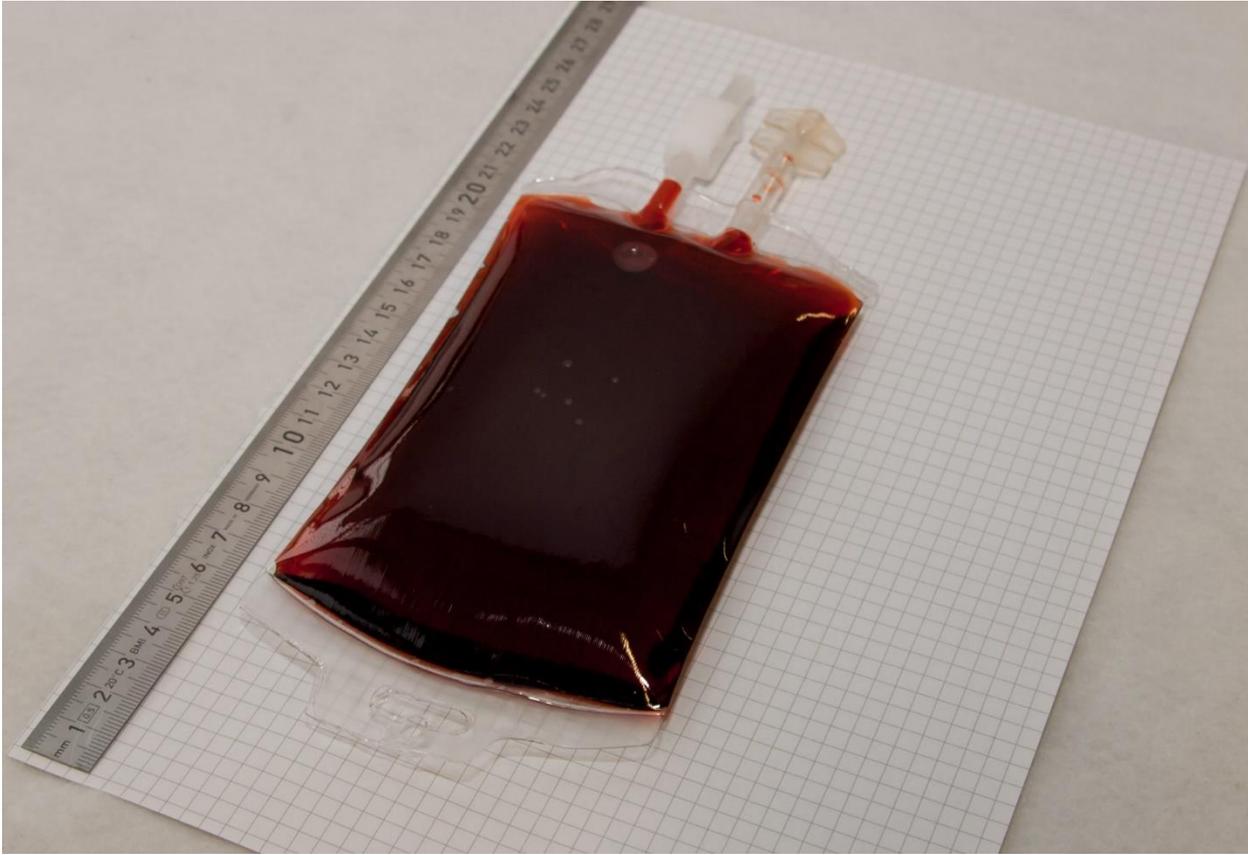
DESIGNED BY: <b>Rieger</b>			I	-
DATE: 07/08/2020			H	-
CHECKED BY:			G	-
DATE:			F	-
SIZE		<b>Automated measuring box</b>	E	-
SCALE	WEIGHT (kg) max. 150g		D	-
DRAWING NUMBER V1.1			C	-
SHEET 1/1			B	-
This drawing is our property; it can't be reproduced or communicated without our written agreement.			A	-

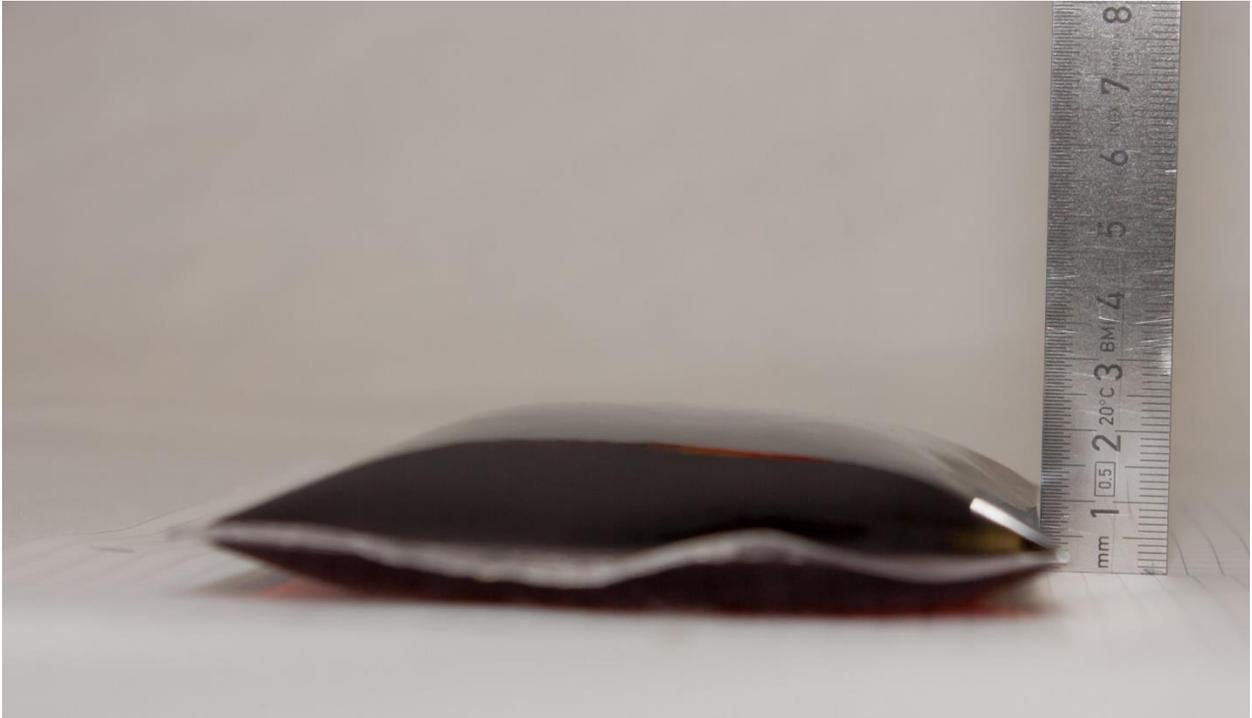
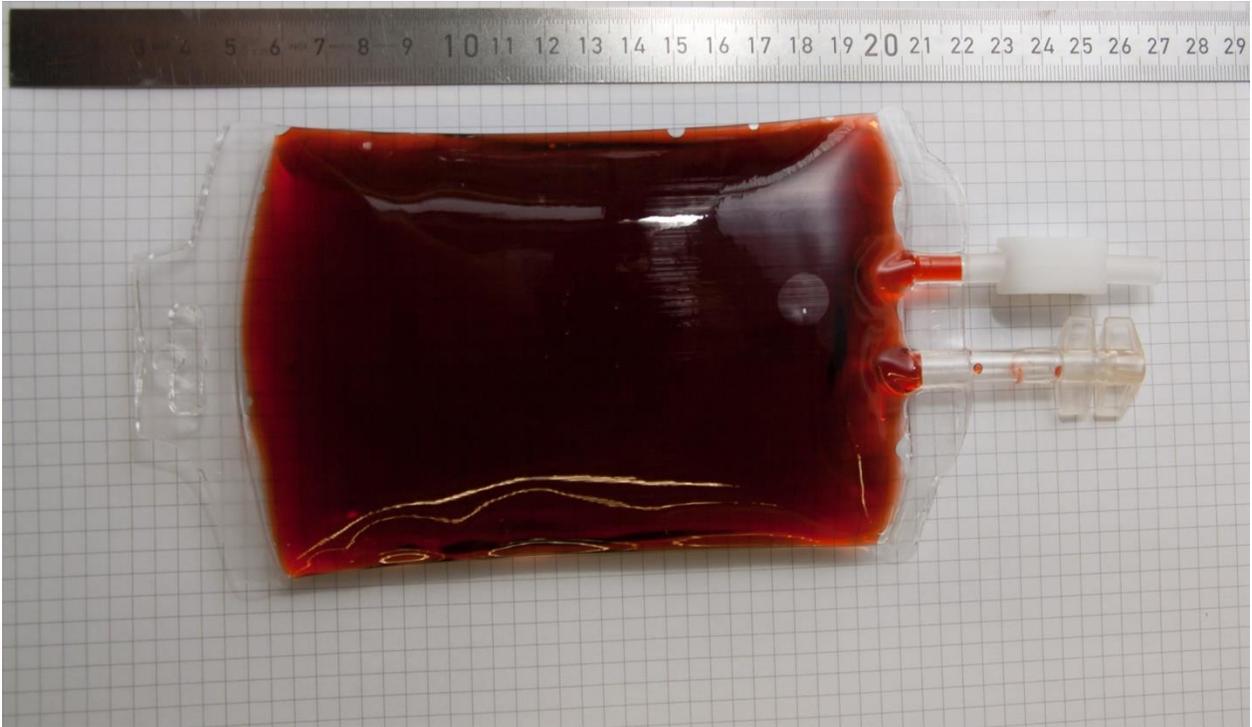
**6.4 PAYLOAD PHOTOS / DIMENSIONS**

100g

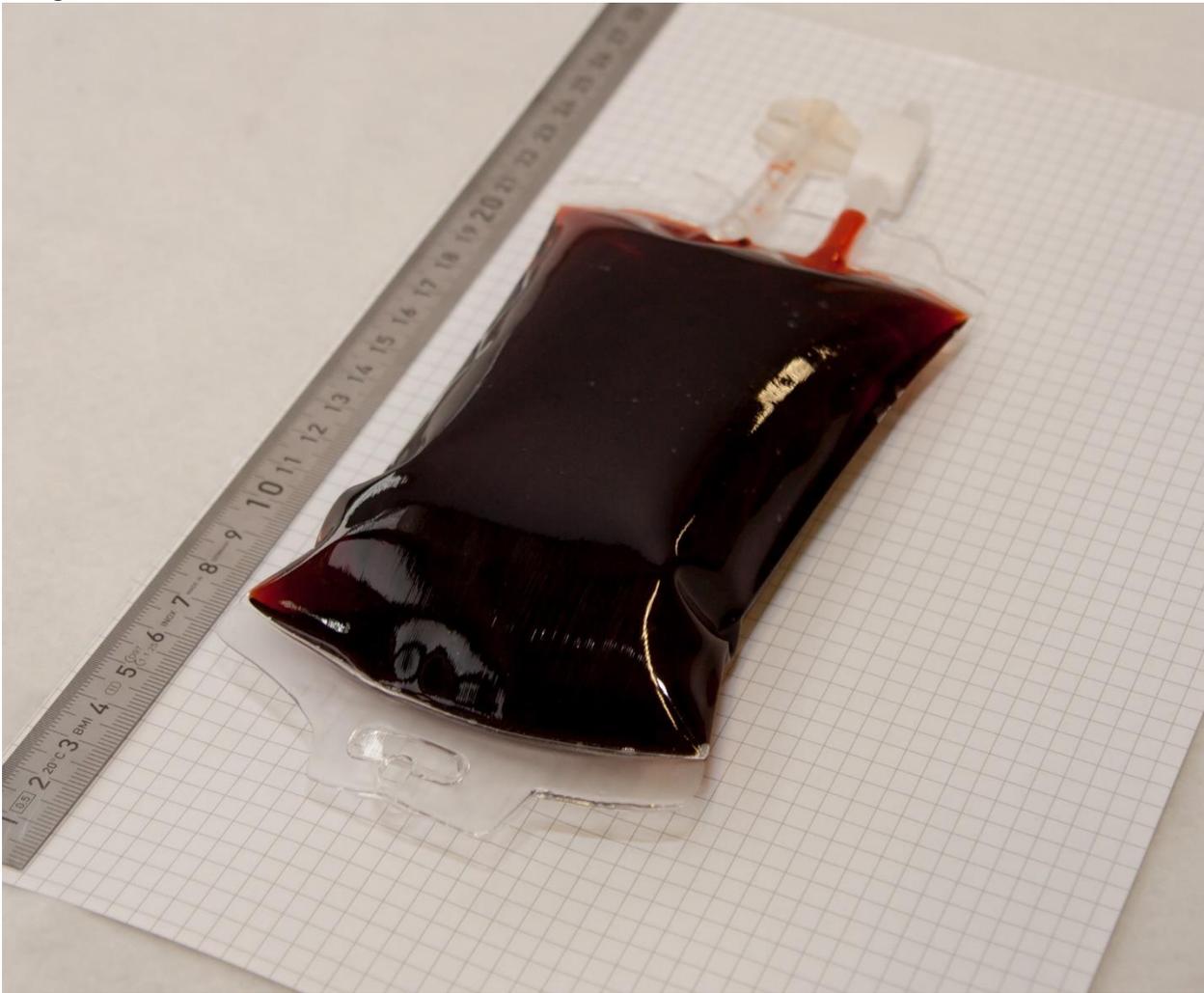


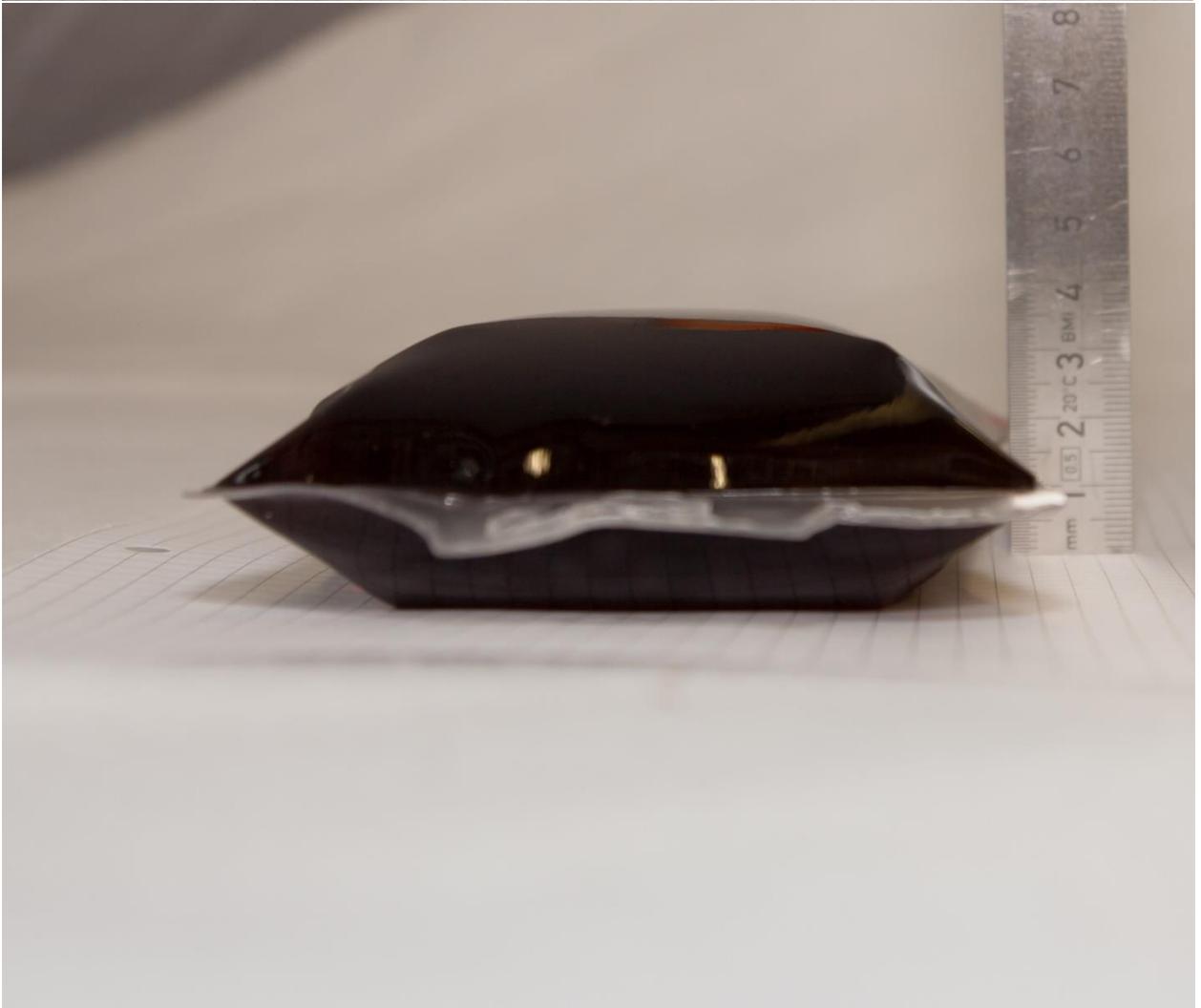
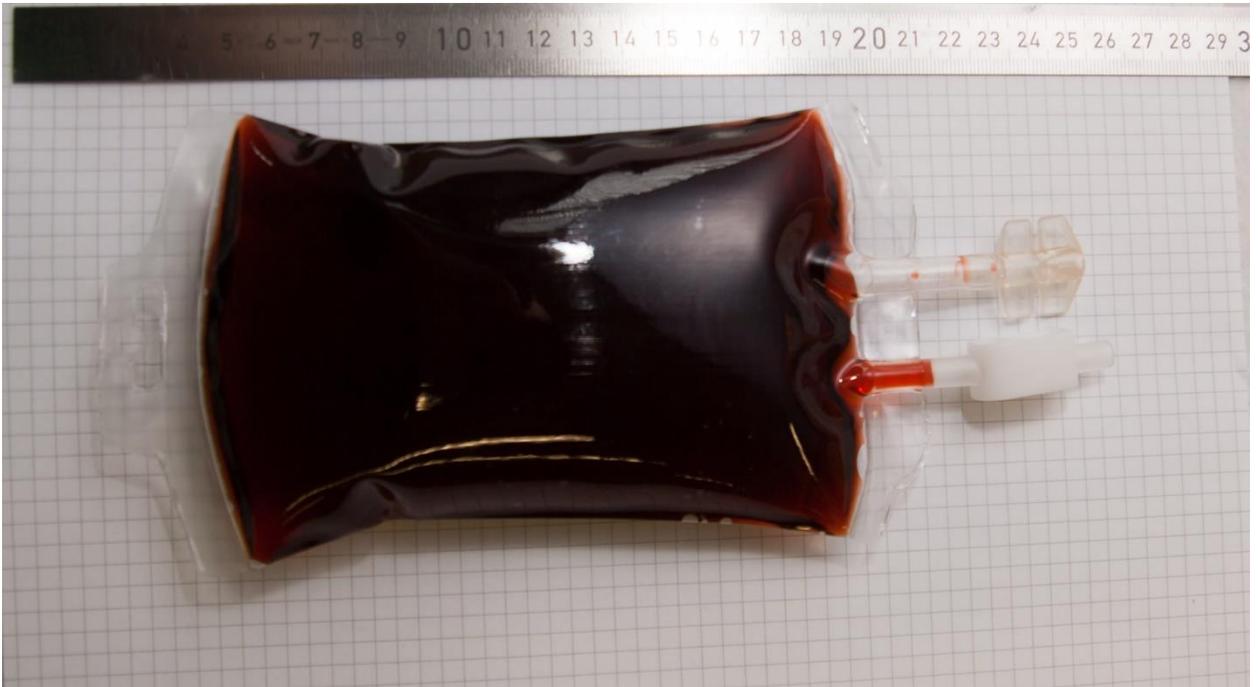
200g





300g





### 6.5 FLIGHTFIELD PHOTOS

These photos are intended to give you a first impression.



Figure 7: Start position eastern winds



Figure 10: Start position eastern winds



Figure 9: Field to the south



Figure 8: Obstacle with no-fly-area up to 5m altitude



Figure 13: 60m Take-off position for eastern winds



Figure 12: 60m take-off position, car parked roughly at the correct position, you have to turn right after takeoff with eastern wind directions.



Figure 11: Field to the north



*Figure 14: From the take-off position to the start position. (easterly winds)*