THE AERONAUTICAL SOCIETY OF SOUTH AFRICA AEROSPACE CHALLENGE

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Abstract

2018 marks the tenth anniversary of the Aeronautical Society of South Africa Aerospace Challenge, an event to promote interest in the field of aeronautics and aviation. This paper describes the event, its objectives and format, changes, enhancements and the benefits to date.

1. Introduction

The Aeronautical Society of South Africa (AeSSA) was formed in 1911 and is a division of the Royal Aeronautical Society. Amongst other roles, the society arranges lectures, conferences, symposia and training courses, as well as award prizes, bursaries and medals for certain categories of personnel in recognition of their achievements in the aeronautical field.

In 2009 the author, a member of the AeSSA council, suggested running a model aircraft competition as a way to encourage interest in both aviation and aeronautics amongst but not limited to scholars and students. The idea was accepted and nine successful events have since been held in either the Pretoria or Johannesburg area.

2. Rules and Objectives

While the rules have been changed and improved each year based on the experiences of the previous year, the basic concepts have been remained.

Team entries have been encouraged for two reasons:

1. So that the team members can both learn the skills to and see the benefit of working with other members.

2. There are a number of people obtaining their engineering degrees who would not have been as exposed to aeromodelling as their colleagues. Being involved in the teams affords them the chance of learning from the more experienced team members.

The maximum number of members in the teams was progressively increased from four per team in 2009 to the seven currently allowed.

A maximum of three models per team is permitted to encourage more designs but this limit has never been reached.

Finally, the models had to be original designs; no major components from existing model aircraft such as wings, fuselage or tails are permitted.

3. 2009 – The Inaugural Event

The first Aerospace Challenge consisted, somewhat optimistically, of two events; a free-flight balsa glider competition and an indoor radio-controlled model aircraft competition. Both events encouraged teams “from one to four competitors” to enter.

The teams were tasked to design and build a model glider with wings constructed out of either balsa wood or with balsa ribs and a maximum wingspan of 50 cm

Two tasks were set, one of maximising flight duration and one of maximising distance flown. The idea of having the two tasks was for the

students to have to deal with conflicting design requirements.

The second event required the contestants to design and build a radio controlled model aircraft to fly three tasks, a high speed pylon race followed by a slow flight and then, for the non-university contestants, a precision landing.

The models had to weigh less than 250 g and the power was limited to a two-cell lithium polymer battery with greater than 250 mAh capacity.

The maximum motor current draw was limited to 5 Amps measured with the aircraft static.

One member of each team had to present their design philosophy to a panel of judges before the competition for a bonus score based on their application of sound aeronautical engineering principles.

The event took place in a C-130 transport aircraft hangar belonging to 28 Squadron at the Waterkloof Air Force Base in Pretoria. The aircraft had been removed for the duration of the competition.

The balsa glider event was held first and was very successful with 20 teams entering.

Fig. 1. Balsa Glider Competition Contestants

With an entry of over 20 models in the radio controlled model event and the glider event finishing later than planned, only a single attempt was possible for each task.

The effort required to check each model for maximum current draw of 5A had a significant effect on the slow flight progress.

Fig. 2. Radio-controlled Model Competition Contestants

This event was also successfully concluded and the general feeling of all those involved and the AeSSA council was that the Aerospace Challenge should become an annual event.

4. 2010 - An Indoor Free-Flight Glider Competition

Based on the success of the balsa glider competition and the ease with which it was run compared with that of the powered models, the format of the 2010 challenge was chosen to be that of an indoor free-flight glider competition.

The competition took place in a large hangar at the Zwartkops Air Force Base in Pretoria.

The maximum wingspan was again limited to 50 cm but in order to provide the older and/or weaker modellers a fair chance, the models were to be launched using elastic bands with the hangar roof limiting launch height and ensuring equal chances for all. Launches were carried out in groups of four or five at a time.

Information was provided with the entry forms on the type of models that could be built and various construction tips.

The competition started at 15h00 on the Friday afternoon and was completed by just after 17h00.

The event was again deemed to be successful with 15 models being flown on the day. There were however no university teams.

Fig. 3. 2010 Balsa Glider Contestants

5. 2011 - A Low Speed Flight Competition

In 2011 the rules were changed to encourage the entry of universities and a requirement added where they would be awarded additional points based on their aircraft design approaches.

An A1 sized poster that covered the design concept (with some structural analysis), performance prediction and stability and control predictions was to be submitted for judging.

The competition focused on the take off and flight portion of the competition with the non-university teams were also scored on their flying.

In compliance with national radio controlled model flying rules and because the flights would take place relatively close to a number of historical aircraft at the Zwartkops Air Force Base, only pilots approved by the national aeromodelling body were allowed to fly the aircraft. These pilots were provided for the teams as required.

Teams consisting of up to six competitors were allowed.

The models were required to take off and fly out and back along a course of 150 m as slowly as possible with a full 355 ml cool drink as payload.

The power was limited to a three cell lithium polymer (LiPo) battery and the maximum current draw from the battery was limited to 15 Amps. The maximum wingspan of the model was limited to 150 cm

The take-off and low speed flight performance scores were each calculated using a formula provided to the teams and combined to form a flight score for each attempt.

Ten teams from both the University of the Witwatersrand and Pretoria University flew along with five private entries.

6. 2012 - A Low Speed Flight Competition

The same rules were retained for the 2012 competition with the only subtle change being required was due to the standard cool drink can being only 330 ml in volume.

The event was again held at the Zwartkops Air Force Base, typically one of the more windless areas in the world. During this year's event however the relatively strong winds played a factor in the results with many aircraft being damaged and some teams gaining an advantage if called to fly in the periods of stronger winds.

7. 2013 - A High Speed Flight Competition

In 2013 the competition rules were changed to focus on high speed flight to reduce the effect of the wind on the slow flying models of the previous year. The cool drink can was retained as a payload.

The National Aerospace Centre, a government funded group with a human capital development mandate arranged for a number of schools to attend and the SA Air Force museum was opened for all.

Fig. 4. The 2013 Competition Contestants at the Zwartkops Air Force Base

8. 2014 and 2015 – New Motor rules

In 2014 the rules were changed to require that all the models used the same electric motor (E-flight Park 450). This was done to reduce the need for testing of the current draw before each flight required by the previous rules reducing the amount of assistance required on the day and the time taken to test all the motors.

The minimum wingspan was reduced to 120 cm and the three cell LiPo power source was maintained with the sizing being left to the teams to determine.

The 2014 rules also allowed teams of up to seven competitors for the first time at the request of one of the universities.

The AeSSA sponsored some motors, speed controllers and batteries for teams who weren't able to purchase for themselves.

Upon realising that some of the students entering the competition had not been exposed to aircraft design principles, the author appended a few pages to the rules describing three increasingly more detailed design approaches that could be used.

The 2015 rules were not altered from those of 2014.

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Fig. 5. The 2015 Competition Contestants at the Zwartkops Air Force Base

9. 2016 – A New Venue

The 2016 event was moved to and hosted by the Johannesburg Model Aircraft Club on their field just north of Johannesburg. One of the benefits of this move was an access to a larger pool of experienced pilots available to fly for the teams.

At the request of the AeSSA council, a rotary winged aspect was included and the event was run in parallel with a local company, DroneSpace, and their school-focussed "Drones for Good Challenge".

With ten school teams having entered the Drones for Good Challenge and eight university teams in the radio controlled model competition, it was not possible to combine the two events and complete the events in the time available. The final solution was that the school teams would fly their quadcopter systems in their competition at the same time as the radio controlled models in different areas of the flying field. Some interest and sharing of information took place between the two groups but the combination of the events wasn't very beneficial to both sides.

The university teams again used the equipment that was supplied by the AeSSA in the previous year although some batteries had to be replaced.

There were two entrants in the Open (non-university) class this year.

Fig. 6. The 2016 Competition Contestants at the JOMAC Field

10. 2017 – Small rule changes

With the 2016 version of the rules working rather well the only change made to the Inter University Challenge was to reduce the minimum wingspan to 100 cm to enable the models to be more easily built (building material comes typically in 100 cm lengths) and to fly faster on the limited power available.

Fig. 7. The 2017 Competition Contestants

The balsa gliders class was added again in 2017 but as an outreach programme focussing on supporting previously disadvantaged school pupils who would not be able to build their own.

The balsa gliders were designed by the author and the wings, fuselage and tail surfaces CNC machined out of sheet balsa. The wings were hand finished to remove the machining marks to improve the aerofoil accuracy.

The parts were assembled into a kit with epoxy and super glue and given to leaders from the various schools for the pupils to assemble.

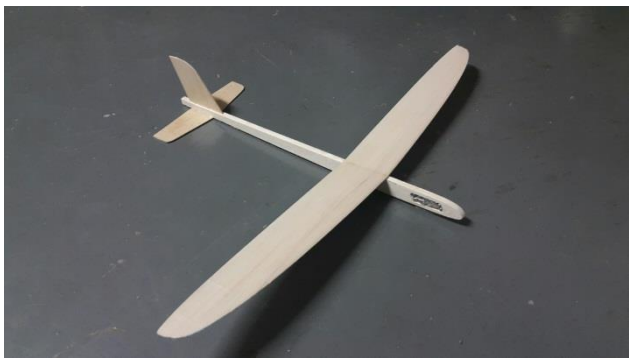

Fig. 8. An Assembled AeSSA Balsa Glider

Fig. 9. Pupils Ready to Launch Their AeSSA Balsa Gliders

The windy conditions on the day caused some problems but the pupils all enjoyed themselves.

11. Conclusion and future AeSSA Challenges

The AeSSA Aerospace Challenge events appear to have been successful in providing a platform for people interested in aviation or even just aero-modelling to design and produce their own aircraft.

The event has been run at a reasonably low cost to the AeSSA and the administration has been relatively simple.

The recent outreach programme was deemed to be successful and benefitted the pupils from two different schools. More schools will be included in 2018, possibly as a separate event.

The 2018 Aerospace Challenge rules introduce unmanned aircraft to the competition.

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