Annex A Report
IGC Plenary, March 7, 2014

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Dear Delegates,

As a preface to my first report as Chairman of the Annex A Committee, I would like to acknowledge the guidance I have received during the past year from my predecessor, Göran Ax. I accepted this job with only a vague understanding of the work involved, and I blame Göran for making it look easier than it actually is. Nevertheless, I am grateful for his advice and will continue to seek it. The members of the Annex A Committee wish Göran all the best in his retirement.

The 2013 edition of Annex A was published with an effective date of December 5, 2013. The significant differences from the previous version are:

- References to the World Class have been removed;
- Safety features have been added to acceptance checks;
- Wing loading limit in the Club Class has been removed;
- Wing loading limit in the 13.5 metre Class has been added;
- Team Cup rules have been rewritten and Team Medals have been added;
- Complaint/Protest procedures have been elaborated.

Additionally, the 2013 edition includes the "one entry per NAC" limit in the 20 metre Multi-seat Class, a limit that should have appeared in the 2012 edition but did not. The Committee apologizes for this mistake.

We have begun work on the 2014 edition of the Annex. At this meeting, you will consider four Year 2 proposals for this edition.

<u>Year 2 proposals from the Committee</u>
Last year the Committee proposed the elimination of start time reporting and the elimination of altitude controls at the start. These were accepted as Year 1 proposals, and they have returned for your final approval. Over the years, and despite the efforts of several experts, the general problem of "energy control at the start" has never been properly solved. The Committee will continue to work on the problem, and we invite your input on this vexed topic.

<u>Year 2 proposals from outside the Committee</u>
- Change of Observation Zone (France)
- Emergency Plan (Germany)

Year 1 proposals

Elsewhere in the agenda you will find a collection of Year 1 proposals from the Annex A Committee. These include proposals to consolidate handicapping rules and to resolve ties in the final results, both of which address situations that occurred in the 2012 competition season.

During the past year, the Committee has debated, without resolution:

- eliminating non-circular Assigned Areas,
- inviting current Champions,
- using the identity information in the Flight Log data, and
- the number of launches allowed each day.

Delegates are invited to offer their opinions on these (and any other) topics during our time together in Varese.

In its 2013 Report to the Plenary, GFAC invited Annex A to justify two things, which we have done in the attached Appendix to this report.

I thank my fellow Committee members Axel Reich, Jiří Cihlář, and Terry Cubley for all their hard work during the past year.

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Appendix to the 2014 Annex A Report

In its 2013 Report to the IGC Plenary, GFAC included this invitation to the Annex A Committee:

> *The Annex A Committee is invited to justify why it is necessary to mandate a calculation system that differs from that used for other IGC performances such as Records, Badges and Diplomas, and, using a spherical Earth Model, how accurate separation (or otherwise) from Airspace can be calculated for flights, as required by Air Law and the FAI GS.*

The Annex A Committee is happy to respond to this invitation to justify these two things, which we will treat one at a time.

1. Justifying the difference in calculation methods between SC3 and SC3A

Assuming that the main section (which governs badges, diplomas, and records) specifies the ellipsoidal earth model for calculations, there is indeed a discrepancy between the main section and Annex A, the latter using the WGS84 geodetic datum for fixes and the spherical earth model for calculations.

In order to find out why this discrepancy exists, we need to have a look at which calculations are deemed important by SC3 and SC3A, and we need to understand the difference between local and global comparisons of flight performances.

SC3 (the main section) speaks of distance calculations. It considers only the distances between pairs of points. Within this limited realm, the use of the ellipsoidal earth model suffices, thanks to the availability of a standard empirical method of performing this calculation (the Vincenty method). The main section does not specify the means of performing any other geometric calculations that may be necessary, nor does it specify any methods of approximation, when such methods are required. The methods of performing any calculations (other than the calculation of distance between pairs of points) are left to the judgment of people: programmers, observers, analysts, and homologators. Because of this, the main section can afford to be mathematically unrigorous, and vague about approximations.

Annex A, on the other hand, must specify a standard for flight analysis that does not depend on the judgment of people.

Unlike in the main section, the methods of all calculations used in the Annex, including approximations where necessary, must be standardized and specified. This is an essential tenet of Annex A: it must contain a bedrock mathematical standard to which any calculated results can be compared.

Some computations require that approximations be made. To specify methods of approximation unambiguously, for each situation, is an enormous, impractical job. Rather than attempting this, the Annex makes one top-level approximation (that of specifying the spherical earth model) that shifts the entire mathematical problem from empirical to analytical, where, by definition, further approximations are not required.

Does the approximation specified in Annex A result in inaccurate distance calculations? Yes! The distances calculated in the Annex are wrong by a factor comparable to the earth's flattening. This is not important for three reasons:

- The inaccuracy is small;
- The calculation of distance is an intermediate step in the calculation of a score. The purpose of the Annex is to calculate unambiguous scores, not accurate distances; and

- The calculation of credited distances in the Annex is 100% fair. Competitions are local. There is no need to compare the flight performances of contest pilots with other contest pilots elsewhere on the globe.

The last point deserves elaboration. Because contests are local, and because credited distances from one contest to another have no official status, there is no need to strive for "fairness" around the world. Obviously, and quite importantly, this is not true of badges, diplomas, and records. Because the main section must be fair around the world, it should specify the ellipsoidal earth model for distance calculations and consequently must rely on the judgment of humans to choose methods of approximation and to resolve disputes.

In summary, the justification for using a calculation system that differs from that used for other IGC performances is that Annex A must specify calculations that produce unambiguous results, without involving the judgment of programmers or the aid of human evaluators.

2. Justifying the accuracy of Annex A calculations with respect to airspace and Air Law

In actual practice, airspace boundaries are enforced by radar, which is a measurement whose precision is far lower than that required by Annex A.

Annex A assumes no responsibility for keeping pilots out of prohibited airspace, and gives no guidance to pilots on how to stay clear. Annex A gives neither good advice nor bad advice to pilots. Annex A does not mislead pilots in any way.

Our Committee is asked to justify the accuracy of the calculations specified in the Annex. The premise of this question - that accurate calculations are important in the enforcement of Air Law - is not accepted by the Annex A Committee.

However, that does not prevent us from answering the question, by way of this example:

> Suppose we are asked to calculate the precise distance in metres from the Lasham clubhouse to the London TMA-4 (both being referenced to the WGS84 Geodetic Datum).
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> The answer is 11297, using the ellipsoidal earth model and 11266 using the spherical earth model. Both answers have the requisite precision, but only the former is accurate.
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> The difference, about three tenths of a percent, is too thin a margin on which to base a legal airspace violation, in our opinion.

The specification of how to arrive at an accurate answer of the required precision would add about 20 pages to Annex A. The method of arriving at the inaccurate yet still precise answer is spherical geometry, the use of which is specified by a single sentence in the preliminary remarks of the Annex.

Furthermore, and perhaps more importantly, calculating the accurate answer requires roughly 20000 times the processing time as calculating the answer that is wrong by three-tenths of a percent. We know of no entity in the world, public or private, that performs the accurate version of this calculation.

In summary, the Annex A Committee, despite disagreeing with the conjecture that Air Law is in any way relevant to the mathematics of the Annex, asserts that the discrepancy between calculations performed on the ellipsoid and the sphere would have no legal bearing in any interpretation of Air Law anywhere in the world.