



**ASSEMBLY — 41ST SESSION**

**TECHNICAL COMMISSION**

**Agenda Item 31: Aviation Safety and Air Navigation Standardization**

**FLIGHT RESTRICTION ZONE (FRZ) FOR UNMANNED AIRCRAFT OPERATIONS  
AROUND AERODROMES**

(Presented by Brazil)

**EXECUTIVE SUMMARY**

The exponential increase in demand for unmanned aircraft (UA) to access the airspace in several areas, such as military, logistics, architecture, agriculture, among others, brings increasing challenges to the current air traffic management structure. One of these is to allow access to the airspace by this new aeronautical segment, especially around aerodromes, where there can be no interaction between unmanned and manned aircraft operations during approach and take-off procedures. The lack of regulations that prohibit or limit small unmanned aircraft system (sUAS) operation around aerodromes has led several countries to adopt different parameters to protect the operations of manned aircraft, maintaining the safety and efficiency of air operations. In the case of Brazil, a study was carried out to create a flight restriction zone for sUAS, considering the instrument flight rules (IFR) protection surfaces provided for in Doc 8168, *Procedures for Air Navigation Services* in addition to other factors. Considering that airspace is made up of a finite volume, the growth of sUAS operation requires global standardization in order to optimize its use. Thus, this paper aims to present the restriction zones for the operation of sUAS around aerodromes in Brazil with a view to proposing studies for the creation and standardization of those zones in signatory countries.

<i>Strategic Objectives:</i>	This working paper relates to the Safety and Air Navigation Capacity and Efficiency Strategic Objectives.
<i>Financial implications:</i>	The financial impacts will depend on approved decisions.
<i>References:</i>	Doc 8168, <i>Procedures for Air Navigation Services — Aircraft Operations</i> Doc 4444, <i>Procedures for Air Navigation Services — Air Traffic Management</i> (PANS-ATM) <i>Unmanned Aircraft Systems Traffic Management (UTM) – A Common Framework with Core Principles for Global Harmonization.</i> <sup>1</sup> <a href="https://www.icao.int/safety/UA/Pages/UTM-Guidance.aspx">https://www.icao.int/safety/UA/Pages/UTM-Guidance.aspx</a>

<sup>1</sup> [Microsoft Word - UTM Draft Framework Edition 3 V1.2 Final Clean 25 Sept 2020 0955.doc \(icao.int\)](https://www.icao.int/safety/UA/Pages/UTM-Guidance.aspx)

## 1. INTRODUCTION

1.1 Several countries are working individually to establish separation parameters between manned and unmanned aircraft to assure safe small unmanned aircraft system (sUAS) access to airspace. Unfortunately, the decentralized work and the lack of studies related to the operation of sUAS can delay or even limit the growth of the industry in some areas of activity, especially around aerodromes.

1.2 With the objective of optimizing the use of airspace, integrating this new aeronautical segment into the existing air traffic management (ATM) structure, this paper presents the restricted area for flights of unmanned aircraft around aerodromes created by Brazil and proposes the definition of parameters by ICAO to define the flight restriction zone for sUAS.

## 2. DISCUSSION

2.1 Flight restriction zone (FRZ) for unmanned aircraft around aerodromes in the world

2.1.1 First of all, this study looked for information in the ICAO documentation to answer the question: how close to an aerodrome is it safe to allow an unmanned aircraft to operate without interfering with the operation of manned aircraft? As there was no answer to this question, a research was carried out to investigate how each country was addressing the issue. The lack of answer and the certainty that the operation of unmanned aircraft was being accommodated in airspace around the world, meant that the research was extended individually to each country.

2.1.2 Although similar in concept, our research found different nomenclatures in the different member States, for instance: no drone zone, no fly-zone, no fly zone drone, FRZ, among others. FRZ was chosen in Brazil, because the surfaces in question do not prohibit the flight of sUAS but require that additional safety measures be adopted, such as coordination with the air traffic control (ATC), for example.

2.1.3 In addition, there is a significant difference in the geometry of these areas in relation to the lateral and vertical limits, height and applicability, because some countries use this restriction area only at public aerodromes or aerodromes operating under instrument flight rules, for example. Although we found different designs of FRZ, it was not possible to understand which parameters were used to obtain those values and geometry.

2.2 Methodology for creating a FRZ for unmanned aircraft operations around aerodromes in Brazil

2.2.1 If we analyze UTM airspace, there is a premise that sets its upper vertical limit at 400 ft height. Considering that a helicopter must fly at least 500 ft high in populated areas, we conclude that there can be 100 ft vertical boundary between a manned and an unmanned aircraft flight, in general. Then, the minimum profile of manned flights under IFR was analyzed.

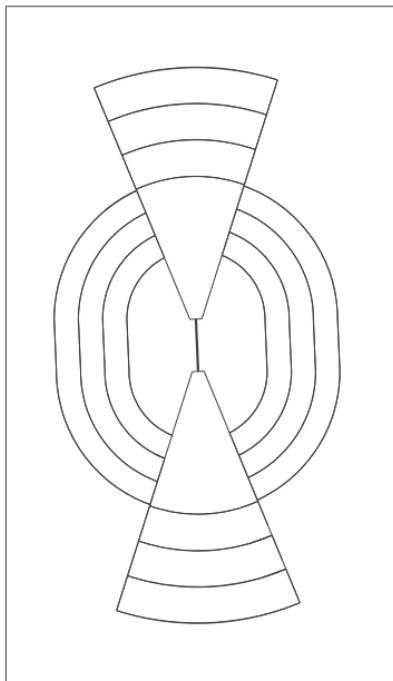
2.2.2 Considering that the surfaces provided for in Doc 8168 are based on at least  $2\sigma$  (sigma confidence limits) in 95% (95 per cent) for the manned aircraft flight profile, a study was carried out that superimposed the protection surfaces of IFR flights (standard instrument departure (SID) and instrument approach chart (IAC)) where the minimum slopes were maintained in each phase of flight within the respective lateral limits. As a result, several slope surface areas were generated that delimit the minimum flight profile of a manned aircraft around aerodromes, regardless of the IFR procedure used.

2.2.3 After the study, as a result, the surface was created containing lateral and vertical limits with the highest restriction among all SID and IAC surfaces analyzed, so that the minimum values of this surface guaranteed the separation of any type of IFR procedure performed.

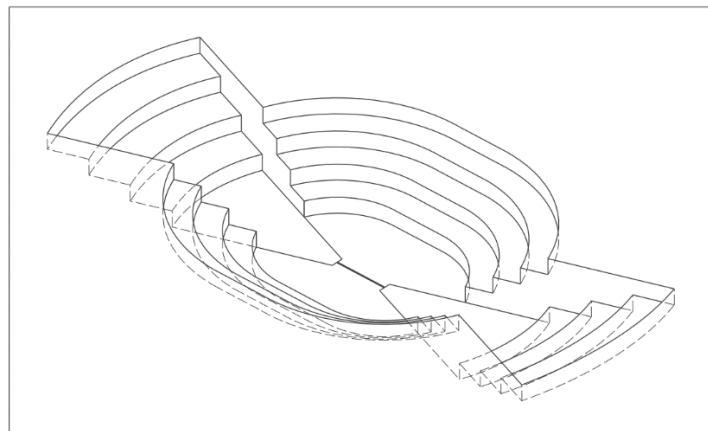
2.2.4 Once this area has been created, which protects the flight of manned aircraft in the vicinity of aerodromes in relation to obstacles, but also provides for maximum lateral flight limits of at least 95 per cent, a vertical separation of 100 ft below was applied to allow unmanned flights, thus optimizing the use of airspace around the aerodromes for sUAS, excluding the section of intersection with the UTM.

2.2.5 However, due to the lack of studies on associated errors involving the operation of sUAS, such as errors in navigation and in altimetry, human error, among others, it was decided to add a buffer of 200 ft in the approach and take-off zones (ATZ) and of 100 ft in the surrounding aerodrome zone (SAZ) in addition to the 100 ft separation mentioned above.

2.2.6 Finally, due to the particularities of the operations involving UA and to facilitate the visualization of the restriction areas imposed to the UA operation around aerodromes, the geometric figure of the FRZ was presented in steps of 100 ft height from a certain distance in relation to the departure-end of the runway (DER) in the approach and take-off zone or around the runway centerline, as shown in the figures below:



**Figure 1. Top View**



**Figure 2. Isometric view**

MINIMAL CONDITIONS TO ALLOW UA FLIGHT				
HEIGHT	100 FT	200 FT	300 FT	400 FT
ATZ DISTANCE	3550 M	4480 M	5400 M	6320 M
SAZ DISTANCE	1740 M	2350 M	2960 M	3570 M

**Table with parameters**

2.2.7 The proposed parameters apply to the worst-case scenario of an aerodrome and may vary according to the IFR procedures, making the FRZ more permissive. For example, if the minimum procedure design gradient (PDG) predicted in the SIDs is greater than the usual 3.3%, distances can be reduced in the portion where the departure slope was more restrictive than the arrival slope, as manned aircraft will reach the separation of 200 ft or 300 ft faster. Anyway, the slope separation methodology continues to be applied.

2.3 Relevant considerations to FRZ analysis

2.3.1 Currently, sUAS operation uses height as a reference for its operation while manned aviation uses altitude. To enable the implementation of the FRZ, it is essential to comply with at least one of the following requirements: availability of 3D terrain data so that the system uses the height in relation to the DER, that is, add the altimetric difference between the DER and the major obstacle within the requested flight area; or that sUAS requests its flight informing flight altitude, not flight height.

2.3.2 In addition to using the same vertical reference to accommodate this new aeronautical segment into the existing airspace structure, it is necessary to have a system that allows the georeferenced visualization of the FRZ so that the user can plan its flight.

### 3. CONCLUSION

3.1 sUAS operations is growing and developing fast. Different initiatives around the world are planning to accommodate this aeronautical segment in a safe, organized, and efficient manner. Considering that the airspace below 500 ft is a finite resource and widely used in large urban centers due to the high number of existing aerodromes, it is essential to optimize its use by reducing as much as possible the UA flight restriction zones around the aerodromes within safety standards. For this, ICAO should make an effort to establish the lateral and vertical parameters between unmanned aircraft and other aircraft around aerodromes, considering this is a fundamental issue for the development of UTM in the world.