Detect & Avoid
Design, Test & Evaluation Guideline

Appendix B:
Assumptions

Version 1.0

ID: REVAERO-1462090167-139327


RevAero UTM Demonstration 2023

RevAero Flight Trials 2022

RevAero; a Defence Jobs QLD delegate at Avalon Airshow 2022

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Development and Approvals

Developed	Approved
Mr Tom Putland Senior Research, Regulation, and Product Development Engineer Revolution Aerospace Mr Angus McLaren Senior Systems Engineer Revolution Aerospace Dr Sarasi Munasinghe Research and Development Engineer Revolution Aerospace	Dr Terry Martin CEO and Co-founder Revolution Aerospace Mr Kristian Cruickshank CTO and Co-founder Revolution Aerospace

Version History

Version	Release Date	Description
1.0	31 January 2024	Initial Release

Contributions

The Guideline has drawn on many different sources of DAA research, development, standardisation, and guidance material across the globe including information produced by the following organisations:

- RTCA
- ASTM
- JARUS
- FAA
- MIT
- EASA

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Attribution

When attributing this publication (and any material sourced from it), the following wording should be used:

References:

[1] T. Putland, A. McLaren, T. Martin, K. Cruickshank, Z. Huang & S. Munasinghe, "*Detect & Avoid Design, Test & Evaluation Guideline-Appendix B,*" Revolution Aerospace, Brisbane, Queensland, Australia, January 2024.

Acknowledgments:

The authors and Revolution Aerospace gratefully acknowledge the following organisational support for for completion of the DAA document package:

- Grant funding from the Australian Department of Infrastructure, Transport, Regional Development, Communications
- In-kind Support from the Queensland Government through Trusted Autonomous Systems (TAS), a Defence Cooperative Research Centre funded through the Commonwealth Next Generation Technologies Fund and the Queensland Government.

Disclaimer

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1 Introduction

This document contains all the assumptions developed as a result of defining the Operational Systems and Environment Description (OSED). They are compiled here for ease of reference.

2 Assumptions

Table 1: OSED Assumptions

Assumption ID	Description
ASSUMP-OSED.1	The UAS will operate under a BVLOS Approval
ASSUMP-OSED.2	A BVLOS operation will exhibit the following characteristics: • The Remote Pilot in Command (RPIC) is unable to maintain visual unaided contact with the Uncrewed Aircraft (UA) for some or all of the operation. • The RPIC is not required to, or is unable to, visually separate the UA from Intruders. • The UA may be operated close to or far away from to the RPIC; the standoff distance is only limited by the UAS Control and Non-Payload Communications (CNPC) data link performance. • The BVLOS approval does not invoke the entirety of either Instrument Flight Rules (IFR) or Visual Flight Rules (VFR) of the air.
ASSUMP-OSED.3	The DAA System will use an EO/IR detection subsystem.
ASSUMP-OSED.4	The; UA Segment, Ground Segment, Communications Segment, and Personnel (including maintenance personnel), are all approved per the requirements listed in the Requirement Set at Appendix E of the Guideline, and as required by the Authority.
ASSUMP-OSED.5	Ownship characteristic dimension will not exceed 8m.
ASSUMP-OSED.6	The Ownship is equipped with ADS-B (In) as a component of the DAA system for cooperative Intruders. The use of ADS-B (Out) is optional (or as required by the Authority).
ASSUMP-OSED.7	The RPIC has access to an approved radio and radio coverage throughout the area of operations to facilitate voice communications with Intruders or other airspace actors. This may be achieved through communications relay from the GCS to the UA, or directly from the GCS.
ASSUMP-OSED.8	If the minimum approved equipment necessary for undertaking DAA is not available to the UAS or RPIC during a failure event (i.e., system failure, lost-link, etc.), appropriate contingency procedures would be enacted to reduce the likelihood of an encounter during this event

Assumption ID	Description
ASSUMP-OSED.9	The Ownship is equipped with enhanced visibility solutions to increase its visibility to any Intruders, as required by the Authority (such as navigation lighting and/or high contrast colour schemes).
ASSUMP-OSED.10	While more than one person may be required to operate a specific UAS in practice, this OSED assumes a single RPIC is responsible for the safe operation of the UAS, or fleet of UA.
ASSUMP-OSED.11	The RPIC has direct and timely access to the relevant DAA displays, and equipment as required to exercise the necessary authority as the remote pilot in command.
ASSUMP-OSED.12	For One-to-Many operations, the RPIC can perform all necessary actions for all aircraft in a timely manner during any DAA event.
ASSUMP-OSED.13	Any UA that are representative of crewed aircraft size will be visually indistinguishable to the DAA system.
ASSUMP-OSED.14	Intruders are not equipped with any DAA system and therefore will not coordinate DAA functions to stay well-clear from or avoid collisions with the Ownship in nominal operating environments.
ASSUMP-OSED.15	For the purpose of this OSED, Intruders can be cooperative or non-cooperative.
ASSUMP-OSED.16	For the purpose of this OSED, Intruders without functioning ADS-B (Out) equipment are defined as non-cooperative Intruders.
ASSUMP-OSED.17	The maximum airspeed for cooperative Intruders within the scope of this guideline is 250kt IAS, with a maximum vertical rate of 5000 fpm and maximum horizontal acceleration of 1.5g (where g is the acceleration of gravity).
ASSUMP-OSED.18	The maximum airspeed for non-cooperative Intruders within the scope of this guideline is 200kt IAS, with a maximum vertical rate of 1500 fpm and maximum horizontal acceleration of 1.0 g.
ASSUMP-OSED.19	Intruder aircraft of any of the following categories are assumed within the scope of the guideline: aircraft, rotorcraft, glider, lighter than air (airship and balloon), or powered lift. Other categories are excluded from scope.
ASSUMP-OSED.20	Intruders will be equipped according to the requirements of the flight rule they are operating under/within. Key equipment that are relevant to this OSED are ADS-B and radio equipment for voice communications.
ASSUMP-OSED.21	The UAS will operate in Class G Airspace and will integrate other Class G traffic.

Assumption ID	Description
ASSUMP-OSED.22	DAA-equipped UA will not fly in a VFR traffic pattern or circling approach. Transit to the DAA authorised environment must be achieved via other approved methods such as visual observers, or protective airspace
ASSUMP-OSED.23	ATC are not required to provided separation services for VFR, IFR, or BVLOS flights in Class G airspace. However, when the UA is in communication range with ATC, the RPIC will take note of traffic advisories, respond to directions, queries, and safety alerts.
ASSUMP-OSED.24	The airspace environment excludes Prohibited, Restricted, or Danger areas. Operation in these environments is subject to additional approval by the competent Authority.
ASSUMP-OSED.25	UA will always be required to give way to a conventionally piloted aircraft, and that normal right of way rules under VFR/IFR do not apply to the UA. This does not prevent a conventionally piloted aircraft from giving way to a UA if they detect it during operation.
ASSUMP-OSED.26	The UAS will operate in AEC 5 airspace, per the JARUS SORA; namely, class G airspace, outside of airport environments, and over rural areas.
ASSUMP-OSED.27	Hovering behaviours during extended operations are within the scope of this OSED. Operational scenarios that do not explicitly consider situations where the UA stops and hovers mid-flight are also possible.
ASSUMP-OSED.28	The Ownship may operate up to a ceiling of 10,000ft AMSL.
ASSUMP-OSED.29	Altitude is to be measured via an authority-approved altimetry subsystems and externally reported according to guideline practice for the airspace and location (i.e., in general, altitude reported in AMSL, as well as implementation of QNH corrections where required).
ASSUMP-OSED.30	The operation of the DAA system is assumed to be under Visual Meteorological Conditions (VMC). Specifically, Day VFR conditions.
ASSUMP-OSED.31	For the purpose of this OSED, the DAA system is not capable of fully functioning in IMC, and, therefore a degraded mode of operation is simply available as a fall back while attempting to return to VMC.
ASSUMP-OSED.32	The RPIC is assumed to be capable of determining the meteorological conditions (VMC or IMC) of the UA's surroundings, and able to avoid entering IMC either via the DAA System, or other means.
ASSUMP-OSED.33	This OSED assumes that the UA and GCS are only operated in environments that they are approved for.
ASSUMP-OSED.34	It is assumed that communication latency is acceptable between the Ownship AV, UAS Ground Segment, and an Intruder, (as well as any 3rd parties) in an encounter.

Assumption ID	Description
ASSUMP-OSED.35	The RPIC can cope with multiple Intruders and correctly follow the guidance provided by the DAA system.
ASSUMP-OSED.36	Human factors/errors are not considered in the scenarios.
ASSUMP-OSED.37	The DAA system can always produce a solution for multiple simultaneous encounters.
ASSUMP-OSED.38	The DAA system is assumed to be capable of prioritising the detection, tracking and the provision of manoeuvre guidance for multiple simultaneous Intruders, to a defined upper limit such that its ability to perform the necessary DAA functions is not degraded.
ASSUMP-OSED.39	A full 360-degree view by the EO/IR payload is not guaranteed and is assumed to be prioritise a forward-facing view with a fixed FoR. Therefore, an Intruder positioned at the rear of the Ownship may not be captured within the DAA FoR.
ASSUMP-OSED.40	The ADS-B (In) receiver is able to detect and track any Intruder broadcasting ADS-B in any direction.
ASSUMP-OSED.41	The UA manoeuvres when commanded in time to prevent the unwanted event (loss of well clear or NMAC).
ASSUMP-OSED.42	Although the Ownship may be equipped with an autopilot capable of performing manoeuvres automatically, based on guidance and alerting information from the DAA system, manoeuvres will be executed manually by the RPIC. Automatic execution of the manoeuvre guidance as a last resort is optional.
ASSUMP-OSED.43	If communication cannot be established between the RPIC and the Intruder pilot, the RPIC is expected to broadcast navigational intent prior to executing an avoidance manoeuvre based on the guidance provided by the DAA system (assuming that VHF communications are available to the RPIC). Regardless of reception of signal by the intruder pilot, the UA is expected to give way as per ASSUMP-OSED.25.
ASSUMP-OSED.44	Communication latency and availability may introduce delays during an encounter event where an immediate manoeuvre may be required to remain well-clear. It is assumed that the necessary manoeuvres will be prioritised and enacted by the RPIC in a timely manner, regardless of communication latency and availability.
ASSUMP-OSED.45	A ditch operation may be required by the Authority if the UA has experienced complete DAA failure with no means of communicating with potential Intruders. The exact threshold for ditching will be determined by the Authority.
ASSUMP-OSED.46	Intruders may be operating under VFR or IFR. For aircraft operating under IFR, VHF communications and ADS-B (Out) are assumed to always be available.

Assumption ID	Description
ASSUMP-OSED.47	It is assumed that there avoidance manoeuvres initiated by the UA do not confuse any intruders that do detect the Ownship.