

Advisory Circular

PERMITS FOR UNMANNED AIRCRAFT OPERATIONS

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GENERAL

Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 3C of the Air Navigation Act (Cap. 6) (ANA), to show that compliance with a statutory requirement has been achieved. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

PURPOSE

This Advisory Circular provides guidance on unmanned aircraft (UA) operations in Singapore that will require permit(s).

APPLICABILITY

This AC is applicable for the person who intends to operate a UA in Singapore.

RELATED REGULATIONS

This AC relates specifically to Part 2 of Air Navigation (101 – Unmanned Aircraft Operations) Regulations 2019, (“ANR-101”).

RELATED ADVISORY CIRCULARS

- AC 101-2-2 BVLOS Operations for Unmanned Aircraft
- AC 101-3-1 Approvals for Unmanned Aircraft Training

- AC 101-4-1 Unmanned Aircraft Pilot Licence
- AC 101-5-1 Registration of Unmanned Aircraft

CANCELLATION

Revision (1) of this AC supersedes revision (0). In this revision, clarifications are made on the various permits required (see paragraphs 1.4 and 1.5), and on the acceptable evidence of the competency of UA pilots (see Appendix 3).

EFFECTIVE DATE

Revision (1) of this AC is effective from 18 August 2020.

OTHER REFERENCES

Nil.

1 APPLICABILITY OF THE PERMITS

1.1 A UA Operator Permit (OP) is required to ensure the safe operation of UA and to mitigate any safety risks posed to other aviation users and the public, when a UA is operated:

- (a) For business or for a purpose that is neither recreation nor education regardless of the mass of the UA;
- (b) For education purpose using a UA of total mass exceeding 7 kilograms;
- (c) For recreation purpose using a UA of total mass exceeding 25 kilograms; or
- (d) Beyond visual line-of-sight (BVLOS).

Note: Illustrations of “recreation purpose” and “education purpose” are described in **Appendix 1**.

1.2 The holder of a UA OP must not operate a UA unless he has a Class 1 Activity Permit (AP1) for that activity.

1.3 A Class 2 Activity Permit (AP2) is required when a UA of total mass not exceeding 25 kilograms is operated outdoors for recreation purpose, or when a UA of total mass not exceeding 7 kilograms is operated outdoors for education purpose, under any of the following operating conditions:

- (a) Height exceeding 200 feet above mean sea level (AMSL);
- (b) Within 5 kilometres of a civil aerodrome or military airbase; or
- (c) Within any restricted area, danger area or protected area, as published in the Government Gazette.

Note: The restricted areas, danger areas, protected areas and areas within 5 kilometres of an aerodrome are shown on OneMap (www.onemap.sg).

OneMap is the only authoritative source for checking against the no-fly zones, other sources and mobile applications (such as those offered by the UA manufacturers) might not provide the correct information on no-fly zones in Singapore. Operating a UA in a no-fly zone without an activity permit issued by CAAS is an offence.

1.4 The holder of a UA Training and Assessment Organisation (UATO) approval is not required to obtain a UA OP or AP1. However, an AP2 will be required if the UATO intends to fly the UA outdoors under any of the conditions as described in paragraph 1.3. For details on UATO requirements, please refer to the Advisory Circular on “Approvals for UA Training” (AC 101-3-1).

1.5 The holder of a UA OP, AP1, AP2 or UATO approval must still register his UA if the total mass of the UA exceeds 250 grams. For details on UA registration, please refer to the Advisory Circular on “Registration of UA” (AC 101-5-1).

- 1.6 For scenarios outside of those described in paragraphs 1.1, 1.3 and 1.4, UA OP and AP are not required. In addition, UA OP and AP are not required for UA operated indoors¹ under any of the following conditions:
- (a) Within a private residence in Singapore for any purpose; or
 - (b) At an experimental site in connection with the construction or testing of that UA, accessible only to the persons involved, and the operations of the UA do not affect the general public.
- 1.7 Notwithstanding paragraph 1.6, operations of UA that do not require any UA OP or AP should adhere to the guidelines in **Appendix 2**.
- 1.8 All UA operations are not allowed outdoors within a prohibited area, as gazetted under the Air Navigation Act.

2 UA OPERATOR PERMIT (OP)

- 2.1 The UA OP allows CAAS to assess if the applicant, its equipment and the personnel flying specified types of UA are fit and capable to conduct UA operations safely. The assessment will include, but not limited to, the applicant's organisational set-up, procedures to manage operations safely including the conduct of safety risk assessments, airworthiness of each UA, and competency of personnel flying the UA.
- 2.2 The UA OP lists the approved UA type(s), type(s) of operations and UA pilot(s), and is typically valid for up to one year. The holder of the UA OP may only conduct an operation that is within the scope granted in the OP, i.e. using the specific UA type(s) for the type(s) of operations with the UA pilot(s) listed in his UA OP. If, during the validity period, there are any changes to the UA OP, the holder of the UA OP is required to submit an application to effect the intended variation.
- 2.3 For the list of information and supporting documents required for a UA OP application, refer to **Appendix 3**.

3 CLASS 1 ACTIVITY PERMIT (AP1)

- 3.1 Unlike the UA OP, which assesses the capability of the holder of the UA OP including his UA, personnel and procedures in assuring safe operation, the AP1 is for the assessment on the specific aspects of the activity, such as:
- (a) The location where the UA is intended to be operated;
 - (b) The type(s) of operation to be conducted;
 - (c) The date(s)/time(s) during which the operation(s) will be conducted at the location(s);
 - (d) The maximum operating altitude;

¹ Indoors, in relation to any place, means any place that has a ceiling or roof and is (except for doors and passageways) completely enclosed by walls or closed windows, whether permanently or temporarily.

- (e) Mitigation measures proposed by the operator to address site-specific circumstances such as nearby buildings/obstacles, crowds, visibility etc. at the time of operations; and
 - (f) Activity applied for is within the capability of the operator as approved in the UA OP.
- 3.2 In the interest of aviation safety, the operation of a UA outdoors within 5 kilometres of a civilian airport or military airbase is subject to more stringent safety assessment by CAAS to prevent the UA from interfering with manned aircraft operation. Any UA operation within 5 kilometres of an aerodrome may be required to de-conflict from manned aircraft operations and have in place robust safety measures to effectively mitigate any risk of a runaway UA.
- 3.3 For convenience of the holder of an UA OP, CAAS may consider granting a single AP1, known as a block permit, that allows for the same UA operation to be carried out multiple times over an extended period of time by the same UA type at the same location. Examples of such activities include:
- (a) A wedding photographer (the holder of a UA OP) who takes aerial photographs (commercial purpose) at Hotel A (specific location) between 5pm to 11pm on 5 Jan, 6 Jan, 12 Feb, 14 Feb and 20 Feb (specific dates/times).
 - (b) A shipbuilder (the holder of an UA OP) performing aerial inspection of ships (specialised service) at Y shipyard (specific location) every day between 12pm and 4pm from 1 Jan to 31 Mar (a block duration).

Under a block permit, the operating periods will be subject to coordination with relevant authorities to ensure that the UA flights can be safely conducted.

- 3.4 Should there be a change in the date(s)/time(s) of an AP1 before the start date of the activity specified in the permit, the operator may seek a variation to the permit, at least one week prior to the affected date/time so that CAAS may be able to review the airspace usage and consult other agencies involved.
- 3.5 If the holder of a UA OP intends to conduct the same activity, i.e. same operation using same UA type at same location albeit at later date(s), for which he had been granted an AP1 previously, he may apply for a “repeat” AP1, for which a processing fee is applicable. Using the example from paragraph 3.3(b), the shipbuilder may apply for a repeat AP1 for the same aerial inspection at the shipyard for a new period from 1 May to 31 July.

Note: A “repeat” is only allowed for AP1s that are granted less than 1 year ago from the intended new period as mentioned above.

- 3.6 For multiple activity locations, a single AP1 may be granted if the activity locations are proximate to one another. However, if the locations are far apart (i.e. exceeding 2 kilometres) and/or the type of operation varies between activity sites, an operator will have to apply for AP1s for each location.
- 3.7 For the list of information and supporting documents required for an AP1 application, refer to **Appendix 4**.

4 CLASS 2 ACTIVITY PERMIT (AP2)

- 4.1 The requirement for an AP2 is described in paragraph 1.3.
- 4.2 In the interest of aviation safety, the operation of a UA outdoors within 5 kilometres of a civilian airport or military airbase is subject to more stringent safety assessment by CAAS to prevent the UA from interfering with manned aircraft operations. Any UA operation within 5 kilometres of an aerodrome may be required to de-conflict from manned aircraft and have in place robust safety measures to effectively mitigate any risk of a runaway UA.
- 4.3 For convenience of the operator, CAAS may consider granting a single AP2, known as a block permit, that allows for the same UA operation to be carried out multiple times over an extended period of time by the same UA type at the same location. The operating periods will be subject to coordination with relevant authorities to ensure that the UA flights can be safely conducted.
- 4.4 Should there be a change in the date(s)/time(s) of a AP2 before the start date of the activity specified in the permit, the holder of the AP2 may seek a variation to the AP2, at least one week prior to the affected date/time so that CAAS may be able to review the airspace usage and consult other agencies involved.
- 4.5 If the holder of an AP2 intends to conduct the same activity, i.e. same operation using same UA type at same location albeit at later date(s), for which he had been granted an AP2 previously, he may apply for a “repeat” AP2, for which a processing fee is applicable.

Note: A “repeat” is only allowed for AP2s that are issued less than 1 year ago.

- 4.6 CAAS may grant a single AP2 to cover multiple activity locations if the activity locations are proximate to one another. However, if the locations are far apart (i.e. exceeding 2 kilometres) and/or the type of operation varies between activity sites, an applicant will have to apply for an AP2 for each location.
- 4.7 For the list of information and supporting documents required for an AP2 application, refer to **Appendix 4**.

5 OTHER PERMITS

- 5.1 Where necessary, any one or more of the following permits may be granted together with the AP1 or AP2:
- (a) A permit granted by the Singapore Police Force (SPF) pursuant to section 7 of the ANA for taking photographs of a protected area;
 - (b) A permit granted by SPF pursuant to section 7A of the ANA for overflying a protected area;
 - (c) A permit granted by SPF pursuant to section 26 of the POA for using UA in a special event area;
 - (d) A permit granted by CAAS pursuant to section 7C of the ANA for discharging a substance from a UA; and

- (e) A permit for use of radio frequencies and power limits that do not comply with the Info-communications Media Development Authority of Singapore (IMDA) guidelines on radio frequencies and power limits for short range devices.
- 5.2 The applicant should therefore provide the necessary details and supporting documents to identify the necessity for the grant of such permits.

6 PERMIT APPLICATION

- 6.1 Permit applications are to be submitted via CAAS website (<https://www.caas.gov.sg/e-services-forms/e-services/application-for-flying-of-unmanned-aircraft>). Application will require login via SingPass/CorpPass/eSOMS ID. For applications by a Singapore organisation, the applicant must login via CorpPass. Entities who are not eligible for SingPass/CorpPass credentials (e.g. overseas-based entities) will login via eSOMS ID.
- 6.2 Other than the information and documents mentioned in the preceding paragraphs, applicants are also required to make the necessary payment upfront during the application. CAAS allows payment via credit cards, telegraphic transfer, internet banking and cheques, and details of the payment methods can be found on the application portal. A list of applicable permit fees is listed in **Appendix 5**.
- 6.3 Upon successful submission of the application, including the applicable fees, CAAS will review the submitted information and documents, and may contact the applicant for further clarifications. Regardless of the outcome of the application, fees paid are not refundable or transferrable.

Note: If the radio frequency band(s) and power(s) used do not fall within the technical specifications set out in the First Schedule of the Telecommunications (Exemption from Sections 33, 34(1)(b) and 35) Notification, the Info-communications Media Development Authority of Singapore (IMDA) will separately contact the applicant for further clarifications.

- 6.4 The typical processing time for a UA OP is 10 working days and 5 working days for an AP, depending on the completeness of the submission of supporting documents and complexity of the UA operations. Applications for BVLOS operations will take at least 3 months. Operators are encouraged to submit their applications well in advance of their intended operations and factor permit processing time into their planning.

The holder of a UA OP should always aim to submit a renewal application 2 to 4 weeks before the UA OP expires. It is the responsibility of the holder of a UA OP to ensure that his UA OP gets renewed timely. Once the UA OP expires, a renewal is not allowed and a new UA OP application will be required.

For applications that have been pending for more than 3 months due to various reasons, the assessment process may be terminated. CAAS will notify the applicant in advance to withdraw the application and re-apply when ready.

- 6.5 Applicants may check the status of their application via eSOMS. CAAS will notify the applicant in writing on the outcome of the application.

7 OPERATOR IS RESPONSIBLE FOR SAFETY

- 7.1 Despite having the necessary permits, the operator remains responsible to ensure that the UA is operated in a safe manner and does not endanger the safety of any person, aircraft or property. He shall also notify CAAS by the quickest available means of any airworthiness and operational incidents/accidents. A non-exhaustive list of reportable safety matters can be found in **Appendix 6**.

Note: The person required to hold the UA OP is the operator, not the client who engages the operator and pays for the service. The operator is the service provider or contractor.

1 RECREATION PURPOSE

- 1.1 As defined in ANR-101, “recreation purpose” means any pursuit or activity engaged in for enjoyment, relaxation or leisure, but not —
- (a) a sporting activity that forms part of an organised group activity or organised competition or tournament (such as a flying display); or
 - (b) a recreational activity provided by a business, or in the course of business.
- 1.2 Some examples of activities that are considered as “recreation purpose” include:
- (a) An individual flying a UA for fun in line with CAAS’ operating conditions.
 - (b) An individual flying a UA higher than 200 feet above mean sea level for aerial photography for personal collection.

2 EDUCATION PURPOSE

- 2.1 As defined in ANR-101, “education purpose” means any lecture, tutorial, seminar, demonstration, class or similar activity on unmanned aircraft, offered or provided by an education institution mentioned in section 72 of the Private Education Act (Cap. 247A) to students enrolled in that education institution.
- 2.2 Some examples of activities that are considered as “education purpose” include:
- (a) A university or tertiary institute mentioned in section 72 of the Private Education Act (Cap. 247A) conducting a course that involves flying of a UA for its enrolled students, as part of its full time curriculum.
 - (b) A public educational institute within 5km of a civil airport / military airbase flying UA outdoors to demonstrate its capabilities to the students.
 - (c) Students of a public educational institute showcasing their UA as part of a school event.
 - (d) A teacher of a public educational institute educating his students on UA technology that involves flying of a UA as part of co-curricular activities.
 - (e) Students of a university or tertiary institute mentioned in section 72 of the Private Education Act (Cap. 247A) conducting flight tests as part of their final year projects.

3 NON-RECREATION OR NON-EDUCATION PURPOSE

3.1 Some examples of activities that are neither considered as a “recreation purpose” nor “education purpose” include:

- (a) A business providing aerial surveying or photography services for a public educational institute.
- (b) An organisation conducting a flight demonstration with its UA to its prospective customers.
- (c) An organiser conducting competitive UA races.
- (d) A company using its UA to carry out inspections of its facilities or properties.
- (e) A farm (the business being agriculture) using its UA to survey crops or spray pesticides.
- (f) A government agency (excluding the Singapore Armed Forces) using its UA to perform aerial surveillance, aerial fire-fighting or as part of the provision of emergency or essential services.
- (g) A factory (or any organisation) using its UA to deliver small articles between various locations in its compound.
- (h) A warehouse using its UA to stock take its inventory.
- (i) A performance involving UA at Chingay Parade or National Day Parade.
- (j) UA used as part of a show staged in the Singapore Indoor Stadium.
- (k) A training service provider conducting UA flying courses for an educational institute’s students on its behalf.
- (l) A public educational institute using its UA to take photographs and videos of its activities and events.
- (m) A company’s public communications department using a UA to take event photographs for marketing or publicity efforts.
- (n) A volunteer using a UA to take photographs and videos for a charity event.
- (o) An individual sharing his personal collection of aerial photographs taken using his UA with business for marketing purposes, regardless of whether there are any monetary exchanges.

Given Singapore's busy airspace and densely populated urban environment, the flying of UA must be carried out in a safe and responsible manner. It is important to note the following safety guidelines.

- 1 Before flying, ensure that the following steps are taken:
 - (a) Read the operating instructions and safety guidelines described within the user manual of the UA.
 - (b) Understand the characteristics of the UA – control functions, maximum flight time, operating range, operating temperature, speed and height capabilities.
 - (c) Check the weather conditions to ensure good visibility and no strong winds.
 - (d) Check the conditions of the UA and controllers – batteries fully charged, no visible physical damage, propeller(s) tightened and free to move, and any other checks as described within the user manual.
 - (e) Register the UA if it has a total mass of exceeding 250 grams.

- 2 When flying, observe these rules:
 - (a) Keep the UA within sight at all times.
 - (b) Land the UA immediately if any aircraft or helicopter is sighted in the vicinity.
 - (c) Fly the UA lower than 200 feet above mean sea level.
 - (d) Fly the UA outside of restricted, danger, protected or prohibited areas, or exceeding 5km radius from any airport or military airbase.
 - (e) Never fly a UA under the influence of any psychoactive substances such as alcohol and sedatives.
 - (f) Never fly the UA over groups of people, public events, or areas full of people.
 - (g) Never fly the UA low on or along any roads.
 - (h) Never fly the UA in any area where there is an emergency response effort ongoing.
 - (i) Never drop any item or discharge any substance from the UA.
 - (j) Never carry any hazardous substances on the UA.

The following documents are required for Operator Permit (OP) applications:

New UA OP Applications

- 1 An Operations Manual, which should include the following information:
 - (a) Identity and contact details of the operator.
 - (b) Description of the operator's nature of work, and its organisational structure pertaining to UA operations, if applicable.
 - (c) General procedures for incident and accident reporting, and management of casualties arising from any accident.
 - (d) Description of an internal training programme to ensure competency and currency for all personnel involved in UA operations.
 - (e) Description of how the flight records, maintenance records and training records are managed.
 - (f) Details of the UA and its associated elements such as the ground control station:
 - (i) Picture(s) clearly showing the UA and its associated elements,
 - (ii) Specifications of the UA and its associated elements,
 - (i) Flight checks to be carried out for all envisaged UA operations,
 - (ii) Emergency procedures to be carried out for all envisaged UA operations,
 - (iii) Maintenance regime of the UA and its associated elements.
 - (g) Description of the type(s) of operation to be conducted and the general procedures to conduct the operation safely.

Note: The Operations Manual has to be approved and signed by the responsible personnel for the organisation's UA operations to confirm that it and any included supporting documents will be complied with at all times.

As the purpose of the Operations Manual is to describe how the operator operate safely in Singapore, it is intended for the Operations Manual to be a "living document" that is useful to the operator in fulfilling its obligation to maintain the UA OP approval and to CAAS for its continued safety oversight. It is, therefore, essential that the Operations Manual is regularly reviewed and changes are incorporated at the earliest opportunity to ensure it remains current. Any proposed amendment to the Operations Manual, other than typographical changes, should be accepted by CAAS before incorporation. Applicants are to maintain proper revision control of the Operations Manual and identify clearly to CAAS the amendments made in the Operations Manual that is to be submitted to CAAS.

A detailed explanation to assist applicants in developing their Operations Manual are provided in **Appendix 7**.

2 If UA used is customised or significantly modified such that there is impact to its critical functions, the following information should be provided to support the airworthiness of the UA:

- (a) Details of analysis carried out to derive the key design parameters such as the maximum flight duration, maximum speed capable and maximum height capable;
- (b) Details of acceptance tests or checks conducted to ensure UA is ready for first flight such as sensor accuracy checks, structural load tests, propulsion thrust measurement, weight and balance, control link range checks, failsafe function verifications, and interoperability tests. This should also not be confused with pre-flight checks;
- (c) Details of environmental tests conducted to verify that the UA is able to operate with no or within acceptable margins of performance degradation in its intended environment such as temperature test, shock and vibration test, water ingress test, and EMI/EMC test.

Note: As it is not the intention for CAAS to certify the UA, it is not required for the operator to conduct the above tests in a certified test house. However, operator should do their due diligence to ensure that any tests, checks or analysis conducted in-house are as accurate and controlled as possible.

3 If BVLOS UA operations is intended to be conducted, a BVLOS compliance checklist and its supporting documents will be required. For details on the assessment of BVLOS operations, please refer to the Advisory Circular on “BVLOS Operations for Unmanned Aircraft” (AC 101-2-2).

4 Supporting evidence of competency of the UA pilot(s):

- (a) Details of any relevant training or course attended, or a physical flight demonstration in the presence of CAAS; or
- (b) Successful completion of UAPL theory test and practical assessment by an Authorised Flight Examiner (AFE(UA)) at a UA Training and Assessment Organisation (UATO) if application is submitted prior to 1 February 2021; or
- (c) Licence number of relevant and valid UAPL issued by CAAS.

Note: From 18 September 2020, CAAS will no longer schedule any physical flight demonstration. For cases where no existing AFE(UA)s are able to conduct the practical assessment due to the UA used, applicants may approach CAAS for assistance. For details on theory test, practical assessment and UAPL requirements, please refer to the Advisory Circular on “UA Pilot Licence” (AC 101-4-1).

5 ACRA BizFile for Singapore-based organisations. For overseas-based entities that do not have an ACRA BizFile, an official letter of intent is required from a Singapore-based organisation that has engaged their services, stating the date(s)/time(s) and purpose of type(s) of operation to be conducted in Singapore.

Applications to Vary the UA OP

- 1 For variations such as a change in the key management personnel of the operator, or the addition/substitution/removal of UA type(s) or type(s) of operations, a revised Operations Manual is required. CAAS may also request for additional documents or information during such applications.

Note: For a change in the operator name but without a change in the unique entity number (UEN), the updated ACRA BizFile will also be required for submission. If there is a change in the UEN, a variation to the UA OP is not allowed as there is a change in legal identity. The operator should apply for a new UA OP instead.

- 2 For variations to include additional UA pilots, the supporting evidence of the competency of the nominated pilots is required:
 - (a) Details of any relevant training or course attended, or a physical flight demonstration in the presence of CAAS; or
 - (b) Successful completion of UAPL theory test and practical assessment by an AFE(UA) at a UATO if application is submitted prior to 1 February 2021; or
 - (c) Licence number of relevant and valid UAPL issued by CAAS.

Note: From 18 September 2020, CAAS will no longer schedule any physical flight demonstration. For cases where no existing AFE(UA)s are able to conduct the practical assessment due to the UA used, applicants may approach CAAS for assistance. For details on theory test, practical assessment and UAPL requirements, please refer to the Advisory Circular on "UA Pilot Licence" (AC 101-4-1).

Applications to Renew the UA OP

- 1 The revised Operations Manual if there are changes since the last issuance of the UA OP.
- 2 Records of flight activities conducted over the past year.
- 3 Records of maintenance conducted on the UA over the past year.
- 4 Records of training attended by personnel involved in the UA operations for the past year.
- 5 Summary of any UA incidents or accidents recorded in the past year. If no incidents or accidents occurred in the past one year, a declaration by the responsible personnel for the organisation's UA operations has to be provided.
- 6 Overseas-based entities are required to submit an official letter of intent from a Singapore-based organisation that has engaged their services, stating the date/time and purpose of type(s) of operation to be conducted in Singapore. If the overseas-based operator is unable to provide a letter of intent or the date(s)/time(s) stated in the letter of intent do not fall within the next validity period, the UA OP will not be renewed.

The following documents are required for Activity Permit (AP) applications:

- 1 Illustration of the whole operation processes:
 - (a) Flight plan (take-off/landing, hover/flight path, height, speed, how visual line of sight is maintained, number and position of pilots and observers, etc);
 - (b) A map or floor plan (e.g. Google satellite map at the appropriate scale) of the activity site with annotation of launch/recovery point(s) and any horizontal flight path of the unmanned aircraft;
 - (c) Indicate if the activity is conducted for, or within proximity of an organised event where crowds are expected (marathon, festival, exhibition, parades, events, etc.).

- 2 Risk Assessment Form:
 - (a) For each activity, please complete the Risk Assessment Form (<https://www.caas.gov.sg/e-services-forms/forms/unmanned-aircraft-systems>). To ensure that the risk assessment is relevant to the activity, the operator should identify hazards specific to the activity and implement control/recovery measures to mitigate the risks.
 - (b) Control / Recovery procedures included in this risk assessment are expected to be incorporated into the Operations Manual.
 - (c) Please identify at least 3 hazards in each section.

- 3 Additional documents (if available):
 - (a) Evidence of adequate insurance coverage for the intended activity;
 - (b) Supporting documents to prove the availability of systems, software, or mechanisms, e.g. manufacturer or product specification, that serve to:
 - (i) ensure that the UA operation can be confined within the planned area of operation;
 - (ii) provide in-flight monitoring of critical system parameters (battery power, rotor performance etc.);
 - (iii) allow post flight review of the flight profile;
 - (c) An illustration of how the unmanned aircraft will drift in the event of power failure at maximum operating height.

As reproduced from the Second Schedule of ANR-101:

Permit Application Type		Fee
UA Operator Permit (OP)	<u>New</u> : Operator assessment + 1st UA type	\$600
	For each UA type added or substituted	\$400
	Renewal	\$200
Class 1 Activity Permit (AP1)	<u>Each</u> activity or <u>block of different dates/times of the same activity</u> (i.e. same location, type of operations and UA type)	\$75
	<u>Repeat</u> activity (same as previously approved Activity Permit) with new dates/times only	\$25
Class 2 Activity Permit (AP2)	<u>Each</u> activity or <u>block of different dates/times of the same activity</u> (i.e. same location, type of operations and UA type)	\$60
	<u>Repeat</u> activity (same as previously approved Activity Permit) with new dates/times only	\$20

Some examples of reportable safety matters:

- 1 Any malfunctions of, or damage to, the UA structure, components, or subsystems, while in operation, which affect its airworthiness or led to difficulty in control of the aircraft.
- 2 Any damage to UA, due to foreign objects or environment, while in operation, which affect its airworthiness or led to difficulty in control of the aircraft.
- 3 Near collision of the UA with other aircraft or objects, near misses, or occurrence that has a potential of causing an accident.
- 4 Incapacitation of flying crew.
- 5 Any airspace infringement event.
- 6 Any other significant safety incidents that may endanger the operations of the UA and/or cause danger to persons and property.
- 7 Any occurrence during the operation of the UA leading to:
 - (a) Missing or total loss of the UA;
 - (b) Requiring major repairs of the UA; or
 - (b) Serious injury or fatality to people.

This appendix provides guidance on the structure of a typical Operations Manual. The guidance is generic and could be applied to the various types of organisations or an individual. While all the components and elements of the Operations Manual must be put in place, the degree of implementation should commensurate with the size, nature and complexity of operations.

A template of the Operations Manual, with explanatory notes indicated within, can also be found on CAAS website (<https://www.caas.gov.sg/e-services-forms/forms/unmanned-aircraft-systems>). Although all applicants are strongly encouraged to use the template, CAAS expects that all operators create their own content adjusted to their operational needs.

Operations Manual Format

The Operations Manual should be accompanied by a cover page, indicating the following:

- Operator name (e.g. ABC Pte Ltd)
For organisations, the registered entity name as listed in ACRA BizFile, or a legally-recognised name is to be indicated. For individuals, registered name as per NRIC/FIN/Passport is to be indicated.
- Title of the document (e.g. UAS Operations Manual)
- Document number and revision number (e.g. ABC/UAS/001 Revision 1)
This should be based on the operator's internal document control framework. For individuals without such document control framework, a reference number should still be created to allow for the unique identification of the document.
- Operator's standard identification number
For organisations, the unique entity number (UEN) is to be indicated. For individuals, the applicant's NRIC/FIN/Passport number is to be indicated.
- Operator's address and contact details
For organisations, the address of the principal place of business is to be indicated. For an individual, the applicant's residential address is to be indicated.
- Approval signatory by the responsible personnel, and date of approval
For organisations, the responsible personnel refers to a person who represent the organisation's management structure and is responsible for all UA operations undertaken by the organisation. For an individual, the applicant is the responsible personnel.

The Operations Manual should also have a content page to provide the reader an idea of the information residing within and what page it can be found on. A suggested content structure is as listed in the following. Detailed explanations to each section are also provided in the following paragraphs.

Section 0 – General

- Record of Revisions
- Foreword
- Acronyms, Abbreviations and Definitions

Section 1 – Organisation Operations

- 1.1 Organisation Profile
- 1.2 Organisational Structure
- 1.3 Responsibilities of the Operator

Section 2 – Incident/Accident Reporting

- 2.1 Reporting Requirements
- 2.2 Management of Casualties

Section 3 – Internal Training

- 3.1 Induction Training Requirements
- 3.2 UAS-Specific Training Requirements
- 3.3 Operation-Specific Training Requirements
- 3.4 UA Pilot Currency Requirements

Section 4 – Management of Records

- 4.1 Management of Flight Logs
- 4.2 Management of Maintenance Logs
- 4.3 Management of Training Logs

Section 5 – Unmanned Aircraft Type

- 5.1 UA Brand / Type 1
 - 5.1.1 UA Configuration List
 - 5.1.2 UAS Specifications
 - 5.1.3 Flight Procedures
 - 5.1.4 Maintenance Plan
- 5.2 UA Brand / Type 2
- ...
- 5.3 UA Brand / Type 3
- ...

Section 6 – UA Operations

- 6.1 Type of Operations 1
 - 6.1.1 Description of Type of Operations 1
 - 6.1.2 General UA Operating Procedures
 - 6.1.3 Additional Operating Procedures
 - 6.1.4 Hazard Identification, Risk Assessment and Risk Mitigation
- 6.2 Type of Operations 2
- ...
- 6.3 Type of Operations 3
- ...

Appendix A – UA Types and Allowable Types of Operation

Appendix B – Flight Logbook Template

Appendix C – Maintenance Logbook Template

Appendix D – Training Records Template

Section 0 – General

Record of Revisions

This section enables the tracking of changes to the document scope, and identifies when key changes were made when the document undergoes multiple revisions.

The key changes to the scope of the document that requires a revision update include, but not limited to the following:

- Changes to organizational structure
- Changes to reporting requirements
- Changes to training requirements
- Changes to recording requirements
- Addition / removal / variation of UA type
- Addition / removal / variation of type of operations
- Changes to appendix

An example as follows:

<u>Revision</u>	<u>Date of Revision</u>	<u>Page / Section</u>	<u>Purpose of Revision</u>
0	10 Jun 2015	All	Initial release
1	19 Sep 2015	p.8 / s.1.3	Included ABC
2	23 Oct 2016	p.10 - 12 / s.2	Removed XXX
		p.19 / App. C	Revised XYZ

Foreword

This section provides introductory remarks and scope of the Operations Manual.

An example as follows:

The Operations Manual contains instructions for the operation and management of UAS and all personnel critical to the safety of UA operation who are controlled under the authority of the UA Operator Permit.

Any changes to the Operations Manual, other than typographical errors or changes that do not affect the meaning of the content, must be notified to and accepted by CAAS.

Acronyms, Abbreviations and Definitions

This section lists any technical terms or phrases that would otherwise be too lengthy to explain or repeat in the main document, and to avoid confusion for the reader.

Consider the following when deciding what to include in this section:

- Use an abbreviation when it will be used at least three times in the manual
- Use an acronym to avoid repetitive use of long and cumbersome titles
- Define all jargons

Section 1 – Organisation Operations

Organisation Profile

This section describes the nature of work the organisation is undertaking, including the details on what the UA OP will be used for.

Consider the following when describing the business profile:

- Type of industry (e.g. aviation, oil and gas, construction, logistics, education, information communication and media etc.)
- Nature of work (e.g. service provider, merchandising, manufacturing etc.)
- Customer base
- Purpose and scope of intended UA operations

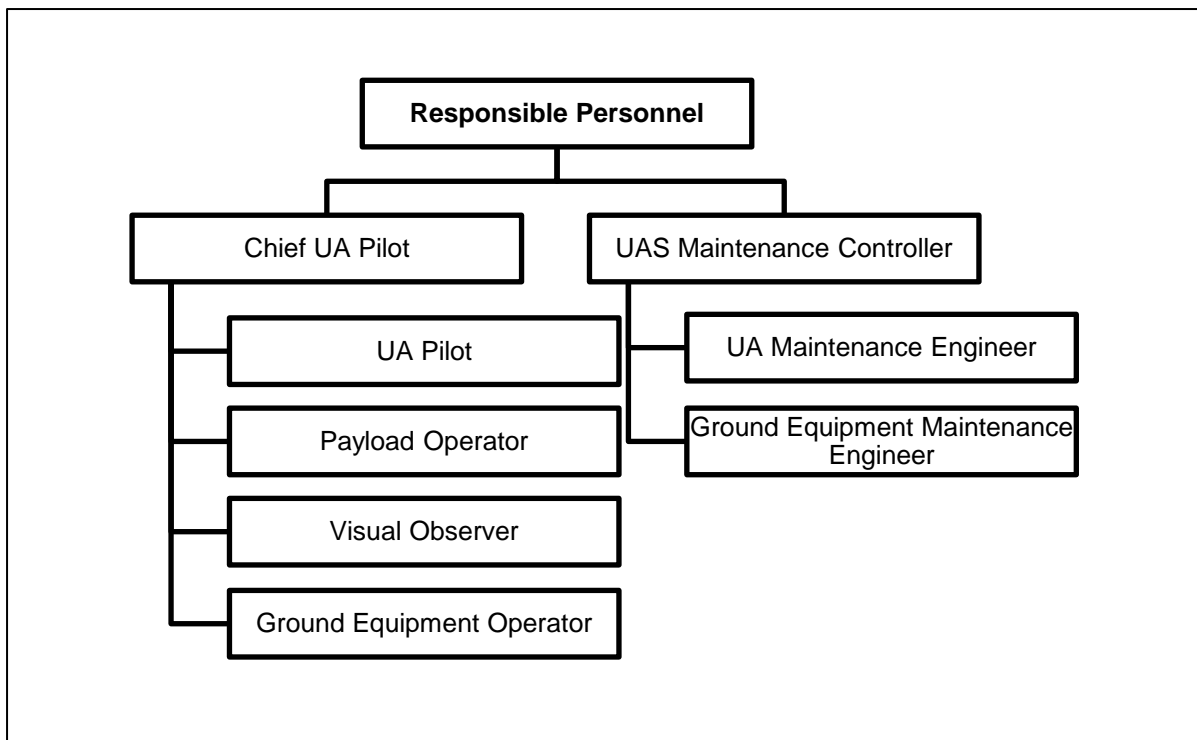
Organisational Structure

This section contains the organisation chart showing lines of responsibility of key personnel pertaining to UA operations only. Names and actual designations should also be indicated for the key personnel.

The person(s) nominated should represent the management structure of the operator's organisation and be responsible for all functions specified in the next sub-section. Dependent upon the size of the organisation, the functions may be further sub-divided under individual persons or combined in any number of ways. Any one person may assume more than one function.

For an individual or a one-man company, an organisational structure is not required.

An example for a typical UA organisation is as follows:



Responsibilities of the Operator

This section contains the responsibilities of the operator, which includes being responsible for providing and allocating the necessary resources for effective safety compliance for all UA operational matters and supervision of all personnel involve in UA operations. These responsibilities should be clearly identified, documented and communicated.

An example is as follows:

The Operator is accountable for the overall compliance of safety requirements and ensuring that adequate resources are available to conduct the operations in accordance to the Operations Manual, to support the scope and conditions in the UA Permit.

The Operator's responsibilities include:

- Providing and allocating manpower, technical, financial or other resources necessary for effective safety compliance;
- Establishing and monitoring of safety performance, and resolution of any safety issues;
- Ensuring all UA activities are conducted with the necessary permits granted by the relevant authorities, and in compliance with the conditions listed in the permits;
- Maintaining all records, such as flight logs, maintenance logs, UA configuration management and UA operation personnel's training records;
- Ensuring all UA pilots and any personnel involve in the UA operations are proficient, qualified, familiar with and implement the procedures set out in the Operations Manual;
- Ensuring that the Operations Manual is complete, relevant and up-to-date;
- Coordinating and communicating with CAAS and other Singapore government agencies on issues relating to safety, any changes to the organisation structure, as well as any enquires pertaining to UA permit application, or general regulatory matters.

Please also note that the operator refers to a person, organisation or enterprise engaged in or offering to engage in UA operations, and does not refer to just the UA pilot in control of the UA.

Section 2 – Incident/Accident Reporting

This section describes the procedures to reporting of any incident or accident relating to the UA, as well as management of casualties as a result of a UA accident.

The sole objective of incident/accident reporting is for the prevention of future of incidents or accidents. It is not meant for CAAS or the operator to apportion blame or liability.

The minimum requirements for reporting to CAAS is as described in the following. However, additional procedures may also be included if there are other emergency planning and response requirements the operator needs to comply with.

The Operator shall inform CAAS at CAAS_ACU_UAS@caas.gov.sg of any airworthiness or operational incident/accident, as defined by the Air Navigation (Investigation of Accidents and Incidents) order, relating to the UA within 24 hours of its occurrence, and follow up with a written report within 3 working days.

The initial notification shall include, but not limited to the following:

- Permit details (such as Operator Permit number, Activity Permit number etc.)
- Date, time and location of the incident/accident
- Casualty and damaged property involved
- Details on UA used and state of UA
- Details of UA pilot involved
- Initial analysis to the cause of incident/accident
- Immediate action taken after the incident/accident

The written report shall include, but not limited to the following:

- Information provided in the initial notification to CAAS
- Investigation outcome
- Root cause analysis / causal factors analysis
- Corrective / preventive actions taken to prevent a recurrence

An example of the general procedures for management of casualties is as follows:

In the event of an UA incident or accident resulting in casualties, all personnel involved in the UA operations shall follow the casualty management plan as set out in the following:

- The UA Pilot shall stop the UA operation as soon as practicable, and attend to the casualty immediately.
- For minor injuries, first aid shall be administered to the casualty and ...
- For serious injuries, the casualty shall be transported to the nearest identified hospital and ...

Useful Contacts:

AMBULANCE	995
POLICE	999
FIRE	995
...	+65 XXX

Section 3 – Internal Training

All personnel involve in UA operations should be trained so that they are equipped to perform their duties effectively. The type of training should be appropriate to the individual's involvement in the operations, and be conducted by personnel who have undergone the appropriate training and have adequate experience in the UA operations.

This section describes an induction training programme for new hires, UA-specific and operation-specific training plan, as well as recurrent and currency training plans for all personnel, especially for UA pilots.

Induction Training, UA-specific Training & Operation-specific Training

Induction training programme is meant for new hires, and should minimally cover the following topics:

- Familiarisation with operator's procedures and processes
- Understanding of individual's job functions, scope and responsibilities

UA-specific training should be aligned with the information presented in the UA type section of the Operations Manual and minimally cover the following areas:

- Operational limitations of the UA
- Capabilities of the UA such as modes of control and failsafe behaviours
- Specifications of the UA
- Emergency handling procedures

Operation-specific training should be aligned to the scope as presented in the type of operations section of the Operations Manual, and minimally cover the following areas:

- Scenario-based procedures and contingencies (e.g. BVLOS perimeter surveillance, aerial mapping, building inspection involving visual observers etc.)
- Training on mode of operation (e.g. GCS, operations centre, etc)

For all trainings, the operator should also identify the necessary pre-requisites for each training and if recurrent training is required. An example of a training plan is as follows:

S/N	Name of Training	Training Type	Pre-requisites	Recurrent Required?
1	XXX	Briefing / Workshop / OJT (XX times) / ...	Nil / [Name of Training] Completed / Valid UA pilot licence / ...	No / Every Month / Annually / ...

UA Pilot Currency Requirements

The minimum number of sorties required for currency is recommended to be at least 1 every 6 months. The operator may increase currency requirements based on their operational needs.

Flights conducted in the course of business may be considered as currency flights. A proxy UA with similar handling characteristics may also be used for currency purposes.

The operator should also identify a corrective action plan for UA pilots who are not current.

An example of a currency plan is as follows:

UA Category / Type	No. of sorties required per year	Corrective Actions for Non-Current UA Pilots
Aeroplane / Rotorcraft / Powered-lift / Airship / ...	X	X no. of satisfactory supervised flights by a current UA pilot / [Name of Training] to be completed again / ...

Section 4 – Management of Records

This section describes what type of records are kept, information collected for each type of records, and how long the records are kept for.

A template of each type of record should also be documented in the Appendix for completeness.

Management of Flight Logs

A Flight Logbook is used to record a UA pilot's flying hours for the purpose of tracking pilot currency. It is also used to record the running hours of the UA flown for the purpose of tracking time to maintenance.

This section should include the minimum requirements that are as described in the following. However, additional items may also be included if required by the operator.

All flights conducted shall be recorded in a Flight Logbook for the purpose of tracking UA pilots' flying hours and equipment running hours.

All flight records shall be kept minimally for a period of 1 year.

Flight details to be recorded in the Flight Logbook includes:

- Date, time and duration of flight
- Location of flight
- Purpose of flight
- UA configuration used for flight
- UA pilot(s)-in-command

It is also recommended for the flight logs to be in an electronic form (e.g. Microsoft Excel) so that the required information may be sorted as necessary (e.g. sort by UA pilot, sort by UA type).

Management of Maintenance Logs

A Maintenance Logbook is used to record all maintenance conducted on the UA. As the maintenance log is also used to keep track the configuration of the UA, each UA should have its dedicated maintenance logbook with a unique identifier assigned to it.

For operators who delegate maintenance to another organisation (e.g. DJI Care), a maintenance log should still be maintained, minimally recording when the UA was sent for maintenance and what was maintained/replaced as advised by the maintenance organisation.

For operators using non-modified commercial-off-the-shelf UA, UA configuration may be tracked at a higher system-level i.e. UA platform, payload (e.g. camera and gimbal), battery and ground control station (e.g. remote transmitter).

This section should include the minimum requirements that are as described in the following. However, additional items may also be included if required by the operator.

All maintenance conducted on the UA, either scheduled or unscheduled, shall be recorded in a Maintenance Logbook. Each UA shall have its dedicated Maintenance Logbook to track its configuration.

All maintenance logs shall be kept minimally for a period of 1 year upon decommissioning of the respective UA.

The Maintenance Logbook shall be divided into following sections:

- Configuration Management –
The part number and serial number of all installed components on the UA, which the Operator can readily replace during maintenance, shall be tracked in this section.
- Maintenance / Defects Log –
The purpose and date of maintenance, name of personnel conducting the maintenance, description of defects found and description of rectifications and repairs conducted shall be recorded in this section. All critical defects shall be rectified before the UA is allowed to be released for operations.

Management of Training Logs

All personnel involved in the UA operations should be appropriately trained. A Training Logbook is used to record any trainings an individual has underwent to be properly equipped for his/her task. The training log will also allow an individual to keep track of his/her currency requirements.

For trainings that any personnel is exempted from with permission from the operator, the reasons shall also be recorded within the training log.

This section should contain the minimum requirements that are as described in the following. However, additional items may also be included if required by the operator.

All trainings related to the safe operations or maintenance of the UA attended by personnel working under the authority of the UA Operator Permit shall be recorded in a Training Logbook. Each personnel shall have a personal Training Logbook.

All training logs shall be kept for a period of 1 year upon the respective personnel's last day of service in the organisation.

Training details to be recorded in the Training Logbook includes:

- Name of training
- Type of training
- Date of training completed
- Purpose of training

Section 5 – Unmanned Aircraft Type

This section describes the UA configurations, UAS specifications, flight and maintenance procedures, and allowable type of operations for a specific UA type.

A separate sub-section should be created for each UA type for better organisation, and each sub-section should contain the information as described in the following paragraphs.

UA Configuration List

This section briefly describes all the configurations of a specific UA type the operator is using. Configurations listed in this section should correspond to the respective configuration management of the Maintenance Logbook.

Each variant of the UA type should have its own table of configurations, and examples are as follows:

<Picture(s) of UA configuration, showing clearly the UA and payload(s) installed.>			
Configuration Name	DJI Phantom X Adv	Configuration Weight	2.0 kg
Payload 1 Brand / Model	Zenmuse 3-axis Gimbal	Payload Weight	0.3 kg
Payload 2 Brand / Model	Zenmuse Z5 Camera	Payload Weight	0.2 kg

<Picture(s) of UA configuration, showing clearly the UA and payload(s) installed.>			
Configuration Name	DJI Phantom X Pro	Configuration Weight	1.9 kg
Payload 1 Brand / Model	Fixed FLIR Camera	Payload Weight	0.2 kg
Power Source	Original on-board battery removed and replaced with a dummy weight. UA powered by ground power via tether system.		

UAS Specifications

This section lists the specifications of the UA, payload(s) installed, ground control station and any other critical systems required for the operation of UA (e.g. tether system, parachutes, airbag, launcher etc.).

For customised/modified UAs, supporting documents on airworthiness compliance such as compliance matrix, analysis reports and test reports are to be submitted to CAAS as well. Document titles, numbers and revisions of these supporting documents submitted are to be listed in this section.

For UA specifications, the following should minimally be included:

- UA brand / model / name
- UA empty mass (without any payload installed)
- UA maximum take-off mass
- UA dimensions (e.g. length and wingspan)

- UA maximum flight duration capable
- UA maximum speed capable
- UA maximum height capable
- UA power source (e.g. on-board battery / power via tether, type of power source, number of cells / voltage, total capacity etc.)
- Radio frequency band & field strength / power

For payload specifications (if applicable), the following should minimally be included:

- Payload brand / model / name
- Payload type / description
- Payload mass
- Any other additional specifications

For ground control station specifications (if applicable), the following should minimally be included:

- Ground control station brand / model / name
- Description of functions (e.g. list of all possible controls available, all possible flight modes including failsafe modes, all possible warning messages displayed etc.)
- Any other additional specifications

Flight Procedures – Flight Checks

This section describes the flight procedures to be followed for all envisaged operations of the UA.

If operator is following flight check procedures as stated in the manufacturer’s user manual, the user manual’s title and revision, and references to the relevant sections of the user manual are to be indicated. The user manual should also be submitted to CAAS for reference. An example as follows:

Pre-flight checks for the above listed UA configurations shall be conducted in accordance with the manufacturer’s instructions, as stated in the following table.

Document Title	Revision No. / Date	Referenced Section / Page
DJI Phantom X Advanced User Manual	V2.0 2016.3	Section – Flight, pg 53 – 54
DJI Phantom X Pro User Manual	V1.0 2017.5	Section 5, pg 61 – 70

If there are no manuals or instructions from the manufacturers, the operator is to develop their own flight check procedures and describe them in this section. Flight check procedures should minimally cover all the critical UA sub-systems such as propulsion system, power system, command and control system, navigation and flight control system, as well as the overall structure integrity.

Flight Procedures – Emergency Procedures

The procedures for emergencies may include pilot intervention or automatic failsafe behaviour of the UA. This section describes procedures that minimally address the following emergencies at all phases of flights:

- Loss of UA control / UA flyaway
- Loss of control link with UA
- Loss of UA power / low UA battery
- Loss of positioning capabilities (e.g. GPS signal loss)
- Any other scenario unique to the UA

The operator should also consider prioritisation when compounded emergencies occur.

An example as follows:

Emergency	Procedures
Loss of UA control / UA flyaway	<ol style="list-style-type: none"> 1) Upon loss of control with UA, The UA pilot shall continuously attempt to regain control by either adjusting the transmitter antenna or moving closer to the UA. 2) If control is not regained after 8 seconds, and the UA does not automatically return to its take-off point or land on the spot, it means that this is not the case of a control link loss. 3) The UA pilot shall continue all means to regain control or take down the UA, and alert CAAS of the incident.
Loss of UA power / UA low battery	<ol style="list-style-type: none"> 1) Upon reaching 30% of battery health, the UA pilot will be alerted via the GCS, he shall then land the UA at the designated landing area. 2) Upon reaching 10% of battery health, the UA will override the UA pilot control and automatically return to take-off point. 3) If there is a loss of GPS signal during this flight phase, UA will automatically land on the spot. 4) For this scenario, the UA pilot shall ensure that there are nobody within the vicinity of the landing area.
Loss of control link with UA	<ol style="list-style-type: none"> 1) Upon loss of control link with UA, UA pilot shall attempt to regain control by either adjusting the transmitter antenna or moving closer to the UA. 2) If link is not regained after 8 seconds, the UA will automatically return to take-off point. 3) If there is also a loss of GPS signal, the UA will automatically land on the spot, instead of returning to take-off point. 4) The UA pilot shall ensure that there are nobody within the vicinity of the landing area.
Loss of positioning capabilities	<ol style="list-style-type: none"> 1) Upon loss of GPS signal, UA will automatically switch to its Vision Positioning System to maintain its position. 2) UA pilot shall, as soon as practicable, attempt to land the UA in a safe location. 3) If both the GPS signal is loss and the Vision Positioning System is faulty, UA pilot shall switch to “manual” mode and attempt to land the UA in a safe location.

Maintenance Plan

This section describes the maintenance plan of the UA, which includes the maintenance criteria, maintenance procedures and maintenance schedule.

If the operator is following the maintenance schedule and procedures as stated in the manufacturer's maintenance manual, the maintenance manual's title and revision, and references to the relevant sections to the maintenance manual are to be indicated. The maintenance manual shall also be submitted to CAAS for reference. An example as follows:

Maintenance for the above listed UA configurations will be conducted in accordance with the manufacturer's instructions, as stated in the following table.		
Document Title	Revision No. / Date	Referenced Section / Page
DJI Phantom X Maintenance Manual	Revision 3.0 2017.5	All

If there are no manuals or instructions from the manufacturers, the operator is to develop their own maintenance plan and describe it in this section. Maintenance plan should minimally cover the maintenance criteria, maintenance procedures and maintenance schedule for the critical UA sub-systems.

If a 3rd-party maintenance vendor is contracted, operator may include details on the maintenance covered and the frequency in which maintenance will be performed.

Section 6 – UA Operations

This section describes the UA operations undertaken by the operator, minimally including the description of the type of operations, UA operating procedures and risk assessment.

A separate sub-section should be created for each type of operations for better organisation, and each sub-section should contain the information as described in the following paragraphs.

Examples of the different types of operations as follows:

- Aerial Photography / Videography (includes aerial mapping, aerial modelling, aerial surveillance, aerial inspection)
- Conduct of training involving flying / operating of UA
- Delivery / Carriage of Items
- Discharge of Substances
- Flight Competition
- Flight Demonstration
- Flying Display (for scenarios where the flight is observed by more than 500 people)
- Flight Test (includes flight for research and development)

Description of Type of Operations

This section describes the type of operations the operator plans to undertake, which minimally includes:

- Intent of the operation
- UA to be used
- Type of operating environment

General UA Operating Procedures

This section describes the general operating procedures for the type of operations as described above, which minimally includes:

- Flight planning, crew communication procedures and/or coordinating instructions, etc.
- General flight profile
- Additional procedures due to operating limitations of area (e.g. within 5km of aerodrome, within enclosed areas etc.)
- Roles and responsibilities of key personnel involved in the operations

Any additional operating procedures that may be required for operating concepts that are specialised in nature (e.g. BVLOS operations, autonomous operations, flight trials and experimentation etc.) may also be included.

Specific details and/or changes to the procedures due to varying location of the intended UA operations should be provided to CAAS during Activity Permit applications.

Hazard Identification, Risk Assessment and Risk Mitigation

Risk assessment is a simple approach to identify hazards, evaluate risks associated with the hazards and decide on measures required to mitigate the risks. This section contains a preliminary risk assessment for the type of operations as described above.

However, please take note that during Activity Permit applications, a more detailed risk assessment, due to having more knowledge on the specific area of operations, will still be required to be submitted to CAAS.

An example of a preliminary risk assessment as follows:

S/N	Hazard	Phase(s) of Flight	Consequence(s)	Causal Factor(s)	Risk Level before Mitigations	Control Recovery Measures /	Risk Level after Mitigations
Section A: Risk Assessment for Type of Operations							
1	Accidental flying into restricted airspace	Take-off, Mid-flight, Approach, Landing	Collision with manned aircraft	Lapse in active monitoring of UA's position / altitude / heading	Remote x Catastrophic = High	UA pilot actively monitor flight parameters and maintain UA within stipulated area of ops. Ensure good continuous radio link between UA pilot and UA.	Extremely Remote x Catastrophic = Medium

						Monitor wind speed in area of ops. Terminate flying when wind speed exceed stipulated limits.	
Section B: Risk Assessment for Area of Operations							
1	Built-up areas in the vicinity of the area of operations	Mid-flight	Drone collides with building and crash lands on nearby people and/or buildings.	Loss of VLOS between UA pilot and UA	Extremely Remote x Catastrophic = Medium	UA pilot must maintain visual contact with UA at all times. Operate UA within published radio range. Maintain safe distance from public roads, buildings and personnel.	Extremely Improbable x Catastrophic = Low

The risk level of a hazard is categorised into low, medium and high, and can be determined using the following matrix:

Risk Severity \ Risk Probability	Catastrophic	Hazardous	Major	Minor	No effect
Probable	High	High	Medium	Low	Low
Remote	High	High	Medium	Low	Low
Extremely Remote	Medium	Medium	Medium	Low	Low
Extremely Improbable	Low	Low	Low	Low	Low

The 4 levels of risk probability are defined as:

- **Probable:** Anticipate to occur $\geq 1x$ during the entire system/operational life of an item; or once in 1000 to 10,000 hrs.
- **Remote:** Unlikely to occur to each item during its entire life. May occur several times in the life of an entire system or fleet; or once in 10,000 to 100,000 hrs.
- **Extremely Remote:** Not anticipated to occur to each item during its entire life. May occur a few times in the life of an entire system or fleet; or once in 100,000 to 1,000,000 hrs.
- **Extremely Improbable:** Not anticipated to occur during the life of an entire system or fleet; or below once in 1,000,000 hrs.

The 5 levels of risk severity are defined as:

- **Catastrophic:** Failure would prevent continued safe flight and landing resulting in:
 - a) One or more fatalities or serious injury to persons or major property damage external to the UA, or
 - b) Uncontrolled loss of UA.

- **Hazardous:** Failure would reduce the capability of the UA or the ability of the crew to cope with adverse operating conditions to the extent that there would be the following:
 - a) Physical distress to persons or property damage external to the UA possibly including injuries;
 - b) A large reduction in safety margins or functional capabilities;
 - c) Higher workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely.

- **Major:** Failure would reduce the capability of the UA or the ability of the crew to cope with adverse operating conditions to the extent that there would be:
 - a) Potential for physical discomfort to persons or minor property damage external to UA;
 - b) A significant reduction in safety margin or functional capabilities;
 - c) A significant increase in crew workload or in conditions impairing crew efficiency.

- **Minor:** Failure would not significantly reduce the UA safety and involve crew actions that are well within their capabilities. It may include slight reduction in safety margins or functional capabilities, slight increase in crew workload (e.g. routine flight plan change).

- **No effect:** Failure would have no effect on safety, i.e. within operational capability of the aircraft or no increase to the workload of the crew.

Appendix A – UA Types and Allowable Types of Operation

Appendices are meant to include any additional information or supplementary data that supports or extends the main document. While the operator can choose what information to include in the appendices, CAAS requests that at least Appendix A – UA Types and Allowable Types of Operation to be created in the Operations Manual.

The purpose of this appendix is to serve as a quick reference to all the approved UA types and the corresponding allowed types of operations as listed in the UA OP.

In addition, if the operator has been approved to conduct BVLOS operations, details of the BVLOS approval such as BVLOS risk level, area of operations, flight plan and operation limitations, are also included.

Some examples as follows:

UA Type	DJI Phantom 3 series
UA Category	Rotorcraft
Maximum Take-off Mass	1.5 kg
Allowable Type of Operations	1) Aerial Photography / Videography 2) Conduct of training involving flying / operating of UA 3) Fight Demonstration
Special Authorisation	Nil

UA Type	Proprietary Custom Mark III	
UA Category	Powered-Lift	
Maximum Take-off Mass	20.0 kg	
Allowable Type of Operations	1) Flight Test 2) Delivery / Carriage of Items	
Special Authorisation	BVLOS Risk Level	Low / Medium / High
	Area of Operations	ABC Road, One North Park
	Compliance Checklist	XXX-01 Rev. 1 – BVLOS Compliance Matrix
	Limitations	Limited to operation during off-peak hours.
	Flight Plan	<Insert picture(s) of flight plan(s)>