

SAFETY NOTICE

**SUBJECT: Guidelines for Building Survey/Inspection Operations
using Unmanned Aircraft**

GENERAL: Safety Notices (SNs) are issued by the Civil Aviation Authority – Macao, China to convey advisory information to Macao aviation entities to enhance safety. SNs contain safety-related recommendations, guidance and/or industrial best practices to specific subjects which may or may not have been addressed by established requirements and regulations.

RELATED REGULATIONS: Part XVI of the Air Navigation Regulation of Macao (ANRM);
Macao Aeronautical Circular no. AC/GEN/013

APPLICABILITY: This SN applies to the operator, either a person or an organization, who wishes to conduct building survey/inspection operations using Unmanned Aircraft in Macao.

CANCELLATION: This SN is the first SN issued on this subject.

1. Introduction

1.1 The use of unmanned aircraft in Macao shall comply with relevant laws and regulations. In addition to laws and regulations, this Safety Notice is issued to provide guidelines and set out some general safety recommendations for building survey/inspection using unmanned aircraft in Macao from the aviation safety perspective.

2. Background

2.1 The Part XVI of the ANRM specifies the requirements to support unmanned aircraft operations in Macao. Operator shall not operate an unmanned aircraft outside any conditions specified in the paragraph 184 of the ANRM except under the authority of and in accordance with an Unmanned Aircraft Activity Permit from the AACM. Whenever the operations of unmanned aircraft having a total mass exceeding 7 kg but not exceeding 25 kg, the operator shall also obtain an Unmanned Aircraft Operator Permit from the AACM in accordance with the Macao Aeronautical Circular no. AC/GEN/013.

2.2 Given that unmanned aircraft has played an increasing role in a wide range of applications, this Safety Notice provides safety-related recommendations to the building survey/ inspection operations using unmanned aircraft to ensure safe operation.

3. Definition

3.1 **“Involved Person”** means a person who takes part in or is well aware of the unmanned aircraft operation, understands the risk, and is aware of the instructions and safety precautions in regard to the unmanned aircraft operation. In practical terms, this means that an involved person must:

- be clearly notified about and aware of the unmanned aircraft operations;
- understand the risks involved;
- have reasonable safeguards introduced for them by the venue manager or the unmanned aircraft operating crew during unmanned aircraft operation; and
- be expected to follow the directions and safety precautions provided.

3.2 A **vehicle or vessel** is considered to be **“under the control of the unmanned aircraft pilot”** (known as “involved vehicle or vessel” hereafter) if:

- Persons on board can reasonably be expected to follow directions and safety precautions for the unmanned aircraft operation to avoid unplanned interactions with the unmanned aircraft; and
- Persons on board should be adequately briefed or informed about the unmanned aircraft operations.

3.3 A **building** is considered to be **“under the control of the unmanned aircraft pilot”** (known as “involved building” hereafter) if:

- Occupants of the building can reasonably be expected to follow directions and safety precautions for the unmanned aircraft operation to avoid unplanned interactions with the unmanned aircraft; and
- Occupants of the building should be adequately briefed or informed about the unmanned aircraft operations.

3.4 **“Uninvolved Person / Vehicle / Vessel / Building”** means any person / vehicle / vessel / building other than an “involved person / vehicle / vessel / building”.



4. Equipment Considerations

4.1 The operator of unmanned aircraft should utilize additional safety system or equipment to ensure safety assurance for sustained flight over uninvolved people, vehicles, vessels or buildings, for example, using lightweight unmanned aircraft (i.e. unmanned aircraft weighing not more than 250g).

Note: “Sustained flight” does not include a brief, one-time transiting over the uninvolved people, vehicles, vessels or buildings, where the transit is merely incidental to a point-to-point operation unrelated to the people or property being flown over.

4.2 For building survey/inspection operations, unmanned aircraft equipped with appropriate navigation lighting (usually red lights on forward rotor arms and green lights on rear rotor arms, or red lights on left wing and green lights on right wing) should be used. The lighting should be visible to the unmanned aircraft pilot at all times during the flight and it should be sufficient for the unmanned aircraft pilots to determine the orientation and direction of the unmanned aircraft visually.

4.3 Rotor blade guard should be installed to avoid collision while manoeuvring the unmanned aircraft in close proximity of building. Obstacle avoidance is also recommended to further mitigate the risk of collision.

4.4 Strobe or anti-collision light system is also recommended for use in building survey/inspection.

4.5 Geo-fence and altitude limiting functions should be used during operations to cage the unmanned aircraft in manoeuvring within a pre-defined flight volume. Real Time Kinematic (RTK) positioning system is recommended.

4.6 Appropriate ground station or remote controller software should also be in place to assist the unmanned aircraft pilot in identifying the unmanned aircraft’s position in real time.

4.7 Anemometer to monitor wind gust at high altitude should be equipped for monitoring the change in wind speed and direction as flying altitude elevates.

5. Personnel Considerations

5.1 The unmanned aircraft pilot for the flight should be competent for the unmanned aircraft operations to be conducted for the purpose of building survey/inspection.

5.2 Other than the unmanned aircraft pilot, sufficient supporting crew and/or visual observer, should be made available to provide additional safety and observation support for the

operations to assist the unmanned aircraft pilot in monitoring the remote controller or assess the unmanned aircraft's position.

6. Operations Considerations

- 6.1 Except under the authority of and in accordance with an Unmanned Aircraft Activity Permit, the unmanned aircraft shall not be operated within the boundaries of the protected area (including the prohibited or restricted flying area) as stipulated in the ANRM. In the absence of such permit, the unmanned aircraft operation should be conducted carefully in order to avoid the inadvertent entry of the aforementioned areas. In addition, the operation area/path should be carefully chosen with sufficient lateral separation from uninvolved people, vehicles, vessels or buildings.
- 6.2 Certain building survey/inspection may unavoidably involve flying over uninvolved people, vehicles, vessels or buildings. If such overflying is unavoidable or sufficient lateral separation cannot be kept, the access to the site(s) of such operations should be controlled. Effective communication should be in place so that any uninvolved person and the appropriate persons of the uninvolved buildings located within such site(s) is aware that an unmanned aircraft may fly over them and their buildings. The unmanned aircraft pilot should not maintain sustained flight over any uninvolved people, vehicles, vessels or buildings, and should reduce as much as possible the time of overflying.
- 6.3 Notice to public for notifying unmanned aircraft operation should be in place. Placement of safety cones, warning signage are recommended to signify that unmanned aircraft operation in the vicinity is in progress. This will enhance the awareness of the unmanned aircraft location to the public nearby.
- 6.4 Before the operation, the unmanned aircraft pilot should conduct comprehensive flight planning (including daylight reconnaissance and site safety assessment), determine the geo-fenced area and altitude limits, etc. Any hazards, restrictions and obstacles should be identified, addressed and recorded.
- 6.5 The unmanned aircraft pilot should take into consideration the intended operation altitude and the obstructions that may come into sight, so as to ensure visual line of sight (VLOS) will be maintained with the unmanned aircraft at all times.
- 6.6 Effective audio communication should be maintained between the unmanned aircraft pilot, visual observer and/or supporting crew at all times during the flight. Communication protocols (e.g. standardized commands and callouts) should be established to communicate collision avoidance information, emergency procedures and corresponding commands, etc.

- 6.7 The unmanned aircraft pilot should brief all crew members participating in the operation, especially the supporting crew and visual observer, to ensure they are fully aware of their responsibilities and the operational task.
- 6.8 The supporting crew should keep the unmanned aircraft pilot updated constantly on an independent monitor on flight parameters of the unmanned aircraft including battery level and satellites tracked.
- 6.9 The take-off and landing (including recovery landing) points should be equipped with adequate lighting to provide clear visual reference and also allow the unmanned aircraft pilot to visually see and avoid hazards and obstacles on the ground to assure safe take-off and landing of the unmanned aircraft.
- 6.10 The navigation lighting (usually red lights on forward rotor arms and green lights on rear rotor arms) of the unmanned aircraft should be visible to the unmanned aircraft pilot at all times during the flight for visual determination of the unmanned aircraft orientation and direction.
- 6.11 Before take-off and during the flight, the unmanned aircraft pilot should ensure the unmanned aircraft achieved a positive satellite lock. Where the manufacturer does not specify the number of satellites to gain lock, the unmanned aircraft should not be flown with less than 7 satellites positively acquired.
- 6.12 The flying speed of the unmanned aircraft should not exceed 20 km/hr.
- 6.13 The minimum lateral separation from uninvolved people, vehicles, vessels or buildings should not be less than 10m.
- 6.14 If the unmanned aircraft pilot fails to visually determine the orientation and direction of the unmanned aircraft, or the unmanned aircraft becomes a hazard to any other aircraft, person or property, the unmanned aircraft pilot should immediately respond to ensure the safety of the operation.
- 6.15 The unmanned aircraft pilot should determine suitable response and fail-safe mechanism for emergency during operation, e.g. loss of command and control link, loss of navigation lighting and loss of GPS signal.
- a) If the unmanned aircraft will return to the 'home' position and land automatically, considerations should be given to possible flight path in accordance with the daylight reconnaissance, site and flight safety assessment conducted prior to the operation, such that, when such function is activated, the unmanned aircraft will not collide with obstacles.



The altitude for such function should also be deliberated for obstacle clearance and avoiding collision risk with other unmanned aircraft, building or objects.

- b) The unmanned aircraft pilot (or with the supporting crew's assistance) should also closely monitor the telemetry data against possible signal interference and determine suitable response to ensure that the aircraft remains under control and that fail-safe mechanism will not be undermined.

6.16 All personnel, including the unmanned aircraft pilots, involved in the building survey/inspection operation are recommended to be provided with appropriate personal protective equipment (PPE) (e.g. reflective apparel, safety vests, etc.)

7. Other Considerations

7.1 The AACM evaluates and issues the permissions as mentioned in 2.1 of this Safety Notice solely in consideration of aviation safety. Such permissions do not constitute any other permissions as required by other individuals or other government departments/agencies for the operation of unmanned aircraft under their jurisdiction.

7.2 The operator of unmanned aircraft should obtain the permission(s) from the building's owner / management party.

7.3 The operator of unmanned aircraft should consider if there are any other laws, regulations, requirements, etc governing the usage of unmanned aircraft (e.g. from the aspects of security and personal privacy, etc.) and obtain the permission(s) from the relevant authority or agency as required.

8. Recommended Actions

8.1 Operators of Unmanned Aircraft conducting building Survey/Inspection operations should review their policy, procedures and training to reflect the safety recommendations contained in this SN.

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