DRONES4VET

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MODULE 02

TRAINING PROGRAMME

FLIGHT PLANNING AND REPORTING

Comunidad de Madrid
Dirección General de Formación
CONSEJERÍA DE ECONOMÍA, HACIENDA Y EMPLEO

DEX
Desarrollo de Estrategias Exteriores

CAMPUS DES MÉTIERS ET DES QUALIFICATIONS D'EXCELLENCE
Habitat, énergies renouvelables et éco-construction
Occitanie

MTU
Ollscoil Teicneolaíochta na Mumhan
Munster Technological University

BZB
Bildungszentren des Baugewerbes e.V.

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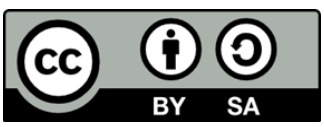
UNIVERSITY OF APPLIED SCIENCES



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1. Objectives of the module

This module describes the checklists to be followed during the various phases of drone use. For the preparation of an operation with UAS, as it is done with any other type of aircraft, a series of steps and actions must be carried out before, during and after the flight in which checklists are normally used.

In this checklist, the person in charge of operations and/or the drone pilot checks the indicated tasks in order. As they are completed, they are marked so that you can be certain that you have taken all the precautions described. This allows you to keep accurate control and confirm that the necessary tasks for the operation have been carried out, particularly in the event of legal action.

An example of "mission sheet" for the open category is presented.

2. Operation planning

All flights must be planned in writing, and a preparation sheet is provided below. The list below covers all the precautions to be taken to ensure that your flight is safe, in compliance with the law, and effective for the job in hand.

- Weather forecasting
    - Websites or weather applications where wind, rain and temperature are displayed
    - METAR: official aeronautical weather information, METARs (Meteorological Aerodrome Reports) are coded messages transmitted by airport weather beacons. They describe the current situation (at the time indicated). Their encoding is explained on Wikipedia, but for easy decoding throughout Europe this site is very useful:

      https://fr.allmetsat.com/metar-taf/france.php?icao=LFTW

      here it is set for Nîmes, France the METAR is the "observation" column.

      other: https://aerometeo.fr/
    - TAF/TAFOR: coded weather forecast message (like the METAR), which does not exceed 24 hours. the same sites can be used.
    - Kp index forecast: level (from 0 to 9) of magnetic disturbance on earth (due to solar activity). A level of up to 4 is acceptable for the precision of the drone's GPS, but beyond that it becomes random and inadvisable (5 to 9 = geomagnetic storm). RTK normally corrects errors caused by high Kp.
- Airspace check
    - Verification airspace restrictions: each country has its own information websites.
    - General restrictions (towns, national park...)
    - Airport approach CTR zone
    - Low-altitude air force training zones
    - Verification temporary airspace restrictions (NOTAM): Notice To Air Men are official instructions indicating flight restrictions, ceilings or floors... It is essential to check them as they change every day and from hour to hour.
- Have authorization
    - In the open category: authorisation from the owner or the person responsible for the place of flight.

    - In specific category European scenarios STS01 and STS02: send the flight declaration and wait for the acknowledgement of receipt. No authorisation, acknowledgement of receipt is sufficient
    - For other cases see Module 1, "Regulations".
    - In the event of flight over the public domain, inform the local police in advance and send them all the qualifications and declarations to avoid a time-consuming check.
- Environment check:
    - Topography
    - Possible affected services
    - Obstacles
    - Buildings
    - Infrastructures
    - Facilities
    - Places where people gather
- Flight scenario options:
    - Open category: outside public areas, etc...
    - Specific category STS01-02: possibility of setting up the perimeter to prevent uninvolved persons from entering. Marking is compulsory.
- Check documentation:
    - Operator's Manual
    - Drone pilot certificates
    - Aircraft Insurance
    - Authorizations and coordination if necessary
- Assure updated firmware:
    - Drone /UAS
    - App
    - Batteries
    - Remote control (Ground station)
- Assure updated flight database
- Perform battery check:
    - Drone /UAS
    - Remote control
    - Display
    - Tablet
    - Phone
- Formatted memory

- Prepare toolbox and spare parts
- Chargers and cables
- Prevention system:
    - Take-off point
    - Flight perimeter using traffic cones and tape
    - Prevention of uninvolved persons by signs "drone flight - do not enter the area".

3. Flight procedures

3.1 Pre-flight check list

Before take-off please follow below steps:

- Ensure safe take-off areas and landing
- Make sure there is a separation of 10 meters (or more, depending on the flight category and sub-category) for all people, property and other possible obstructions.
- Be sure to inform all people around about operations.
- Make sure take-off areas and landings are level and free of debris and other obstacles (a specific take-off plate or carpet can be use)
- Complete a visual inspection of the equipment.
- Assure a memory card (i.e. Micro SD) is placed within the drone.
- Check the propellers.
- Remove clamp and lens protector.
- Assure batteries are installed/inserted properly.
- Complete drone operation settings:
    - Check all the data via the display settings and parameter sections of the remote control (R/C).
    - Follow any calibration instructions given by the drone instructions (compass, magnetometer, gyro…)
    - Mark point of return home (RTH): wait for the RC to indicate that the RTH point has been correctly defined.
    - Set RTH height.
    - Set battery charge alerts.
    - Check battery temperature.
    - Check flight mode.
    - Verify transmission signal control and video.
    - Verify connection to satellites and RTK if the drone is so equipped.
    - Verify Configuration for Obstacle Detection mode.
    - Define the geo-cage in all 3 dimensions
    - Adjust camera settings.
- Place antennas in position.

3.2 Take-off procedures

- Announce “take-off!” verbally and loudly
- Take off at 2 meters in hover mode
- Review telemetry data
- Check correct operation of joysticks
- Check that the R/C controls are working properly by making small movements:
    - Left joystick: up/down - left yaw / right yaw
    - Right joystick: forward pitch / reverse pitch - right roll / left roll
- Take photo and test video
- Climb up to 3.00 meters for safety and begin the flight

3.3 Post-flight procedures

- Clean and check
  - the drone
  - the propellers
  - the filter of the cooler air fan
- Perform a SD Card backup
- Fill in the log book
- Maintenance plan (look on the Manex and/or in the user manual) if the drone needs to undergo any particular maintenance, perform it or schedule it.
- Put the batteries in storage, do not leave them connected to the drone.
- Depending on the course of the flight: Reports

4. Example of drone mission form

This form can help you to prepare the flight. It is dedicated to flights in open category.

It is a checklist and a reminder. This is just one example, and there is always room for improvement.

DRONE MISSION FORM

UAS OPERATOR .....

Drone type .....

FLIGHT IN OPEN CATEGORY, SUBCATEGORY .....

PILOT → ..... – students :.....

.....

Drone number and official **identification** number → .....

Date → .....

project/lesson →.....

☐ **Reception** by the pilot of the overflight authorization by e-mail from the owner(s)

Model : I, the undersigned, declare that I authorize Mr. xxx to carry out a drone flight in the area of my property, plot(s) ... for a topographic mission and to take pictures. I understand that the camera of the drone will capture details of my property from different angles, as well as indirectly views of the interior of my home through the windows. These shots are not intended to be disclosed to third parties outside the project. At my request, the pictures can be destroyed after the topographic mission has been completed and the three-dimensional model and/or plan has been returned.

Address of the drone mission → .....

Cadastral plot(s) concerned → .....

Flight zone on official UAS authorisation map for open category →

.....

maximum AGL Altitude → .....

NB : in residential areas, maximum height 50m AGL

NB : overflight of the public domain forbidden

NB : overflight of people forbidden

Weather, copy the METAR and TAF information of the nearest airfield →

.....

Origin : internet site = https://fr.allmetsat.com/metar-taf/france.php?icao=LFTW

METAR: LFTW 140830Z AUTO 24006KT 210V280 9999 FEW049 BKN180 OVC210 12/08 Q1010 BECMG 32020G30KT

TAF: LFTW 140200Z 1403/1503 25010KT CAVOK BECMG 1408/1410 31012KT BECMG 1410/1412 32020G30KT BECMG 1417/1419 34010KT

☐ **conclusion** good weather, CAVOK validation

☐ use of the virtual reality headset (FPV). Person in charge of the supervision in direct vision of the drone if FPV →.....

☐ **pre-flight visit of the drone**

- Good condition of the propellers
- Good condition of the drone, solidity of the arms, traces of impact, all screws well tightened...
- Presence of the identification sticker
- Drone battery charge higher than 75% and not distorted
- Good installation of the batteries (no space between the battery and the drone)
- Cleanliness of the lens and freedom of the camera

☐ **Remote control settings and pre-flight checks**

- Good condition of the **joysticks**, solidity of the **attachment** of the smartphone/tablet, good condition of the **connection** cable, antennas
- **Updated** application
- Maximum flight **altitude** setting ("altitude cage")
- Return To Home (**RTH**) altitude in relation to the environment and the altimetry limitation
- set hovering after take-off at 2.0m
- Adjustment of the **planimetric cage** from the take-off position avoiding the overflight of neighbouring properties with a margin equal to half the programmed maximum altitude.
- **Video** in working order
- Good **GPS** and local map reception
- Phone/tablet **charge** above 75% in conjunction with the controller
- check flight mode and Programming of **speeds**: **inclination**=..... **rotation angle**=.....
- Good **wifi** reception
- Sufficient space in the drone's **memory card** (formatted is best)

☐ Preparation of the **working area**

- Mark out the **take-off** area
- **Close** the area to non-involved persons and forbid access to it
- Position the georeferencing **targets** (GNSS+RTK) or dimensional targets (facade)

☐ Possession of mandatory **identification** and **certificates** documents (take out on location, PDF ok)

- **Certificates** of the drone pilot
- **Documentation** of the drone
- **Aircraft** insurance
- **Operator's** manual.

☐ Reading of the emergency procedures below

- If there are **several drones** in flight, each take-off location takes into account the virtual cage to avoid the **interpenetration** of the flight areas and the **altitudes are different**
- Loudly warn "**take off**" and "**landing**", check before taking off or landing
- No flying over **people**
- No shooting outside the **mission area**(s)
- No flying in the red zone of the **airfields**
- End of the flight at **20% of battery** (drone or controller)
- If **FPV**, the indications of the **person** in charge of the direct supervision must be **respected**
- In case of **loss of control**, risk of crash: **warn** loudly "attention loss of control" and insist that people in the danger zone move away and be vigilant
- Do not approach **other aircraft** (helicopters, planes, other drones)
- Do not fly on **accident** sites of any kind
- Do not fly near a **fire**
- Do not fly near **railroads**, **highways** and high traffic roads
- Do not fly over or take pictures of sensitive military or civilian sites

Signature committing the pilot to respect the conditions of the mission sheet

Possible remarks

5. Reporting

5.1 Automatic flight log

Drones generally have a digital recorder that saves in memory the records of each of the flights that are made.

This "black box" generates a backup with the telemetry data which is sent to the radio control and from there to the device you use as a monitor. This information is stored in a "Flight-Record" file system, which in short and in the jargon we call "flight log".

The flight log is essential when we need to know what happened to our drone while it was flying.

All these telemetry data are received on our mobile device/tablet in real time to show us on the screen the height, distance, positioning, satellites, compass, video/radio power, flight modes... in short, everything we see on the screen is what the drone is sending to know what is happening, but it is also sending more information that we do not see.

What happens during the flight is recorded as a backup both in the drone itself and in a backup file stored on our device so that we can analyse it.

What are the LOG data used for?

- Failure of navigation instruments (compass) or positioning (GPS)
- Radio communication failures using automatic RTH.
- Detect warnings issued by the drone in flight that have not been acknowledged.
- View efficiency, cell status, battery life remaining.
- Error in the gimbal reporting; why it may be failing.
- See coordinates received from the GPS and reception data (eventually the good connexion to RTK).
- View joystick positions throughout the flight.
- Emergency landing due to battery failure
- Recover the lost drone.

Depending on the version installed on IOS / Android operating system, you will have to search for the telemetry file that the drone sent and was recorded in the memory of the mobile/tablet. To search for said file you have to connect the device with which you fly to your computer to be able to explore the different folders that the flight APP has.

Once you find the Flight-Record, you have to copy/paste it to the computer so that they can be analysed.

Example for DJI:

The path to find them in the mobile/tablet memory is as follows in the DJI system files:

- DJI Pilot: enter the internal memory and look for the folder DJI/dji.go.v3/FlightRecord

- DJI Go4: enter the internal memory and look for the folder DJI/dji.go.v4/FlightRecord

- DJI Fly: enter the internal memory and look for the folder DJI/dji.go.v5/FlightRecord

The files look like this:

DJIFlightRecord_2021-03-18_[10-09-57].txt

5.2 Manual log book

The main objective of this logbook is to keep an organization and greater control of the operator or operating company. If there are several pilots, you will know how much each one flies. The flight hours that our aircraft have, places, type of operation or work that we have carried out. With this monitoring we will make it much easier for us to organize, prevent and improve regarding the maintenance of our drones.

It must include in its content and structure what is indicated in the following sections.

Each student should have his own log book to show his flight history for certification or employment.

DEFINITIONS:

Student Pilot-in-Command (SPIC): Person who acts as pilot-in-command on a flight receiving instruction or being supervised by a qualified instructor or examiner when the latter is not in control of the flight of the aircraft.

Student pilot (SP): Person who receives instruction or performs a flight test as a pilot using a station dual command control during a flight in which a qualified instructor or examiner acts as pilot in command.

Co-pilot: A remote pilot other than the pilot-in-command who has the ability to act on the aircraft using a dual command control station, provided there are control transfer procedures defined by the operator, excluding the student pilot whose objective is to receive flight instruction.

Remote pilot: Person designated by the operator in charge of tasks essential to the operation of an aircraft. remotely piloted and manipulating the flight controls as required during flight time.

Pilot in Command (PIC): The remote pilot designated by the operator to be in command and in charge of the safe conduct of the flight.

Flight time: Total elapsed time from the moment a C2 link is established between the RPS and the RPA for takeoff purposes until the time the C2 link between the RPS and the RPA is terminated at the end of the flight.

Solo Flight Time: Flight time during which a student pilot in command (SPIC) controls the aircraft system remote controlled.

Dual instruction time: Flight time during which a student pilot (SP) receives flight instruction by a qualified instructor, or performs a flight test supervised by an examiner, using in any case a station dual knob control.

STRUCTURE of the form:

The flight book shall contain, as a minimum, the following information:

a) Personal details:

Name and address of the holder

b) For each flight:

1. Flight date
2. Place of flight (or from/to)
3. Departure and arrival time
4. UAS category, brand, model and registration (serial or registration number)
5. Total flight time
6. Landings
7. Activity carried out and operational conditions
8. Pilot Function-Hours
9. Observations and annotations: for example certification by an instructor (with signature)

1	2	3		4		5		6	
Date (dd/mm/yy)	**Place of operation** (or from /to)	**Hours**		**RPAS**		**Time of Flight**		**Landings**	
		Start	Arrive	Category, Brand, Model	Registration			Day	Night
				Total in this sheet					
				Total, from previous sheets					
				Accumulated Total					

7	8										9
Activity and operationals conditions	**Role of Pilot - Hours**										**Remarks and annotations**
	Pilot in command		Copilot (double control)		Student Pilot in command		Student Pilot (Double control)		Instructor / Examiner		
											I certify that all of the above is true. Signature of the pilot

Figure 1 Flight log

6. Accident report

A drone accident can occur in a number of ways, including collisions with other drones, collisions with structures or obstacles, and even incidents where a drone injures a person on the ground.

6.1 Causes of drone accidents

Pilot Error:

This may include insufficient training, incorrect calculation of distances or altitudes, and failure to comply with EASA regulations or local laws. In addition, distractions or reckless behavior can also contribute to pilot error.

Equipment Malfunction:

Another possible cause of drone accidents is equipment malfunction. This can range from bad batteries to software glitches or even manufacturing defects. When a drone is not working properly, it can quickly become uncontrollable, leading to accidents or injuries.

Weather-Related Incidents:

Drones are highly susceptible to adverse weather conditions, such as high winds, rain, and fog. These factors can reduce visibility, interfere with the drone's navigation system, or cause the drone to lose control. If a drone pilot does not take weather conditions into account, it can lead to serious accidents.

Regulatory Noncompliance:

The EASA has established regulations governing drone operations, including restrictions on altitude, speed, and flying near people or restricted airspace. Failure to comply with these rules can cause accidents with other aircrafts.

6.2 Types of drone injuries

Physical Injuries:

Drone accidents can result in a variety of physical injuries, ranging from minor cuts and bruises to more serious fractures and even traumatic brain injuries.

Emotional distress:

The psychological impact of a drone crash should not be underestimated. Victims may experience anxiety, depression, or post-traumatic stress disorder (PTSD) as a result of the incident

Invasion of privacy:

Drones have the potential to invade personal privacy, especially if they are equipped with cameras or other recording devices.

Property Damage:

Drone accidents can also result in major property damage, such as broken windows, damaged roofs, or even fires.

6.3 Drone accident liability

Negligence:

In many drone accident cases, negligence on the part of the drone operator, manufacturer, or another party is a contributing factor.

Product Liability:

If a drone accident was caused by a defect in the drone or its components, the manufacturer, distributor, or retailer may be liable under product liability law.

Trespassing and nuisance:

Drones can sometimes trespass on private property or cause a nuisance, leading to potential trespass or nuisance claims.

6.4 Steps to take after a drone accident

European Regulation No 376/2014

One of the reasons drone crashes should be reported is that the incident report helps them regulate and promote aviation safety. This is more true when they identify what caused the drone crash.

EU Regulation 376/2014 (art. 7) requires you to transmit your data to the Authority in a format compatible with ECCAIRS2 [1] software and the ADREP[2] taxonomy developed by the ICAO. This requirement is intended to facilitate data exchanges between computer programs that are not always compatible, and thus to facilitate data processing.

The various ways in which you can meet this obligation are detailed on the national Ministry's website (https://www.ecologie.gouv.fr/notifier-incident in France). The procedures for notifying the Authority directly are also specified.

DISIDENTIFICATION: Reports sent to the Authority must not contain any information that could enable the identification of persons involved or concerned by the event (name, contact details, etc.). In certain cases, however, it may be useful, or even essential, for the Authority to have the name and contact details of a contact person, for example to obtain further information on a notified event that it considers to be of particular interest. Under no circumstances will these data be recorded in the national ECCAIRS safety events database managed by the Authority

(1) *European Coordination Centre for Accident and Incident Reporting Systems.* **(2)** *Accident/Incident Data Reporting.*

Definition of incidents to be reported

Commission implementing regulation (EU) 2015/1018 defines all the incidents that are mandatory to report, in 5 annexes. When you encounter an incident, check in the list if it has to be reported, drones mostly comply with the rules of ANNEX 5 : OCCURRENCES RELATED TO AIRCRAFT OTHER THAN COMPLEX MOTOR-POWERED AIRCRAFT, INCLUDING SAILPLANES AND LIGHTER-THAN-AIR VEHICLES.

ANNEX V:

1.1. Air operations

(1) Unintentional loss of control.

(2) Landing outside of intended landing area.

(3) Inability or failure to achieve required aircraft performance expected in normal conditions during take-off, climb or landing.

(4) Runway incursion

(5) Runway excursion.

(6) Any flight which has been performed with an aircraft which was not airworthy, or for which flight preparation was not completed, which has or could have endangered the aircraft, its occupants or any other person.

(7) Unintended flight into IMC (Instrument Meteorological Conditions) conditions of aircraft not IFR (Instrument flight rules) certified, or a pilot not qualified for IFR, which has or could have endangered the aircraft, its occupants or any other person.

(8) Unintentional release of cargo. (commercial operations)

1.2. Technical occurrences

(1) Abnormal severe vibration (for example: aileron or elevator 'flutter', or of propeller).

(2) Any flight control not functioning correctly or disconnected.

(3) A failure or substantial deterioration of the aircraft structure.

(4) A loss of any part of the aircraft structure or installation in flight.

(5) A failure of an engine, rotor, propeller, fuel system or other essential system.

(6) Leakage of any fluid which resulted in a fire hazard or possible hazardous contamination of aircraft structure, systems or equipment, or risk to occupants.

1.3. Interaction with air navigation services and air traffic management

(1) Interaction with air navigation services (for example: incorrect services provided, conflicting communications or deviation from clearance) which has or could have endangered the aircraft, its occupants or any other person.

(2) Airspace infringement.

1.4. Emergencies and other critical situations

(1) Any occurrence leading to an emergency call.

(2) Fire, explosion, smoke, toxic gases or toxic fumes in the aircraft.

(3) Incapacitation of the pilot leading to inability to perform any duty.

1.5. External environment and meteorology

(1) A collision on the ground or in the air, with another aircraft, terrain or obstacle (includes vehicle).

(2) A near collision, on the ground or in the air, with another aircraft, terrain or obstacle(includes vehicle)requiring an emergency avoidance manoeuvre to avoid a collision.

(3) Wildlife strike including bird strike which resulted in damage to the aircraft or loss or malfunction of any essential service.

(4) Interference with the aircraft by firearms, fireworks, flying kites, laser illumination, high powered lights lasers, Remotely Piloted Aircraft Systems, model aircraft or by similar means.

(5) A lightning strike resulting in damage to or loss of functions of the aircraft.

(6) Severe turbulence encounter which resulted in injury to aircraft occupants or in the need for a post-flight turbulence damage check of the aircraft.

(7) Icing including carburettor icing which has or could have endangered the aircraft, its occupants or any other person.

Of course if you make a mistake when piloting, just touching a tree or crashing on a wall because of your fault with no specific damage to the tree or the wall, without jeopardising or compromising drone operation, the report is not mandatory.

Any other incident can be voluntarily reported, but you should respect the same process.

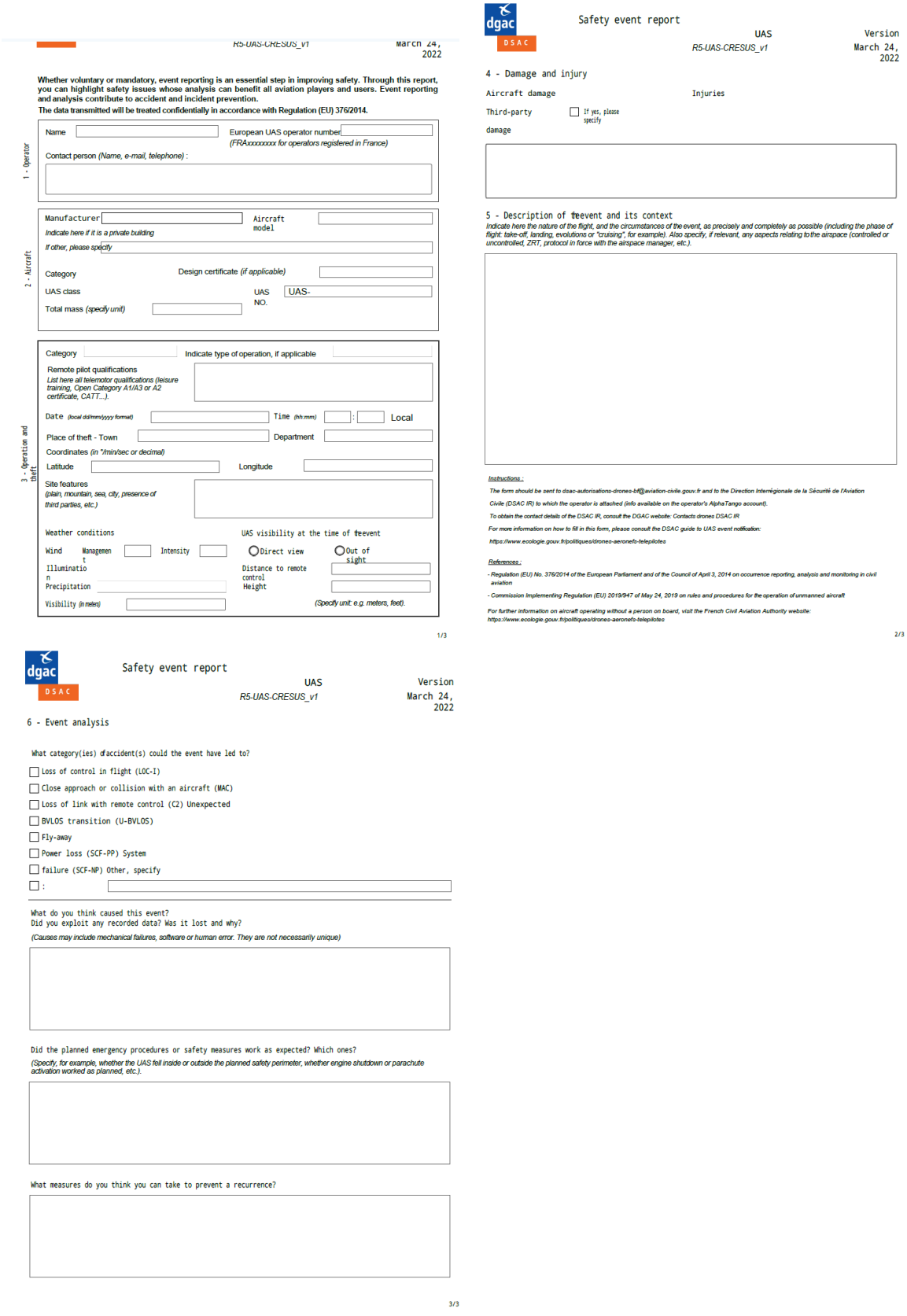
Aviation Authority reporting

Report the accident to the national agency of your country

In France the report has to be made within 72 hours, by the use of the CRESUS form.

Below you can see the automatic translation by www.deepl.com of the form. It is a French form so the translation is just to show as an example how a report can be made.

Check in your country which form is to be used.



R5-UAS-CRESUS_v1 March 24, 2022

Whether voluntary or mandatory, event reporting is an essential step in improving safety. Through this report, you can highlight safety issues whose analysis can benefit all aviation players and users. Event reporting and analysis contribute to accident and incident prevention.
The data transmitted will be treated confidentially in accordance with Regulation (EU) 376/2014.

1 - Operator

Name | European UAS operator number (FRAxxxxxxxx for operators registered in France)

Contact person (Name, e-mail, telephone) :

2 - Aircraft

Manufacturer | Aircraft model

Indicate here if it is a private building

If other, please specify

Category | Design certificate (if applicable)

UAS class | UAS NO. UAS-

Total mass (specify unit)

3 - Operation and theft

Category | Indicate type of operation, if applicable

Remote pilot qualifications
List here all telemotor qualifications (leisure training, Open Category A1/A3 or A2 certificate, CATT...).

Date (local dd/mm/yyyy format) | Time (hh:mm) : Local

Place of theft - Town | Department

Coordinates (in °/min/sec or decimal)

Latitude | Longitude

Site features
(plain, mountain, sea, city, presence of third parties, etc.)

Weather conditions

Wind | Management | Intensity

Illumination

Precipitation

Visibility (in meters)

UAS visibility at the time of the event

Direct view | Out of sight

Distance to remote control

Height

(Specify unit: e.g. meters, feet).

1/3

dgac DSAC

Safety event report

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4 - Damage and injury

Aircraft damage | Injuries

Third-party damage | If yes, please specify

5 - Description of the event and its context

Indicate here the nature of the flight, and the circumstances of the event, as precisely and completely as possible (including the phase of flight: take-off, landing, evolutions or "cruising", for example). Also specify, if relevant, any aspects relating to the airspace (controlled or uncontrolled, ZRT, protocol in force with the airspace manager, etc.).

Instructions :

The form should be sent to dsac-autorisations-drones-bf@aviation-civile.gouv.fr and to the Direction Interrégionale de la Sécurité de l'Aviation Civile (DSAC IR) to which the operator is attached (info available on the operator's AlphaTango account).

To obtain the contact details of the DSAC IR, consult the DGAC website: Contacts drones DSAC IR

For more information on how to fill in this form, please consult the DSAC guide to UAS event notification:
https://www.ecologie.gouv.fr/politiques/drones-aeronefs-telepilotes

References :

- Regulation (EU) No. 376/2014 of the European Parliament and of the Council of April 3, 2014 on occurrence reporting, analysis and monitoring in civil aviation
- Commission Implementing Regulation (EU) 2019/947 of May 24, 2019 on rules and procedures for the operation of unmanned aircraft

For further information on aircraft operating without a person on board, visit the French Civil Aviation Authority website:
https://www.ecologie.gouv.fr/politiques/drones-aeronefs-telepilotes

2/3

dgac DSAC

Safety event report

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6 - Event analysis

What category(ies) of accident(s) could the event have led to?

- ☐ Loss of control in flight (LOC-I)
- ☐ Close approach or collision with an aircraft (MAC)
- ☐ Loss of link with remote control (C2) Unexpected
- ☐ BVLOS transition (U-BVLOS)
- ☐ Fly-away
- ☐ Power loss (SCF-PP) System
- ☐ failure (SCF-NP) Other, specify
- ☐ :

What do you think caused this event?
Did you exploit any recorded data? Was it lost and why?
(Causes may include mechanical failures, software or human error. They are not necessarily unique)

Did the planned emergency procedures or safety measures work as expected? Which ones?
(Specify, for example, whether the UAS fell inside or outside the planned safety perimeter, whether engine shutdown or parachute activation worked as planned, etc.).

What measures do you think you can take to prevent a recurrence?

3/3

Figure 2 French CRESUS form to declare a drone incident (automatic translation)

If a drone pilot fails to report a drone crash, they will face civil penalties. Also, when reporting your drone crash, you must provide the Authority with full details about the crash as requested. Failure to report all relevant details may cause a delay in report processing and be subject to penalties.

7. Examples of common setting possibilities

The following chapter shows setting options for most drones. There are several types of drones, each with its own applications. In order to acquaint oneself with these options is to check the owner's manual and go through the RC screen as you go.

Figure 3 Example of double display interface (DroneVolt.com)

The icons on the side of the screen give access to various parameters.

- System status: This icon indicates the aircraft's flight status and displays various warning messages.
- Obstacle detection status: Red bars are displayed when an obstacle is close to the aircraft. Orange bars appear when obstacles are within detection range.
- Battery level indicator: The battery level indicator provides a dynamic display of the battery level. The coloured areas of the battery level indicator represent the power levels required to perform different functions.
- Flight mode: The text next to this icon indicates the current flight mode. These parameters allow you to modify flight limits and set gain values.
- GPS signal strength: Displays the current number of GPS satellites connected. The bar indicates an adequate GPS signal. RTK sign indicates connection to accuracy enhancement system (subscription required).
- 3D detection system status: activate or deactivate the functions provided by the 3D detection system.
- Wi-Fi settings
- Battery level: this icon indicates the current battery level. Set the different battery warning thresholds and display the battery warning history.
- General settings: Press to access the general settings menu.
- Gimbal Slide: Displays gimbal inclination
- Photo/video toggle
- Shooting/recording button
- Camera settings
- Playback: Press this button to access the playback page and preview photos and videos as soon as they are captured.
- Flight telemetry: This area displays flight information, such as flight speed, altitude from take-off point, etc.
- Virtual joystick: Touch this option to display virtual joysticks for controlling the drone via your mobile device's touchscreen.
- Smart RTH: launches the RTH procedure. Touch to return the aircraft to the last saved docking point.
- Automatic take-off/landing: Press to initiate automatic take-off or landing.

Dependant on type of drone there might be more options that are not discussed in this section.

7.1 System Status

There are number of indicators of UAVs systems:

- **GPS status**: Typically, if the bar is green, there is a solid GPS connection and can fly safely. If it's yellow, it means fly with caution, as the drone may be in ATTI mode, which means it doesn't have enough GPS signal to maintain a stable position. Finally, if the bar is red, it means that the drone cannot fly and offering steps to be taken to remedy the situation.
- **Compass:** Information about drone`s orientation. Occassionally needs to be recalibrated when you fly from a new location. Pay attention to this as the compass can very easily be disrupted by electromagnetic interference.
- **IMU (Inertia Measurement Unit):** IMU is a barometer and a gyroscope used by the drone to see its attitude and angle when flying. If a drone prompts you to recalibrate it, follow the onscreen instructions.
- **ESC (Electronic Speed Control) Status:** This informs about a problem with your motors. If a warning is displayed, try resetting the drone, if the warning can`t be deleted then it is possible that drone needs to be repaired.
- **Vision Sensors:** These are the sensors that check for obstacles when flying. It is strongly recommended to keep these turned “on” at all times.
- **Obstacle Detection Status:** This is a visual warning that pops up on the screen when the drone detects that it is close to an obstacle.

7.2 Battery Level Indicator

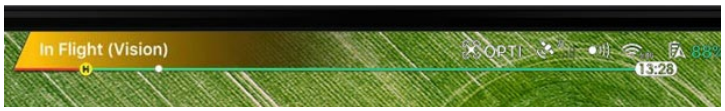

Figure 4 Battery level

This shows how much power drone`s battery has left. The line gets shorter as the battery power is depleted. The first dot on the left is when the drone will automatically land due to low power. The second dot is when the app will try to activate RTH unless user stops it. On certain DJI models, the yellow H represent a home point and moves along the line to show how much power will be required to get the drone back home.

Cell analysis and settings: Displays the state of the battery, and in particular the voltage of its cells: there should be no difference greater than 0.1V between cells, which would indicate a fault. If this is the case, change the battery and dispose of it in a fireproof bag.

Here user can set the percentages for very low battery warning and low battery warning.

Figure 5 Battery cells levels (displayed in Volt units)

7.3 Flight Mode

There are typically three flight modes available:

Positioning mode (GPS) : This mode is when all the drones' sensors are active, so the drone should always be stable. This is the safest mode to the fly the drone in; it will react to lack of interaction from the operator and the drone will automatically brake and then hover in position.

Attitude or ATTI mode (no GPS) : The aircraft will switch to ATTI mode if there is no GPS signal or it is weak, and it is too dark for the Vision Systems to work. The aircraft will only maintain its altitude, but it will drift carried by the wind or other areological disturbances.

Sport or free mode (GPS without obstacle recognition) : In Sport Mode, a drone can fly at full speed while using GPS for positioning. However, the forward and downward vision systems will be disabled, so the aircraft won't be able to sense and avoid obstacles.

7.4 General Settings

Measurement Units: Here a pilot can choose how parameters are displayed in DJI GO 4, and have a choice of in SI (International System of Units) m/s, km/h, or Imperial units such as MPH (miles per hour).

Peripheral actions: depending on the type of drone, there are different generic settings to choose from.

Live Streaming: Option to enable live streaming to Facebook or other popular social media platforms. It is done by enabling your preferred platform and log into the user`s account, and then following the onscreen prompts.

7.5 Map

In the Map settings the R/C will store the local map, so it doesn't need to be downloaded every time. This is achieved though **Show Flight Route** and **Cache the Map** options.

Toggling between map and live view displays the map in full screen mode.

The **Erase Flight Route** function allows to erase the line of the route that was flown on a map.

7.6 Video Cache

If this option is enabled, the system will save videos onto paired **phone** as well as on installed **Micro SD** card. If this option is enabled, the maximum amount of space to be used for storage and video cache can be defined. The option to automatically clear space once a certain amount of disk space has been used is also available.

Some drones offer **Record audio** option with video cache. If this option is activated, the mobile device will record the sound during taking a video activity.

7.7 Main Controller Settings

Remote control calibration: An option to calibrate a remote control's joysticks and toggle wheels. This is available when the drone is switched off. To calibrate, simply follow the on-screen instructions.

Control mode: An option to select how the joysticks operate on the drone. Every drone has a "default" setting.

Home Point Settings: An option to set up either the current position of the aircraft or the controller's position as the home point.

RTH Altitude: Drone pilot can set the altitude that the aircraft will go to once RTH option is triggered. It is crucial take a close look at the environment to define altitude and arrival behaviour (hovering height or landing).

Beginner Mode: This is a learning mode on some drones. In this mode, the drone will only take off if it has a good GPS signal, and its flight distance, height, and speed will be limited. Beginner mode lets first-time users get familiar with the controls safely. Once the operator feels comfortable flying the drone, it can be toggled off.

Flight characteristics: These parameters control the speed at which joystick movements are translated into motion by the drone. The higher the value, the more responsive the drone will be to stick movements.

> **Ground speed (horizontal):** used to position the drone at "slow speed". Remember: a speed limited to 3m/s allows to fly at 5m from people in open category A2; a speed limited to 5m/s allows to fly in European scenario STS01.
>
> **Attitude:** The speed at which your drone reacts and stabilizes.
>
> **Brake:** This function controls the braking speed of a drone in GPS mode. The higher the value, the harder the braking.
>
> **Yaw speed:** This parameter controls the speed of the yaw movement. The higher the value, the faster the aircraft will yaw.
>
> **Gain:** These parameters control the speed at which the aircraft reacts to external forces such as wind. It is recommended not to modify them unless the operator is an experienced pilot. Changing these parameters will change the way the aircraft flies, and if one set them incorrectly, drone may be unstable in flight. EXP modifies feedback by adjusting the remote control curve. Sensitivity implements this by adjusting the reaction speed of the device during flight.

Customize buttons: It is also possible to define the action of certain RC buttons according to user`s preferences. Be careful when using an RC programmed with the habits of another pilot.

Remote control type: Option to define a controller as master or slave if two remote controllers are being used.

Remote control link: To link the remote control with the drone.

Activate/deactivate front LEDs: Option to activate or deactivate the front lights of the camera, to avoid glare when taking photos.

7.8 Obstacle avoidance settings

A title suggests, this option allows to control which sensors are activated. The recommendation would be to leave all sensors switched on at all times.

Enable Obstacle Avoidance: If this setting is enabled, the drone will detect obstacles around it (depending on its number of sensors) and limit the maximum approach speed (by adjusting it) so that it can stop in time when it detects something. Obstacle avoidance may not work in low light conditions (300 lux or less), and will have difficulty detecting fine obstacles such as cables.

Enable reverse flight: If this option is enabled, the drone will fly backwards when an approaching subject is tracked. Please note that some drones may not have rear obstacle sensors, therefore it is imperative to take caution when flying backwards.

Show radar map: If this option is enabled, the application will display a small radar map at the bottom left of the flight view, indicating the drone`s orientation during flight.

Enable vision positioning: An option where the downward sensors will be activated, helping to keep the aircraft in a fixed position when hovering. If deactivated, the aircraft will drift while hovering if the GPS signal is too weak.

Landing protection: When this function is activated, the aircraft checks the suitability of its landing area before touching down.

Landing Accuracy: If this option is activated, the aircraft will attempt to land at the exact point from which it took off when the RTH is triggered.

RTH Obstacle Check: This option allows the aircraft to automatically climb to avoid any obstacle if one is detected during RTH. For some very fast drones, if the distance is less than 100 meters, the aircraft will not avoid the obstacle because it will be moving too fast.

7.9 Pictures Settings

Auto: The camera decides what it thinks are the optimal settings for photos or videos.

Aperture (A) This controls how much light gets through when pictures are taken. This is measured in 'f-stops.'

- A smaller f-stop number means a bigger aperture and so more light comes through
- A bigger f-stop number means a smaller aperture, so less light comes through.

In this mode, once Aperture option is set, other settings will still be set automatically to match exposure.

Shutter (S) The Shutter controls for how long light is let into the lenses.

To simplify the shutter,

- a low shutter speed lets more light in and is good for taking pictures in dim lighting
- a high shutter speed lets in more light and is good for taking crisp shots of moving objects or people.

In S mode, you can set the shutter speed, but other settings will be set automatically to match exposure

Manual (M) – An option to set both Aperture and Shutter manually for maximum control.

EV (Exposure Compensation Value): This dial shows difference between user defined and the recommended settings before taking a photo. Ideally, it is desired the EV to read "0" value:

- if value is "+2" then your whites will be far too bright
- if value is "-2" then picture will be very dark.

There are some situations where high or low EV is desirable, for example taking picture is dark environment with a slow shutter speed then will require a higher EV setting.

Playback shows photos or videos previously taken.

Centre-weighted Metering informs the camera to evaluate the light in the middle of the frame.

AF Lock/Unlock option that locks or unlocks the autofocus.

Advanced camera settings for quick access to ISO, Shutter, and EV settings.

Camera Forward/Down will switch camera direction from facing forward to 90° downwards.

Gimbal follow/FPV mode. Follow mode is used for video shooting, which supports 3-axis stabilization. FPV mode locks Roll axis stabilization, so the pilot can see the camera's horizontal tilt while turning or going sideways.

Centre Auto Focus makes the camera focus on the centre of the frame

Right Dial ISO/Shutter Control allows adjustment of the shutter speed.

Zoom In makes the camera zoom in.

Zoom Out makes the camera zoom out.

Portrait Mode makes the camera rotate into a vertical position.

Focusing/Metering switches between focus and metering when in manual focus.

AE Lock locks the focus and exposure values when taking a photo.

7.10 Image Transmission Settings

This option controls the signal between the aircraft and the remote controller. The signal can be set to Auto or Manual. Once can choose transmission mode for streaming directly to a mobile device.

Figure 6 Video transmission frequency setting (DJI)

Image transmission settings affect the quality of the image visible in the camera view.

Here are some typical options:

- **Smooth mode:** 720p 60fps;
- **Normal mode:** 720p 30fps;
- **HD:** 1080p 30fps (fps=frames per second)

Please note that using Smooth mode and HD mode will increase the bandwidth needed to send the transmission stream, thus reducing the wireless range. Furthermore, some drones can't record in 4K when using HD transmission mode, or can't record in 4K or 2.7K in Smooth mode.

7.11 Wi-Fi Settings

Figure 7 WIFI channel setting (DJI)

The Wi-Fi settings screen will indicate the strength of the Wi-Fi signal, and if there is any interference, it also allows to switch between 2.4 GHz to 5.8 GHz frequency. Option to reset the Wi-Fi settings and change the username and password is also typically available.

7.12 Camera Gimbal Settings

Follow: In this mode, the camera will remain stable and maintain the horizon

FPV: This orients the gimbal with the movement of the drone. So when changing the orientation of the drone, the camera view will move with it.

Centring Camera: If selected the camera will move into centre place horizontally or vertically.

Adjust Gimbal Roll: Option to adjust the tilt of the gimbal if it is misaligned. This is available when flying rather than adjusting it when landed.

Gimbal Auto Calibration: The drone will automatically try to centre the gimbal, this must be done when the drone is on a level surface.

Advanced Settings:

Gimbal Pitch Speed: This controls the speed at which the gimbal tilts. A higher value means a faster-moving gimbal and lower value means a slower gimbal.

Unable Upwards Gimbal Tilt Limit to 30 Degree: Turning this off will allow the camera to tilt up beyond 30˚, but with some drones propellers will be visible any shots you take. Unless flying backward.

Gimbal Pitch Smoothness: This controls how quickly the gimbal will come to a complete stop after moving it. A lower value means a quick stop and a higher value means a slower stop.

Enable Synchronized Gimbal Pan Follow: Enabling this option, makes the camera move with the yaw stick. This helps videos to be smoother when moving the yaw stick.

7.13 Camera Settings

Single Shot: The standard mode, it takes only 1 picture every time after tapping the shoot button.

HDR Shot (High Dynamic Range): If this option is selected then the camera will take three images of the same scene. One will be underexposed, another overexposed and the last will be properly exposed then it will combine the three images to create a more dynamic JPEG.

Multiple: With this mode, the camera will take multiple pictures after pressing the shoot button. This mode if recommended when trying to get a shot of a moving subject.

AEB (Automatic Exposure Bracketing): This can be set to 3 or 5 shots and works similarly to HDR Shots taking overexposed, underexposed and properly exposed photos. However, in AEB the images are in RAW and not combined as this is up to the user to combine them with image editing software.

Pano: Capture a panoramic image quickly. Pano option has another mode attached to it called Sphere mode; this is where the drone will take multiple shots and stitch them together to make a sphere shaped image.

ShallowFocus: This mode allows to create a depth of field effect in a photo.

Image Format: Choice of size and ratio of pictures:

- 4:3 this is the old standard 35mm size that used to be common during the SD era of TVs.
- 16:9 this is the common size for HD capable devices
- 3:2 is the traditional size for printed photos (3:2 P4P).

Image file recording: Option allows to choose between taking photos in RAW, JPEG and RAW + JPEG. RAW format is specific to each camera, and decoding the image will be needed using the brand's software to be able to read and use it. RAW doesn't compress the file, or only slightly, allowing to keep all the detail/information; JPEG is a standard compressed format with a certain loss of information.

Auto Sync HD Photos: If this setting is enabled then the aircraft will stream full resolution pictures taken from the drone to the R/C during flight.

Histogram: Turning this on will make a little histogram box appear on the screen. This box will show the exposure of the picture before taking it. The graph contains the blacks or shadows, the highlights or the bright areas, and the mid tones.

Mechanical Shutter: If this is enabled then it will prevent getting 'jelly' images when taking a photo of a fast movie subject.

Over Exposure Warning: If this option is "on" the app will inform the pilot when the photo is overexposed.

Video Caption: This option enables a text-based subtitle file (SRT) with a video recording that contains information about Altitudes, GPS, ISO, Shutter, Barometer, Home Point GPS coordinates, etc.

Grid: This option adds guidelines grid to help frame pictures better following the rule of thirds. There is also option to turn on diagonals to help find leading lines.

Anti-Flicker: This function prevents flickering when recording in artificial light, or when filming screens, and offers two options : 50 Hz and 60 Hz. These options are region based:

- Europe being 50 Hz
- US is 60 Hz.

Peak Focus Threshold: This adds flashy lines around edges to indicate focus. There is an option to switch between off/low/normal/high when activated.

White Balance:

This is the process of removing unrealistic colour casts so that objects which appear **white** in person are rendered **white** in your photo. It is measured in Kelvins. If **Auto** option is selected, then the camera will decide the best setting. The operator can choose from a selection of profiles manually.

Colour Temperature	Light Source
1000 – 2000 K	Candlelight
2500 – 3500 K	Tungsten Bulb
3000 – 4000 K	Sunrise/Sunset (clear sky)
4000 – 5000 K	Fluorescent Lamps
5000 – 5500 K	Electronic Flash
5000 – 6500 K	Daylight with Clear Sky
6500 – 8000 K	Moderately Overcast Sky
9000 – 10000 K	Shade or Heavily Overcast Sky

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