**Standard Operating Procedures for DJI M300 Mapping Flights**

**Overview:**

This SOP is written for DJI M300 flights above forestry research trials and does not extend to flying within 30m of bystanders or over buildings. All relevant Transport Canada (TC) drone regulations are adhered to.

**Emergency procedures:**

* Lost link procedure:
  + Maintain visual contact for as long as possible. After 3 seconds, failsafe RTH will engage at the aircraft.
  + Control will return if communication is re-established.
  + Try to regain the link:
    - moving location may help if there is radio interference
    - be prepared to fly manually in ATTI mode if needed
    - power-cycle the controller
  + If fly-away occurs:
    - Note altitude, bearing, speed, battery/time remaining.
    - Air Traffic Control(ATC) notification is required according to TC guidelines where a drone is likely to enter controlled or Class F Special Use Restricted Airspace. Contact details in Safety Plan.
  + In case of imminent and immediate threat to public safety call 24/7 emergency 1-877-992-6853

**Documentation Kept Onsite (Digital or Hard-copy):**

* All UAV pilots must carry a valid pilot certificate.
* Certificate of registration for all UAV’s over 250g
* All UAV and payload manuals.
* Site maps
* Relevant SOP’s and THA’s
* Safety Plan
* Flight log

**M300 Specifications**

* Maximum Flight Time: Up to 55 minutes (without payload)
  + With payload: 31-34 minutes (depending on battery needs of paylod)
* Weight: Approx. 3.6 kg (without payload, with single downward gimbal)
* Max Payload Capacity: Approx. 2.7 kg
* Max Speed: 23 m/s (in S-mode)
* Max Ascent/Descent Speed: 6 m/s / 7 m/s
* Operating Temperature: -20°C to 50°C (-4°F to 122°F)
* Transmission Range: Up to 15 km (FCC compliant)
* Camera Compatibility: Supports multiple payload configurations, including Zenmuse cameras (H20, H20T, L1, P1) and 3rd party cameras that contains the M300 on their compatibility lists
* Obstacle Sensing: Six-directional sensing and positioning (front, back, left, right, up, down)

**Prior to Flight:**

* Confirm flight plans and airspace on Navdrone app or webpage <https://portal.navdrone.ca/>
* Within 24 hours of any flight, check for relevant NOTAMS (CEW7/CFH7/CYEG).
* Check for hardware upgrades and save change logs
* Check weather
* Conduct survey of site - boundaries of area of operation
* Check safety of altitudes and routes to be used on the approach to and from
* Check proximity of crewed aircraft operations
* Proximity of aerodromes, airports, and heliports
* Location and height of obstacles, incl wires, masts, buildings, cell phone towers & wind turbines
* Horizontal distances from persons not involved in the operation
* Check KP Index: <https://www.swpc.noaa.gov/products/planetary-k-index>
* Check wind with anemometer
* Complete safety orientation with all flight participants, including communication of procedures, safe areas to stand during takeoff and landing, where to seek cover in the event of a crash, and other emergency procedures. More detail listed separately in a safety orientation checklist.
* Choose takeoff location carefully, must be level and have no obstacles within 3m

**Setup RTK Unit:**

D-RTK base station

* Choose site of RTK to have the most open skyline possible.
* RTK site needs to be close to takeoff location, safe from traffic and obstacles and be marked for consistent use.
* Confirm charge and install batteries in RTK
* Setup RTK on tripod and confirm level and height of antenna (default 2m)
* Ensure RTK display lights are facing area of operations to allow easy monitoring of RTK status
* Turn on D-RTK. Wait for 2 green lights and one flashing for confirmation, usually within 5 min

Emlid RS3 RTK base station\*

* Power on M300 RTK Controller:
* Connect to base station Wi-Fi: Power on the M300 RTK controller and connect to the base station’s Wi-Fi, the password is emlidreach
* Navigate to RTK settings: Open camera view and tap on the top right … icon, find rtk settings and select custom RTK network with RTK enabled.
* Custom RTK Input: Manually input the RTK information, including the base station location, mount point, username, password, and other relevant details obtained from the Emlid Flow app’s Local NTRIP info page. Hit save once completed, drone will require a reboot anytime RTK base station source changes.
* FIX confirmation: Once orientation and positioning both display FIX, then the drone is ready for flight missions.
* Error: In the event of a save error, check for typos, or if controller is connected to base station Wi-Fi, or if the Emlid flow app output mode has been configured correctly (Local NTRIP).

**DJI M300 Pre-flight Procedure**

* Install landing gear and ensure rotating locks are tight without overtightening.
* Remove aircraft from case, place on stable surface (table) and inspect for damage.
* Extend propeller arms, twist locks to match icons without over tightening.
* Inspect arms, legs, and chassis for damage, notable wear, etc.
* Propeller check: leading edge, cracks, or breaks.
* Inspect motors: check give/resistance of each motor is equal.
* Inspect batteries for cracks, bulging, etc.
* Ensure batteries were paired in the charger so they are the same point in their life cycle.
* Newer TB65 batteries can not be hotswapped with older TB60 batteries. The drone must be power cycled when switching between battery versions
* Install the batteries by sliding in from the back and locking the rotating lever.
* Insert SD card in the payload(s) as required.
* Inspect and attach required payload(s).
* Ensure gimbal is secure and lens cap removed.
* Position aircraft on launch pad.

**Controller Pre-flight Procedure:**

* Check battery and install external battery.
* Double-check flight plan details (specific to payload):
  + Overlap
  + Altitude
  + Speed
  + Margins
* Check RTH height is appropriate for any obstacles between flight plan and takeoff location.
* Check and confirm obstacle avoidance alerts and braking are correctly set.
* Confirm RTK connectivity and power cycle if needed.
* For proven TF flights remove previous DTM’s then add the DTM associated with the flight plan for unproven TF flights follow test procedures in the next section.
* Confirm controller antenna up.

**Flight Operations:**

* Power on if required and wait for double green flash repeats: GPS lock in P-Mode with visioning systems enabled.
* Calibrate the M300 compass carefully following controller directions. This step is required prior to every flight in which the drone has moved more than 5km.
* Perform a final pre-takeoff assessment of safe conditions.
* Communicate where all flight participants should be standing during take-off and landing.
* Ask participants to stand in these designated areas; announce ‘arming’ when engaging props.
* Clearly announce ‘takeoff’. Automated takeoff will hover at about 1.2 m.
* Once safe/obstacle free altitude has been reached confirm proper controller responses by making small movements: Forward & back, side-to-side, up and down.
* Rise above obstacles, tip pilot camera down 20° (if available), and perform 360° reconnaissance before flight, noting hazards and navigational landmarks.
* Press play on mapping flight and constantly (every 2 min) monitor the controller for:
  + Battery levels (controller and drone) – RTH at 20-25% Must take into account distance
  + RTK signal
  + RC connectivity
  + Windspeed
* Maintain Visual Line of Sight (VLOS) during flight for pilot, or a visual observer in direct communication with the pilot. In the event visual sighting is lost and cannot be regained, pause the flight and activate RTH.
* Ensure backup landing zone has been scouted and a waypoint made for roadside sites that could be disrupted by traffic.

**Special considerations for Terrain Following flights:**

* A DTM test flight is required prior to the first TF flight at any new site. Test flight procedures:
  + Remove all existing Digital Terrain Models and load new DTM
  + Make small flight plan over road with proximity to and VLOS of takeoff spot
  + Perform all relevant preflight safety checks
  + Load the H20T and ensure the laser rangefinder is engaged
  + Manually lift the M300 off and hover at a safe altitude
  + Upload and start test flight plan ensuring the laser range finder elevation reading matches the TF elevation, if not cancel flight and rebuild DTM paying special attention to geoid/ellipsoid elevation
  + Return to home and follow all post flight procedures
* DJI Terrain Following (TF) flights as of March 5, 2024 fly to the starting point at the TF elevation with non DJI payloads. This could potentially create safety considerations with any downhill flight.. For example a flight at 40m TF height that is downhill of the takeoff can easily be at head height. The drone will attempt to fly at this height.
* DJI payloads as of March 05, 2024 have a safe altitude setting and will ascend to this altitude before commencing flight
* Manual takeoff and flight to safe elevation before uploading the flight plan is recommended for all downhill flights with non DJI payloads.

**Post Flight Procedures:**

* Confirm landing zone is free from obstacles.
* Announce ‘landing’ to instruct all flight participants to stand in designated safe areas.
* After landing, announce ‘disengage’ when turning off the propellers.
* Place lens caps on payload.
* Power off M300 and move to table or secure location.
* Remove payload from gimbal, replacing caps on gimbal mounts on both the payload and M300
* Eject SD card from payload and confirm data.
* Transfer data immediately onto external HD drive according to appropriate file structure.
* Fill flight log completely.
* If last flight at location, break down drone by removing batteries, folding wings, placing in case and removing legs.

**Battery Management:**

* **Battery Types:**
  + TB60 Battery:
    - Capacity: 5935 mAh
    - Voltage: 52.8 V
    - Charging Time: Approx. 60 minutes (using BS60 Intelligent Battery Station)
    - Battery Life: Approx. 200 cycles
  + TB65 Battery:
    - Capacity: 5880 mAh
    - Voltage: 44.76 V
    - Charging Time: Approx. 70 minutes (using BS65 Intelligent Battery Station)
    - Battery Life: Approx. 300 cycles
* Storage: Store batteries at 50-65% charge in a cool, dry place. Avoid storing fully charged or depleted batteries.
* Pre-flight Check: Ensure batteries are fully charged and check for any physical damage or swelling before each flight.
* In-flight Monitoring: Regularly monitor battery levels during flight using the DJI Pilot app.
* Post-flight Handling: Allow batteries to cool down to room temperature before recharging.
* Avoid Over-Discharge: Land the drone before the battery level drops below 20% to prevent over-discharge and extend battery life.
* Maintenance: Regularly update the battery firmware and check the battery health status using the DJI Pilot app.

**Personal Protective Equipment:**

* High Vis
* Hard hat
* Sunglasses
* Sturdy footwear
* Bear spray

**Equipment:**

* M300 drone
* L1 payload
* P1 payload
* H20T payload
* MicaSense payload
* MicaSenseP Dual payload
* Mavic3 drone
* Mini2 drone
* RTK
* Battery case
* SD card case
* Anemometer
* Handheld radio
* Walkie-talkie
* Canopy
* Chairs
* Table
* Pilons
* Road signage
* Landing pad
* Water can
* Fire tool (axe, shovel)

**Relevant Task Hazard Analyses (THAs)**

Drone Flights in Forestry; Driving Safety; Field Operations

**Contact:**

Updated by Jacob King on June 27, 2024. This SOP will be refined over time, as efficiencies are developed through experience. For any questions, please contact [Jacob.King@nrcan-rncan.gc.ca](mailto:Jacob.King@nrcan-rncan.gc.ca) or, Miriam Isaac-Renton at [miriam.isaac-renton@nrcan-rncan.gc.ca](mailto:miriam.isaac-renton@nrcan-rncan.gc.ca).