DRONE PILOT TRAINING MANUAL

PUBLICATION DRAFT

Introduction

Knightwerx provides practical training resources for operators, organizations, and teams seeking to improve proficiency with unmanned aircraft systems. This manual supports safe, disciplined, and repeatable drone operations through structured instruction, operational checklists, flight-planning guidance, and core principles of sUAS handling.

It may be used as a standalone reference, but it is most effective as a companion to Knightwerx instructor-led drone pilot training services. It is intentionally drone agnostic. Aircraft-specific training, limitations, checklists, and manufacturer instructions remain mandatory before operating any particular system.

Knightwerx

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1. Purpose and Scope

The Knightwerx Drone Pilot Training Program provides a structured, platform-agnostic framework for developing safe and proficient small unmanned aircraft system (sUAS) pilots. It is designed for instructor-led classroom instruction, hands-on equipment familiarization, simulator or low-risk practice, supervised flight training, evaluation, and/or recurrent proficiency training.

This manual addresses general pilot knowledge and operating practices that apply across common multirotor, fixed-wing, and vertical-takeoff-and-landing aircraft. Aircraft-specific limitations, control mappings, firmware behavior, battery specifications, checklists, and emergency procedures must be taught from the applicable manufacturer documentation and organization-approved operating procedures before a pilot operates a particular system.

This manual is not a substitute for an FAA certificate, required aeronautical knowledge testing, airspace authorization, aircraft registration or Remote ID compliance, manufacturer instructions, insurance requirements, site rules, or any applicable federal, state, local, tribal, or foreign law. The remote pilot in command remains responsible for determining that each operation is lawful and safe.

2. Training Audience, Prerequisites, and Objectives

Training Audience. The primary audience is beginning or transitioning drone pilots who require a practical foundation in safe sUAS operations. The program may also be used to train visual observers, payload or camera operators, safety observers, mission coordinators, and supervisors responsible for drone operations.

Prerequisites. Before flight training, each student should:

(1) meet the legal qualifications applicable to the intended operation;
(2) complete required organizational safety training;
(3) disclose any limitation that may affect safe performance;
(4) review the aircraft manufacturer's manual; and
(5) demonstrate basic familiarity with the controls, displays, batteries, and communications equipment to be used.

Training Objectives. At completion, a qualified student should be able to:

(1) explain pilot-in-command responsibility;
(2) identify applicable operating rules and airspace constraints;
(3) conduct a site survey and risk assessment;
(4) interpret basic weather information;
(5) inspect and configure an aircraft and control station;
(6) perform normal takeoff, hover or climb, maneuvering, navigation, approach, and landing;

(7) maintain visual awareness and crew coordination;
(8) recognize abnormal conditions;
(9) execute an appropriate abort or emergency response;
(10) complete post-flight inspection and documentation; and
(11) demonstrate sound aeronautical decision-making.

3. Roles and Crew Resource Management

Remote Pilot in Command (RPIC). The RPIC has final authority and responsibility for the operation, including the go/no-go decision, aircraft condition, crew assignments, airspace compliance, risk controls, and termination of flight when safety margins are reduced.

Person Manipulating the Controls. A trainee or other designated operator may manipulate the controls only under the direct supervision and authority of the RPIC when permitted by applicable law and organizational policy.

Visual Observer (VO). When used, the VO assists the RPIC by maintaining awareness of the aircraft, air traffic, people, obstacles, weather, and hazards. The VO must understand agreed callouts, remain able to communicate immediately with the RPIC, and avoid distractions.

Payload or Camera Operator. A separate payload operator may be used to manage sensors or mission equipment without interfering with flight safety. The RPIC may direct the payload operator to stop work whenever workload or conditions require full attention to aircraft control.

Crew Brief. Before flight, the crew should confirm roles, operating area, planned profile, communications, launch and recovery locations, lost-link behavior, abort criteria, emergency actions, and who has authority to call an immediate stop. Any crew member may call “Abort” or “Stop” for an observed safety hazard.

4. Regulatory and Operating Readiness

Before each operation, the RPIC must identify the legal basis for the flight and verify all qualifications, registrations, markings, Remote ID status, airspace permissions, operating limitations, and required documents. Commercial or other non-recreational operations in the United States are generally conducted under 14 C.F.R. Part 107 unless another authority applies. Recreational flyers must satisfy the requirements applicable to recreational operations, including the FAA’s required safety test.

The RPIC must determine whether the planned operation involves controlled airspace, flight near airports or heliports, operations over people or moving vehicles, night operations, restricted or prohibited areas, temporary flight restrictions, sensitive facilities, public lands, or local restrictions. When authorization, waiver, coordination, or owner permission is required, it must be obtained before launch.

Training flights should be conducted in an area suitable for instruction, with a defined flight boundary, adequate separation from nonparticipants, a designated launch and recovery zone, and a clear method to stop entry into the operating area.

5. Equipment and System Familiarization

Each student must receive aircraft-specific familiarization before operating a new platform. At a minimum, the instructor should identify the airframe, propulsion system, propellers or rotors, flight controller, navigation sensors, communications links, control station, antennas, payload, battery system, status lights, arming method, flight modes, return-to-home or recovery behavior, geofencing features, and emergency motor-stop function, if equipped.

Control Station Familiarization. The student should demonstrate correct power-up and power-down sequencing; identify aircraft status, satellite or navigation status, battery state, control-link quality, altitude, distance, orientation, flight mode, warnings, map layers, and return point; and explain how to recognize stale, lost, or unreliable telemetry.

Flight Modes. The instructor must explain the modes available on the training aircraft and the consequences of mode changes. The student must not use automated flight modes until the instructor has explained required inputs, limitations, cancellation methods, and expected behavior following loss of navigation or control link.

Software and Firmware. Training should use approved software and firmware configurations. Updates should not be installed immediately before a flight event unless necessary, tested, and approved. Configuration changes must be documented and verified before flight.

6. Battery and Power-System Safety

Use only batteries, chargers, power supplies, connectors, charge profiles, and accessories approved for the aircraft. Manufacturer limits control. Never infer a safe charge voltage, current, discharge threshold, storage state, or temperature range from another battery chemistry or model.

Before charging or flight, inspect the battery for swelling, deformation, puncture, leakage, corrosion, unusual odor, excessive heat, damaged wiring, loose connectors, contamination, or impact damage. Remove questionable batteries from service and isolate them in accordance with the organization’s battery safety procedure.

Charge in a suitable area away from combustible materials, maintain supervision, provide ventilation as appropriate, and keep suitable fire-response equipment available. Confirm battery type, cell count, charge mode, current, and balance connection before starting. Do not charge a hot, frozen, wet, damaged, or recently impacted battery unless the manufacturer expressly permits it.

For flight planning, use conservative reserve criteria based on manufacturer guidance, battery health, temperature, wind, payload, and mission demands. A pilot should land before reaching a critical battery state and should treat rapid voltage drop, imbalance, unexpected temperature, or inconsistent state-of-charge indications as an abnormal condition requiring prompt recovery.

7. Weather and Environmental Assessment

The RPIC should assess current and forecast conditions for the entire operating period. Relevant factors include wind speed and gust spread, wind direction, temperature, precipitation, visibility, ceiling, density altitude, solar activity or magnetic disturbance when relevant, terrain effects, and the likelihood of rapidly changing conditions.

Wind. Compare sustained wind and gusts with the aircraft's demonstrated limitations and the student's proficiency. Account for stronger winds above obstacles and for turbulence near buildings, trees, ridges, vehicles, and other structures. Plan the first portion of flight so that adequate energy remains for a return against the wind. (It is strongly recommended that a suitable wind measurement device is utilized, such as the Knightwerx Darqmatter Sensor.)

Temperature and Moisture. Extreme heat or cold may reduce battery performance, change material behavior, affect displays, and alter endurance. Do not operate in precipitation, icing, condensation, dust, salt spray, or other environmental conditions beyond the aircraft's approved capability.

Sun and Visibility. Consider glare, low sun angles, haze, background contrast, and visual obstructions. Reposition the crew or modify the flight plan when the aircraft cannot be reliably seen or its orientation cannot be determined.

8. Site Survey and Operational Risk Assessment

Site Survey. Conduct a site survey before setup. Identify the intended flight boundary, launch and recovery points, emergency landing areas, terrain, structures, wires, antennas, trees, vehicles, people, animals, electromagnetic interference sources, compass hazards, public access points, and any area that must not be overflown.

Launch/Recovery Zone. Establish a sterile launch and recovery zone. Keep nonparticipants outside the operating area and position the crew so the pilot can maintain awareness without walking backward into hazards. Use cones, signs, barriers, or a safety assistant when appropriate.

Risk Assessment. Complete a documented risk assessment proportionate to the operation. Consider pilot proficiency, aircraft condition, mission complexity, proximity to hazards, weather, lighting, airspace, communications, fatigue, distractions, and emergency landing options. Apply controls such as reducing altitude or distance, adding a VO, moving the launch point, delaying the flight, using a smaller aircraft, or canceling the operation.

Go/No-Go. The RPIC should not launch when a critical safety control is unavailable, required authorization is missing, the aircraft has an unresolved discrepancy, weather exceeds limits, the operating area cannot be secured, crew communication is ineffective, or the pilot is not fit for duty.

9. Standard Preflight Procedure

The following checklist is a general framework and must be supplemented by the aircraft-specific checklist.

1. Mission and Legal Review. Confirm purpose, operating authority, airspace, authorizations, site permission, weather, notices or restrictions, and planned flight boundary.
2. Crew Brief. Assign RPIC, person manipulating controls, VO, payload operator, and safety duties; review communications, lost-link behavior, abort criteria, emergency landing areas, and expected flight profile. (If applicable.)
3. Aircraft Inspection. Verify airframe integrity, landing gear, arms, fasteners, propellers or rotors, motors, control surfaces, payload attachment, antennas, wiring, vents, sensors, and battery compartment.
4. Power System. Verify battery identity and condition, adequate charge, secure installation, clean and fully seated connectors, and sufficient controller and accessory power.
5. Control Station. Verify approved application and configuration, correct aircraft selection, maps and home point, control link, telemetry, storage capacity, controller sticks and switches, flight mode, and return-to-home parameters.
6. Navigation and Sensors. Allow required initialization; verify position solution, heading, altitude reference, attitude display, compass status, inertial sensor status, and absence of unresolved warnings. Calibrate only when required by the manufacturer or an approved procedure.
7. Control Check. With the aircraft restrained or otherwise made safe, verify expected response of controls and control surfaces without exposing personnel to rotating propellers. Test motor-stop or emergency-disarm functions only in accordance with manufacturer guidance.
8. Final Area Check. Confirm people and obstacles are clear, airspace is clear, wind remains acceptable, the launch surface is suitable, and all crew members are ready. Announce arming and launch.

10. Fundamental Flight Training

Training should progress from simple, low-risk exercises to more complex maneuvers. Instructors should limit altitude, distance, speed, automation, and environmental difficulty until the student demonstrates consistent control.

Exercise 1 - Orientation and Control Inputs. Identify aircraft heading and demonstrate small, smooth inputs in each control axis. Explain how aircraft-relative controls change as the aircraft turns.

Exercise 2 - Takeoff and Stable Hover or Climb. Perform a controlled takeoff, establish a safe training altitude, hold position and heading, and make a controlled landing. Fixed-wing students should demonstrate the corresponding launch, climb, pattern, approach, and recovery procedures.

Exercise 3 - Translational Maneuvers. Fly forward, backward, left, and right while maintaining altitude and awareness. Progress to squares, rectangles, circles, and figure-eight patterns in both directions.

Exercise 4 - Nose-In and Changing Orientation. Demonstrate control with the aircraft facing away, sideways, and toward the pilot. Use deliberate inputs and recover to a stable hover or safe flight path after instructor-induced orientation changes.

Exercise 5 - Altitude and Distance Management. Climb and descend to assigned altitudes, stop precisely, maintain the operating boundary, and return without relying solely on map display or automated recovery.

Exercise 6 - Precision Landing. Conduct normal and reduced-area landings while accounting for wind, obstacles, prop wash, ground effect, and personnel separation.

Exercise 7 - Automated Features. After manual fundamentals are demonstrated, practice position hold, return-to-home, waypoint or mission modes, and other automation. Verify settings first, maintain the ability to intervene, and understand how to cancel the automation safely.

Exercise 8 - Scenario Flight. Plan and execute a representative mission that integrates site assessment, crew briefing, launch, navigation, payload tasking, battery management, abnormal-event response, recovery, and post-flight documentation.

11. In-Flight Operating Practices

Maintain visual awareness of the aircraft and surrounding airspace. Continuously scan for manned aircraft, other drones, birds, people, vehicles, obstacles, changing weather, and unexpected activity. Yield and descend or land as necessary to avoid conflict.

Monitor battery state, control-link quality, navigation status, warnings, wind effects, flight time, distance, and the energy required to return and land. Do not continue merely because the aircraft has not yet reached a software warning threshold.

Use standardized callouts for launch, altitude changes, boundary approach, traffic, low battery, return, landing, loss of visual contact, degraded link, and abort. Acknowledge critical callouts so the crew knows they were heard.

Avoid unnecessary low flight, high-speed passes, flight toward people, abrupt maneuvering near obstacles, or operation behind structures. Maintain a recovery path and an emergency landing option throughout the flight.

12. Abnormal and Emergency Procedures

Emergency procedures are aircraft-specific. The following priorities provide a general decision framework:

- protect people;
- maintain or regain aircraft control;
- avoid manned aircraft;
- move away from hazards;
- land or terminate the flight in the safest available area; and
- notify appropriate authorities or site personnel when required.

Loss of Visual Contact. Announce the condition, stop or stabilize the aircraft if safe, use the VO and telemetry to reestablish location, and initiate the approved recovery procedure. Do not continue the mission without reliable awareness of aircraft position and flight path.

Degraded or Lost Control Link. Verify controller power and antenna orientation, avoid unapproved configuration changes, and allow the programmed lost-link action to occur if appropriate. Be prepared for the aircraft to hover, land, return, or continue a programmed route depending on configuration. The lost-link behavior must be briefed before flight.

Loss or Degradation of Navigation. If the aircraft can be safely controlled without position hold, transition to the appropriate mode and land. Avoid aggressive inputs. If safe control cannot be maintained, use the approved emergency procedure for the platform.

Unexpected Aircraft Movement or Flyaway. Announce the emergency, attempt the approved recovery actions, warn people in the projected path, and provide location and direction information to the crew. Do not chase the aircraft in a manner that creates additional hazards.

Low or Critical Battery. Terminate the mission and land at the nearest suitable location. Account for wind and avoid delaying recovery to complete a payload task. If battery behavior is abnormal, choose a landing area that reduces risk to people and property.

Motor, Propeller, or Control Failure. Maintain control if possible, reduce exposure to people and property, and conduct an immediate landing or other manufacturer-prescribed response. Do not relaunch until the cause is understood and the aircraft is cleared.

Manned Aircraft Conflict. Yield immediately. Descend, move away, or land as necessary. Never maneuver in a way that increases uncertainty for the manned aircraft.

Fire, Smoke, or Battery Thermal Event. Do not touch or transport the aircraft or battery until the immediate hazard is assessed. Move people away, contact emergency services when warranted, and follow the site battery-fire plan. A damaged battery must be quarantined and must not be reused without qualified technical review.

Injury, Property Damage, or Reportable Event. Stop operations, provide emergency assistance, secure the area, preserve relevant records, notify organizational leadership and insurers as applicable, and determine whether regulatory reporting is required.

13. Post-Flight Procedure and Maintenance Awareness

(1) Announce landing and confirm the landing area is clear. Land under control and disarm using the approved sequence.
(2) Power down in the manufacturer-recommended order. Remove the aircraft battery only after propellers or rotors have stopped and the system is safe to approach.
(3) Inspect the aircraft, propellers or rotors, motors, landing gear, payload, antennas, fasteners, wiring, and battery for damage, heat, contamination, or unusual wear.
(4) Record flight time, battery usage, warnings, hard landings, impacts, maintenance discrepancies, and any unusual behavior. Download and preserve logs when required.
(5) Clean and store equipment using manufacturer guidance. Place batteries at the appropriate storage state when they will not be used within the recommended period.
(6) Do not fly an aircraft with an unresolved discrepancy. Tag or otherwise identify equipment that is out of service, and document the corrective action and return-to-service approval.

14. Evaluation, Qualification, and Recurrent Training

Evaluation should measure judgment and procedural discipline as well as stick-and-rudder skill. A student should pass only when performance is repeatable and does not require unsafe instructor intervention.

Evaluation Criteria. Recommended evaluation areas include:

- regulatory and airspace readiness;
- weather interpretation;
- site survey and risk assessment;
- crew briefing;
- aircraft inspection;
- control-station setup;
- battery safety;
- takeoff and landing;
- orientation control;
- flight-boundary compliance;
- visual scanning;
- battery and link monitoring;
- response to instructor-generated abnormal conditions;

- post-flight inspection; and
- documentation.

Pass/Fail. The instructor should use a pass/fail standard or a 1–5 scale:

- A rating of 1 indicates unsafe or substantially deficient performance;
- A rating of 3 indicates satisfactory performance with minor coaching; and
- A rating of 5 indicates consistently precise performance with strong judgment and crew coordination.

Any critical safety violation results in an unsatisfactory evaluation regardless of total score.

Qualification Sign-Off. Qualification should identify the aircraft category and model, permitted operating conditions, instructor, date, and any limitations. Transition training is required before operating a materially different aircraft, control system, or mission profile.

Follow-On Training. Recurrent training should occur at an interval established by the organization and whenever a pilot has been inactive, has experienced a safety event, will operate a new aircraft or payload, will conduct a more complex mission, or demonstrates a decline in proficiency.

15. After-Action Review and Records

Post-Training Brief. Conduct a brief hot wash after training or operations once the aircraft is safe. Discuss what was planned, what occurred, what went well, what needs improvement, and whether any safety or maintenance issue must be resolved before further flight.

Records. Preserve records appropriate to the operation, including date, location, aircraft, pilot and crew, purpose, flight duration, weather, battery identifiers when used, maintenance status, airspace authorization, anomalies, incidents, and corrective actions. Protect sensitive, personal, proprietary, export-controlled, and customer information in accordance with applicable policy.

Corrective Action. Corrective actions should identify the issue, risk level, responsible owner, due date, verification method, and closure status. Critical issues affecting aircraft control, propulsion, battery safety, communications, navigation, or required legal authority must be closed before the next flight.

Appendix A

General Preflight Checklist

☐ Pilot qualifications and required documents confirmed

☐ Aircraft registration, markings, and Remote ID status confirmed as applicable

☐ Airspace, restrictions, authorizations, and site permission confirmed

☐ Weather and environmental conditions within limits

☐ Crew roles, callouts, lost-link action, abort criteria, and emergency areas briefed

☐ Flight boundary and sterile launch/recovery zone established

☐ Airframe, propulsion, propellers/rotors, controls, payload, antennas, and fasteners inspected

☐ Aircraft, controller, payload, and accessory batteries inspected and sufficient

☐ Correct aircraft and approved software/firmware configuration selected

☐ Home point, return altitude, geofence, altitude limit, and lost-link settings verified

☐ Navigation, compass, attitude, altitude, control link, and telemetry status normal

☐ Control direction and flight mode confirmed

☐ Storage capacity and recording settings confirmed when required

☐ Final people, obstacle, airspace, and wind check complete

☐ RPIC announces go/no-go decision and arming

Appendix B

Flight Evaluation

Student Name: _____ Date: _____ Aircraft: _____

Instructor/Evaluator: _____ Location: _____

Rate each item 1–5 or Pass/Fail:

1. Regulatory and airspace preparation _____
2. Weather and site risk assessment _____
3. Crew briefing and communications _____
4. Aircraft and battery inspection _____
5. Control-station setup and status interpretation _____
6. Controlled takeoff or launch _____
7. Stable hover/flight and altitude control _____
8. Orientation changes and maneuvering _____
9. Boundary, obstacle, and traffic awareness _____
10. Battery, link, and system monitoring _____
11. Response to abnormal or emergency scenario _____
12. Controlled approach and landing/recovery _____
13. Post-flight inspection and documentation _____

Overall Result: Qualified/Additional Training Required

Limitations or Corrective Training: _____

Instructor Signature: _____ Student Signature: _____

Appendix C

After-Action Review Template

Event/Training Name:

Date/Time:

Location:

Aircraft/Configuration:

Pilot and Crew:

Training Objective or Planned Flight Profile:

Weather and Operating Conditions:

What Was Planned:

What Actually Occurred:

What Went Well:

What Needs Improvement:

Safety Issues, Anomalies, or Maintenance Discrepancies:

Corrective Actions/Owner/Due Date:

Aircraft Cleared for Further Flight: Yes/No

Follow-Up Training Required: Yes/No

RPIC or Instructor Approval/Date:

References

- Federal Aviation Administration, Unmanned Aircraft Systems resources and current operating guidance.
- Federal Aviation Administration, Small Unmanned Aircraft Systems Regulations (14 C.F.R. Part 107) and associated waivers and authorizations.
- Federal Aviation Administration, Remote Identification of Drones guidance.
- Applicable aircraft manufacturer flight manual, safety notices, maintenance instructions, and battery documentation.