Aircrew Operator's and Maintenance Manual: DJI Phantom 3

1. Introduction

The **DJI Phantom 3** is a commercial hobby type UAS commonly used for photography and recreational use, and provides a stable platform for aerial photography. This document describes operating and maintenance procedures developed by the University of Nevada AirCTEMPs instrument center. This document is intended for CTEMPs aircrew familiar with the operations and maintenance of the DJI Phantom 3. The following DJI documents provide supplemental and more detailed information: Phantom 3 Quick Start Guide, Phantom 3 Advanced User's Manual, Phantom 3 Intelligent Flight Battery Safety Guidelines, Phantom 3 Safety Guidelines and Disclosure. New AirCTEMPs aircrew are encouraged to familiarize themselves with the above DJI documents before operation or maintenance, and during training.

1.1 Performance Specifications

Aircraft

Weight (including battery)	1280g
Operating temperature	0°C to 40°C
Max ascent	5m/s
Max descent	3m/s
Max flight speed	16m/s (ATTI mode, no wind)
Max flight altitude	6000m
Max flight altitude A.G.L.	122m (FAA regulations, Geofenced)
Flight time	23m (approximate)

Radio Control

Frequency	2.4GHz
Control signal range	2000m
Receiver Sensitivity	-101dBm

Drone Smart Battery

Type	Lithium Polymer
Weight	365g
mAh	4480
Vdc	15.2 (4 cell)

Controller Battery

Type	Lithium Polymer
mAh	6000 (4 Cell)
Vdc	7.4 (working voltage)

2. Operation Checklists

2.1 DJI Phantom 3 Pre-Mission Checklist

___ Flight Log, Registration, Manual, Check lists, Com Radios

___ Firmware up to date, log book check

___ Airframe no cracks or separation

___ Motors free and no roughness

___ Motor Airframe and Accessory screws tight

___ Propellers and spares in good condition

___ Gimbal guards in place

___ Batteries half charge for transport, or full charge if mission imminent

___ Craft and control battery charger

___ Control switches, sticks, tablet mount functioning

___ Primary and backup tablet check and map(s) cashed

___ Tablet charger

___ Primary and spare USB cable

___ SD card(s) cleared and firmware up to date

2.2 Preflight Checklist

Registration, Manual, Log, Com Radios

Craft

Airframe and Hardware	Check
Gimbal	Locks removed and gimbal free
Propellers	No nicks, cracks
Motors	Free
Flight Battery	4 Lights, Voltage recorded
Camera SD Card	Installed

Control

Battery	3-4 lights
Sticks	Full and smooth
Mode Switch	Check and in P
Tablet	Attached, screen clean
Antenna	45 degrees

2.3 Power Up Checklist

Control	On
Tablet	On
Flight Battery	On
Connection Established	Check
Data Channel	Check and set
Compass	Calibrate if new location
Flight Battery	Record voltage
Home Point	Establish
Take off Area	Clear for 5m

2.4 Takeoff and Hover

Taking off Home Point	Audio check
Controls	All axis check
Video Link	Check
Telemetry Data Collection	Check
Camera Gimbal	Check
Camera	Start

2.5 Landing and Shut Down

Camera	Stop
Landing Area	Clear for 5m
Motors	Stopped
Battery and Flight Time	Recorded
Flight Battery	Power Off

2.6 Post Flight

Flight Battery	Off
Control	Off
Motors	Check and remove propellers
Gimbal	Install locks
Airframe and Hardware.	Check
Camera SD card.	Removed and mission labeled.

2.7 DJI Phantom 3 Common LED Codes

Normal

	Red, Green and Yellow Flashing sequentially	Start up and self-test
	Green and Yellow flashing alternately	Warming up
	Slow green flash	Safe to fly **P** mode with GPS
	Two Green flashes	Safe to fly **P** mode no GPS
	Yellow flashing	Safe to fly **A** mode no vision or GPS

Warning

	Fast Yellow flashing	Lost control signal
	Slow Red flashing	Low battery warning
	Fast Red flashing	Critical battery warning
	Alternate Red flashing	IMU error
	Solid Red	Critical error
	Red and Yellow flashing alternately	Compass calibration needed

For other error codes refer to Phantom 3 Quick Start Guide

3. Lost Link Procedures

3.1 DJI Lost Link Protocol

DJI lost link protocol (failsafe) is initiated if control signal is interrupted or lost for a period of greater than 3 seconds. This will initiate a return to home position at a specified altitude which is set in the MODE > Advanced Settings > Failsafe mode on the controller tablet. If signal is lost the craft will hover in place after 3 seconds the failsafe will initiate and the craft will climb to the preset altitude AGL above the home point altitude and fly directly to the home point at this altitude and initiate an auto land. Note, the aircraft will stop its ascent to this altitude and return to home immediately if the throttle stick is moved during fail safe. The DJI flight controller does not provide a means of programming a remote lost link landing point.

3.2 Home Point Establishment

The PIC shall access the flight course to determine if terrain or obstacles are within the course area. If there are any terrain or obstacles ensure that the return to home altitude is set to clear these obstacles. To set or check the return to home flight altitude (AGL above home point) enter MODE > Advanced Settings > Failsafe mode. Note the aircraft will stop its ascent to this altitude and return to home immediately if the throttle stick is moved during fail safe. The PIC shall establish home point at the takeoff location. The DJI flight controller does not provide a means of programming a remote lost link landing point.

3.3 Fly-Away

The DJI flight controller failsafe mode is to land immediately or return to home. Because of this fly-away is unlikely to occur providing that proper start up procedures are followed and the craft is not launched before GPS satellite acquisition has occurred and home point has been established.

In the event of a suspected fly-away the craft should be monitored and if it appears the craft is not responding to controls, or does not appear to be following fail safe mode of land immediately or return. ATC shall be notified of the last position and altitude and heading of the craft, and of the approximate flight time remaining.

3.4 Recovery

All reasonable efforts shall be made by the flight crew to recover lost aircraft, with crew safety a priority.

3.5 Imminent Crash

If all attempt to regain control fail and a crash is Imminent. PIC is to first: attempt to, if at all possible, steer the UAS away from bystanders and other field workers. Second: audibly communicate to any nearby workers or bystanders of the imminent crash, forcing all nearby personnel and bystanders to keep their eyes on the UAS if possible.

4. Maintenance

4.1 Introduction

Because the DJI Phantom 3 is powered by electric motors and lithium polymer batteries, and the manufacture DJI does not have a specified TBO or specified periodic maintenance, UNR AirCTEMPs conducts physical inspection of craft pre- and post-flight and post-mission for any mechanical defects or indication of ware or aging of the airframe and components. Since flights are of a duration of approximately 20 minutes, because of battery capacity, problems with propulsion motors such as indications of bearing ware should be evident on inspection and initial power up. Also because of the short duration of flight, motors have a low likelihood to fail catastrophically during flight. Because this is a multi-rotor VTOL craft and does not have control surfaces, there are no moving parts or actuators other than the flight motors that require inspection or for ware or function. The lithium polymer battery life expectancy is dependent on charge and discharge rates and storage practices, and have an unpredictable life expectancy. To predict battery replacement interval, the voltage of each battery shall be recorded in a battery log along with the flight time and the percent battery remaining as indicated on the tablet display.

4.2 Inspection and Maintenance Procedures

UNR AirCTEMPs Phantom 3 is to be inspected by the PIC pre- and post-flight- and pre- and post-mission by the AirCTEMPs Technician.

Pre- and Post-mission Inspection

_____ **Static Start Up**

Remove gimbal locks. Remove propellers or secure aircraft landing gear to test bench. Start aircraft and ensure indicator lights and annunciators are functioning. Arm motors and listen for uniform idle operation.

_____ **Control**

Test control sticks for correct motor response. Test function of controller switches, and sticks.

_____ **Firmware**

Check last firmware update in log book and confirm firmware is current version. Update as needed.

_____ **Airframe**

Airframe no cracks or separation. Replace airframe shell or other components if cracks are detected. Shell separation may be due to miss alignment and may snap into place with slight pressure. Confirm that shell separation is not due to missing or loose screws or hardware, and replace any damaged components.

_____ **Motors**

Motors free and no roughness. Inspect motors visually for any debris between rotor and stator. Place propeller on motor and spin with finger to confirm motors turn freely with slight detent due to motor magnets. Any grinding, ticking or squeaking sound may indicate debris in the motor or worn bearing. Clean or replace motor as necessary.

_____ **Propellers**

Inspect primary propellers and spares for cracks chips or nicks. Replace cracked or chipped propellers. Small nicks may be sanded or burnished.

_____ **Gimbal**

Inspect gimbal for free movement and put guards in place.

_____ **Batteries**

Confirm batteries are at half charge for long term storage or full charge if mission is imminent.

_____ **Tablet**

Check tablet for current flight app. version.

_____ **Accessories**

Check flight, controller and tablet battery chargers cables and connectors.

_____ **Test Flight**

Schedule test flight if control systems, propulsion motors or airframe components have been replaced, or if firmware has been upgraded.