

# PUMA AE LAUNCH\_RECOVERY PROCEDURE

## 1 Launch

Upon completion of Pre-flight Check, the Air Vehicle is ready for launch. To obtain airspace clearance, follow the airspace management procedures.

Follow these steps to launch the Puma-AE Air Vehicle.

1. (VO) Determine wind direction. Always launch Air Vehicle into wind.
2. (MO) Point Air Vehicle nose in takeoff direction.
3. (VO) Select MAN mode (using Hot Key Button). Horizontal stabilator will move from autoland to flight position. VO states "Clear prop."
4. (MO) Grasp Air Vehicle from bottom aft of skid pad. Assume correct stance for launching Air Vehicle depicted in Figure 1-1.  
Acknowledge with "Prop clear."
5. (VO) Throttle up to full power (press Toggle Switch forward and hold until 100% throttle achieved [3 seconds]).

<b>CAUTION</b>
Wait until motor is at full throttle for three seconds before launching Air Vehicle. Otherwise, crash landing and possible damage to Air Vehicle could result.

6. (MO) Wait for motor power to stabilize (approx. 3 seconds) then throw Air Vehicle into wind. Throw it upward at angle between 10° and 25°. Maintain focus on correct stance and technique.



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## Figure 1-1 Puma-AE Launch

### **CAUTION**

In the event of a bad launch, the VO must be prepared to command Autoland immediately to minimize damage to the Air Vehicle.

7. (VO) Provide joystick inputs to adjust for desired flight path. If launch appears to be unrecoverable, VO must command Autoland immediately.
8. (VO) Maintain climb direction into wind until approx. 200-300 ft. AGL then select appropriate flight mode and deploy payload by selecting camera.

## **2 Flying the Mission**

It is critical that the system is continuously monitored while a mission is being flown. Both operators are responsible for monitoring Air Vehicle and GCS status throughout flight. Key aspects that should be watched are:

- Video output
- Battery voltage
- Waypoint data
- Warnings
- Range and bearing

As required, the MO may deviate from the flight route depending on the mission as it evolves and what is observed on the ground. The VO switches between flight modes as needed to complete the mission.

## **3 Landing, Recovery and Inspection**

### **WARNING**

Air Vehicles in flight can cause a danger to personnel or objects in the area if flight path and flight control are not managed properly, especially during takeoff and landing.

Personnel in the area of the landing site should be prepared to move quickly if necessary.

### **WARNING**

Do not look directly into the laser illuminator beam. Do not look into the beam through any magnifier. When verifying laser function, point the beam straight down at a non-reflective surface. Never direct the laser upward, at a

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reflective surface, or toward any personnel during this check. Make sure the laser is turned off at the end of Pre-flight Check. When approaching the Air Vehicle landing site, treat the laser as if it were on and take appropriate precautions until the Air Vehicle battery has been removed. Failure to comply may result in eye and/or skin injury.

Puma-AE is designed with an Autoland feature that causes the Air Vehicle to descend in a deep stall. This enables landings in confined areas. The landing is triggered either by VO command automatically in an autonomous NAV landing, upon LOL if set in the flight profile, or autonomously by Air Vehicle in order to touchdown at the L waypoint. Always land the Air Vehicle into the wind. This helps to slow forward motion and stabilize the Air Vehicle horizontally during descent. Survey the landing site before initiating a landing or from the air just prior to activating the landing.

### CAUTION

During LOL mode, the Air Vehicle will not automatically align itself to land into the wind, which could cause damage to the Air Vehicle.

### CAUTION

Autoland can be initiated at any time and from any altitude. Greater chance of Air Vehicle damage exists if Autoland is commanded at altitudes lower than 100 ft. AGL.

### CAUTION

If the payload is deployed, command the payload to retract and confirm retraction is complete prior to commanding Autoland. Do not command Autoland at an altitude of less than 100 ft. AGL to ensure that the payload has enough time to stow.

Upon commanded, autonomous, or LOL Autoland, power is cut from the engine, the gimbaled payload is stowed, and the stabilator deflects fully upward. The Air Vehicle pitches nose-up and begins a steep descent to the ground with wings level. Impact with the ground usually causes the Air Vehicle components to separate. This is normal and helps dissipate the impact of landing and protect the Air Vehicle. Landing pads on the bottom of the fuselage also provide impact protection. When the Air Vehicle is

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landed on water, the impact may cause the wing and stabilator to separate from the fuselage. The lanyards will prevent these parts from floating away from the fuselage. It is possible to safely abort the flight at any time. For typical landing procedures, it is recommended that Autoland be initiated above 100 ft. AGL. Attempting to recover control of an Air Vehicle in Autoland is not recommended at altitudes below 100 ft.

### 3.1 Autoland, VO-Initiated

NOTE
Autoland is a 1:1 deep stall based on zero wind. Increased wind speed will decrease Air Vehicle glide distance.

The following procedure outlines a VO-initiated landing.

1. Ensure laser illuminator is off.
2. Command gimbaled payload to retract and confirm retraction is complete prior to continuing to next step.
3. Direct Air Vehicle to altitude of approx. 100 ft. AGL and orient Air Vehicle into wind.
4. When Air Vehicle is approx. 45 degrees from operator's LOS and still at approx. 100 ft. AGL and flying into wind, Air Vehicle is properly oriented for Autoland.
5. Press Hot Key and Enter buttons simultaneously to manually enter Autoland. "AUTOLAND" will flash on VO Hand Controller screen.
6. VO should continue to fly Air Vehicle to ground ensuring nose of Air Vehicle remains directed into wind.
7. Record flight/mission data.

### 3.2 Autonomous Landing, VO-Initiated

In this instance, the operator commands the Air Vehicle to go to Waypoint E in NAV mode.

1. Ensure laser illuminator is off.
2. Verify location and altitude of waypoints E and L, terrain clearance, and wind direction.
3. Reroute Air Vehicle to waypoint E.
4. When Air Vehicle reaches waypoint E and turns to waypoint L, command gimbaled payload to retract and confirm retraction is complete. Gimbaled payload will automatically retract if the Air Vehicle altitude is less than 150 ft. above L.
5. Air Vehicle will fly to waypoint L and will initiate an Autoland such that it lands near waypoint L.

### 3.3 LOL Actions

During pre-flight procedures, the operator selects one of the following three LOL actions: Land Now, Go To Rally, or Finish Flight (see Sections 3.3.1 - 3.3.3). The LOL action is automatically engaged after 3 continuous seconds of loss of uplink (loss of

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downlink only does not initiate LOL mode). The link status bar on the Hand Controller will appear as a red bar (indicating no signal).

CAUTION
Do not attempt to regain control of the Air Vehicle after LOL if altitude is below 100 ft. AGL.

If link is reacquired, control of the Air Vehicle can be resumed. To resume control of an Air Vehicle in Autoland when link is reacquired:

1. Press Hot Key Button by itself once. This will put the Air Vehicle in MAN mode at 0% throttle.
2. Begin manually piloting Air Vehicle and immediately add power.

### 3.3.1 LOL: Land Now

If the LOL action has been set to Land Now, the Hand Controller will read "AUTOLAND" (not flashing). The Air Vehicle is in Autoland descent at this time. The current Air Vehicle coordinates indicate the location of Autoland.

### 3.3.2 LOL: Go to Rally

If the LOL action has been set to Go To Rally, the Air Vehicle will ascend to the rally altitude, then proceed to the E Waypoint and then to the L Waypoint. The Hand Controller will read "En Route Rally." Upon reaching the L Waypoint, the Hand Controller will also read "AUTOLAND" (not flashing). Gimbaled payload will automatically retract if the Air Vehicle altitude is less than 150 ft. above L.

### 3.3.3 LOL: Finish Flight

If the LOL action has been set to Finish Flight:

- In NAV mode, the Air Vehicle will continue its mission until flight loop time expires, then proceed to Waypoint E for landing at Waypoint L.
- In all other modes, the Air Vehicle will perform Go To Rally.

## 3.4 Unintended Landing

If the GCS is still powered-up and the GPS link was good at the time of the crash, the last known coordinates will be displayed on the Hand Controller. A recovery team should record the last known coordinates or lat/long location and other data that will aid in search (altitude, range, distance, heading, wind direction and speed), then plot the location on a map and/or program it as a waypoint on a hand-held GPS before moving to the area to begin a search for the Air Vehicle.

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The GCS can be taken to the vicinity of the downed Air Vehicle and used to pick up video signal from a grounded or crashed plane, provided it is intact enough to transmit. An Autolanded Air Vehicle may transmit for quite a long time after landing, as battery usage is significantly diminished after the motor is off.

### 3.5 Post-Flight Procedures

#### 3.5.1 On-ground Landing

Follow these steps to recover and inspect an Air Vehicle.

1. Retrieve fuselage by approaching from side or rear, keeping body away from propeller area.

NOTE
Write down all pertinent last good data before disconnecting Air Vehicle battery. Data is lost when battery is disconnected.

2. Remove wing assembly if still connected.
3. Disconnect battery from Air Vehicle.
4. Gather remainder of Air Vehicle components.
5. Inspect all components for damage.
6. Prior to departing launch/recovery site, inventory and account for all equipment.
7. Unlock Air Vehicle from GCS unless power has been recycled prior to launching another Air Vehicle.

#### 3.5.2 Maritime Landing

1. Retrieve fuselage by approaching from side or rear, keeping body away from propeller area.

NOTE
Write down all pertinent last good data before is connecting Air Vehicle battery. Data is lost when battery is disconnected.

2. Drain all excess water from fuselage.
3. Remove wing assembly if still connected.
4. Run motor at 100% for 10 seconds.
5. Extend camera and ensure no water is visible in gimbal housing.
6. Retract payload.
7. Disconnect battery from Air Vehicle and remove payload.
8. Fresh-water-rinse fuselage, battery terminals, Pitot tube, and avionics static cup.
9. Wipe components dry. If re-launching Air Vehicle, ensure all components, with special attention to battery and payload terminals, are thoroughly dried.

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10. Stow/install battery.
11. Remove and replace Pitot tube and avionics static cup with fresh hardware.
12. Gather remainder of Air Vehicle components.
13. Inspect all components for damage.
14. Prior to departing launch/recovery site, inventory and account for all equipment.
15. Unlock Air Vehicle from GCS unless power has been recycled prior to launching another Air Vehicle.