V-22 Osprey VTOL *Manual Addendum, Nacelle Alignment*

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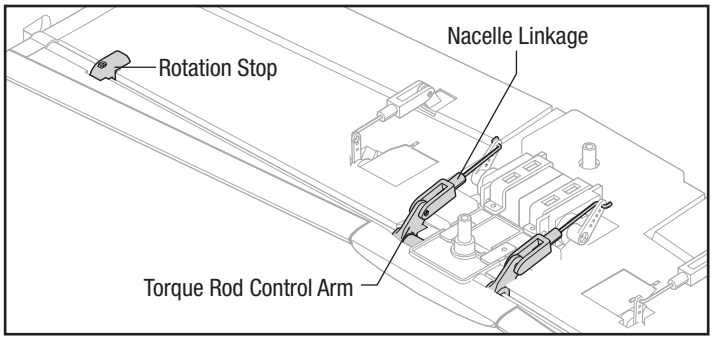
The following information has been added to the V-22 Osprey manual.

BEFORE THE FIRST FLIGHT OF THE AIRCRAFT

Check the nacelle movement to ensure proper alignment. Fully cycle the nacelles 2 or 3 times to ensure they are transitioning evenly. If the nacelles are not aligned, use the information below to adjust the nacelles before attempting flight.

If the aircraft displays unwanted yaw or roll during the transition from multirotor to airplane mode, check the nacelle alignment.



IMPORTANT: The following information refers to the movement of the nacelles when transitioning from multirotor to airplane mode. While in multirotor mode, the nacelles may not always be vertical or aligned with each other. This is due to the way the aircraft uses the nacelle movement to control yaw in multirotor mode. While in airplane mode however, the nacelles should be aligned with each other.

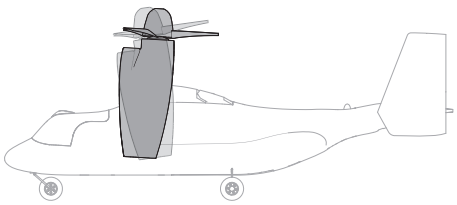
If the motor nacelles do not move in unison the aircraft may yaw or roll slightly when transitioning from multirotor to airplane mode. For example, if the left nacelle is *slightly* lagging behind or not traveling far enough when changing into airplane mode, the aircraft may yaw to the left during the transition. If the left nacelle is lagging *far* behind, the aircraft may yaw to the left and roll to the right during the transition.

IMPORTANT: Always check for proper nacelle alignment ***with the wing upright***.

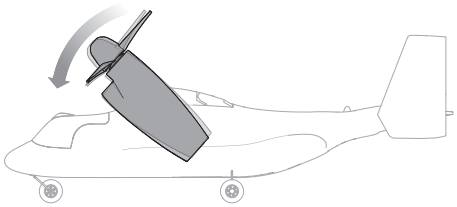
To check the travel of the nacelles:

1. Power on the transmitter.
2. Enable throttle cut.
3. Power on the aircraft and place it on a flat surface. Wait for the aircraft to initialize.
4. After initialization, with the aircraft upright, cycle the flight mode switch from multirotor to airplane mode 2-3 times, allowing the nacelles to finish transitioning each time before switching. Observe the movement of the nacelles. They should start moving at the same time, remain even through the full range of travel and stop at both the same time and same angle.

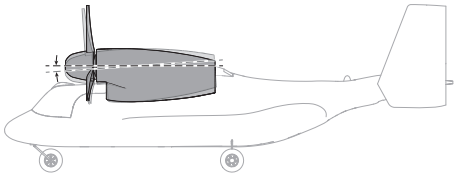
Multirotor Mode: The nacelles may be at different angles.



Transition to Airplane Mode: The nacelles may differ slightly but should be close to the same angle.



Airplane Mode: The nacelles should both be at the same angle, at or just below horizontal.



Adjusting the Nacelle Alignment

Pushrod Length Adjustment

The pushrods for the nacelle linkages should be 39-40mm long from the clevis pin to the z-bend. Due to the differences in the splines of the output shafts of the nacelle servos, the pushrods will not necessarily be identical in length. Check both linkages to ensure they fall within this range. Turn the clevis in or out until the length is within this range on both linkages.

Fine Tuning Pushrod Length

Determine if one of the nacelles is not traveling far enough **OR** one of the nacelles is traveling too far, overdriving against the rotation stop when in airplane mode.

IMPORTANT: Always check for proper nacelle alignment ***with the wing upright***.

If one of the nacelles is not traveling far enough:
shorten the linkage for the nacelle that is lagging behind.

1. Remove the wing.
2. Remove the clevis from the torque rod control arm.
3. Shorten the linkage by turning the clevis in 1/2 turn increments clockwise.
4. Re-connect the clevis to the torque rod control arm.
5. With the wing upright, re-check the movement of the nacelles.

If one of the nacelles is traveling too far, overdriving against the rotation stop:
lengthen the linkage that connects that nacelle rotation servo to the torque rod.

1. Remove the wing.
2. Remove the clevis from the torque rod control arm.
3. Lengthen the linkage by turning the clevis in 1/2 turn increments counter-clockwise.
4. Re-connect the clevis to the torque rod control arm.
5. With the wing upright, re-check the movement of the nacelles.

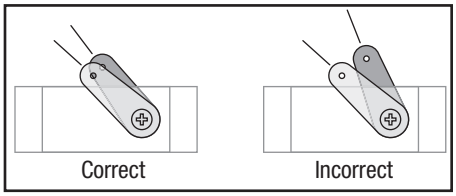
With the aircraft upright on a level surface in airplane mode, the nacelles should be even with each other and level with the surface the plane is sitting on or pointed slightly down (no more than -2°).

Servo Horn Adjustment

Both servo horns must be at similar angles when in airplane mode for the aircraft to transition from multirotor to airplane mode correctly.

To check for correct servo horn location:

1. Remove the wing.
2. Disconnect the nacelle linkages.
3. Check the length of the linkages as noted above.
4. Power on the transmitter.
5. Enable throttle cut.
6. Power on the aircraft and place it on a flat surface. Wait for the aircraft to initialize.
7. Set the flight mode switch to airplane mode, allowing the nacelle servos to fully transition. Observe the servo arms from either wingtip. The horns should both be at a similar angle, within a few degrees, similar to the illustration.



8. Manually rotate the nacelles to the airplane mode position until the rotation stops touch the wing.
9. Attach the linkage z-bends to the servo arms.
10. Attach the linkage clevises to the torque rod control arms. The linkages should attach to the control arm without having to force them in either direction. If a pushrod does not fit correctly, remove the corresponding servo horn and rotate it one spline on the servo output shaft in the required direction to make the linkage fit easily.
11. With the wing upright, cycle the nacelles to ensure they are tracking correctly. If after adjusting the servo arm alignment, the nacelles are not even during the transition to airplane mode or if they do not stop at the same angle in airplane mode, go to the *Fine Tuning Pushrod Length* section to adjust the nacelles.