Tango 2 Gyroplane
N255EE
Operating Handbook

Table of Contents

Introduction

Gyroplane N255EE (“Aircraft”) is a unique example of a Tango 2 gyroplane. It has been custom built from a first-generation frame and body and has prototype features not found in other Tango gyroplanes.

Some of these modifications change the standard operating procedures and may change the aircraft’s performance. It is, therefore, important to read this handbook with special attention to the sections on preflight, postflight and all operating processes.

Safety Notice

The Aircraft is Experimental Amateur-built and carries the posted notice:

“THIS AIRCRAFT IS AMATEUR-BUILT AND DOES NOT COMPLY WITH FEDERAL SAFETY REGULATIONS FOR STANDARD AIRCRAFT.”

The Aircraft has been inspected and issued an Airworthiness Certificate. It shall be operated as an Experimental Aircraft in Phase I, followed by Phase II testing for the purposes of education and recreation only.

Disclaimer

Use of this manual constitutes an agreement by the user to hold harmless the builder, operators and owners of the Aircraft from all actions which may result from errors or omissions in this manual.

Controls & Instrumentation

The Aircraft has some of the standard Tango 2 instrumentation along with some additional components. Please consult the list below for a complete list of instruments and controls.

Note that this list is “as-built.” Changes to this list (if any) will be found in the Airframe Log and/or Engine, Prop & Rotor Log.

Flight Controls

- Rotor Control Cyclic (front and rear seats)
- Rudder Pedals (front and rear seats)
- Throttle (front and rear seats)
- Wheel Brakes (front seat only)
- Electric Rotor Brake (front seat only)
- Electric Pre-rotator Control (front seat only)

Instrumentation

- Airspeed Indicator ASI (front seat only)
- Altimeter (front seat only)
- Vertical Speed Indicator VSI (front seat only)
- Compass (front seat only)
- Yamaha Engine Monitor (front seat only)
    - Digital Engine RPM
    - Speed Sensor (used for Rotor RPM*)
    - Fuel Indicator w/low fuel lamp
    - Diagnostic Code Display
    - Engine Warning Light
- VHF Radio w/Intercom (front and rear seats)
- Hobbs Meter (front seat only)
- Digital Volt Meter
- Running Lights
- Strobe Lights

Instrumentation (continued)

- Landing Lights
- Rotor Brake Status Lights (front seat only)
- Pre-rotator Status Lights (front seat only)
- USB and Lighter Power Ports (front seat only)
- Keyed Master Switch (front seat only)
- Independent Ignition Switch (front seat only)
- Push-button Starter Switch (front seat only)
- Electric Rotor Trim (front cyclic only)
- Radio Push-to-talk PTT (front and rear seats)
- Intercom Push-to-talk PTT (front and rear seats)
- GA headphone/mic jacks (front and rear seats)
- Instructor panel (rear seat only)
- Switch/Breaker Panel (front seat only**)

* *Rotor RPM displayed on Yamaha Speed Sensor requires a multiplication factor for accurate rotor RPM.*

** *Additional fuses are located in the wiring harness behind the rear seat and in the relay mounted above the battery.*

Other Key Components

Engine

The Aircraft has been constructed with a Yamaha YG3 fuel-injected engine equipped with a centrifugal clutch connecting a 3.0:1 gear reduction drive. Refer to publications from Yamaha for engine maintenance and performance specifications. The serial number is listed in the Engine Log.

Propeller

The Aircraft has been constructed with a 69” 3-blade Luga Prop. The blade serial numbers are listed in the Engine Log. The propeller has been pitched to allow an engine RPM of 8250 at full throttle with a static thrust of 540 pounds.

Rotor System

The Aircraft has been constructed with 29’ Sky Wheels fiberglass rotors. However, the rotor head is the standard Tango 2 model, adapted to US rotors by installing metric-to-SAE bushings in the teeter bolt bearing inserts.

Fuel Tanks

The Aircraft is equipped with two, 7 US gallon fuel tanks for a total of 14 gallons. Regular 87 octane auto gas (with or without ethanol) is the recommended fuel. The aircraft may be operated with 100LL AVGAS, however, the time between oil changes should be halved along with the spark plug replacement life.

Preflight Checklist

It is recommended that the complete preflight checklist is followed before each flight, even if the flight is short or just following a previous flight. Any defects found should be corrected prior to flight.

This checklist is in a basic walk-around format with the exception of focus on certain critical component checks that should be performed together.

1. Check fuel level manually. Inspect inside tank for water or foreign objects. Secure fuel cap.

2. Check starboard side wheel, wheel nut and brake mechanism. Ensure tire is in good condition and properly inflated, brakes clear of debris, brake lines not leaking and wheel nut properly installed.

3. Check battery leads and hold-down straps.

4. Check rear walking beam keel connect pivot point and starboard rotor control yoke to push-rod tie-rod end. Ensure no wiring, tubing or cables obstruct walking beam, yoke or push-rod.

5. Check wiring and lighting along mast is secure.

6. Inspect starboard side of engine. Check motor mounts secure, muffler secure, water, oil and vacuum lines secure and not leaking.

7. Inspect rear of engine. Verify pre-rotator belt is in good condition, pre-rotator actuator and solenoid on mast in appropriate position (disengaged) and pre-rotator brake holds drive-shaft secure.

Preflight Checklist (continued)

8. Check prop for defects or damage.

9. Check tail wheel free and wheel bolt secure.

10. Check rudder cable pulley bolts tight, but pulley wheels turn freely. Rudder cable in the pulley tracks.

11. Check rudder hold-down bolts tight and rudder cable stop secure so rudder cable does not slip on rudder pulley. Check rudder to vertical stabilizer bolts secure.

12. Check port side of engine. Check motor mounts secure, water, fuel, oil and vacuum lines secure and not leaking. Check air filter clean and secure.

13. Advance throttle and visually verify throttle body linkage moving appropriately. Check oil level. Check coolant level.

14. Check rotor control yoke to push-rod tie-rod end connection. Ensure no wiring, tubing or cables obstruct the port yoke, walking beam or push-rod.

15. Check port side wheel, wheel nut and brake mechanism. Ensure tire is in good condition and properly inflated, brakes clear of debris, brake lines not leaking and wheel nut properly installed.

16. Engage wheel brakes and check wheels locked.

17. Align rudder pedals parallel in front seat position. Verify rear rudder pedals also parallel. Verify front wheel and rudder properly aligned.

Preflight Checklist (continued)

18. Disengage the rotor brake. Verify full forward, aft, left and right travel in cyclic. Verify both cyclics move together and are not obstructed.

19. Check rotor head. From the rear of the aircraft, pull on the rotor, push on the rotor and check for any play in the bearings. Rotate the rotor clockwise and counter-clockwise and check for play in the torque tube bushings. Give the rotor blade a gentle push and watch the tip as it moves around 180 degrees. Repeat for the other rotor. Any “jump” in the travel or noise could signify main rotor bearing damage.

20. Re-engage rotor. Check rotor trim setting.

21. Walk around body and verify all body connecting screws, windshield screws and access panel screws are installed and tight.

22. Check seat belts. Secure rear seat belts and seat pad if not carrying a passenger.

23. If required, check landing lights, strobes and position lights.

Engine Start Procedure

1. Safety check. Verify passenger properly seat belted or rear safety belts and seat pad are secure. Remind passenger to avoid contact with the cyclic, throttle or rudder pedals, unless directed. Verify pilot seat belts.

2. Turn off all panel switches. Turn ignition switch off. Insert key in Master Switch.

3. Engage wheel brakes and hold. Turn Master Switch on. Turn Ignition switch on. Clear area (verbally). Set throttle full aft (SLOW). Fuel Injected engines do not require choke or primer. Then:

Press and hold starter button until startup.
Leave throttle full aft (SLOW) for warm-up.
Expect low temp warning on initial startup.
Check for oil pressure warning.
Check for engine fault codes during warm-up.
Verify fuel display matches visual check.
Shut down if any engine fault codes continue.

4. Turn on ACCESSORY switch, VHF Radio switch (if required), NAV LIGHTS switch (if required) and SPOTLIGHT switch (if required).

Taxi Procedure

1. Test and Verify Intercom communications with passenger (if required). Check radio transmit/receive if possible. Announce taxi intentions as applicable.

2. Clear area prior to moving.

3. Verify rotor brake ON and cyclics locked forward (red indicator light).

4. Release wheel brake and increase throttle as required. Do not exceed 4000 engine RPM or taxi faster than a fast walk. Steer with rudder pedals and use wheel brakes as required.

Pre-rotation Procedure

1. Set rotor brake OFF (green indicator light). Verify full aft cyclic travel.

2. Hold cyclic full forward.

3. Engage and hold wheel brakes FIRMLY.

4. Set pre-rotator ON (red indicator light).

5. Increase throttle to 3000 engine RPM. Once rotor RPM stabilizes, increase engine RPM to 4000.

6. At desired rotor RPM, set pre-rotator OFF (green indicator light). This pre-rotation system will disengage immediately from the rotor head ring gear, and the belt drive will lock down after about 10 seconds.

7. Verify green indicator lights on both pre-rotator and rotor brake.

Avoiding Rotor Flap

Rotor flap is a dangerous condition that can cause serious damage to a gyroplane and/or injury to pilot and passengers. It occurs when the wind introduced into a gyroplane rotor system causes greater lift in the advancing blade and greater loss of lift in the retreating blade than can be offset by the centrifugal force keeping the rotors level. This allows the retreating rotor blade to strike the teeter plate on the rotor head with downward force, spring-loading the retreating rotor blade. As the blades continue around, the spring-loaded blade becomes the advancing rotor blade. It is not only spring-loaded to rise quickly, but being now the advancing rotor blade, it also has too much lift, as it was excessive lift in the advancing blade that started the flap.

A bad rotor flap on a take off roll can easily damage the tail, cause the rotor to strike the ground or propeller and even flip the machine over. Fortunately, it is preventable. If you act quickly when you first detect a flap, it is very correctable.

A bad rotor flap will jerk the cyclic around with enough force to cause bad bruises on arms and legs. **At the first sign of a minor bump in the cyclic, you must act quickly. First, push the cyclic full forward immediately. Then, reduce the throttle.** Pushing the cyclic forward sets the rotor system parallel the earth and thus eliminates the wind coming through the rotors (that caused the flap). Reducing the throttle slows the machine down further. It is a good practice to start your takeoff run over from the beginning after a flap.

Avoiding Rotor Flap (continued)

If a flap occurs that is anything but a minor bump in the cyclic, stop and inspect the rotor system and any other related components for damage.

Most normal takeoff rolls include a pre-rotation above 100 rotor rpm (“RRPM”) to as much as 200 RRPM. In general, once the rotor exceeds 160 RRPM it is appropriate to be slightly more aggressive adding throttle. Above, 200 RRPM, it is generally save to add full throttle and the possibility of a flap is very unlikely.

Note that strong winds require additional care in adding throttle as excessive wind through the rotor system is the cause a flap. Note too, that even if you pre-rotate to 200 RRPM or greater, it may take several moments to begin moving at a speed that will support that RRPM. You may lose RRPM during your initial roll and end up with too much throttle and a flap if you hurry things. Instruction in short roll takeoffs is recommended.

It is a reasonable practice to taxi with the rotors spinning in certain situations, such as exiting a runway or taxiing on a taxiway for a pending departure. NEVER taxi with the rotors below 80 RRPM. If the rotors decay to a speed below 80 RRPM, you must stop and engage the rotor brake or immediately pre-rotate to a more stable RRPM to avoid a flap.

Takeoff Procedure

1. Pre-rotate to desired RRPM and set the pre-rotator OFF (green indicator light).

2. Move the cyclic full aft at a moderate pace, but with deliberation. Do not jerk the cyclic back. The cyclic should remain centered left to right) throughout the takeoff roll. If there is a crosswind, the cyclic may be held very slightly left or right into the crosswind to compensate.

3. Place feet on rudder pedals for steering and release the wheel brakes.

3. Gradually increase the throttle. Ensure the RRPM is increasing. **Steer with the RUDDER PEDALS ONLY. NEVER try to steer left or right with the cyclic while the main wheels are on the runway on takeoff or landing.**

4. Continue gradual throttle increase through 160 RRPM. After 160 RRPM, throttle increase may be slightly more aggressive.

5. The nose will rise somewhere between 240 and 300 RRPM, depending primarily on the weight of the front seat pilot and density altitude. Immediately move the cyclic forward and do not allow it to continue moving up. This is especially important in gusty wind, when the nose may try to point straight up if the cyclic remains full aft. The ideal angle for takeoff is nose wheel 4” above the ground.

6. Holding the takeoff angle will require increasing the cyclic forward pressure as speed increases.

Takeoff Procedure (continued)

7. The main gear should leave the ground at about 35 mph, +/- weight and density altitude. Allow the Aircraft to lift a few feet, then level off in ground effect until the airspeed reaches 60 mph, then climb out maintaining 60 mph for a normal departure. If clearing a 50’ obstruction, use 55 mph for the target airspeed until clear of the obstruction, then continue the climb at 60 mph.

Landing Procedure

1. Verify green indicator lights on both pre-rotator and rotor brake.

2. Set throttle to 5000 RPM abeam approach end of runway (for normal landing).

3. Use cyclic to set airspeed to 60 mph.

4. Make altitude adjustments using throttle.

5. Continue final to 1-2 feet AGL and level out. Use rudders to align the Aircraft with the runway. Straight alignment is critical on touchdown.

6. Set attitude slightly nose up and allow speed to bleed off and main gear to touchdown.

7. Set throttle full aft on touchdown and move cyclic back, keeping the nose wheel off the ground as long as possible. **DO NOT BEGIN A TOUCH-AND-GO TAKEOFF UNTIL AFTER THE NOSE WHEEL HAS TOUCHED DOWN AND THE AIRCRAFT HAS COME TO A STOP.**

8. If leaving the runway, move the cyclic full forward and centered left-to-right once the aircraft has stopped and engage the rotor brake. Continue holding the cyclic until the rotor-brake locks the cyclic full forward.

9. Taxi slowly and carefully until the rotors come to a full stop. It may be necessary to hold the cyclic centered left-to-right until the rotors stop.

Emergency Procedures

Engine Out

1. First, determine emergency landing point. Then continue;

2. Cycle Master Switch off and on. Cycle Ignition Switch off and on. Press starter.

3. If engine does not start. Try step 2 independently with various throttle settings, idle, half-throttle and full-throttle.

4. Time permitting, call a mayday on VHF radio frequency 121.5.

5. Execute engine out landing at emergency landing point.

Fire

1. Turn Master Key Switch OFF. Set throttle full aft.

2. Determine emergency landing point.

3. Time permitting, call a mayday on VHF radio frequency 121.5.

4. Execute engine out landing at emergency landing point.

Engine Console Warming Lights

Any oil, fuel, coolant or other warnings that appear on the console may not be dealt with in flight. If practical, shut the engine down. Land immediately.

V Speeds (in mph)

V_{NE}	110
V_{NO}	100
V_X	55
V_Y	60
V_C	80
V_{LOF}	35
V_{REF}	60

Maintenance Notes

1. Use 87-93 Octane auto gas as a preference, with or without ethanol. 100LL AVGAS may be used when auto gas is not available, however, spark plug replacement interval and oil change interval should be halved.

2. Typical cruising fuel burn is 3.7 gallons per hour. Typical climb fuel burn is 5 gallons per hour. Typical descent fuel burn is 3.5 gallons per hour.

3. Refer to the Yamaha engine operating manual for engine maintenance.

4. Reduction drive maintenance requires oil change every 100 hours and at annual condition inspection. Centrifugal clutch inspection required at annual condition inspection.

5. Prop bolts torque to 16 foot-pounds every 25 hours.