Pilot Report: CarterCopters® Technology Demonstrator

Part 1 of a 2 part article

Larry Neal, Chief Test Pilot

When you agree to do a favor for a friend, you never know what adventure awaits you. This certainly applied when Rusty Nance phoned to ask if I could help arrange the use of an Air Command autogyro for a photo shoot at Olney, Texas – not far from where I live. A Dutch TV crew was scheduled to film the Carter-Copter Technology Demon-strator (CCTD) during flight-testing and wanted to do a comparison between the CCTD and a popular 2-place autogyro. Rusty was Chief Test Pilot for CarterCopters® LLC and knew I had good relations with the people at Air Command International — which was also nearby. I agreed to make the arrangements. "Oh — and by the way" he added almost as an afterthought, "how would you like to be my co-pilot in the CCTD?"

Weeks later, following many hours spent flying right seat as Rusty's co-pilot / flight-test engineer, the events of September 11 conspired to put me in the pilot's seat. Rusty's real job is flying AH-64 Apache attack helicopters for the South Carolina Air National Guard. Their heightened alert status now keeps him close to the base — so I inherited his moonlighting job with CarterCopters by default. Fortunate for me, Rusty was permitted to return to Texas for a few days during the next series of flight-tests to help bring me up to speed. Brad King agreed to take over my previous job in the right seat.

Flying the CCTD is a challenge — not because it is more difficult to fly than a helicopter, autogyro or fixed-wing — but because it is a combination of all three types of aircraft. As with any new aircraft, correct procedures must be learned before you can fly safely. Familiarity with the forces acting on the cyclic and (to a lesser extent) the collective is very important. Dual flight controls have been designed for the CCTD but not installed — so both the stick forces and flight procedures must be learned through experimentation. The drill is the same for any aircraft with only one set of flight controls – and especially autogyros. Numerous taxi runs that gradually increase in speed, followed by increasingly longer hops – until the moment of truth when you make your first traffic pattern.

The best way to explain what its like to fly the CCTD is to put you in the right seat as co-pilot / flight-test engineer. A pair of NOMEX fire-retardant overalls is required for safety. Our helmets are the same as those used by NASA test pilots. Our first stop is the briefing / flight-test control room in a small building near the flight line – where a military trained flight-test pilot from the Golden Arm Associates (GAA) leads the pre-flight briefing. Paul Smith, former Chief Test Pilot for the military portion of the Joint Strike Fighter program, founded the group. GAA has developed an industry-standard test program to safely and efficiently achieve Carter Copter's program goals. Their job is to provide on-site technical expertise and flight-test oversight.

Before each mission, the test team reviews telemetry data from the CCTD's previous flights and predicts what will happen in the upcoming flight. The test director monitors the real-time data throughout the flight-test and controls the mission based on how well the new data compares with predicted. To enable the test director to accomplish his responsibilities quickly and safely, he uses CarterCopters state-of-the-art 60-channel data acquisition system, which automatically downloads real-time data from the CCTD and digitally stores it on an upgraded desktop PC. The telemetry system displays the data real-time in strip chart format.

Following each mission, the entire test team (including the flight crew) reviews the data and adds qualitative comments. These sessions usually result in a design or procedural change – the goal being a safe and successful completion of the next flight. Since almost every mission expands the CCTD's flight envelope into a previously unknown realm, the process developed by GAA follows the methodical approach used in larger and more expensive test programs. Introducing this high level of professionalism to the test process has significantly reduced risk and improved efficiency.

The pre-flight briefing covers test mission priorities, flight-test techniques, safety of flight and safety of test instrumentation, as well as all the standard flight-briefing items. We also cover recent modifications to the CCTD and expected results. We pay special attention to abort criteria and abort techniques in order to cover all contingencies and ensure the entire test team knows their particular responsibilities. Several personnel are incorporated just to enhance safety. From chase crews to the test director, everyone must be on the same sheet of music during the entire flight.

Following the briefing, the pilot and co-pilot are responsible for doing a thorough pre-flight inspection of the CCTD – parked right outside the building. Then the co-pilot followed by the pilot climbs onto the left wing and eases though the doorway into the cockpit. It takes a couple of minutes to settle into the seats, adjust and buckle the 5-point attachment seat belt – put on your helmet and plug into the intercom system.

Once settled, we start the CCTD's engine. This is much like starting an automobile–which is not surprising since the engine is a stock Corvette LS 6 producing 325 hp @5000 RPM at MSL. The engine starts smoothly and idles quietly – just like the sports car it was developed for.

After engine start, we switch on and voice-check our communications. In addition to standard airplane radios, we have a hot mike (always transmitting) tuned to a CB frequency. Next, I engage the rotor pre-rotator and spin-up the rotor to 200 rpm. This lets us conduct a telemetry check, determine the status of the rotor and other flight controls while the test team is checking key data telemetry parameters in the control room. Full rotor-pitch collective and cyclic stick travel are each 14 inches – and I check to make sure I have full authority with these flight controls. In addition to the usual displays found in conventional aircraft, the CCTD includes the following indicators: (1) degrees of rotor flapping, (2) Mu ratio, (3) engine hp, (4) engine efficiency (computed in brake specific fuel consumption), (5) propeller thrust, (6) rotor lift, (7) propeller efficiency, (8) true airspeed and (9) stick forces. Display automation includes three programmable display screens, voice alarms and an audible rotor-rpm indicator. All information provided in the cockpit is sent automatically to the monitoring station in the flight-test control room.

With these checks complete and the rotor still spinning, we now taxi to the active runway. The high-inertia of the spinning rotor provides stability and allows the CCTD to taxi safely without concern for sudden wind gust or taxiway bumps that could otherwise cause the rotor to cut of the CCTD's tail. A typical rotor pre-rotation of 200 rpm allows the aircraft to taxi for approximately ten minutes before another spin-up is required.

Pre-Take off procedures begin on the runway threshold when we lock the brakes and once again engage the pre-rotator clutch. This time the engine rpm is gradually increased to 2800 and a maximum of 1800 foot-pounds of torque applied – until the rotor reaches 350 rpm. At this rpm, the high-inertia rotor has stored a tremendous amount of energy. The co-pilot calls out the numbers and handles radio communications. The rotor spin-up normally takes about 3 min (a more aggressive application of power cuts this time in half).

The CarterCopter Technology Demonstrator -- during a recent test flight piloted by Larry Neal and Brad King

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To Be Continued

Larry Neal, Rusty Nance and Brad King are all active members of the PRA. See www.cartercopters.-com/ccteam_pilots.html for biographical summaries.

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