2008 NASA CAFÉ Foundation GAT Challenge

The Sacramento day dawned bright and sunny with an expected high of 98 deg F (37 deg C). We had travelled across the USA from a very successful week at Oshkosh where, although the crowds were smaller than previous years, many were interested in the Pipistrel motorgliders, particularly the upcoming Taurus Electro, an electric powered version of the Taurus self-launched glider. Quite a few comments and questions were fielded about last year's Comparative Aircraft Flight Efficiency (CAFÉ) Foundation General Aviation Technology (GAT) Challenge so we were keen to make a big impression in this year's event.

Vance Turner, the owner of this year's Team Pipistrel entry, Michael Coates, the distributor of Pipistrel aircraft into the US, and I proceeded to inspect the handiwork of the Pipistrel factory staff who had flown over in the weeks before to install the new 100hp Rotax and Woodcomp propeller which would hopefully propel us to victory in this year's challenge. Our aircraft this year was a standard Pipistrel Virus SW which had been modified to allow a higher Vne and incorporate the larger capacity engine. After a thorough review of the modifications, and some additional minor modifications of our own, we proceeded to test fly our entrant.

Figure 1 - The first test flight of the modified Pipistrel Virus SW

After an initial solo flight, I joined Michael for some flight testing of the new installations so as to determine the optimum power settings for economy and performance. Unfortunately an issue with the engine prevented us from obtaining full power so we aborted the take-off roll. As we taxied back to the hangar Michael remarked that we had lost braking on the right wheel and I

noticed smoke emanating from the wheel cover. Upon closer inspection, we found that the brake line had been torn free from the caliper and brake fluid had leaked onto the hot disc, causing smoking.

The standard wheels had been replaced with Berringer high performance wheels and brakes however the original brake line routing resulted in sharp bends around the lower landing leg area. We surmised that the plastic rotatable fitting used on the Berringer brakes, coupled with the sharp bend in the brake line, had allowed the brake line to move and catch on the inner clips of the disc. This, in turn, had ripped the line from the plastic fitting and caused the brake fluid loss and subsequent brake failure. Our problem then was how to fix the brakes with no spare parts and only one day before the commencement of the challenge.

Several hours passed as we travelled to every conceivable motorbike store, aircraft repairer and hydraulic parts reseller in the area. Our issue – the aircraft is from Europe and all parts are metric; the USA is still predominately non-metric. We could obtain parts readily from suppliers elsewhere, but that would take one or two days and we didn't have the time. So we reverted to good old Aussie ingenuity and sheer determination. We reviewed every component of the old brakes which had been removed, and every nut, bolt and fitting in Vance's expansive hangar. Finally we found a component on the old brakes which could be substituted with the fitting on the new to fix the breakage. Disaster averted.

Figure 2 - Michael (sitting) and Vance survey the brake problem

With flight tests completed and confidences restored, we undertook the quick flight across the amazing terrain of California to arrive at Sonoma County Airport housing the CAFÉ Foundation hangar on the western side of the field. Being the first to arrive, we were greeted by several of

the volunteers of the CAFÉ Foundation who were preparing for the next week's challenge. Vance arrived a few hours later in his modest RV, headquarters for Team Pipistrel.

Figure 3 - Team Pipistrel Headquarters

Much of the preparations had been completed but there was still a lot more work to come with final tweaking of the instrumentation still underway. In order to get a head start on the proceedings of the next few days, and to prove the instrumentation, the CAFÉ Foundation team began immediate preparations of our aircraft for the challenge.

Figure 4 - Joe and Steve check the equipment while Brien (background) works on the weight and balance spreadsheets

The CAFÉ Foundation is supported in its efforts by skilled volunteers from Santa Rosa's Experimental Aircraft Association (EAA) Chapter 124. These dedicated individuals are on hand whenever required to assist with all activities related to the event including general handling of

the aircraft, monitoring refueling and other operations, providing escorts for the teams and visitors and any other administrative tasks as required.

Figure 5 - Volunteers assist with aircraft weigh-in

The highly sensitive and accurate equipment is connected in parallel with the aircraft systems through the pitot and static lines. To ensure that no tampering occurs, a camera is also placed in the aircraft which records the pilot's actions throughout the flight. Additional instrumentation measures noise levels within the cockpit. All measurements are relayed directly to a ground receiving station through radio telemetry links. When the aircraft travels out of range of the receiving station, the data is automatically buffered and retransmitted once the aircraft returns and as a final failsafe the equipment also records all of the information which can be downloaded later into the CAFÉ's computer. To calibrate the equipment and adjust for pitot and static line anomalies, an external barograph is fitted to the wings and a series of calibration flights are undertaken. CAFÉ Foundation staff review the video footage from the onboard cameras after every flight.

Figure 6 - Pipistrel Virus SW with barograph fitted

A number of test flights were conducted for the benefit of the CAFÉ Foundation to enable them to correctly calibrate and test their equipment in-flight. This proved invaluable as a number of issues were discovered and rectified early prior to the fitment of the equipment to the various other entrants, saving both time and effort for the CAFÉ Foundation volunteers and team entrants alike. NASA officials were on hand throughout the challenge to oversee all aspects of the data collection and to ensure that the NASA approved rules were adhered to. Every aspect of the challenge is scrutinized, from buying fuel at the local service station and refueling operations to making any modifications to engine and equipment fittings on the aircraft. Once the aircraft have been equipped, calibrated and weighed no further modifications are permitted and the aircraft are effectively impounded for the duration of the challenge. All team members must be escorted whenever they approach the aircraft to ensure that the equipment and aircraft were not tampered with.

Figure 7 - NASA Official Scott supervises the proceedings

Other entrants began to arrive over the following days. These were led by Bob Basham of Team Flight Refine flying a Flight-Design CT, John Dunham of Team Lambada flying a customised UFM-13 Lambada and Geoff Stevenson of Team Aerochia flying a Diamond DA20-A1 sporting a highly

modified Rotax 914 fitted with a bio-diesel engine for additional boost. Unfortunately the fifth entrant this year, Team Wilkinson Aero Sport flying a Dynamic WT9, was unable to overcome engine problems in time to attend the event and withdrew only days before.

Figure 8 - Team Aerochia's Diamond DA20-A1 fitted with a bio-diesel boost engine

Trials and tribulations abound throughout the challenge with flat tyres, engine problems and general maintenance issues rearing their ugly heads on numerous occasions. Both Team Flight Refine and Team Pipistrel experienced flat tyres but with assistance from the many volunteers the task of rectifying the issues and continuing the program was smooth and effortless. Unfortunately Team Aerochia was forced to withdraw at the last minute due to a faulty engine management sensor which prevented them from flying.

Figure 9 - Team Flight Refine succumbs to a flat tyre

The GAT Challenge comprises a number of individual events which aim to accurately determine the efficiency of entrant aircraft. These events also define the parameters for use in the overall CAFÉ 400 event which determines the most efficient aircraft using a base formula:

V x MPG x W

where

V = aircraft's average velocity over the course
MPG = average miles per gallon of fuel used
W = aircraft's payload in pounds

In addition to the efficiency prizes, awards are made for the following:

- Community Noise Prize for the quietest aircraft
- Green Prize for the most efficient aircraft
- CAFÉ Safety Prize for the aircraft deemed to incorporate the most pilot, passenger and flight safety features
- Quietest LSA Prize for the quietest LSA category aircraft
- Showcase Prizes for:
  - Quietest Cabin
  - Best Angle of Climb
  - Shortest Takeoff
  - Best Glide

In order to evaluate each of the entrants, three test pilots each fly with the team pilot and, using the Cooper-Harper rating system, rate the aircraft. A further five CAFÉ Board members also fly with the team pilots in order to evaluate the aircraft for ease of flying by general pilots.

Figure 10 - Test Pilot "CJ" prepares to launch with Team Pipistrel

The official results for the 2008 CAFÉ GAT Challenge are:

CAFE Safety	Pipistrel N2471P	$50,000
Community Noise	Lambada N109UA	$20,000
Quietest LSA	Lambada N109UA	$10,000
Green Prize	no winner	n/a
CAFE 400	Pipistrel N2471P	$2,000
Cabin Noise (tie)	Lambada N109UA Pipistrel N2471P	$3,750 ($1,875 each)
Shortest Takeoff	Pipistrel N2471P	$3,750
Best Angle of Climb	Pipistrel N2471P	$3,750
Best Glide Ratio at 100 MPH	Flightdesign CTSW N135CT	

Team Aerochia achieved special mention at the award presentations for their efforts to introduce bio-diesel engines into the challenge.

Figure 11 - Pipistrel Virus with winnings

Team Pipistrel is lucky to have direct support from the Pipistrel factory who have committed to using the knowledge gained from these events to further improve their already remarkable products. Future versions of the Virus SW, due for release in early 2009, will incorporate many of the modifications and information learnt from these challenges to provide more efficient, quieter aircraft into the market.

Figure 12 - Team Pipistrel with the Pipistrel Virus SW entrant in "war paint"

The following table details some of the performance characteristics determined by the CAFÉ Foundation for each entrant:

	Pipistrel N2471P	Flight Design CT N135CT	Lambada N109UA
Takeoff Distance	924 feet	1168.1 feet	1011 feet
Top Speed	145 mph	117.7 mph	130 mph
Slowest level flight speed	51 mph	44.5 mph	47 mph
Cabin Noise	91.5 dBA	94.5 dBA	91.5 dBA
Community Noise	67.4 dBA	68.1 dBA	62.9 dBA
Miles Per Gallon	28.8 MPG	25.2 MPG	26.5 MPG
Rate of Clilmb	1039 fpm	458.2 fpm	769.5 fpm
Angle of Climb	8.9 deg	3.9 deg	6.7 deg
Empty Weight	717.3 lb	751 lb	732 lb

Even with the intense competition, the NASA CAFÉ Foundation GAT Challenge fosters camaraderie, friendship and teamwork from all involved. We were certainly privileged to work and compete with such a great team of professionals.

Further information on the CAFÉ Foundation and the GAT Challenge can be found at http://cafefoundation.org.