Prelude to a Tragedy Bill Compton

In January 2014, I learned Babar Suleman was planning a Beech 36/TN550 around-the-world flight with his 18 year-old son, Haris. I offered help and we exchanged hundreds of emails. They departed[1] eastbound on June 19; on July 22, behind schedule, they dropped into the ocean on takeoff from Pago Pago, American Samoa. They both perished. This is what I know of it.

Target CAS Cruise Control

Babar planned his legs at "constant power", 14 gallons/hr, LOP (lean of peak EGT)[2]. His range projections were pessimistic and prompted him to tank for 280 gallons, 50 more than my suggestion. I gave him the following information on "target CAS" aka "constant angle of attack" cruise control, for more efficiency on his longer legs.

Nautical air miles per gallon (Nam/g) is determined by aircraft weight, calibrated airspeed[3] (CAS) flown, and center of gravity (CG). A world flight needs 2,000 nautical mile range plus reserves. To best carry the extra fuel needed, CAS should be adjusted down for the constantly decreasing aircraft weight, and a rearward CG should be maintained so the tail pushes up rather than down.

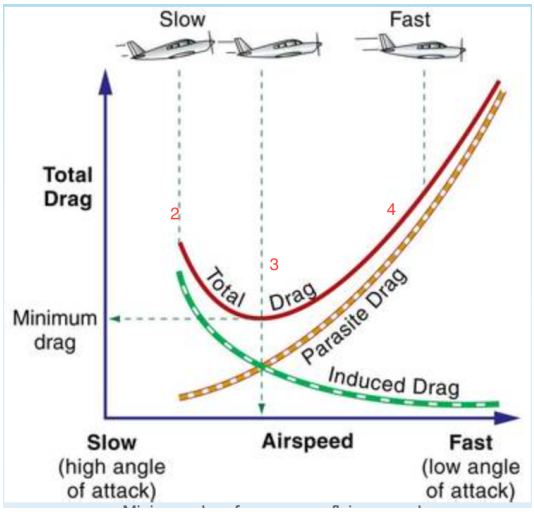

Fig.1 Zone 2 loses range to induced drag, zone 3 is most efficient, zone4 loses range to excess parasite drag. Airspeed is CAS.

[1] http://flyaroundtheworldin30days.com/

[2] Lean of Peak EGT mixtures can generate power on less fuel flow with lower cylinder head temperatures and intra-cylinder combustion pressures than Rich of Peak EGTs.

[3] Calibrated airspeed is indicated airspeed corrected for installation error.

Point 3 is the CAS of V_{LDMAX} and gives maximum air miles/gallon for a specific weight at any density altitude. For our Bonanza[4], at 3400 pounds, V_{LDMAX} is 112 KCAS and can yield 14.3 Nam/g. Those numbers vary by weight[5]; below they are adjusted to the higher weights flown by Babar. Maintaining V_{LDMAX} (or slightly faster) on the drag curve and getting the maximum increases in Nam/g requires CAS to be reduced as fuel is consumed:

Aircraft weight	4600	4400	4200	4000	3800	3600	**3400**	3200	3000
$V_{L/DMAX}$ decreasing>	130	127	124	121	118	115	**112**	108	105
Nam/g increasing>	10.6	11.0	11.6	12.2	12.8	13.5	**14.3**	15.2	16.2

Best range is maintained at CAS (not TAS) for L/Dmax, but that's pretty slow and involves very low power settings. Going faster at 16% more CAS with a 4% range loss[6] is more practical.

To give Babar a cruise profile, I asked for his CAS/TAS/fuel flows over a range of aircraft weights on the early legs; he sent random cruise numbers, but omitted weights. So I suggested he fly the CAS numbers vs. weights for our V35TC and check his LOP fuel flows against ours[7].

Aircraft weight	4600	4400	4200	4000	3800	3600	3400	3200	3000
1.16 V_{LDMAX} CAS	1*51*	*147*	144	140	137	133	130	127	124
0.96 Nam/g	*10.2*	*10.6*	11.1	11.7	12.3	13.0	13.7	14.6	15.5

At FL170, standard temperatures, LOP, the above CAS/Namg are predicted to give:

KTAS	*196*	*191*	188	182	178	173	169	166	162
Fuel flow[8]	*19.2*	*18*	16.9	15.6	14.5	13.3	12.3	11.4	10.4

(Italicized numbers for 4600 and 4400# were adjusted downward to avoid power > 85% in the cruise profile below.)

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[4] A 1966 V35TC.

[5] $V_2 = V_1 (W_2/W_1)^{1/2}$ and $Namg_2 = Namg_1 (W1/W2)$

[6] Byington, Melville R., Jr Piston Aircraft Range Performance. JAAER, Fall 1993

[7] Babar's higher compression engine was more efficient, yielding 14.9 HP/gallon/hr. compared to 13.7 for the V35TC.

[8] KTAS flown/Namg = fuel flow. (188/11.1 = 16.9 gph)

I estimated this profile at FL170 for him if his fuel flow numbers were similar. His preferred altitude was FL110; CAS and Nam/g would be the same, TAS and gph less.

TOTALS				NEXT LEG			ESTIMATED		
wgt	fuel usd	hhmm	dist	fuel	time	dist	SR	gph	KTAS
4600	0	0	0						
Take off, climb ROP 120 KCAS to 17,000 ft TOC				13.6	:24	55		34	137
4518	13.6	:24	55						
LOP cruise at 17.4 gph*				19.6	1:04	200	10.8	17.4	188
4400	33.3	1:28	255						
LOP cruise at 17.4 gph*				33.3	1:51	353	11	17.4	192
4200	66.7	3:19	608						
LOP cruise 144 KCAS				33.3	1:58	370	11.1	16.9	188
4000	100	5:17	978						
LOP cruise 140 KCAS				33.3	2:07	386	11.6	15.7	182
3800	133	7:24	1364						
LOP cruise 137 KCAS				33.3	2:19	410	12.3	14.5	178
3600	167	9:43	1774						
LOP cruise 133 KCAS				33.3	2:30	433	13	13.4	174
3400	200	12:13	2207						
LOP cruise 130 KCAS				33.3	2:42	456	13.7	12.4	170
3200	233	14:55	2663						
LOP cruise at 125 KCAS				33.3	3:00	486	14.6	11.2	163
3000	267	17:55	3149						

Tanks dry, no wind: 11.8 Nam/gal, 176 KTAS, 14.9 GPH

Figure 2. Starting at 4600#, 267 gallons usable, weight estimated at TOC (top of climb), and at each 200#/33.3 gallons of fuel used. For cruise segments, fuel for leg (33.3 gallons) times SR= leg distance. SR is Nam/gal for weight and CAS.
*Adjusted to not exceed 85% power for cruise.

<u>Adequate vs. Excessive Fuel</u>

I had ferried a 300 gallon A36TC from Sydney to Anchorage (solo) in 1995, but a full fuel take off from Tarawa at 108 degrees F left me wary of high take off weights. Before there were good ocean wind forecasts, fuel totalizers, LOPoperations, engine analyzers, and GPS, it seemed wise to gas up with as much as the airplane could lift.

Now this seems better: 110% computed fuel for destination, missed approach, diversion and landing at the alternate, plus another 1hr30min fuel for holding/contingency. Equal time point (ETP)[9] is part of the oceanic flight plan, and checks on planned vs actual fuel burns early in the flight should validate going to and beyond the ETP, otherwise, it's better to turn back and re-evaluate[10].

Crossing the Pacific Ocean, a new wrinkle developed for Babar. His trip planner doubted that Christmas Island had avgas. This was critical, as Christmas is halfway between Pago Pago and Honolulu. Babar emailed me his concerns on July 20 and requested help.

My son Steve, a cardiologist, had held clinics at Christmas Island; he emailed a native friend who called the fuel company, I then relayed avgas availability to Babar on July 21. He acknowledged, but had already fully gassed the airplane for non-stop to Honolulu. Now he had 4609 pounds, a 28% overload, according to documents dated 7/22.

Babar had twice mentioned dread of fuel exhaustion over water, with concern for the 2090nm Honolulu to Monterey leg. Now, through error, he was faced with a 2260nm leg. He asked for expected airspeeds over gross weight and burning 14 gph, which I couldn't answer. I urged him to fly the calibrated airspeeds based on totalizer fuel burned, and again estimated 3000+ nm range. He was incredulous of the range but said he would fly the airspeeds.

Departure Planning

Eastbound, Babar and Haris were losing daylight hours on each leg. To avoid night arrivals, they had adopted pre-dawn departures.

For this takeoff, I advised a higher speed for lift off and staying in ground effect[11] until wheels were up and climb airspeed reached. Babar replied: "… We plan to take off with 10 degrees of flaps, accelerate in ground effect, start a slow climb to 200 feet, retract gear, climb to 500 feet retract the flaps…" Earlier the same day (7/21) he had written: "I can easily carry 250-260 gallons of fuel…"

None of that made sense to me. My concern was the higher induced drag encountered with premature rotation in an overloaded airplane, which can lead to a stall and disaster. At 4600 pounds with an airplane normally grossing 3600, the CAS for liftoff should be multiplied by the square root of (4600/3600): 1.13.

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[9] Equal Time Point = Total distance X ground speed of return/ground speed of return + ground speed of continuing

[10] Flight Planning, Wind, and Reserves ABS Magazine, Feb 2010, pp12-14

[11] Ground effect is an area of increased lift and reduced drag encountered when an airplane flies within a wingspan of the surface.

Flaps can lead to premature liftoff and are best avoided. A touch of down trim is good, so rotation will be intentional when the desired CAS is reached. Once airborne, staying in ground effect can reduce drag and give safe refuge while retracting the landing gear and accelerating. From there, maintaining Vy[12] and precise pitch is paramount, rate of climb, not so much.

Pago Pago Takeoff

Haris had been flying from the left seat and doing a nice job on instrument approaches, earning his father's trust. But he lacked experience, having about 300 hours.

On arrival at the airport they were faced with a direct 15 knot crosswind[13], gusting to 23. This was a night departure with no moon, headed out over the ocean and away from the lights of the island. If Haris had done instrument takeoffs in his training, this would be more challenging: a sudden transition from visual with the runway lights to a black hole departure on instruments. Meanwhile he must stay in ground effect, maintain pitch in turbulence, and avoid lateral drift until reaching Vy and climbing away.

Witnesses reported the aircraft did not climb well, wobbled, then pitched down into the water. The aircraft sank to a depth beyond recovery. Haris' body and various items were found floating on the surface.

Stress, Fatigue, and Error

A 2008 article in ABS Magazine warned that a human awake 14 hours was more impaired than if legally drunk at .08%[14]. With fatigue, humans become progressively impaired, unaware of their errors and complacent of consequences. Fatigue may be heightened by discomfort, prolonged inactivity, hypoxia, sleep debt, dehydration, hunger, inability to void or stretch, circadian rhythm disruption, and perhaps stressing over weather, fuel, or inability to meet expectations of others. The most cautious, deliberate, and mature person can make irrational decisions in such circumstances[15].

Babar emailed me his intent, on the day of departure, to purchase life vests, ship survival suits and other items home, and sleep during that day, counter to body rhythms and not at all easy. They had cancelled a flight to Honolulu a day earlier due to adverse upper winds and thunderstorms along the ITCZ[16] near the equator, neither of which would scrub a shorter 1261nm flight to Christmas Island, and which could have been done with 100 gallons less fuel. Babar was in error with his

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[12] YouTube Vy or Die

[13] NSTU 230851Z 34015G23KT 10SM SCT019 BKN100 28/23 A2981

[14] ABS Magazine, June 2008 pp.10826-7. I'm a Little Tired but I'm OK. Janet Lapp RN PHD CFI

[15] ABS Magazine Dec 2004. A Leg Too Far,

[16] ITCZ, InterTropical Convergence Zone.

refusal to believe avgas was available at Christmas Island; these decisions may have resulted from stress and fatigue.

The final, critical error was the night takeoff, overweight, with a novice pilot in the left seat, in the face of strong and gusty crosswinds. Babar was a careful and deliberate man and probably would not have let this happen had he been rested and alert. There were hints of stress in his last emails. He was a devoted father, nothing could have been worse for him than the loss of his son and the disaster for his family. We all see this happen in various forms again and again; these are tragic wastes and a huge loss to our society.

Let's accept the insidious nature of fatigue and the dangers that follow. We should approach every flight with a willingness to cancel in the face of newfound risk, no matter the inconvenience, expense, or embarrassment. Let's all resolve to find the courage to cancel if at all uncertain. Just a few such decisions in a career of flying may be key to our longevity.