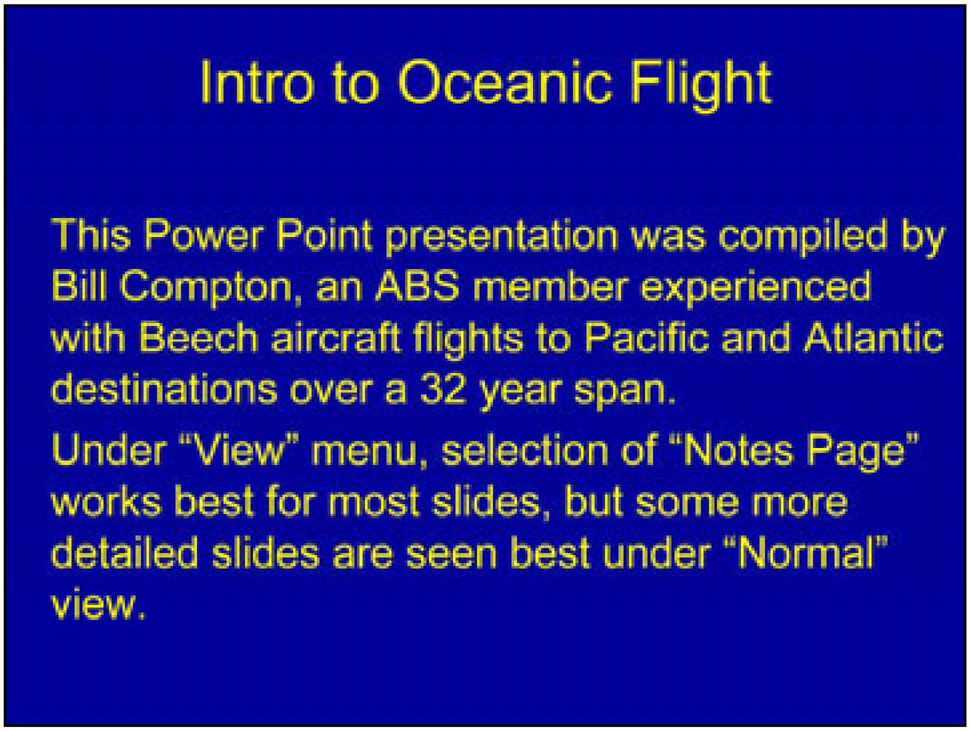


Seven round trips to the Hawaiian Islands are in the log, the first 4 done before Loran or GPS was available. There were 4 Europe trips, and 2 to the Caribbean.

Loran, and then GPS, were tremendous advances for oceanic navigation. Previously, flights were made with Dead Reckoning, ADF, and hourly astro fixes, resulting in a hop- scotch back and forth across the course line.

With Loran and then GPS, the aircraft could be held on track with precision, certainly improving odds should search and rescue be needed.

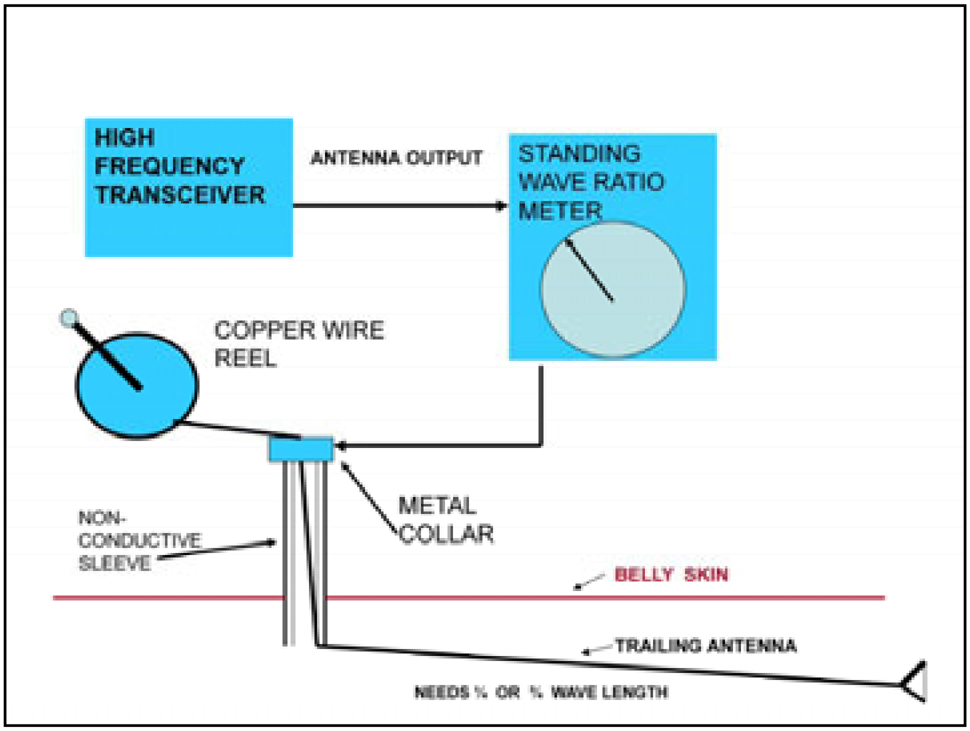
Digital engine and fuel monitoring, coupled with Lean of Peak operations, have immensely improved peace of mind for all flights.

The longer oceanic legs are between mainland and the Hawaiian Islands, also the US East Coast and the Azores. 2000 nm range with 3 hour reserve will get you just about anywhere with neutral winds.

That range can be met by tanking a Bonanza, Centurion, Comanche, or Mooney, and cruising it 5-10% above the calibrated air speed (CAS) for best range.

Light twins are more complicated for the longer range flights. Two engines need more fuel, without a proportional increase in useful load or airspeed. A twin tanked for a long crossing might be so heavy that an engine failure early in the flight would leave it unable to continue on the remaining engine.

That little dangle under the Bonanza's belly is a hose and funnel for a trailing wire HF antenna.



High frequency communications are needed for oceanic flight. HF radios have special antenna needs.

The trailing wire antenna is simple and effective, but it is a chore to tune and to change frequencies. Each frequency requires a different antenna length, ¼ or ¾ the wave length. The antenna is tuned by transmitting while adjusting the wire length to the lowest reading on the SWR meter.

Before landing, one must remember to reel the line back in. Amelia Earhart learned that the hard way. She lost her antenna on a landing, then was unable to communicate effectively when she got into navigational difficulties on her last flight.

It's smart to reel in the wire if you're close to a thunderstorm.

Here is an alternative to the trailing wire antenna.

An antenna “tuner” or “coupler” can electronically tune a fixed length antenna to the correct wavelength. This Icom HF transceiver with AH-4 coupler requires 23 feet of antenna length, which means stringing the wire from roof to tail to wingtip on the Bonanza. The cross- ways antenna adds drag and collects ice easily.

The Icom 706 is a ham unit modified by removal of the block on aviation frequencies. A ham unit is OK for Part 91 operations and less spendy than aviation sets.

Frequency changes are quick and easy with this setup.

"Pilots must maintain HF communications capabilities with ARINC at all times within the Oakland FIR". ARINC is a firm providing HF communications through "San Francisco Radio", which passes the info on to the controllers at Oakland Center. So, on HF, you don't talk directly to a controller. There are similar facilities for other oceanic areas.

But HF has limitations- there may be times when you can't get through.

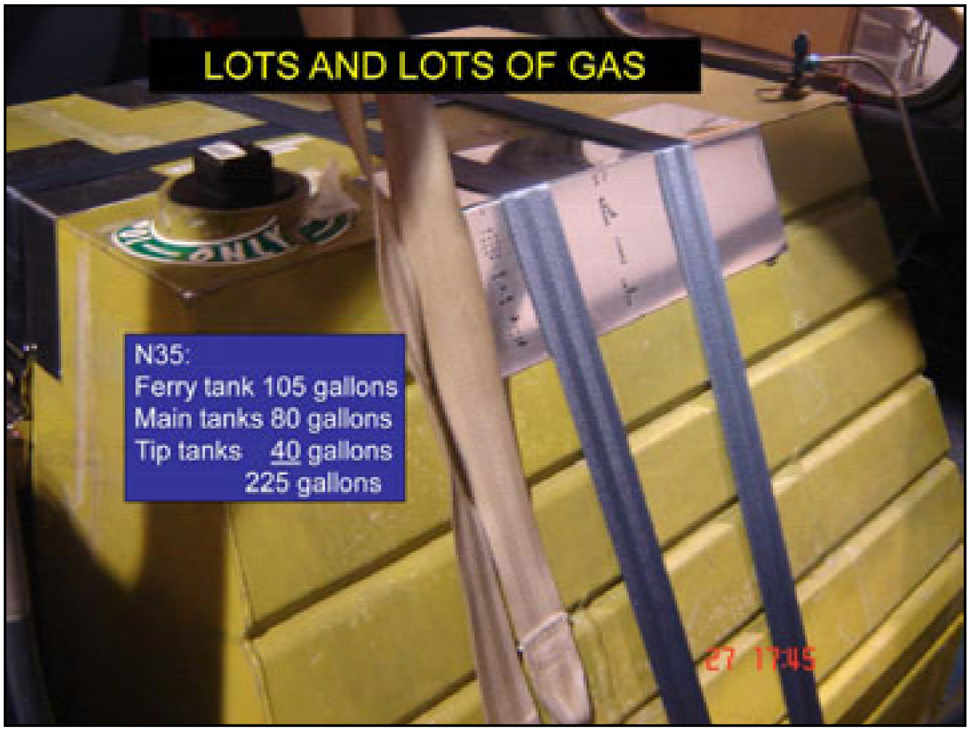
Oakland Center lists a telephone number in the Pacific Supplement for sat phone calls, limited to "distress and urgency situations or other exceptional circumstances only". They do not want the sat phone used for primary communication.

Relays are another backup. If your HF doesn't get through, on busy routes you can contact an airliner on VHF 121.5 and ask him to pass the word. They are always interested and helpful.

Listening to HF radio there is static which cannot be squelched out. Because of fatigue from listening, the airlines have a system called SELCAL. Each flight has a code, a series of aural tones which alert the flight crew to turn up the volume on the HF radio to receive a message.

Pilots of small aircraft must listen to static for the entire flight. On frequency one hears the SELCAL tones, followed by messages between the radio operator and various flights. It does get old.

Newer large aircraft have CPDLC, a controller- pilot data link communication system, in which messages and clearances come up on a cockpit video screen via satellite.

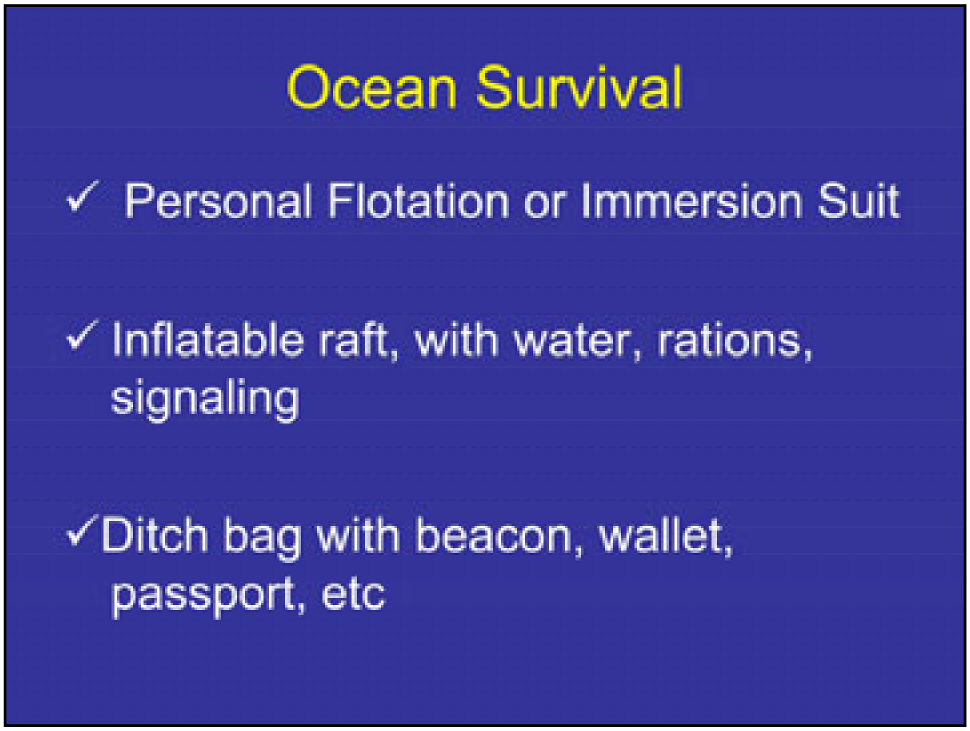


This is an aluminum ferry tank designed for Beech aircraft. There are now bladder tanks available which also will do the job.

A Special Flight Permit is required from FAA for overweight operations. Usually 10% over gross is readily granted, after inspection of the tank installation.

In these times of high security concerns, it is best to have all the paper work in order.

Work out the CG carefully!

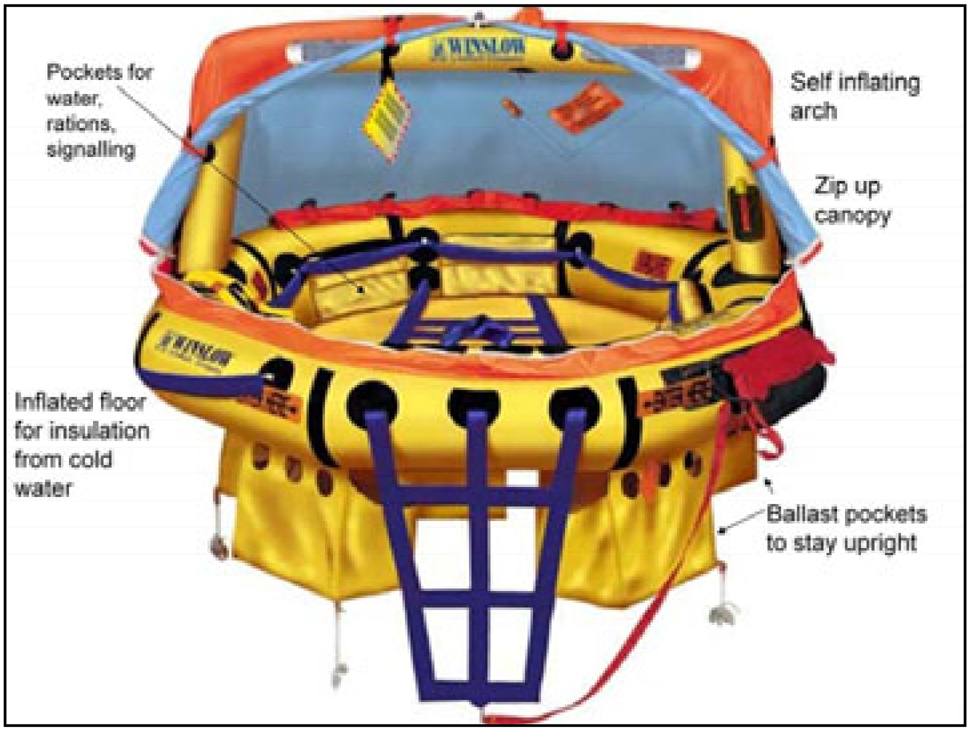


There is always the slight possibility of ending up in the water. Good information can be found about ditching and ocean survival on the Internet.

Ideally, gear up, minimum or no flaps, door opened and in trail, mush it in on the back side of a swell and into the wind.

Once stopped, exit the aircraft into the raft, with a “ditch bag” containing all else needed.

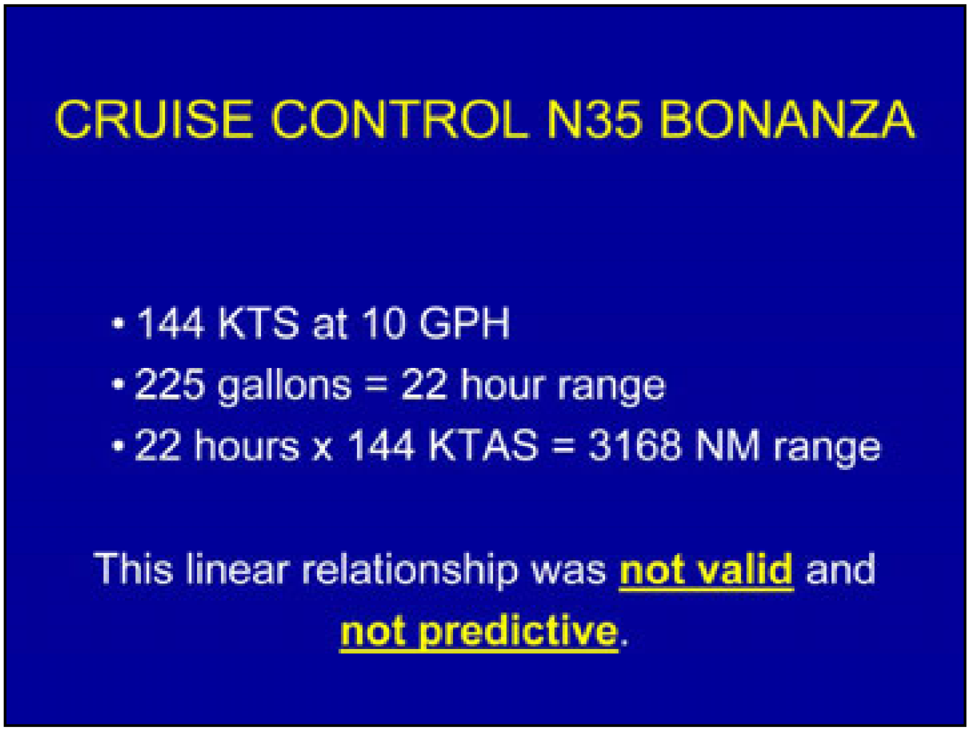
Then push free of the aircraft and let it sink (like you have any choice in the matter).



Should you ditch in mid ocean, you can't very well look up expecting to see a helicopter lowering a harness. More likely a ditch survivor will be in his raft for a day or two, awaiting a ship diverted to the location for a pickup. So a good raft could become a great investment.

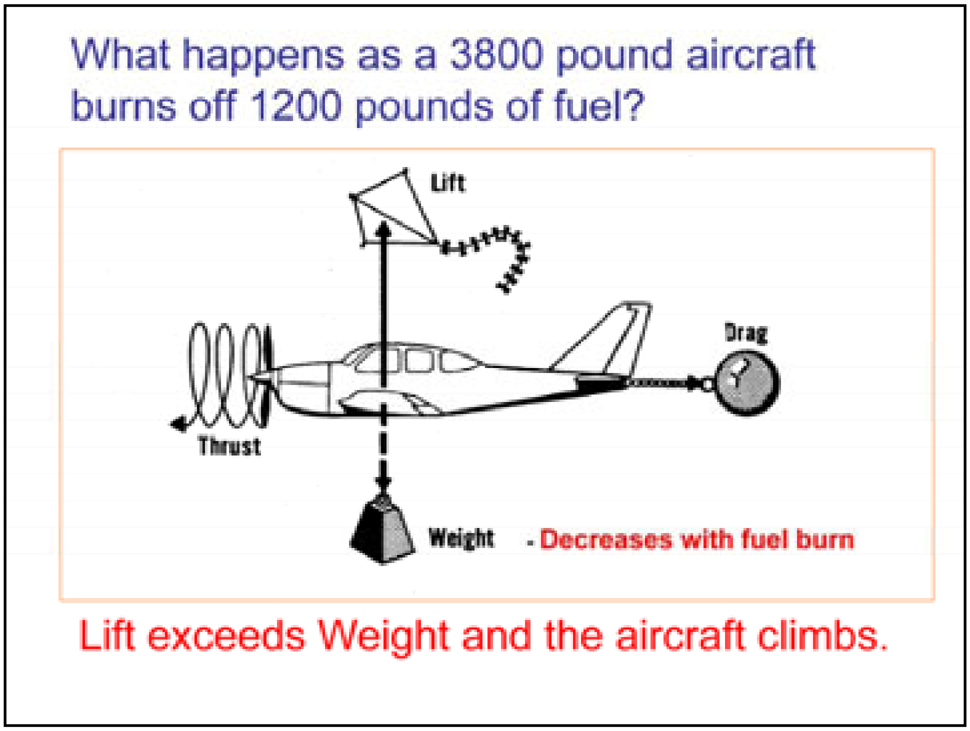
This is a Winslow 4 man raft with zip up canopy and inflatable floor. Hypothermia was an over- riding concern in selecting it.

Water temperature maps are on the internet. Flying over cold water, it is best to wear an immersion suit. There are several varieties, from neoprene to GoreTex. Survival in cold water, in street clothes, sounds iffy.



Just as automobiles get more miles per gallon at lower speeds, aircraft get better range if slowed down in the range of 40-55% power. More detail follows.

My initial assumption was that fuel flow and airspeed would be constant for a long range flight. But lightening the aircraft by a third, with fuel burn- off, will dramatically affect airspeed and range.



You can let it climb

or

You can hold it down and accelerate.

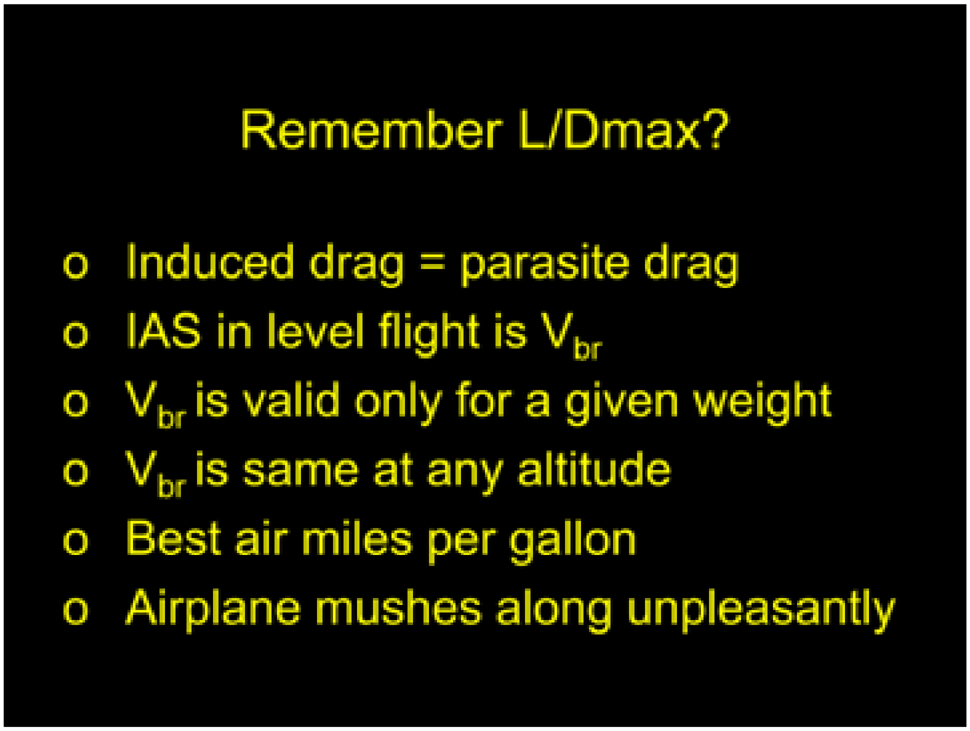
or

You can decrease power to maintain airspeed and altitude

OR

You can serially power back to maintain the same angle of attack while decreasing airspeed as the aircraft lightens..

If you are thus maintaining the AOA for L/Dmax, this is a maximum range profile.



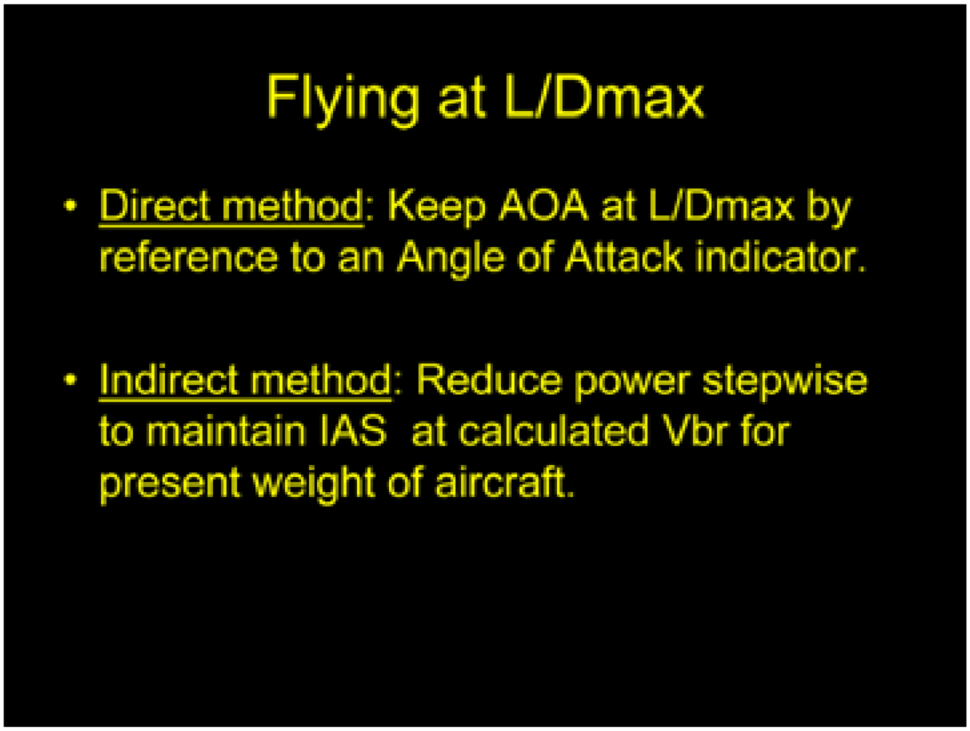
You already knew most of this.

It says IAS, but really means CAS.

IAS: indicated air speed

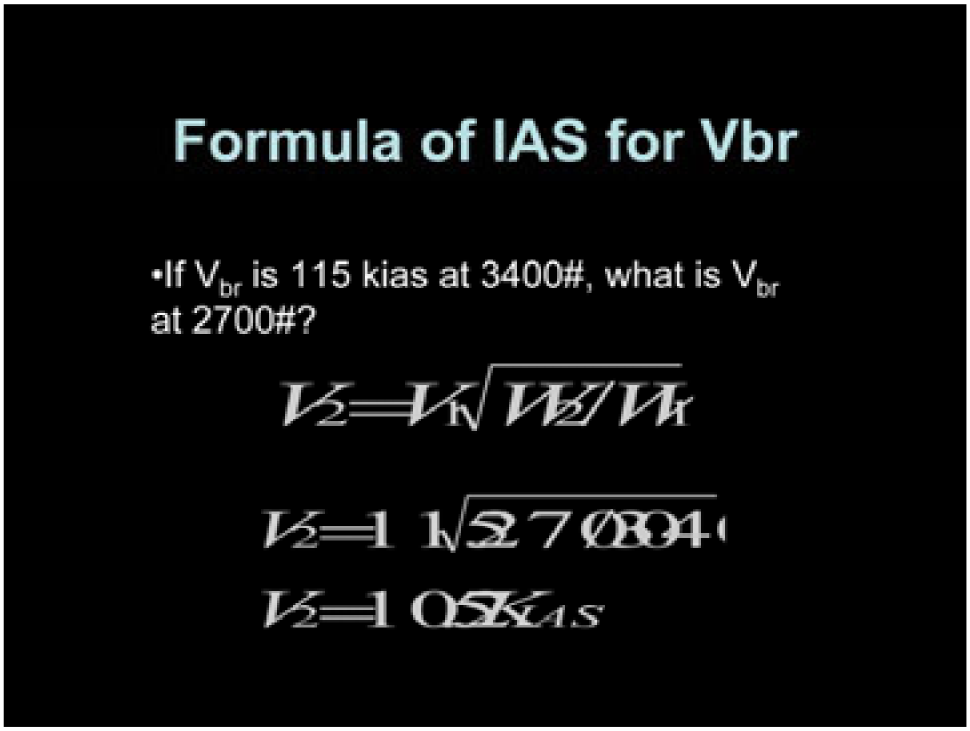
CAS: Calibrated air speed, IAS corrected for installation error.

Vbr: CAS for best range



Maybe with glass panels, we all will some day have AOA instrumentation. But for now, we can work around the problem.

AOA: angle of attack



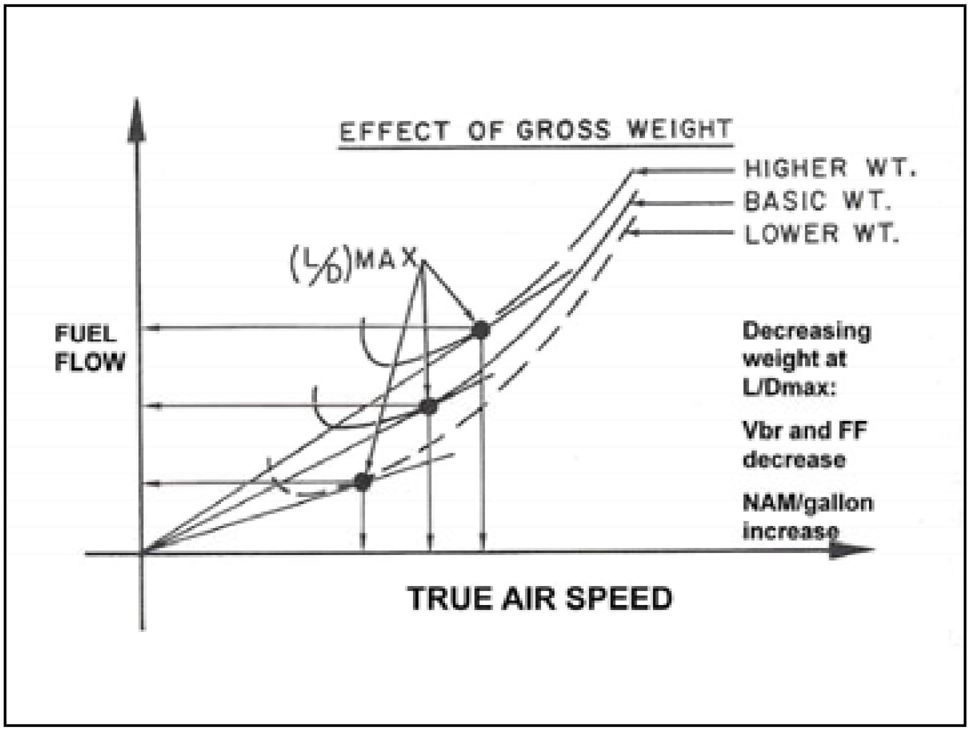
Here is the formula, so if you know Vbr for one weight of the aircraft, you can compute it for other weights.

If you maintain the decreasing values of Vbr as fuel burns off, you will be maintaining the AOA for best range.

Having a fuel totalizer will simplify the job of knowing the weight of the aircraft at any point along your flight.

If it is not legible, here it is again:

.V2 = V1 X the square root of (W2/W1)



As aircraft weight decreases, Vbr and FF decrease, but not proportionally, so that NAM/gal increases.

Related Formulas applying at LDmax:

$$Pr2 / Pr1 = [W2 / W1]^{3/2}$$

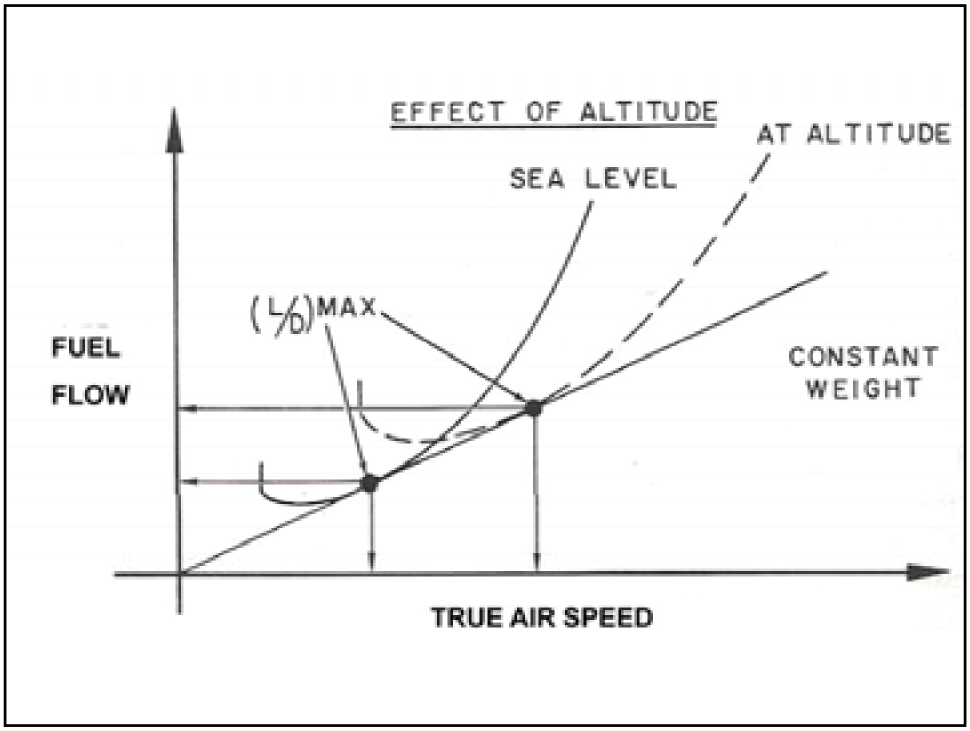
Pr is Power Required

3/2 means square root of the cubed number

$$SR2 / SR1 = W1 / W2$$

SR is Specific Range, Nautical Air Miles/ gallon fuel.

W is aircraft gross weight.



Range for prop aircraft is unaffected by altitude.

It seems no one wants to believe this. Everyone has observed that if you go higher, you will have better range.

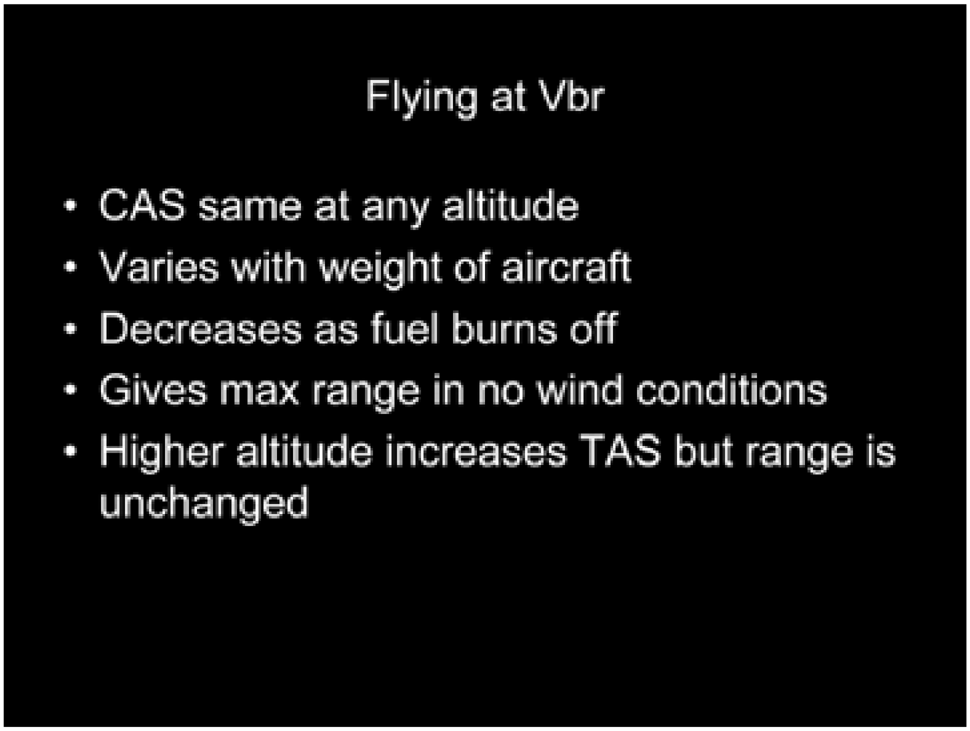
Given: Vbr is a Calibrated Air Speed, and is constant for a given weight at any altitude.

So, one assumes that the same CAS can be obtained with the same fuel flow at a higher altitude, get higher TAS, and NAM/gal naturally increases.

But – it just isn't so. Going higher at the same fuel fllow results in a lesser CAS, which is closer to Vbr, so NAM/gal increases for that reason.

That CAS at the lower altitude would have given the same NAM/gal.

Normally we cruise our aircraft far in excess of Vbr.



It doesn’t quite come together?

Try it this way:

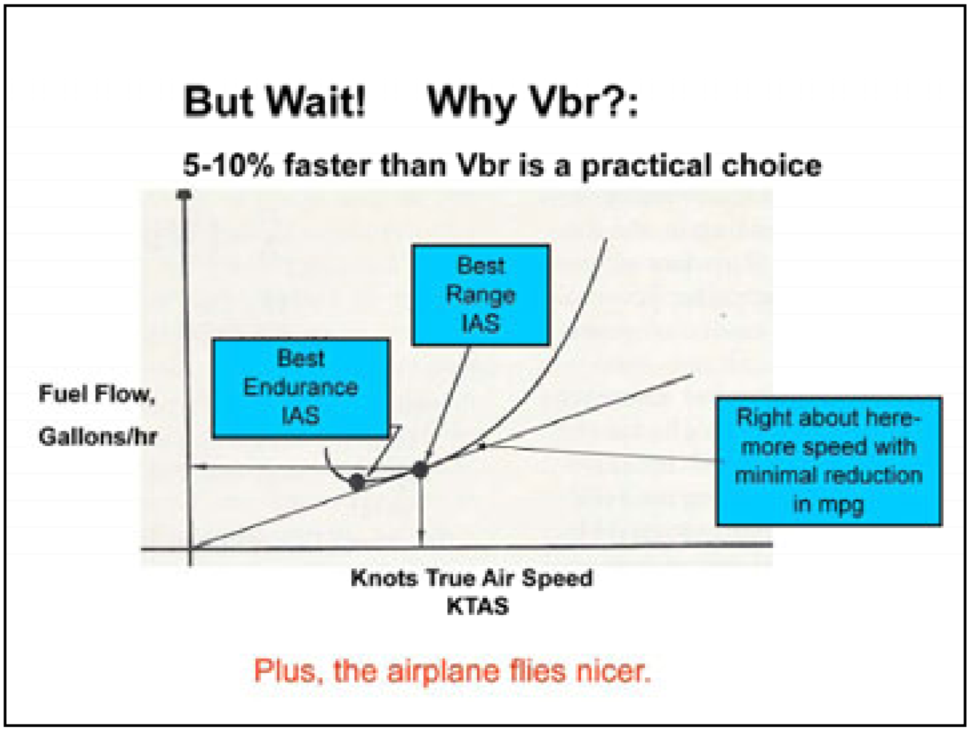
You are flying at 8000 ft with power set to maintain Vbr for current weight of the aircraft, call it 115 KCAS, you are burning 11 gph, mixture is LOP, and TAS is 129.

You climb to 12,000 feet, set power to 11gph, and find CAS is less than 115, which is still your Vbr. There is no logic here for going slower than Vbr, so you add power to reach 115CAS.

Now, your TAS is 137.

Predictably the fuel flow required is 11.7 gph.

Your TAS is better, but your NAM/gal is unchanged.



This is what the airlines did for oceanic cruise control with prop aircraft. The idea is that a 5-10% increase in speed over Vbr causes minimal reduction in range, and makes a good trade- off.

Aerodynamics for Naval Aviators suggests that a speed 3-5% higher than Vbr will still achieve 99% of maximum range.

Cruise 5-10% above Vbr lets the airplane fly even a little faster, still without much loss of range.

V35TC 12,000 ft , LOP: Vbr + 10%

time	gph	tot fuel	kias	air nm	namg	weight
takeoff	32		110	0		3803
00:20	12.5	10.5	125	36		
02:00		31.4		289	12.1	
04:00		56.4		599		
06:00		79.4		889		
08:00		101		1179		
10:00		123		1467		
12:00		144		1751		
14:00		164		2031		
16:00		183		2317		
18:00		201		2587		
20:30	9	223	113	2937	15.6	2460

10-12,000 feet, NO WIND

Here's a profile for a V35TC Bonanza, made up by calculation, log review, and testing to achieve constant AOA.

Note the intentional reduction of power and speed as fuel is burned off, resulting in better air miles per gallon.

Of course, this is not the only method of "cruise control". You could instead maintain a constant airspeed or a constant power for simplification, but you will lose some range, and it doesn't really simplify anything!

Namg = Nautical Air Miles / Gallon fuel

POWER MANAGEMENT TSIO520

Those familiar with the Continental 520 engine might look at this and think, “Wow, 2400 rpm and 32.5” must be something like 95% power, how can that work on 14 gph?”

Well, that is a lot of power ROP, but it’s far less LOP, where, in fact, HP depends on fuel flow rather than air flow. In an engine with 7.5/1 compression, HP is 12.7 times gph –but ***only when LOP***.

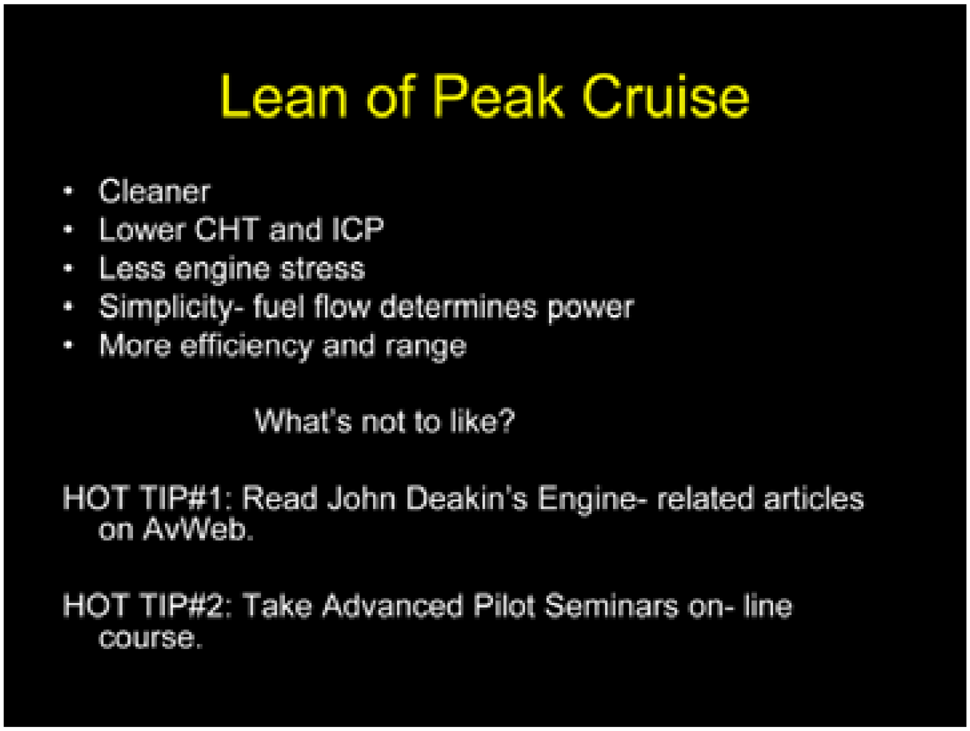
So fuel flow of 15 gph would develop 190 HP. In this 285 hp engine,190/285 is .666, so this is only 67% power.

The engine is cooler, with lower intracylinder pressures, lower fuel flow than if it was running ROP at the same HP.

(ROP for same HP would be at a lower manifold pressure)

LOP: Lean of Peak EGT

ROP: Rich of Peak EGT



If you are not familiar with LOP operations, you might read the John Deakin articles on Avweb. If you aren't converted, at least it will be fun reading.

LOP ops in the V35TC might include:

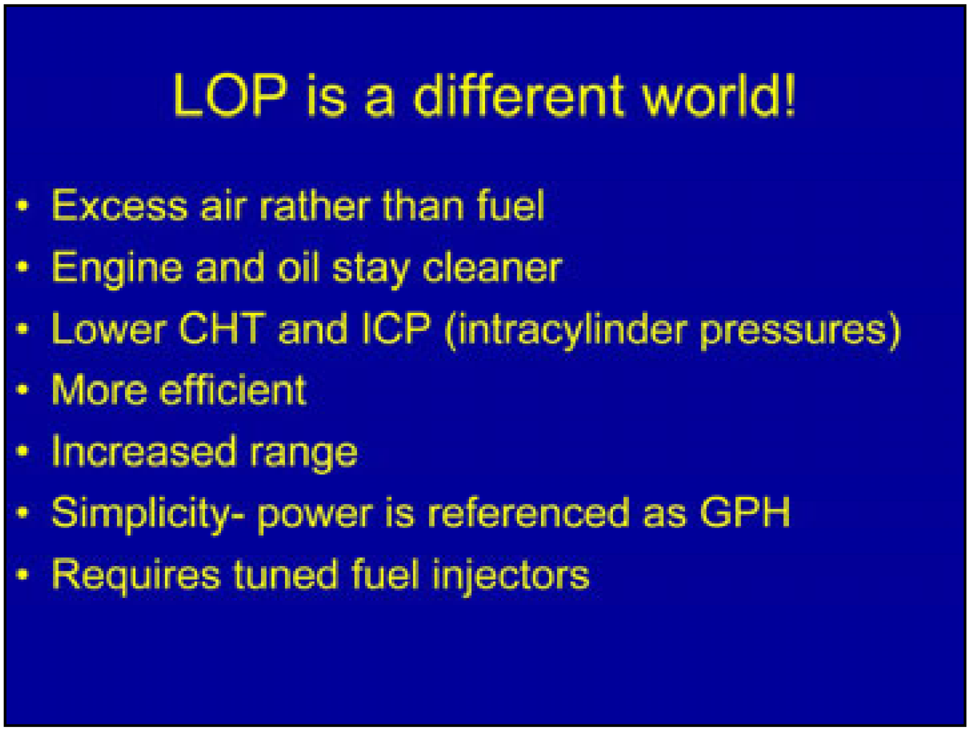
Full throttle from take off to top of descent.

Leveling at top of climb, RPM is reduced from 2700 to 2500, then mixture is brought right back to 15 gallons per hour, instantly transitioning the engine to LOP.

Then RPM is reduced to cruise setting, somewhere between 2000 and 2500 rpm, depending on range needed.

Then, for fine- tuning, the mixture is richened, watching EGTs, until the first cylinder peaks EGT, identifying it as the richest. Then mixture is again leaned to 20-80 degrees shy of that peak. All other cylinders are then leaner, and safer.

Best to not try this without first learning the details.



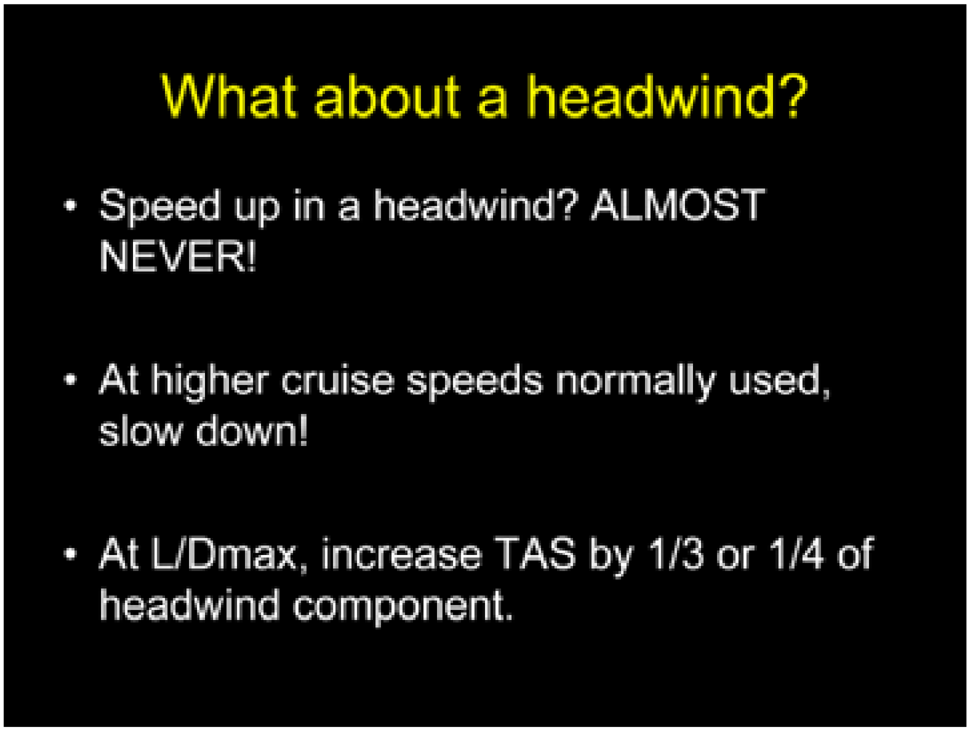
Operation on the lean side of peak EGT slows the flame front of combustion so that the peak intracylinder pressure is later in the piston stroke where the mechanical advantage is better.

Typically with an injected engine, peak EGT among cylinders will vary by 2-3 gph, and the engine will still run smoothly ROP- but not LOP.

With widely spread EGT peaks, the engine will be shaky on the lean side since the power output of individual cylinders will differ so much.

To run smoothly LOP, the injectors must be matched to the airflow of the cylinders. GAMI sells tuned fuel injectors for Continental and Lycoming engines, and Advanced Pilot Seminars offers an online course to learn this technology.

See www.gami.com

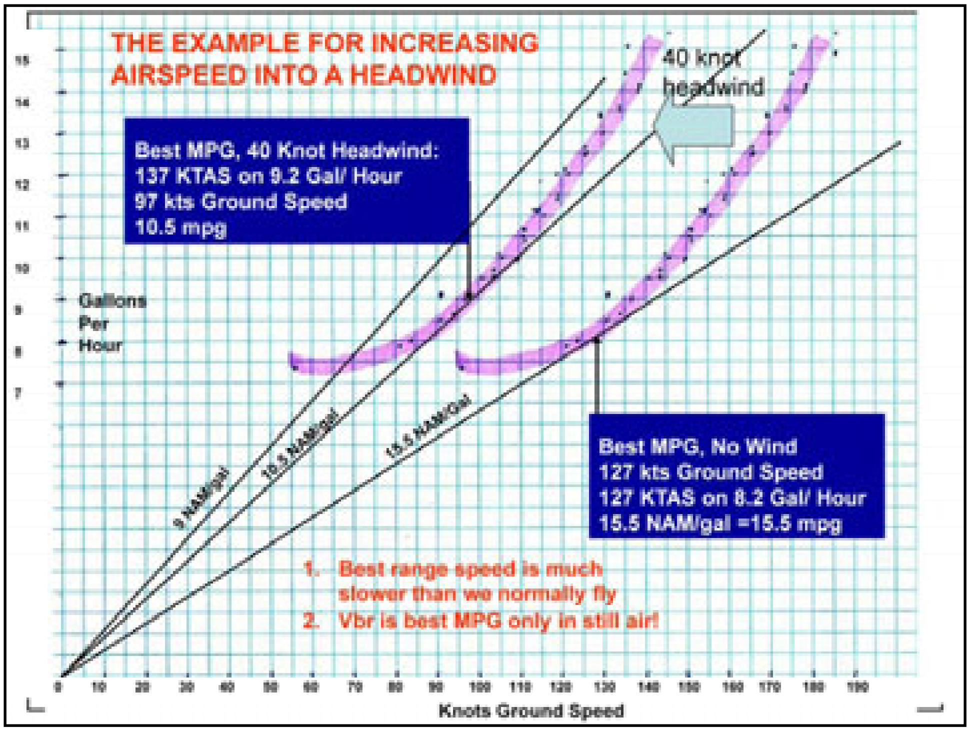


When asked about best range strategy in a headwind, many pilots say it is best to speed up.

I hope they say this because they think they are outwitting a trick question, and wouldn't really do this in practice when tight on fuel.

Those persistent in the belief cite this logic: If you are flying at 100 ktas into a 100 kt wind, you can't get to your destination unless you speed up. True, but this is an extreme example in which the airplane should not even be in the air.

The proper strategy can be appreciated with a spread sheet or graph. Next, a graph.



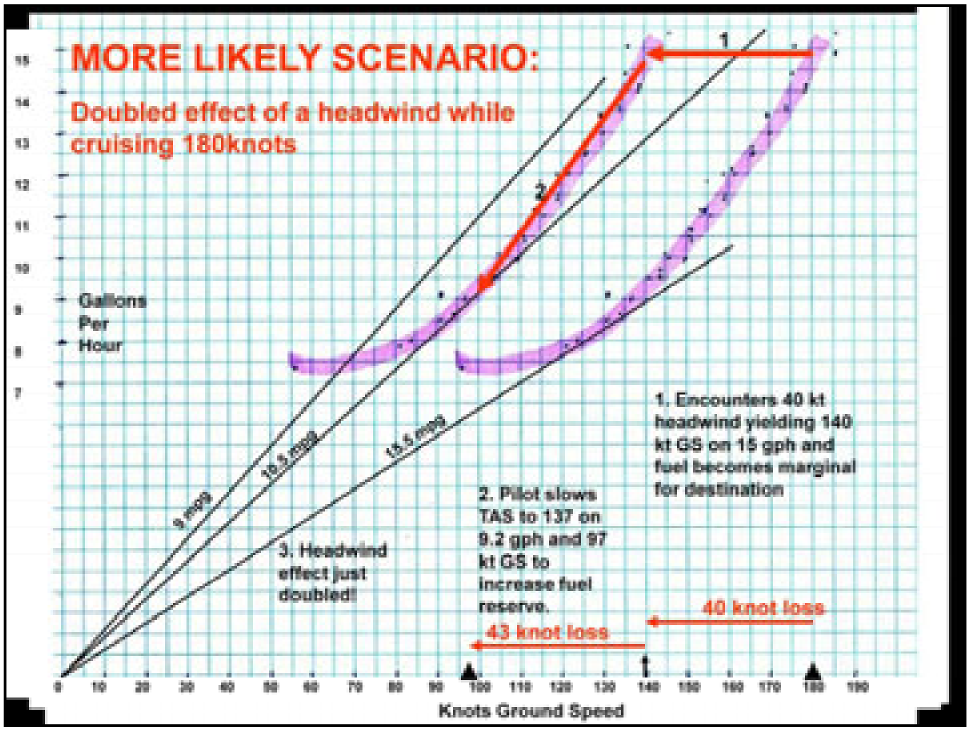
For the purple curve on the right, there is no wind, so airspeed equals groundspeed.

The purple curve on the left represents groundspeed resulting from a 40 knot headwind.

The slanted straight lines represent ratio of fuel to ground miles, ie mpg. Where the purple curves are tangent to a line from the 0/0 point represents the best MPG possible.

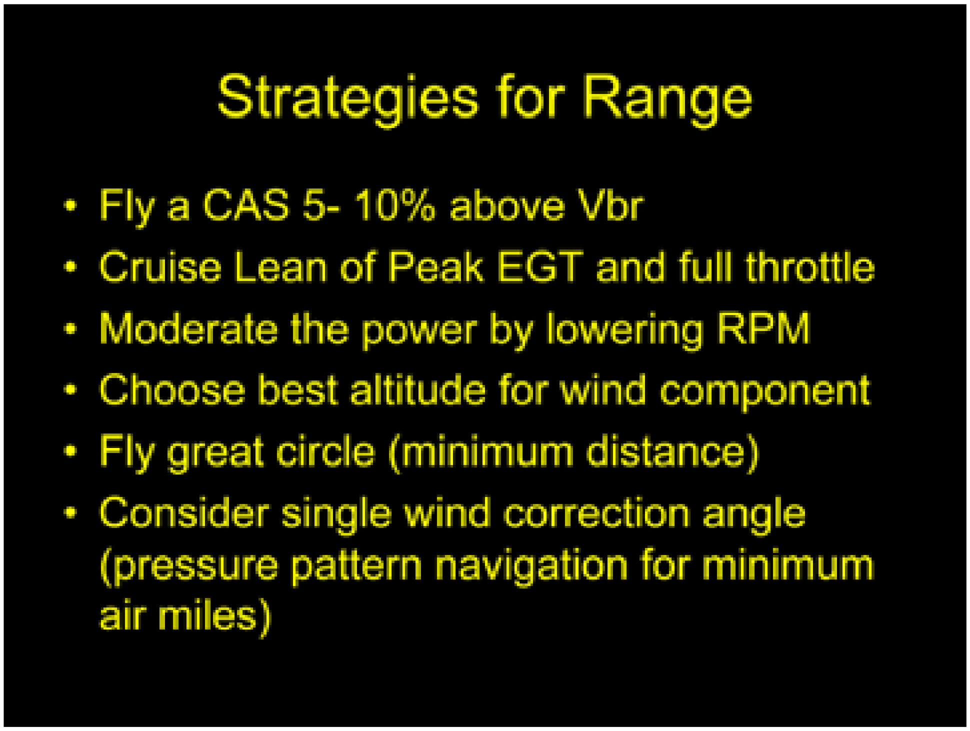
Notice how the differing slope of the MPG lines affects where the tangent occurs.

In this unlikely example, increasing power does increase range. But it's a bad example, like, who flies a Bonanza cross country at these speeds?



This is a more likely scenario showing that at normal cruise speeds, range is increased by slowing down in a headwind, in which case there is a doubled negative effect on ground speed.

It makes more sense to flight plan to a closer destination; you then have enough fuel so there is no need to slow down into that headwind.

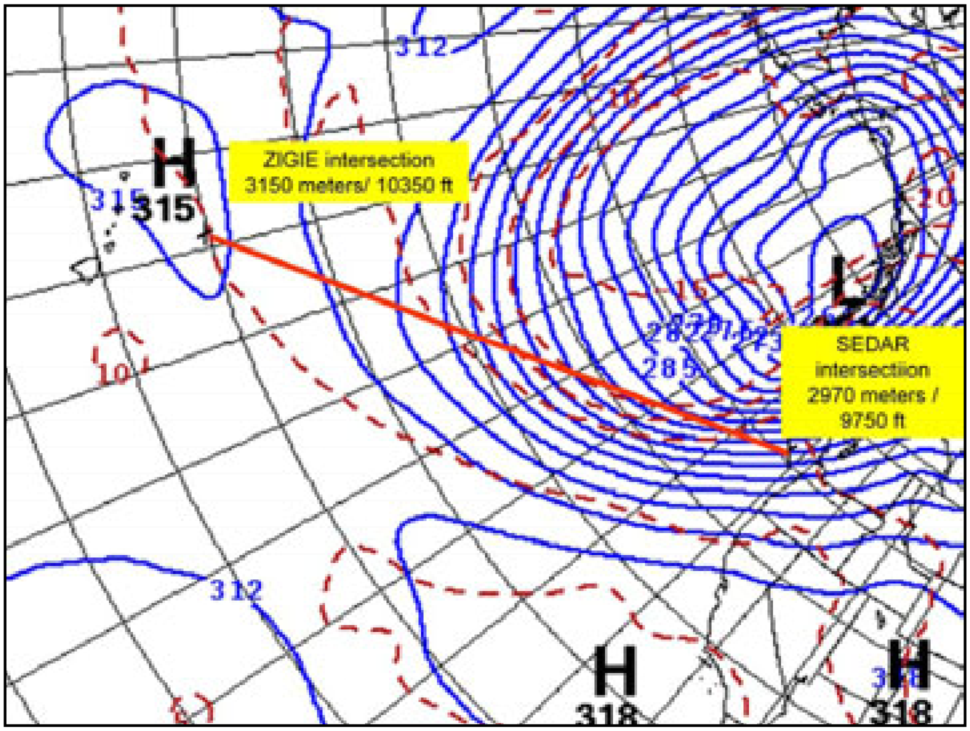


Pressure pattern navigation is fascinating stuff, and I've put together a few slides about it which I hope you will find interesting.

Before Inertial Nav and GPS, flight navigators compared radar altitude to pressure altitude to derive crosswind component and wind correction angle.

Now we can compare GPS altitude to pressure altitude as a monitor of real vs forecast weather and winds.

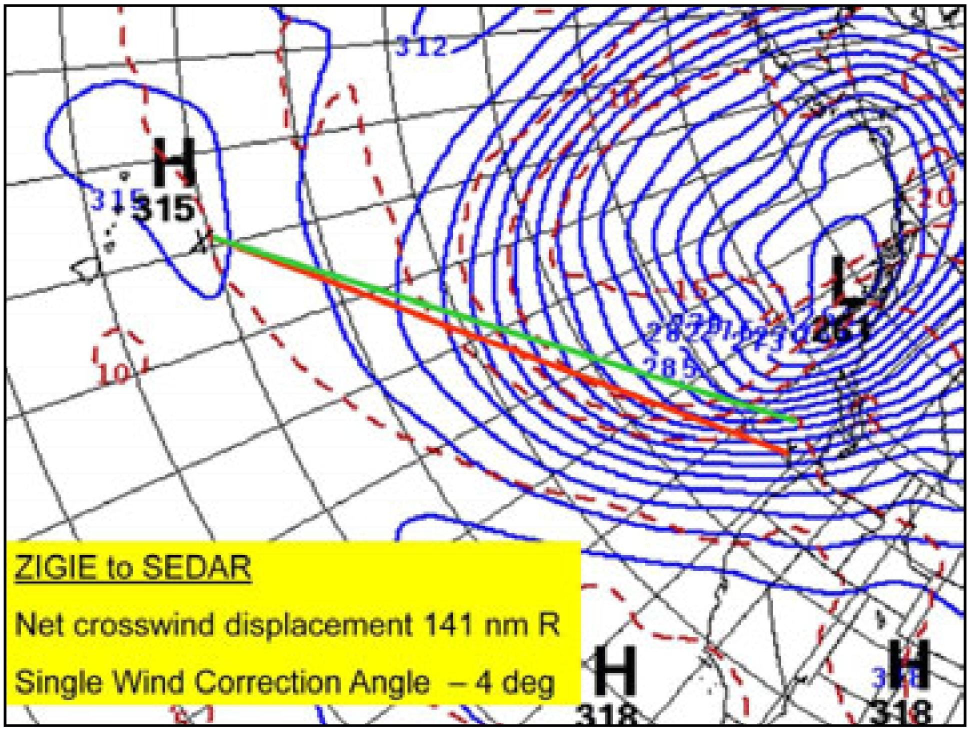
(Pressure altitude is defined as altimeter reading when set to 29.92 inches.)



This is a chart of 700 mB pressure heights for a flight from Honolulu to Bellingham, WA. The 700 millibar level is 3150 meters near Honolulu and ZIGIE intersection, and slopes down to 2970 meters by SEDAR intersection off the Oregon coast.

Winds flow counter clock wise around the low center and parallel to isobars at altitude, so there will be a tailwind, and initially a crosswind from the left, then from the right.

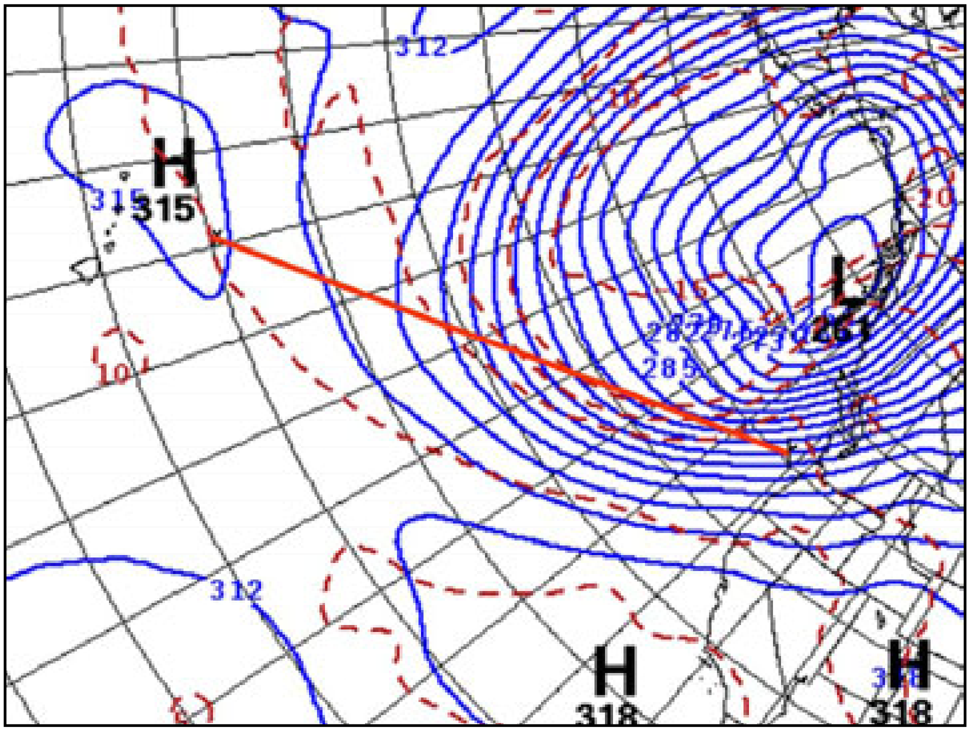
Cross wind component can be solved from data on the isobars, both before and during flight.



The Jeppesen CR3 computer takes true airspeed (155kts), mid latitude (35 deg), pressure drop (- 600 ft) and gives net crosswind displacement ZIGIE to SEDAR as - 141 nm.

On backside of CR3, inputs are total distance and net crosswind displacement to give single wind correction angle of – 4 degrees.

The green line on the chart would be track with a -4 degree wind correction angle if there was no wind, arriving 141 nm left of SEDAR. But the cumulative effect of the wind is a drift 141 nm to the right, which should take the flight across SEDAR.

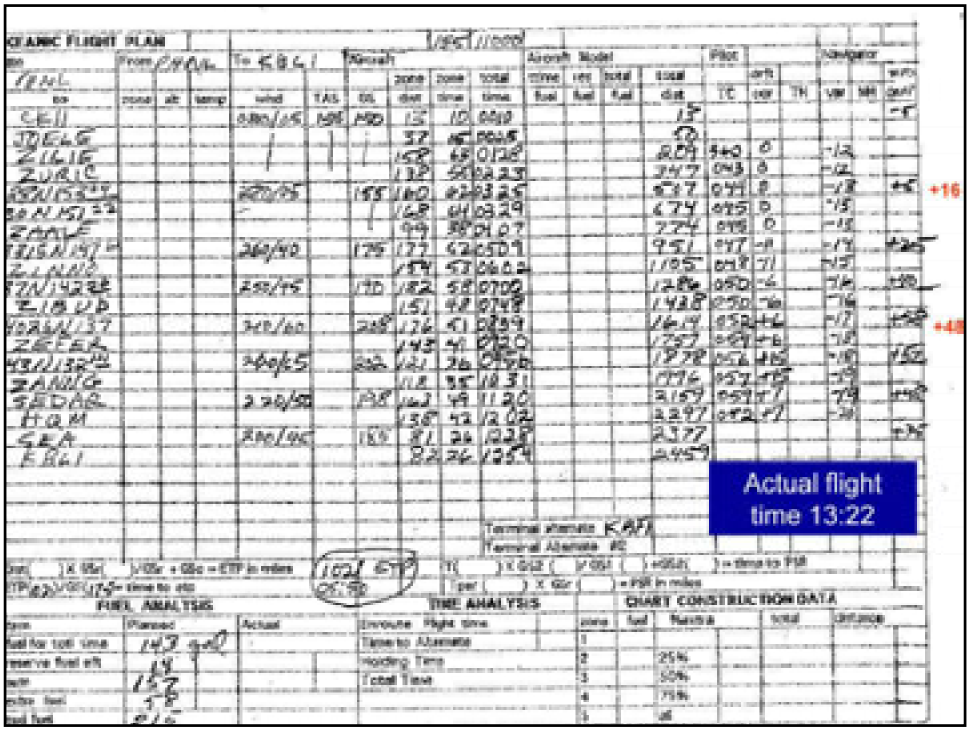


The flight plan ZIGIE to SEDAR intersections, using forecast winds, had wind correction angles of -11 degrees at halfway changing to +7 degrees approaching SEDAR.

The more an aircraft is crabbed into a crosswind, the more groundspeed is lost. With a single drift correction of -4 degrees, the aircraft would drift left of, then right of, and finally back on to the great circle by arrival at SEDAR. This should be a faster route.

But what waypoints do we file? They can be computed, but is it worth the trouble, and would ATC balk at the odd track?

It was late in the day, there was a great tailwind anyway, and I wanted to get off and leveled at altitude before dark.



Here’s the flight plan on a published track.

The red figures represent average wind component for the first and second halves of the flight, which gave ground speeds for the formula for the Equal Time Point.

There’s another formula on there for PSR, Point of Safe Return. That is more of a military deal, like if the enemy captured the destination.

If you remember the movie “The High and the Mighty”, the PSR was dramatized by the navigator: “Captain, we just passed the Point of No Return!”

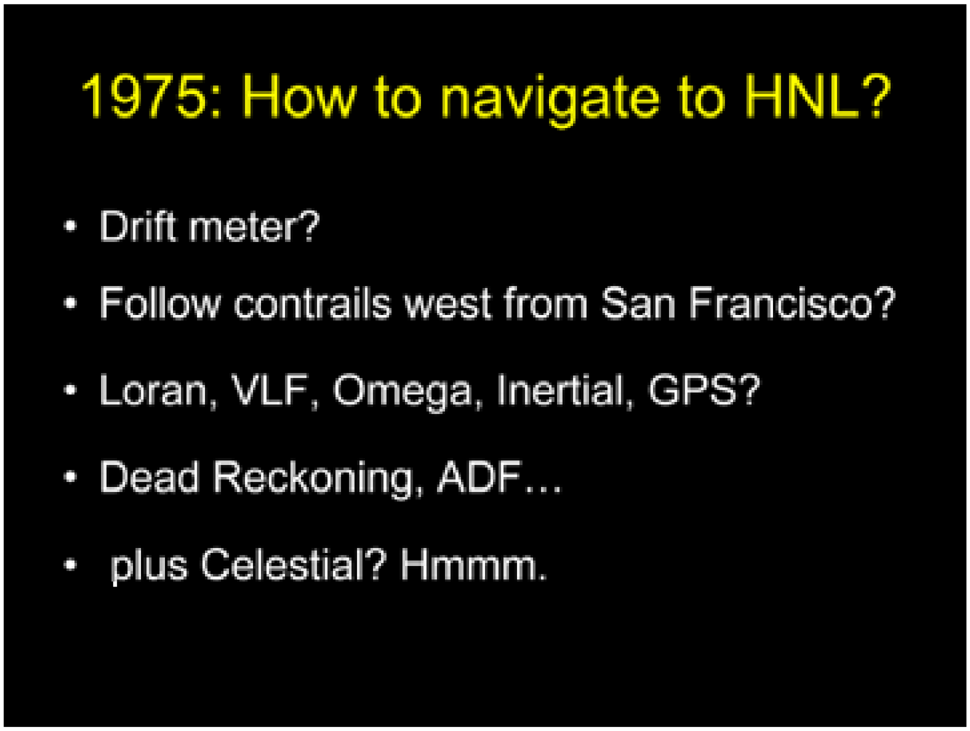
Leveling off at 11,000 feet departing Honolulu, I noticed GPS altitude was about 11,300 ft.

Then, approaching the Oregon coast at 11,000 feet, I snapped this picture showing GPS altitude 10,620.

Eureka! This was like radar altitude vs pressure altitude, showing height changes of pressure levels. The loss in height was about what would be expected from the pressure chart.

In olden days, “Bellamy drift” used differences between radar altitude and pressure altitude as a flight progressed to obtain crosswind component and wind correction angle. Could this now be done using GPS altitude? If so, why? We already have track from GPS.

Maybe it could be useful.

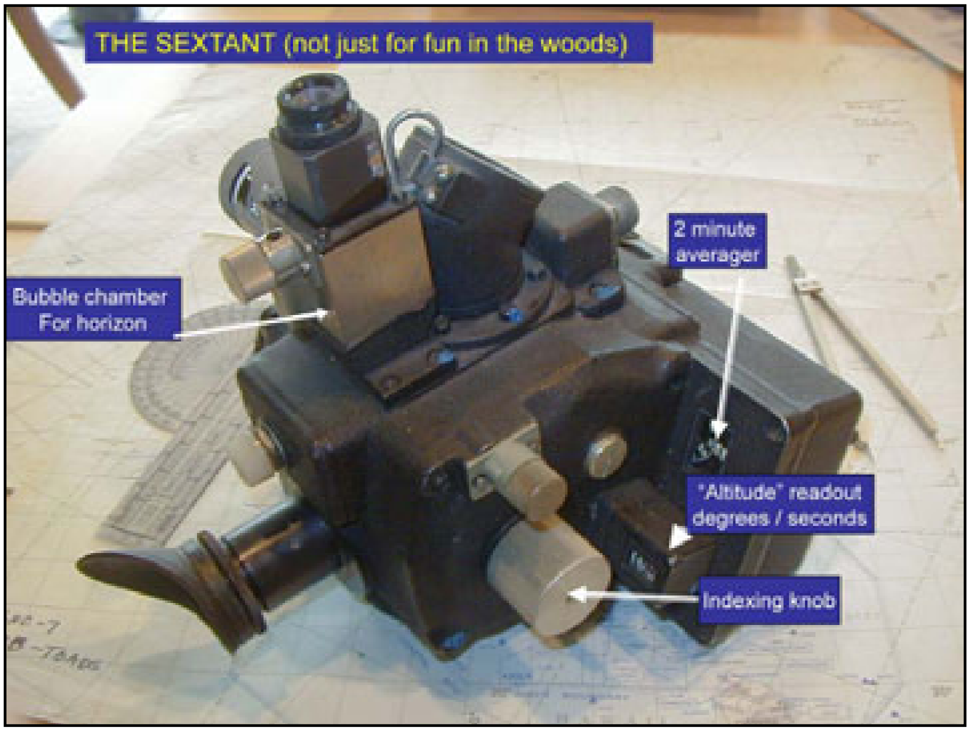


The third line lists items which were either too heavy, too large, too expensive, or not yet invented in 1975.

The professional ferry pilots were using Dead Reckoning plus ADF.

The airlines had gone to Inertial Navigation and eliminated their flight navigators, who had used Loran, Bellamy drift, and Celestial.

I read that Sir Frances Chichester had used Astro flying an open cockpit biplane from Australia to New Zealand. Wow! I couldn't find any reference to other solo pilots using it. So, I remained curious about it.

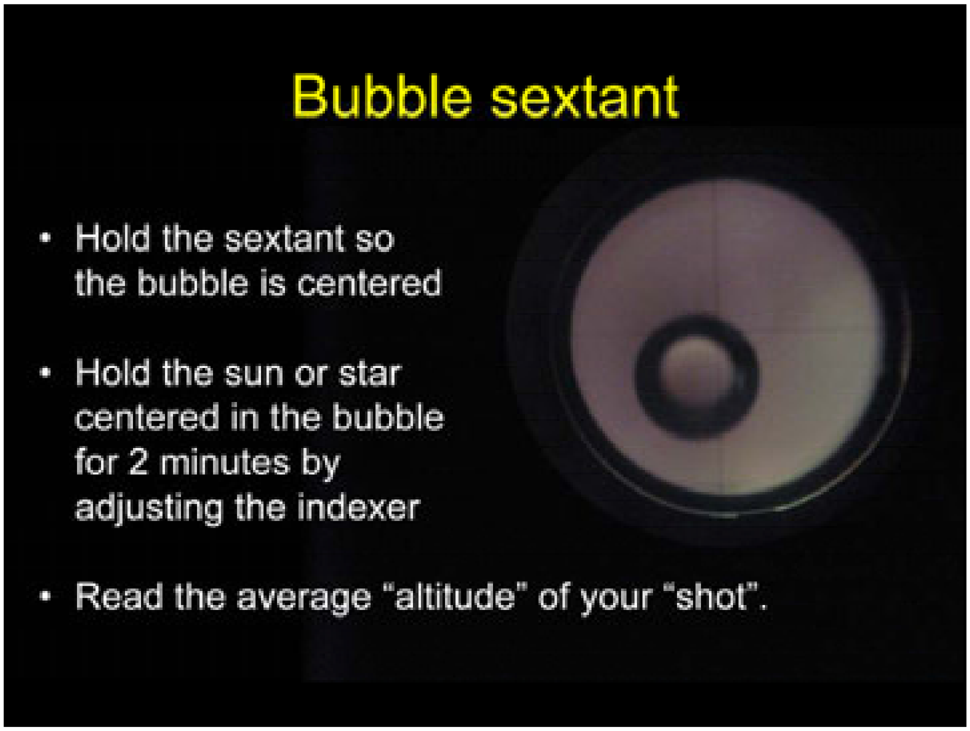


Then an ad appeared in Trade a Plane for surplus sextants, and this arrived in the mail.

It is a Kollsman handheld sextant. It was used in older transport aircraft which had an “astrodome”, a plexiglas bubble into which the navigator could pop the sextant to take sights.

When pressurized aircraft came along, the “periscopic” sextant was developed, with an optical column which was placed through a port in the cabin ceiling. It rotated, like a U- boat periscope, to get the proper bearings for sights.

Bonanza windows are pretty good for astro. Taking shots at right angles to the glass minimized refractive error.



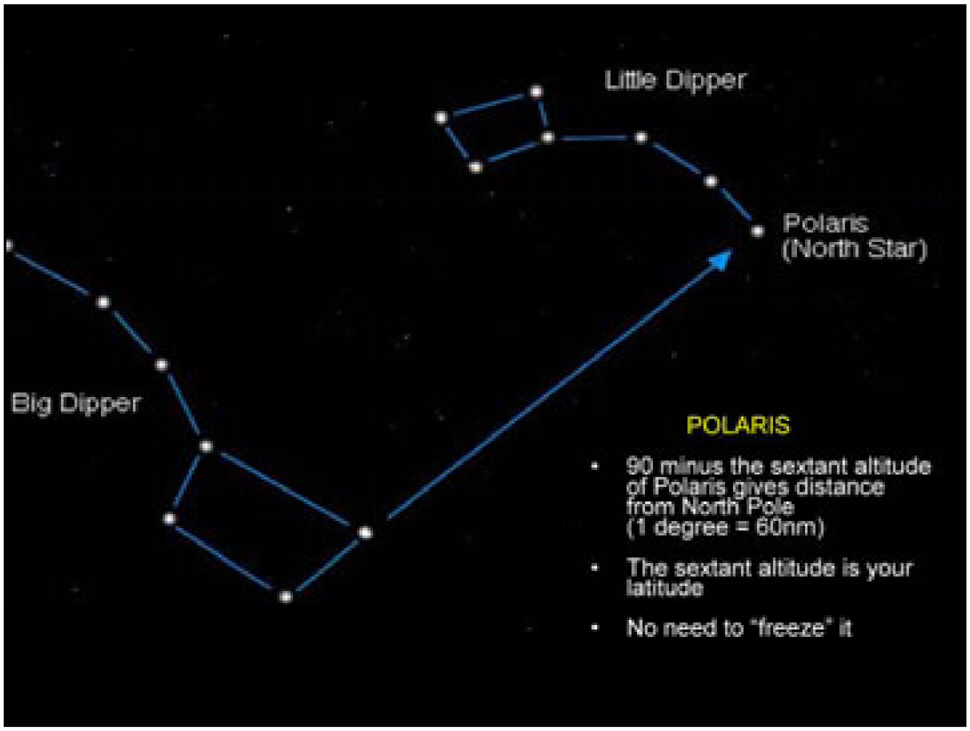
A sextant only measures the angle of a body- sun, moon, planet, or star- above the horizon. That angle is called "altitude" observed, "Ho", or "the shot".

The nautical sextant measures the angle between the sea's horizon and the body, caught in an instant.

The aeronautical sextant instead is held level by centering a bubble seen through the viewfinder, while the celestial body is centered in the same bubble by turning the index knob. Since aircraft do not remain perfectly level, the sight is taken over 2 minutes, and mechanically averaged for the mid time.

It is difficult to keep the bubble centered, and the body centered in the bubble, for 2 minutes, and it can be impossible in turbulence.

The quality of the shot determines the accuracy of the fix.

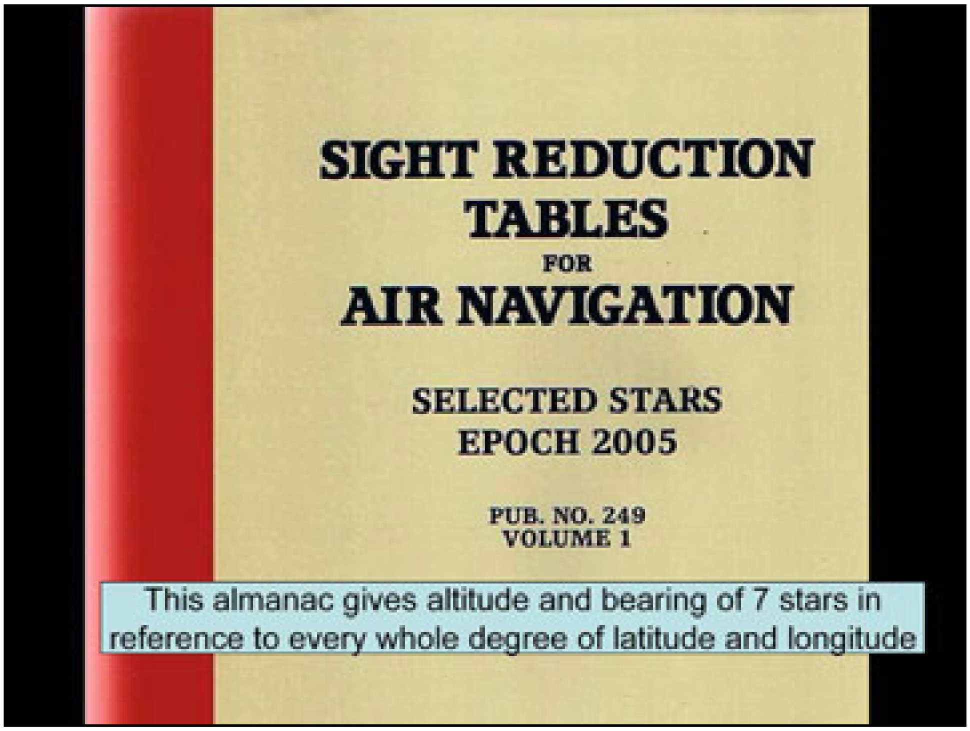


The quickest and easiest way to use your newly obtained sextant is to take a sight on Polaris, the North Star. While everything else in the sky is constantly moving, Polaris remains fixed above the North Pole, so you don't need a clock to "freeze" it- basically, whatever the altitude of Polaris, that is your latitude, though to be exact there is a small correction for time.

This illustrates a useful concept: each degree of latitude is 60 nautical miles.

And, the distance from equator to north pole is 60 X 90 = 5400 nautical miles over a 90 degree latitude change.

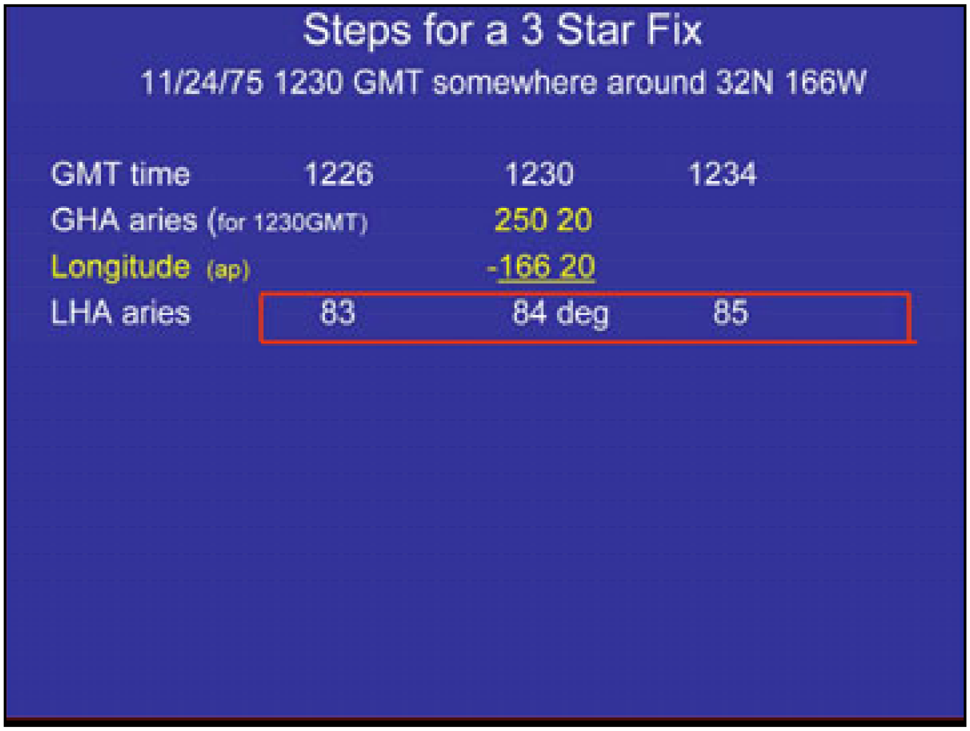
Quite the coincidence? Not!



HO 249 offers altitude and bearing of 7 stars at every whole degree of latitude and longitude. The spherical trigonometry is all done by this almanac, and the remaining tasks are procedural and logical.

I'm going to run through a 3 star fix here. Hang on to your hat, this will be quick and painless. It's all about logic rather than fancy mathematics.

Oh, a very neat thing about a 3 star fix: the stars maintain their relationship to each other and move across the sky in harmony, so one calculation will work for 3 stars.



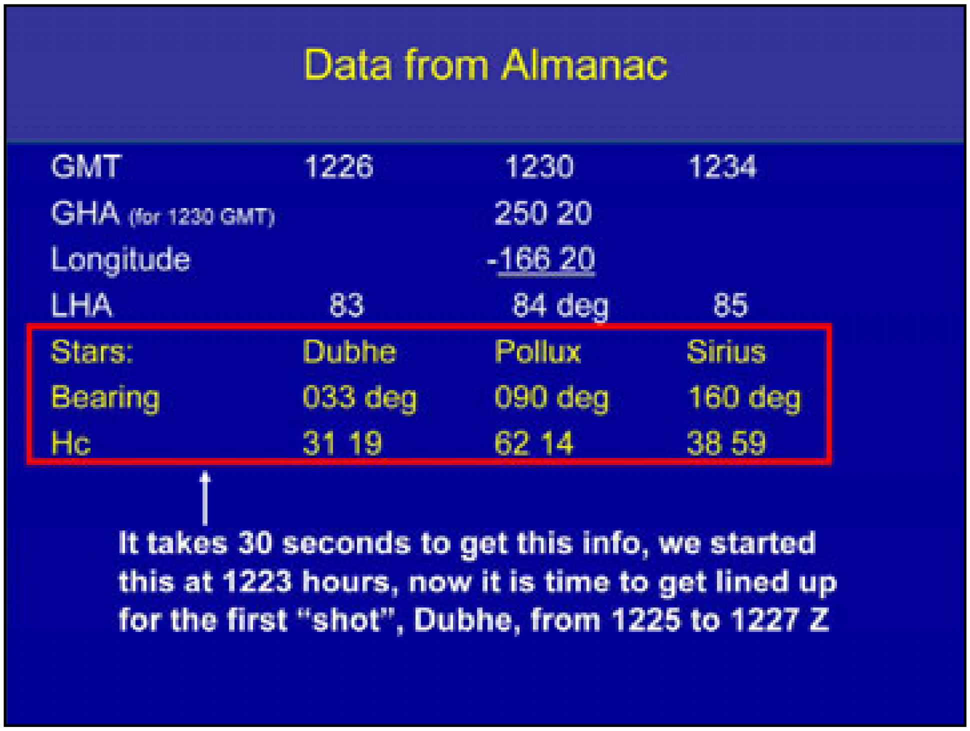
One looks up GHA (Greenwich hour angle of Aries) for the date and Greenwich time of the fix. This is obtained from HO249, Air Almanac, Nautical Almanac, or a handheld calculator.

Aries: it’s just a reference point in the sky.

Here, 166 20W was used as the longitude of the “assumed position” to have a whole number of LHA to work with.

This subtraction changes the Aries sky reference from the Greenwich 0 degree longitude (GHA) to the longitude of the aircraft’s “assumed position” (local hour angle: LHA).

Why are the three LHAs not the same? The shots can’t be taken simultaneously so they are timed 4 minutes apart, in which time the earth turns one degree, so each successive shot is an additional one degree of LHA (Local Hour Angle).



Of the seven stars offered by HO249, I used these three familiar ones.

The "computed" star bearings and altitudes (Hc) in the red box were simply copied from HO 249.

Here is the logic: This data says that at position 32N 16620W, on 11/24/75, at times 1226,1230, and 1234 GMT respectively, these 3 stars will be at these bearings and altitudes.

Of course the airplane can't be at that place at all those times, but we can work with that. Our shots will actually tell us the <u>offset</u> of our 1230 GMT position from 32N 16620W, the "assumed position".

GMT= "Greenwich Mean Time", Zulu Time, or Coordinated Universal Time- they all mean the time at 0 degrees longitude, London, England.

SHOTS vs ALMANAC

GMT (time)	1226	1230	1234
Stars:	Dubhe	Pollux	Sirius
Bearing	033 deg	090 deg	160 deg
Hc	31 19	62 14	38 59
Ho	33 45	63 22	38 33

"Shots" of the 3 stars, taken at times 1225-7, 1229-31 and 1233-35 GMT

TAKING THE SHOTS

1224: set sextant at 31 19, checked the compass for 033 degrees, looked there and found Dubhe

1225: adjusted index knob to center Dubhe, triggered timer

1227: shot ended. Recorded Ho as 33 45 at 1226Z time

1228: Rewound sextant, set 62 14 and found Pollux

1229: Centered Pollux, hit trigger

Etc etc.

1235: finished the Sirius sight.

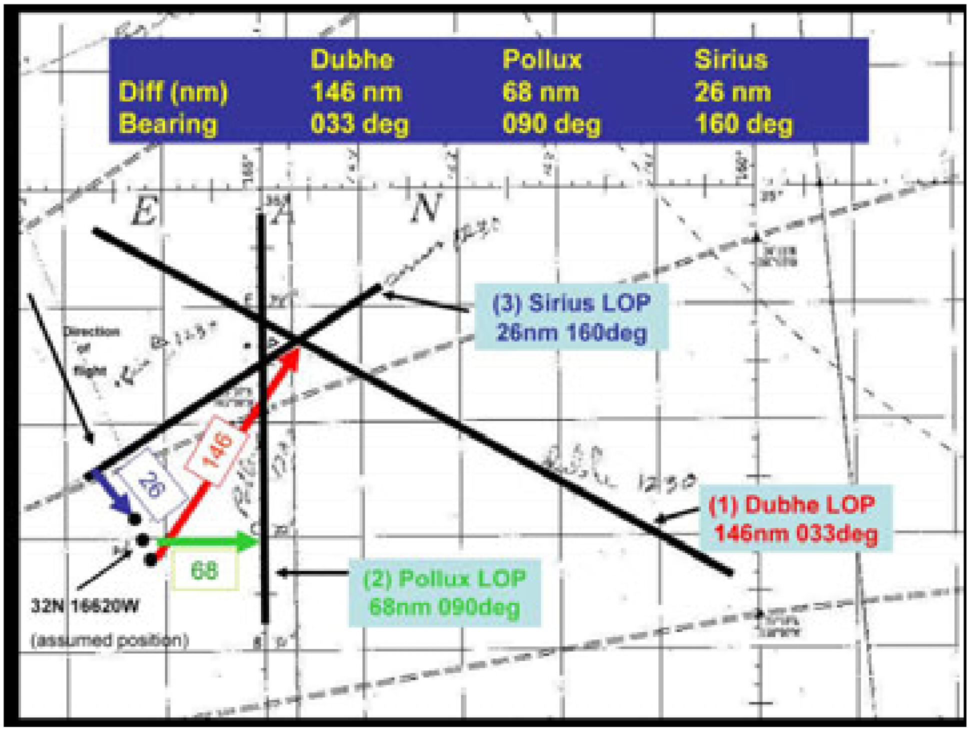
The red box now encloses the actual shots observed.

SHOTS vs ALMANAC

GMT (time)	1226	1230	1234
Stars:	Dubhe	Pollux	Sirius
Bearing	033 deg	090 deg	160 deg
Hc	31 19	62 14	38 59
Ho	33 45	63 22	38 33
diff	2 26	1 08	- 26
diff in nm	146	68	- 26
bearing	033 deg	090 deg	160 deg

After finding the difference between calculated altitudes and observed altitudes, and converting the difference from degrees and minutes to nautical miles, the red box now has the data to plot the offset from the “assumed position”, 32N 16620W, which we can now take to the chart to plot our position.

I degree = 60 minutes = 60 nautical miles, remember?



The difference and bearing of Dubhe was for a shot at 1226 hrs at the AP 32N16620W. But, our fix is for 1230, and in that 4 minutes the aircraft progressed 10 miles on a southeast course: therefore we plot the Dubhe LOP from a point 10 miles SE of the assumed position ("advancing the LOP").

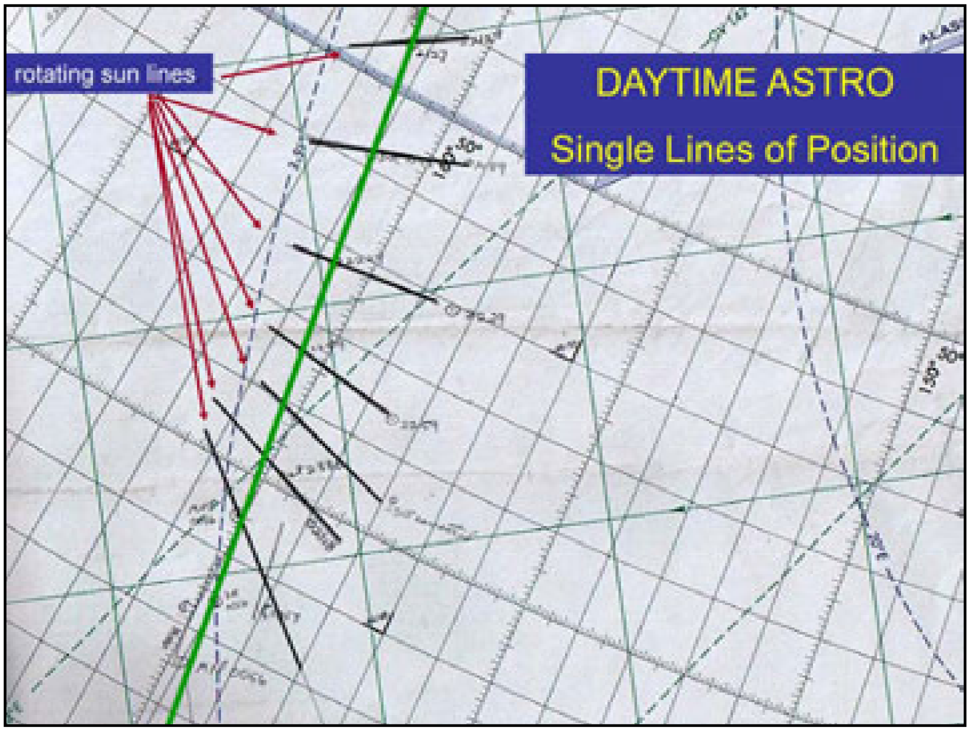
Pollux stays where it is, shot time is fix time.

But Sirius data for 1234 hrs needs to be retarded 10 miles for the opposite logic applied to the Dubhe shot ("retarding the LOP").

Thus there are 3 black dots for plots from the AP.

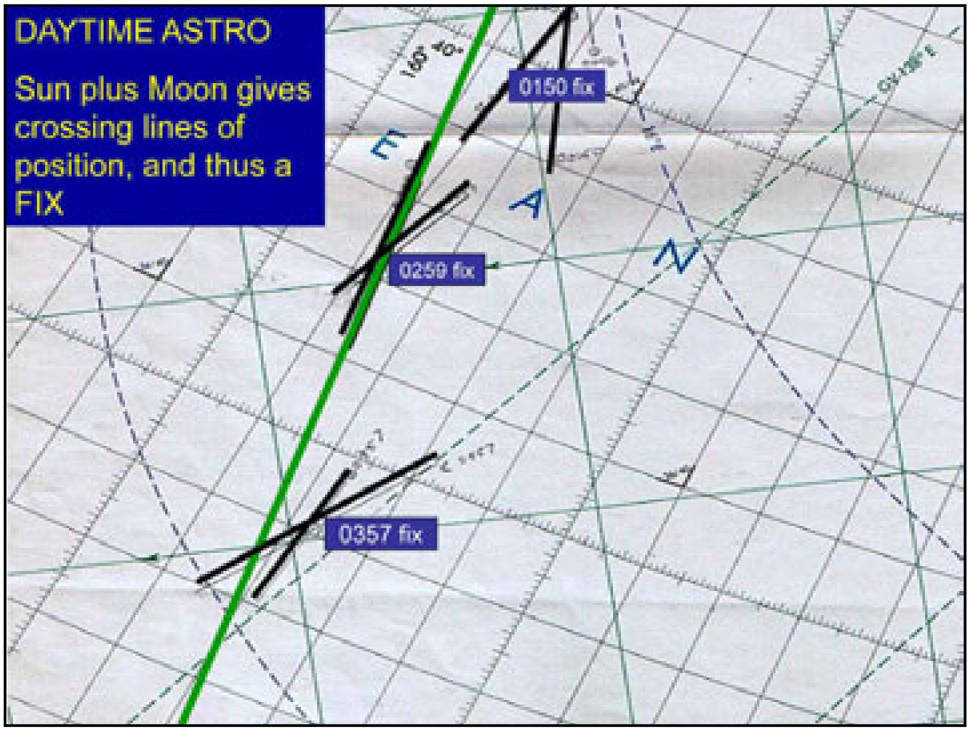
Since the difference for Sirius was negative, that LOP is plotted away from the AP. There is a mnemonic, HOMOTO, which covers that.

No, LOP is not Lean of Peak, here it's Line of Position.



Daytime flight is less demanding than night flight, except the stars are gone. So for Astro, the navigator usually has only the sun for guidance. That's known as Single Line Of Position (SLOP) navigation. It is most useful around noon, when the angles change quickly- as in this slide.

This is a flight from Cold Bay to Maui, 1978.



At times the moon is visible and good for a second line of position to cross with the sun line.

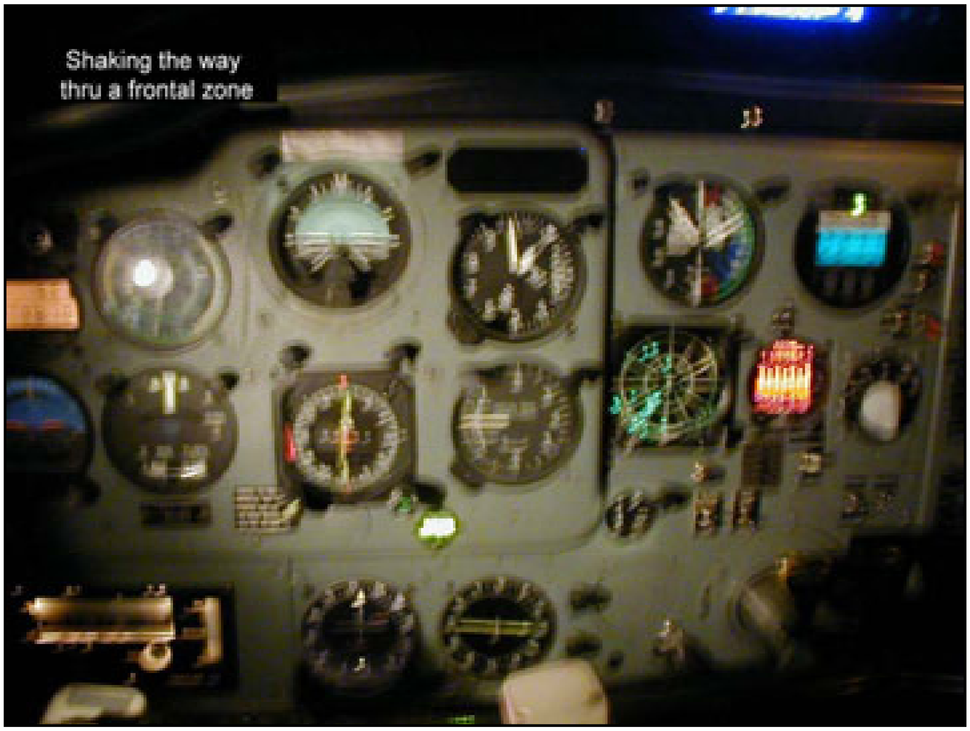
The sun and moon computations are independent of each other.

Sometimes the planet Venus can be sighted during the day, more likely at jet altitudes than down at 7 to 12,000 feet where light aircraft fly over water. I've never been able to find Venus with a sextant in daytime.

Same flight as last slide, a little later in the day.

It can be pretty out there.

Likewise it can be totally black- turn down all the lights, it’s overcast, no light out there anywhere- like being locked in a closet.



Gotta have an autopilot.

Why hand fly a long trip if you have a decent AP? Better to keep yourself fresh, move around the cabin, eat, drink, whiz, take some star sights.

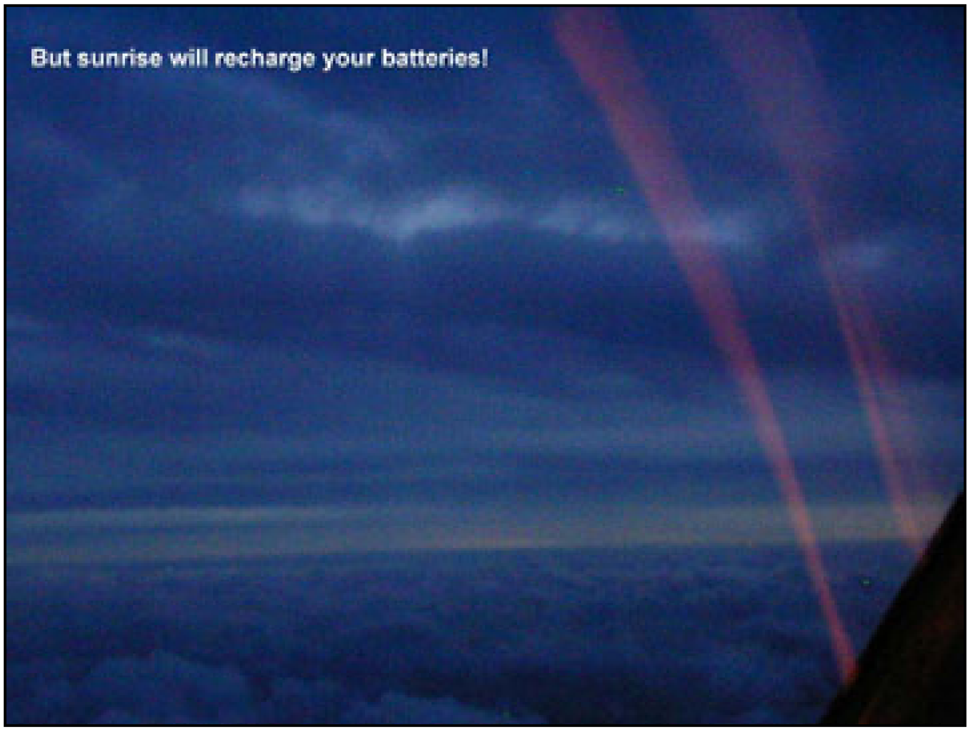
Whatever happens, don’t go to sleep!

The light here is from an LED headband, which plays forever on two AAA batteries. It always shines where you are looking, a great night time aid.

If you look at this for 5 seconds, you may start to yawn.

If there is nothing but black outside, the sea is far below, there are no other aircraft out there at your altitude, you may as well crank up the interior lights, let the autopilot do its thing, pick out some music, and make yourself comfortable.

You could read a book, take some star sights, listen to airline gossip on 123.45, or get out your sat phone and call your cousin in Peoria: “Guess where I’m calling from?”.



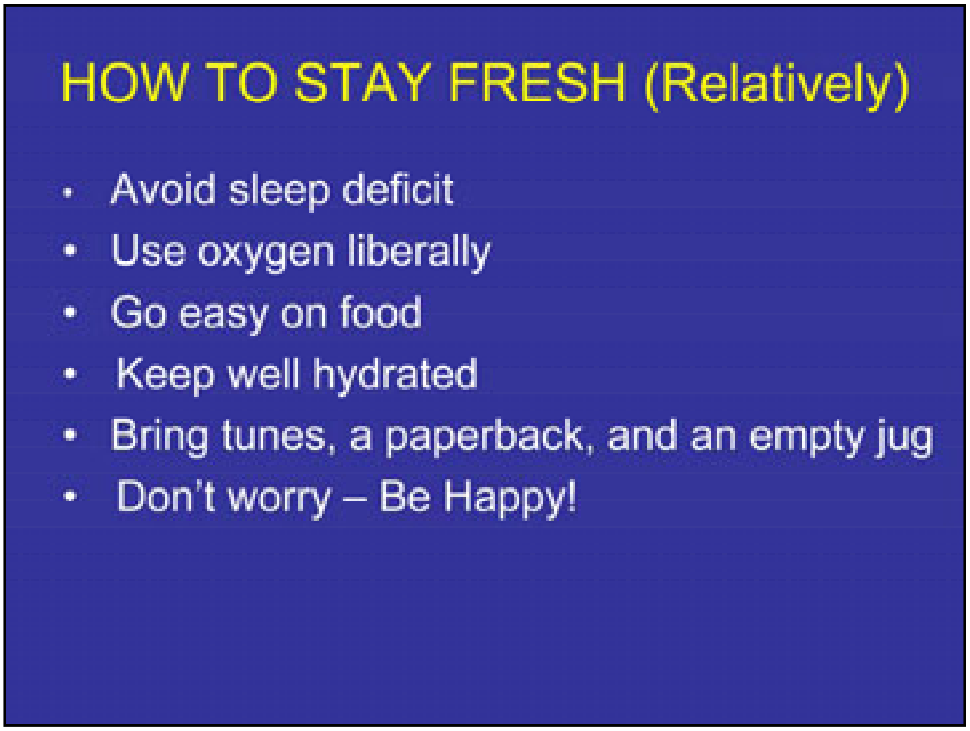
It is so great when the sun comes up after a long night over water.

The Garmin 396 is plugged into the cigarette lighter and stays charged.

There is a Garmin 530 unseen on the right side panel. Apparently the 396 and the 530 are cribbed up with the same algorithms, as the nav info from each is always identical.

Losing the vacuum pump would leave the electric AI (over on the left), the pitot-static instruments, and the panel page of the G396.

Losing the alternator would mean hand- flying the aircraft and navigating by the G396, which should be good for at least 8 hours, even more if the display is dimmed.



Remember, it's all fun.

When pilots ask about oceanic flying, they start off with a bunch of questions: fuel, communications, how to stay awake, etc..

Then they comment on the size of the pilot's nuts.

Then they talk to their friends and say that guy is really nuts!

What data is there that engine failure is less probable over water? It is likely that any one flying over water on one engine will have clean plugs and injectors, recent OK compression check and borescope, clean fuel, intact fuel system, know his engine, etc etc.

Possibly the oceanic risk is less than scud running or IFR without currency.

Goals

Miss no details

Flight plan with precision

Minimize flight time but keep 3 hour reserve

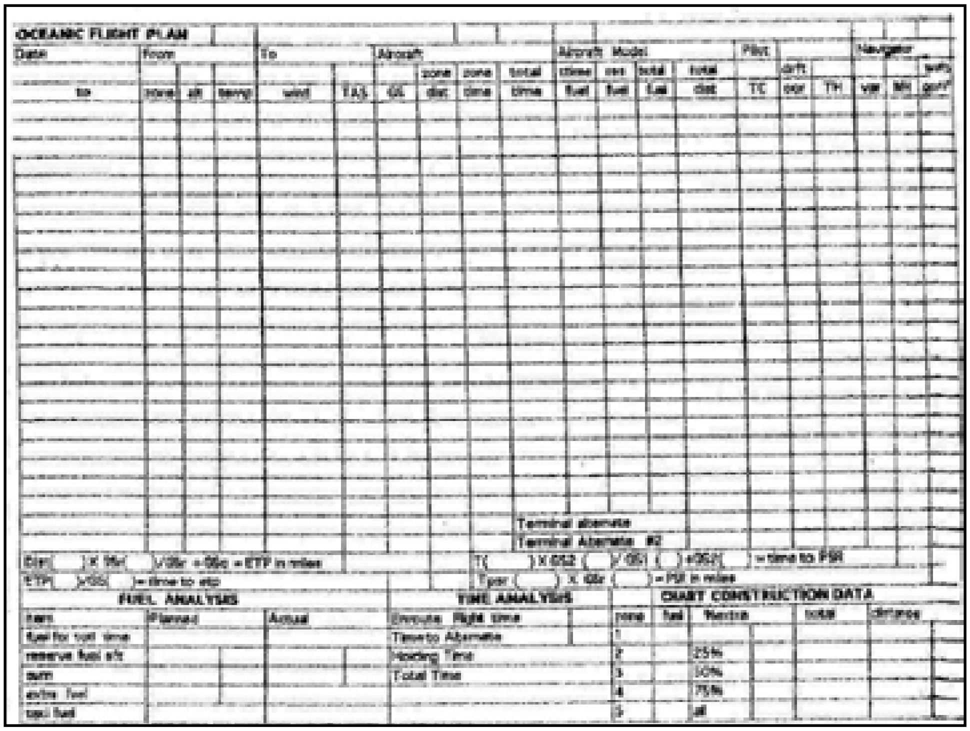
Record GPS altitude of waypoints

Check flight planned drift against Bellamy drift

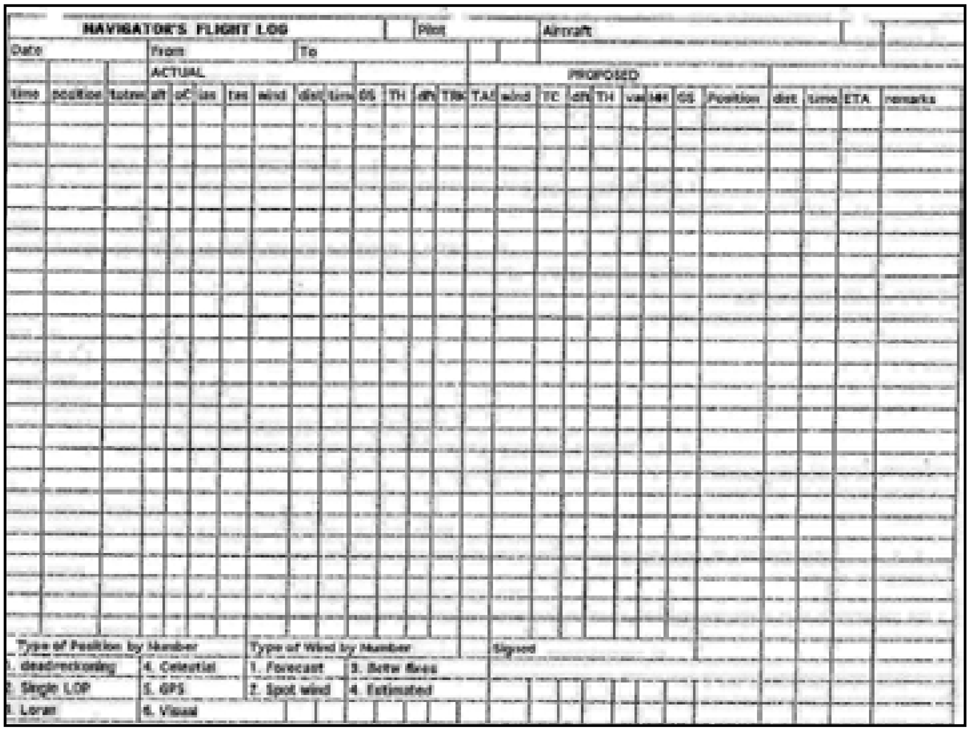
Record headings flown to maintain track

Some goals of a future trip.

Message to other Bonanza owners: you have a very capable airplane !



A logical and orderly tool for flight planning.


NAVIGATOR'S FLIGHT LOG

Pilot

Aircraft

Date

From

To

ACTUAL

PROPOSED

time | position | alt | ias | tas | wind | dist | GS | TH | wind | TC | TH | GS | Position | dist | time | ETA | remarks

Type of Position by Number

1. deadreckoning
2. Single LOP
3. Loran
4. Celestial
5. GPS
6. Visual

Type of Wind by Number

1. Forecast
2. Spot wind
4. Estimated

Signed

Keep a good log for later reference. The data may be valuable to you on a future trip, and it’s nice to be well organized.

Suggested References

- HO 216 Air Navigation US Govt Printing Office 1967
- Aerodynamics for Naval Aviators Office of the Chief of Naval Operations
- Flying High Performance Singles and Twins John C Eckalbar Skyroad Projects, 1994
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- HO249 Sight Reduction Tables for Air Navigation, Volume 1 Celestaire
- Air Vagabonds Anthony J Vallone Smithsonian 2003
- The Sky Beyond Sir Gordon Taylor
- Ocean Flying Louise Sacchi ,McGraw- Hill 1979
- Staying Current Dan Manningham, Ziff- Davis 1980
- Aircraft Emergency Procedures over Water United States Coast Guard CG306
- Fly the Engine Kas Thomas, TBO Advisor Books 1993
- Emergency Landing Techniques in Small Fixed Wing Aircraft NTSB-AAS-72-3
- International Flight Information Manual www.faa.gov/ATs/aat/ifim/
- Earthrounders.com
- Advanced Pilot Seminars online course www.gami.com
- Engine Related Articles John Deakin www.avweb.com
- Oceanic forecast charts at www.nco.ncep.noaa.gov/pmb/nwprod/analysis/