Transition to the DA40

Alameda Aero Club

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Feedback: cfi.erik@icloud.com

Goal: Cover key information and hazards for pilots transitioning from C172 aircraft

Not a substitute for review of Aircraft Flight Manual and other applicable resources.

Always obtain ground and flight training from a qualified flight instructor.

Agenda

- What isn’t covered
- Sources of information
- Aerodynamics
- Preflight planning
- Preflight inspection
- Fuel management
- Engine management
- Aircraft questionnaire
- Transition training
- VFR / IFR transition risk management
- Notes for CFIs

What isn’t covered

What isn’t covered

These topics require more in depth coverage

- G1000
- KAP140 autopilot
- See separate slide decks and resources focusing on these topics

Sources of information

Sources of information

What to review before beginning training

- Official (manufacturer) resources for the DA40 are layered
  - Original DA40 was certified with round gauges
  - G1000 installation is under a supplemental type certificate (STC) from Garmin, not Diamond
  - Diamond Optional Design Changes can introduce additional differences per airframe

Sources of information

What to review before beginning training

- Online resources are a good starting point…
  - BUT the documentation in the actual airplane is authoritative for approved information and limitations
    - 14 CFR 91.9 (a): No person may operate a civil aircraft without complying with the operating limitations specified in the approved Airplane Flight manual, markings, and placards

Sources of information

What to review before beginning training

- Aircraft Flight Manual (AFM aka POH)
  - Available online from Diamond
    - http://support.diamond-air.at/da40-180_afm_bas+M52087573ab0.html
      - Be sure to download the complete manual, not the revision package
      - Need detailed systems info? Check out the maintenance manual and illustrated parts catalogue accessible from the above link
- N22QT Weight and Balance dated 2018-09-18
  - https://app.box.com/s/3g7uss6r2znx7tsmapgvehsfiz46i73a

Sources of information

What to review before beginning training

- Garmin G1000
  - STC - updates AFM
    - https://app.box.com/s/xxkttj929mdtacl7wwunfrfu6a91cxjh
  - Garmin pilot’s guide
    - https://app.box.com/s/m62ibdqifwo88dn6ae84kpjz5qoqks9g
  - Garmin G1000 Guide for DPEs and CFIs
    - https://app.box.com/s/8f67ftztn47a43xj3msoafg0sg6r438p
  - G1000 ADC/AHRS failure mask
    - https://app.box.com/s/q7u9m8ai51wofldiwrb0qpa8nx58ffmb

Sources of information

What to review before beginning training

- Garmin G1000
  - CAP G1000 VFR Transition Course Part 1 (PFD/MFD)
    - https://app.box.com/s/0wl52qatuv7ok1rneoqd2araytnm7xjc
  - CAP G1000 VFR Transition Course Part 2 (KAP 140)
    - https://app.box.com/s/nba97c5toqz5s65zq0bhy2v3uwekox8e
  - CAP G1000 IFR Transition Course Part 1 (PFD/MFD)
    - https://app.box.com/s/riqu733vj57nt2rd9c2wsjyjmbvhj2vf
  - CAP G1000 IFR Transition Course Part 2 (KAP 140 - nearly identical to VFR above)
    - https://app.box.com/s/gpvxjv0l18tpbxs5hm5ozmbgl41yg2qq
  - Optional: Max Trescott's G1000 Glass Cockpit Handbook
    - http://www.g1000book.com/

Sources of information

What to review before beginning training

- KAP 140 autopilot
  - Pilot’s Guide
    - https://app.box.com/s/jsc0mfweofaxsqghy5gcfo3viocjpnl7
    - Note: guide is not G1000 specific
- Hartzell Propeller STC
  - https://app.box.com/s/m3yee4riu5177dz6ilsw97ce7b6fz039
- AAC Checklists
  - Normal
    - https://app.box.com/s/dhnnho5az59wjxjkxkwn0ex5jxh4xgxf
  - Emergency
    - https://app.box.com/s/h2ec519s2oq9nj47gie2cb844ft4h2ta

Sources of information

What to review before beginning training

- Strongly recommended: John Ewing's Concise Guide to the DA40-180
  - https://books.apple.com/us/book/the-concise-guide-to-the-diamond-da40-180/id896502675
- Optional: Gyronimo Mass & Balance / Performance calculator app
  - https://apps.apple.com/us/app/da40-180/id697864144
  - The app has not been updated for all Diamond Optional Design Changes; it may not represent all the W&B limits available for the DA40
- Aircraft questionnaire (see Transition Training section for details): https://app.box.com/s/b0jbi25w4fra3amzwykafmnpduihgvyx
- Recommendations or Pilot Reports on DA40 resources appreciated: cfi.erik@icloud.com

Aerodynamics

Aerodynamics

Approach hazards

- Comparing the C172 and DA40
  - The DA40 has a high aspect ratio, laminar flow wing.
    - This, when combined with the wing being closer to the ground during landing means ground effect is more pronounced than high wing airplanes like the C172
  - Compared to a C172, the DA40 has a low drag airframe
  - Hazard: easy to build excess airspeed, hard to get rid of excess airspeed during approach (especially with less than full flaps)
  - Hazard: tendency to float during landing, resulting in more runway required
  - Hazard: tendency to ballon during landing, increasing the risk of nose / tail strike

Aerodynamics

Approach hazards

- A relatively flat landing attitude (compared to that used in a C172) helps
    - Holding the DA40 off in the flare will result in the plane using up a lot of runway
    - When held off in the flare, as airspeed slows towards a stall, the plane will plop hard on the runway
    - Hazard: Holding the airplane off the runway in the flare will result in a hard landing
    - Hazard: Holding the airplane off the runway in a flare that is too high will result in a very hard landing

Aerodynamics

Approach hazards

- The key to successful and safe DA40 landings is
  - accurately flaring at the correct height
  - holding the landing attitude
  - letting the main wheels touch
- A full stall landing is neither required nor desirable in the DA40
  - Don’t try to land a DA40 the way you would a C172
- Airspeed control is critical to avoiding these hazards…

Aerodynamics

Approach hazards

- … but too little airspeed is also a problem.
- During approach at published speeds DA40s tend to be unstable in pitch
  - Hazard: tendency to over control during landing, increasing the risk of nose / tail strike
  - Slightly increasing approach speeds overcomes pitch instability during approach
  - Hazard: higher than published approach speeds will require more runway distance than published performance charts indicate

Aerodynamics

Flaps

Aerodynamics

Flaps

- Three flap positions:
  - UP
  - T/O (Vfe 108 KIAS)
  - LDG (Vfe 91 KIAS)
- The only approved flap setting for takeoff is flaps T/O
- Flaps T/O are always used for takeoff
  - There is no published takeoff performance data with flaps UP
  - Hazard: running off the end of a short runway if a takeoff is attempted without flaps
  - During takeoff briefing nominate an abort point
  - Use checklist to ensure proper takeoff configuration
- Published landing performance data for flaps LDG and flaps UP

Aerodynamics

Short fields not considered

- There is no published value for Vx in the AFM
- There is no published short field takeoff or short field landing procedure in the AFM
- Takeoff and landing performance charts include an adjustment for obstacle height from 0 to 50 feet

Aerodynamics

Hartzell Propeller

- N22QT has an STC (supplemental type certificate) for the installation of a Hartzell two blade aluminum propeller
    - This replaces the original three blade composite MT propeller
        - The AFM is based on the three blade composite MT propeller, not the Hartzell two blade propeller
- Hazard: Hartzell STC landing distance with or without flaps is greater than AFM landing distance
    - Hartzell STC: “Increase total landing distance over obstacles by 5%”

Preflight planning

Preflight planning

IFR Considerations

- Non-WAAS RNAV approach IFR requirements (see AIM 1-1-17)
    - Aircraft must be equipped with an alternate approved and operational means of navigation suitable for navigating the proposed route of flight.
        - Per the AFM VOR-LOC-GP receiver, marker beacon receiver, and both VHF com radios must be working in addition to equipment required for Day and Night VFR
        - Emergency switch seal wire must be intact
        - 30 day VOR check must be valid
- Flight plan based on approaches which rely on GPS at either the destination OR the filed alternate(s)
    - Filed flight plan can not be based on approaches which rely on GPS at both destination and alternate(s)
    - For example, an ILS approach that requires DME would rely on GPS, even though it is not an RNAV approach.
- Conduct RAIM prediction (and in aircraft, RAIM check via G1000)
- Confirm approach minima without WAAS are sufficient for weather
    - LP and LPV minima require WAAS

Preflight inspection

Preflight inspection

Doors

- Both the front canopy and rear passenger doors must be unlocked for flight
    - Currently one door is unlocked when the key is vertical, and the other door is unlocked when the key is horizontal
    - Open both doors at the beginning of the preflight to ensure they are unlocked and to inspect hinges
    - Control the opening of the doors with your hands so that they open / close slowly and do not slam (repeated slamming will damage the doors)
    - In strong winds, close doors when not in use to avoid damage

Preflight inspection

Doors

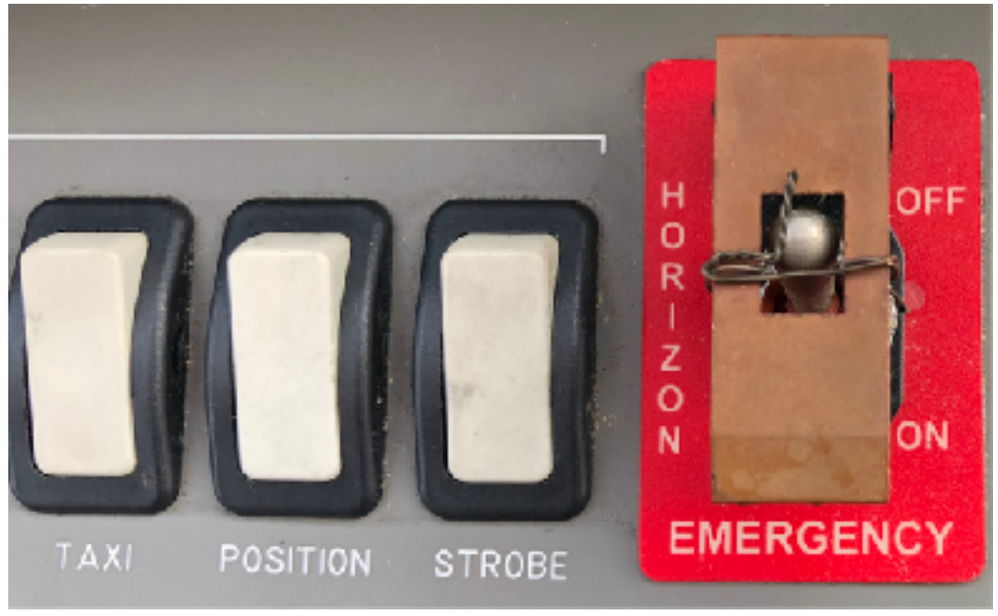
- Use gentle pressure when operating door handles
    - Don’t force the door handle; if gentle pressure doesn’t move the handle try changing the lock position
    - Forcing the door handle when the lock is engaged will break the lock
- Brief your passengers not to touch anything red in the airplane unless it is an emergency and you’ve briefed them or asked them to touch a red thing.
    - Pulling the red rear door emergency release handle in flight will cause the rear passenger door to separate from the aircraft
    - Do not attempt to close the rear door if it comes open in flight. Doing so will cause it to open and then it will separate from the airframe.
- The front canopy may be opened in flight in an emergency for smoke evacuation

Preflight inspection

Rear door emergency release handle (red)

Preflight inspection

Emergency switch seal



- Be careful during preflight that you do not damage the seal wire; if the wire is not intact then per the AFM IFR flight is prohibited.

- If the Horizon Emergency switch is activated by accident, the witness wire must be reinstalled and the horizon emergency battery must be replaced!

- The emergency switch may be used if the airplane experiences a total electrical failure. Once switched on, an independent battery will provide 90 minutes of power to the standby attitude indicator and flood light.

- In a total electrical failure, other available instruments are the magnetic compass, an altimeter and airspeed indicator.

- To operate the switch pull the cover towards you hard enough to break the wire seal, then pull the switch down.

Preflight inspection

Required equipment

- AFM Kinds of Operation lists required equipment that must be on board as well as operational for different types of operations (daytime VFR, Night VFR, and IFR).
- Garmin STC has its own list of requirements.
- Key items which must be on board the aircraft for it to be airworthy
  - Fuel quantity measuring device (Always)
  - G1000 Cockpit Guide (Always)
  - Flashlight (Night/IFR)

Preflight inspection

Seats and Rudder pedals

- The seats (front and rear) with respect to human comfort
  - are not adjustable
    - don’t move up or down
    - don’t move backwards or forwards
    - don’t recline
  - Some may find this uncomfortable, but the 6’1” author finds the seats no worse than C172 seats
- The one ergonomic consolation is that each pilot’s set of rudder pedals can be moved farther away or closer to the pilot
  - Rudder pedals may only be adjusted on the ground, never in flight

Preflight inspection

Seats and Rudder pedals

- Move pedals aft:
  - With your feet resting lightly on the pedals
    - pull the T-handle with enough pressure to move the rudder pedals aft
    - and when in position release the T-handle
    - apply pressure with feet on pedals

Preflight inspection

Seats and Rudder pedals

- Move pedals forward:
  - With your feet applying pressure on the pedals
  - lightly pull the T-handle to move the pedals forward
  - when in position release the T-handle
  - apply pressure with feet on pedals

Preflight inspection

Seats and Rudder pedals

Preflight inspection

Control stick with control lock (right seat)

Preflight inspection

Control stick with control lock (left seat)

Preflight inspection

Parking brake control

- Unlike a C172, operation of the parking brake control by itself does not apply the parking brake
- The DA40 parking brake control is a one way valve that retains brake pressure applied with the brake pedals
- In the upper position as shown in the previous picture the parking brake is released
- To operate the parking brake, pull the lever downwards, then press both toe brakes three times to build up pressure.
- Do not use the parking brake for extended periods; always chock / tie down the aircraft when left unattended
- Ensure parking break is released before landing!

Preflight inspection

Control surface hinge roll pins

- Flap and aileron hinge pins are secured in place by a roll pin
  - AFM: “The absence of this roll pin can lead to the loss of the hinge pin and a consequent loss of flight safety.”
- There is one roll pin per hinge
  - Only one roll pin even if there are multiple hinge brackets
- The pins are small, and sometimes hard to see.
- Inspecting the pins requires lying on your back underneath the wings.
- To be airworthy the pin must be present and flush with the bracket.

Preflight inspection

Control surface hinge roll pins

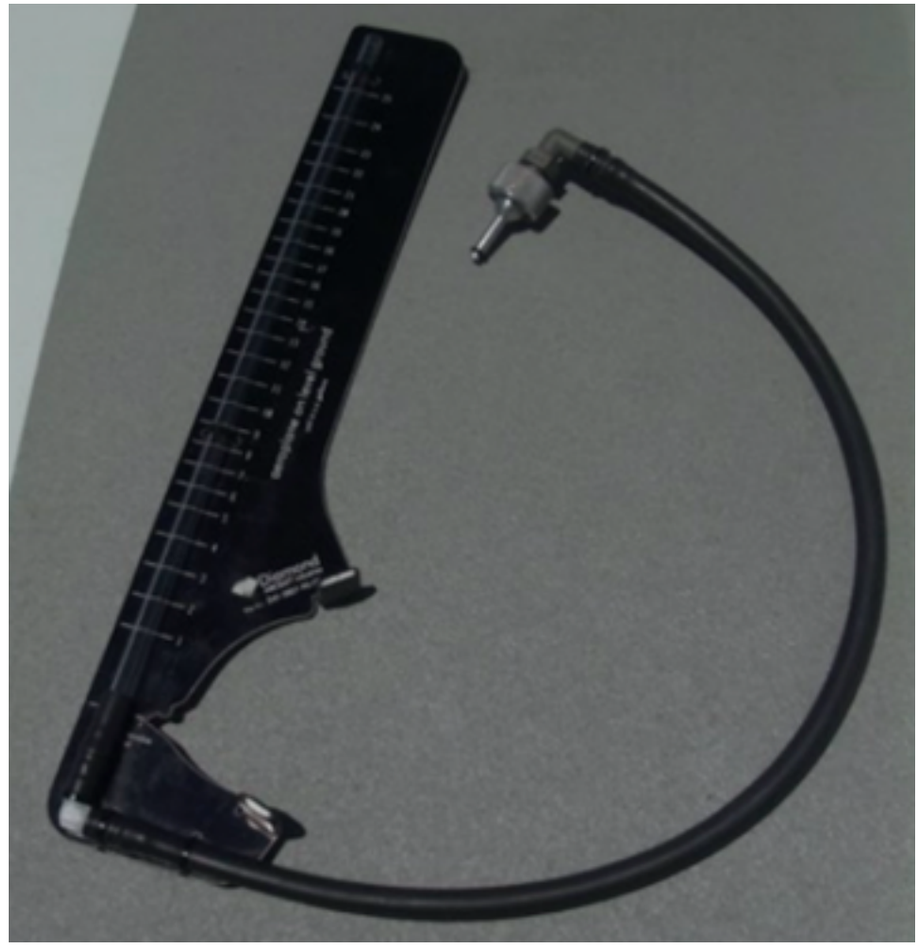
Preflight inspection

Fuel indications

- A full fuel tank can be determined by looking inside the fuel tank and noting the fuel is at the top of the tank opening.
    - Due to tank geometry, it is not possible to determine any fuel level other than full fuel by looking inside the tank or by sticking something into the tank via the tank opening.
- The G1000 fuel tank quantity indicators support a range from 0 to 17 gallons of 20 total gallons per tank.
    - AFM: “When the fuel quantity indicator reads the maximum amount of fuel detectable, the correct fuel quantity must be determined with the fuel quantity measuring device. If this measurement is not carried out, the fuel quantity available for flight planning is the indicated amount.”
- The G1000 fuel totalizer depends on pilot input along with fuel flow data to estimate fuel remaining. The last pilot may not have input correct data.
- With less than full tanks, the only way to independently determine tank fuel quantity is to use the fuel quantity measuring device.

Preflight inspection

Fuel quantity measuring device



- Be careful when handling the fuel measuring device; if it is not present in the aircraft or is broken, the aircraft is not airworthy
- Dispose of fuel appropriately; improper disposal of fuel (such as dumping it on the ground) risks a fine of $25,000 or more.
- Wear nitrile gloves when using the fuel measuring device to prevent leaded fuel from coming into contact with your skin
- Hold the indented portion of the device against the wing near the inner stall strip with one hand
- Use your other hand to insert the nozzle in the fuel tank sump and press up firmly to open the sump
- Wait for fuel to fill the tube and when stable read the fuel quantity on the scale
- Close the fuel sump but keep the nozzle in the sump opening, then tip the fuel from the open top of the tube into a fuel sampler

Preflight inspection

Headset jacks

- Headset jacks are at the back of the center arm rest facing the rear seats
- Mic and headphone jacks are paired horizontally
- Top to bottom seat order: Front left, front right, rear left, rear right
- The white boxes are meant to indicate incorrect seat positions for the particular set of headset jacks.
  - The white boxes do not indicate a seat.
  - Hazard: plugging your headset in the wrong position will mean your PTT switch will not activate your microphone

Fuel management

Fuel Management

Switching tanks

- Fuel indications discussed previously.
- Mixture knob has a silver release lever
- Fuel selector valve has three positions:
  - Left tank
  - Right tank
  - Off
    - To select Off pull up on the round knob before rotating the selector
- Hazard: Unlike a C172 there is no BOTH position and tank selected must be actively managed throughout a flight
- AFM: Before takeoff and landing select fullest tank
- In cruise switch tanks as needed
  - AFM: Max. permissible difference between right and left tank 10 gallons

Fuel Management

Fuel pump

- Electric fuel pump used to prime engine and aid the engine driven fuel pump as required

- On/off switch on panel next to ignition switch and above engine controls
- Electrical fuel pump on during
  - Engine prime and start
  - Takeoff
  - Landing
  - Loss of RPM / engine problems in flight
  - Operation at high altitudes

Engine management

Engine management

Before takeoff check / run up

- A common practice for checking the operation of the propeller governor on the ground is to rapidly pull the prop control far aft to low RPM and push it forward to high RPM three times
    - This unnecessarily stresses the seals in the prop hub and if done frequently can lead to an early propellor overhaul
- The AFM has a minimum RPM reduction of 250 during this check
    - The AAC checklist uses this reduction as a target
- Move the prop control slowly during this check to avoid exceeding this target

Engine management

Cylinder Head Temperature Limits

- Cylinder Head Temperature (CHT) of the hottest cylinder is displayed in the standard engine indications using a color based indication (green / yellow / red)
    - By selecting the Engine soft key all CHTs may be displayed both with color indication and numerical value (degrees F)
- CHT color based indications are defined in the Garmin STC according to the following AFM limits in degrees F
    - Green: 150 - 475
    - Yellow: 476 - 500
    - Red: above 500

Engine management

Cylinder Head Temperature Limits

Engine management

Cylinder Head Temperature Limits

Engine management

Cylinder Head Temperature Limits

- "CHT measures heat energy wasted during the power stroke, when the cylinder is under maximum stress from high internal pressures and temperatures.”
- CHTs above 400°F should be considered abusive, and grounds for “doing something right now” to bring them down - Mechanic Mike Busch
- In order to protect our DA40’s engine, consistent with AFM guidance, AAC leadership have set an operational limit of 400 degrees for all CHTs.
  - If any CHT reaches 400 degrees, take immediate action to lower it by setting mixture to rich, increasing airspeed (to increase cooling), descending to denser air if needed, and significantly reducing power.
- For more information see
  - https://resources.savvyaviation.com/understanding-cht-and-egt/
  - https://resources.savvyaviation.com/understanding-cht-and-egt-2/

Engine management

Variable pitch propeller

- The DA40 has a variable pitch, constant speed propeller
  - In flight, use the blue knob to select the desired RPM (constant speed)
    - The propellor governor will then vary the pitch of the propeller to maintain the desired RPM
    - In cruise, RPM is adjusted to a value that will yield the desired performance per data in the AFM
- Generally speaking, unlike a C172, in flight the throttle position doesn’t determine the engine RPM
  - So how do we determine what throttle setting to use?

Engine management

Setting the throttle

- A different engine gauge - manifold pressure (MP) - is used to set the throttle
  - MP is a measure of how hard air is being pushed to the cylinders via the induction manifold
  - The higher the MP, the more air is being pushed into the cylinders and therefore available to burn fuel
  - In cruise, MP is adjusted to a value that will yield the desired performance per data in the AFM
- Once RPM and MP are set, how do we properly adjust the mixture?

Engine management

Adjusting the mixture

- Lean of Peak EGT mixture settings are not approved by the AFM and the DA40's engine has not been modified to support Lean of Peak EGT operation
    - Do not operate with a mixture that is Lean of Peak EGT
- How we set the mixture depends on what performance we seek: best economy or best power.
- Best economy (power settings of 75% or less):
    - On the G1000 select the Engine soft key to display individual cylinder head temperatures; at no point should CHTs exceed 400 degrees
    - Slowly pull the mixture control back towards lean until the engine starts to run rough
    - Then push the mixture control forward just enough to eliminate the engine roughness
    - Monitor cylinder head temperatures; at no point should CHTs exceed 400 degrees
        - If at any point temperatures do reach 400 degrees immediately advance the mixture to improve engine cooling. If needed increase airspeed via a descent or take other action as required to reduce engine operating temperature.

Engine management

Adjusting the mixture

- How we set the mixture depends on what performance we seek: best economy or best power.
- Best power:
  - First set mixture for best economy
  - Slowly enrich the mixture until Exhaust Gas Temperature is about 100 degrees lower
  - Monitor cylinder head temperatures; at no point should CHTs exceed 400 degrees
    - If at any point temperatures do reach 400 degrees immediately advance the mixture to improve engine cooling. If needed increase airspeed via a descent or take other action as required to reduce engine operating temperature.

Engine management

Over square operation

- Commonly taught guidance for operating engines with variable pitch propellers:
    - Always reduce manifold pressure (throttle) before reducing RPM (blue knob)
    - Always increase RPM (blue knob) before increasing manifold pressure (throttle)
    - Never allow the manifold pressure to exceed the RPM / 100.
        - For example, if you are operating at 2400 RPM, set the manifold pressure to no higher than 24 inches Hg.
- You probably won’t do any major harm to an engine by following this guidance…

Engine management

Over square operation

- BUT operating according to this guidance
  - May not be consistent with an airplane’s AFM
    - Isn’t always the most efficient way to operate an engine
    - Could cause more wear and tear than alternatives
- The range of alternatives can be described in terms of the prior guidance as “over square operation”

Engine management

Over square operation

- Over square operation for the DA40 in short is
  - discarding the prior guidance
  - following the manufacturer’s procedures and suggested settings
    - always operating the engine within the manufacturer’s approved ranges for RPM and MP
- For more more info on why over squared operation is good see Mike Busch’s article
  - https://www.avweb.com/features_old/why-over-square-is-good/

Engine management

Over square operation

- The DA40 AFM has maximum RPM and manifold pressure limitations.
- Note that these limitations are in no way connected to each other.
- It is consistent with these limitations to operate the engine at a continuous RPM of 2400 with full throttle
- At sea level this means the manifold pressure will most likely be above 24 inches Hg

DA 40 AFM | Diamond AIRCRAFT | Operating Limitations

2.4 POWER-PLANT LIMITATIONS

a) Engine manufacturer : Textron Lycoming

b) Engine designation : IO-360 M1-A

c) RPM limitations

Max. take-off RPM : 2700 RPM

Max. continuous RPM : 2400 RPM

d) Manifold pressure limitations

Maximum : FULL throttle

Engine management

Over square operation

- The DA40 AFM has normal operating RPM and manifold pressure ranges.
- These ranges are depicted in green on the engine instruments.
- We can use these ranges to define lower limits on RPM and MP

2.5 ENGINE INSTRUMENT MARKINGS

Engine instrument markings and their color code significance are shown in the table below:

NOTE

When an indication lies in the upper or lower prohibited range, the numerical indication will begin flashing as well.

Indi-cation	Red arc/bar = lower prohibited range	Yellow arc/bar = caution range	Green arc/bar = normal operating range	Yellow arc/bar = caution range	Red arc/bar = upper prohibited range
Manifold pressure	--	--	13 - 30 inHg	--	--
RPM	--	--	500 - 2400 RPM	2400 - 2700 RPM	above 2700 RPM

Engine management

Over square operation

- For takeoff, omitting steps except those related to engine management, the DA40 AFM gives the procedure on the right

- The AFM procedure calls for a reduction in RPM without reducing MP
  - “Safe height” is at the discretion of the pilot. Do not reduce RPM until you no longer need max power.
  - Although the Hartzell STC authorizes use of 2700 RPM for takeoff and cruse climb, conditions permitting follow the AFM procedure for reduced engine wear and noise inside / outside the cabin

- At sea level, the AFM procedure will most likely result in operating over square

4A.3.7 TAKE-OFF

Normal Take-Off Procedure

1. Transponder ..... ON/ALT
2. RPM lever ..... check HIGH RPM
3. Throttle ..... MAX PWR (not abruptly)

Above a Safe Height:

8. RPM lever ..... 2400 RPM

Engine management

Over square operation

- For a Vy climb, the DA40 AFM gives the procedure on the right
- The AFM procedure calls for 2400 RPM with throttle full forward
- Note that per AAC procedure CHTs should be monitored and kept below 400 F
- For cruise climb the engine management procedures are the same, the airspeeds are higher to facilitate engine cooling

4A.3.8 CLIMB

Procedure for Best Rate of Climb

1.	Flaps	T/O
2.	Airspeed	67 KIAS (1200 kg, 2646 lb) 66 KIAS (1150 kg, 2535 lb) 60 KIAS (1000 kg, 2205 lb) 54 KIAS (850 kg, 1874 lb)
3.	RPM lever	2400 RPM
4.	Throttle	MAX PWR
5.	Mixture control lever	RICH, above 5000 ft hold EGT constant
6.	Engine instruments	in green sector

Engine management

Over square operation

- For cruise, the DA40 AFM gives the procedure on the right
- The AFM procedure calls for RPM in the range 1800 - 2400 when in cruise
- MP is set according to the performance table
- Note that per AAC procedure CHTs should be monitored and kept below 400 F

4A.3.9 CRUISE

1.	Flaps	UP
2.	Throttle	set performance according to table
3.	RPM lever	1800 - 2400 RPM

NOTE

Favorable combinations of manifold pressure and RPM are given in Chapter 5.

NOTE

To optimize engine life the cylinder head temperature (CHT) should lie between 150 °F (66 °C) and 400 °F (204 °C) in continuous operation, and not rise above 435 °F (224 °C) in fast cruise.

NOTE

The oil temperature in continuous operation should lie between 165 °F (74 °C) and 220 °F (104 °C). If possible, the oil temperature should not remain under 180 °F (82 °C) for long periods, so as to avoid accumulation of condensation water.

Engine management

Over square operation

- For descent, the DA40 AFM gives the procedure on the right
- The AFM procedure calls for RPM in the range 1800 - 2400 when in descent
- MP is set as required to obtain the desired airspeed and descent rate
- Note the indications for excessive engine cooling rate

4A.3.11 DESCENT

1.	Mixture control lever	adjust as required for the altitude, operate slowly
2.	RPM lever	1800 - 2400 RPM
3.	Throttle	as required
4.	Electrical fuel pump	ON at high altitudes

CAUTION

When reducing power, the change in cylinder head temperature should not exceed 50 °F (22.8 °C) per minute. This is normally guaranteed by the 'self adapting inlet'. An excessive cooling rate may occur however, when the engine is very hot and the throttle is reduced abruptly in a fast descent. This will be indicated by a flashing cylinder head temperature indication.

Engine management

Over square operation

- The recommended settings for best economy (fuel/endurance) and best power (indicated airspeed) profiles follow.

- To use these tables
  - find the section corresponding to your desired power output percentage
  - select the row corresponding to your altitude
  - select the lowest RPM that supports your profile
  - and under that RPM read the manifold pressure to set

			Engine Power as % of Max. Take-Off Power						
			45 %				55 %		
	RPM		1800	2000	2200	2400	2000	2200	2400
Fuel Flow	Best Economy		5.8	6	6.3	6.6	7	7.2	7.5
[US gal/h]	Best Power		-	-	7.3	7.7	-	8.5	8.7
ISA	[°C]	[°F]	Manifold Pressure (MP) [inHg]						
MSL	15	59	**22.7**	21.3	20.2	19.0	**23.9**	22.4	21.2
1000	13	55	**22.4**	21.0	19.9	18.7	**23.6**	22.2	21.0
2000	11	52	**22.1**	20.7	19.6	18.4	**23.3**	21.9	20.7
3000	9	48	**21.8**	20.4	19.3	18.2	**23.0**	21.6	20.4
4000	7	45	**21.5**	20.2	19.0	17.9	**22.7**	21.2	20.1
5000	5	41	**21.2**	19.9	18.7	17.6	**22.3**	20.9	19.8
6000	3	38	**20.9**	19.6	18.4	17.4	**22.0**	20.6	19.5
7000	1	34	**20.5**	19.3	18.2	17.1	**21.7**	20.3	19.3
8000	-1	31	**20.2**	19.0	17.9	16.9	**21.3**	**20.0**	19.0
9000	-3	27	**19.9**	18.7	17.6	16.6	**21.1**	**19.7**	18.7
10000	-5	23	**19.6**	**18.4**	17.3	16.3	-	**19.4**	**18.4**
11000	-7	19	**19.3**	**18.2**	17.0	16.1		**19.1**	**18.1**
12000	-9	16	-	**17.9**	**16.7**	15.8		-	**17.8**
13000	-11	12		**17.6**	**16.4**	15.5			**17.6**
14000	-13	9		-	**16.1**	15.3			-
15000	-15	6			**15.8**	**15.0**			
16000	-17	2			**15.5**	**14.7**			
17000	-19	-2			-	**14.5**			

			Engine Power as % of Max. Take-Off Power				
			65 %			75 %	
	RPM		2000	2200	2400	2200	2400
Fuel Flow	Best Economy		7.9	8.2	8.5	9.2	9.5
[US gal/h]	Best Power		-	9.5	9.8	10.7	11
ISA	[°C]	[°F]	Manifold Pressure (MP) [inHg]				
MSL	15	59	26.8	**24.9**	23.4	**27.3**	25.8
1000	13	55	26.4	**24.5**	23.2	**26.8**	25.5
2000	11	52	26.0	**24.2**	22.9	**26.5**	**25.2**
3000	9	48	25.7	**23.8**	22.6	**26.1**	**24.8**
4000	7	45	25.4	**23.5**	22.3	-	**24.5**
5000	5	41	-	**23.1**	22.0		**24.1**
6000	3	38		**22.8**	**21.7**		-
7000	1	34		**22.4**	**21.4**		
8000	-1	31		-	**21.0**		
9000	-3	27			**20.7**		
10000	-5	23			-		

The areas shaded grey under each RPM heading are the recommended bands.

Correcting the Table for Variation from Standard Temperature

- At ISA + 15 °C (ISA + 27 °F) the performance values fall by approx. 3 % of the power selected according to the above table.
- At ISA - 15 °C (ISA - 27 °F) the performance values rise by approx. 3 % of the power selected according to the above table.

Engine Management

Alternate air

- Alternate air draws unfiltered air from inside the engine compartment instead of fresh air through the air filter.
- Alternate air lever is next to the pilot's right knee.
- To activate pull back to rotate the lever up towards the instrument panel
- Alternate Air on for
  - Unintentional flight into icing conditions
  - Engine problems in flight
  - Restarting the engine in flight

VFR / IFR transition risk management

VFR transition risk management

Suggestions to guide conversation with your CFI

- Without proper training and skill, the G1000 and autopilot can become distractions and therefore sources of risk.
    - With proper training and skill, the G1000 and autopilot become resources the pilot can use to reduce workload and manage risk.
- Eyes up and outside during critical phases of flight and when the aircraft is in motion on the ground
    - Flying VFR, almost everything you need can be had by looking outside the airplane, supplemented by the familiar presentation of the standby instruments and magnetic compass
    - Experiment with the G1000 and autopilot in cruise at a safe altitude, conditions permitting
- Use simulators as much as possible to avoid spending time (and money) learning the G1000 and autopilot with the engine running

VFR transition risk management

Suggestions to guide conversation with your CFI

- The pattern is another big area of risk for reasons already discussed
    - Start with long runways at low altitude airports for takeoff and landing from initial transition training until you are proficient, then slowly relax your limits
    - Suggested minimum runway length of 4,000 feet for takeoff and full stop landing, 5,000 feet for touch and goes
    - Hazard: Runway 33 at KOAK can not be used per these suggestions
        - As an exercise run the performance numbers on runway 33 for various temperatures, and consider the effect of a low pass on 28R or being restricted north of 28R will have on the runway length required
        - An initial takeoff from runway 33 when departing KOAK may be a reasonable tradeoff of risk and convenience but be sure you use takeoff flaps

IFR transition risk management

Suggestions to guide conversation with your CFI

- Even more so than VFR, if you are not familiar and proficient with them the G1000 and autopilot are big distractions and therefore sources of risk
    - In particular, the PFD presentations and usage are different, even if you're used to a G5
    - The autopilot and its integration with the G1000 are not user friendly
- Consider separating VFR training with a CFI and VFR solo proficiency building from IFR training with a CFI and IFR proficiency building
- Consider making several VFR flights and flying practice approaches under VFR as well as with a safety pilot in simulated instrument conditions with and without the autopilot before operating in actual IFR conditions

Transition training

Transition training

Objectives

- Ensure members understand how to mitigate key risks when operating the DA40
- Minimum training time: 3 hours dual flight instruction
    - Members not familiar with the G1000 should expect to need more training time
        - Especially if they wish to fly the aircraft IFR
- This minimum training time is intended to enable the member to work up to proficiency on their own
    - Members are encouraged to seek additional training time and be conservative in their use of the aircraft as needed while they build proficiency

Transition training

Aircraft questionnaire

- Aircraft questionnaire: https://app.box.com/s/b0jbi25w4fra3amzwykafmnpduihgvyx

- Fill out the aircraft questionnaire while you are going through the AFM and other materials

- The questionnaire is intended to be an aid to learning key information and to foster discussion with your CFI
    - There are no intended trick questions

- Review the questionnaire with your CFI when you begin training

- Your CFI will work with you to correct any errors on the questionnaire

- When completed, the questionnaire will be added to your member file

Transition training

Training Tasks - Ground

- Aircraft Questionnaire
- Transition to the DA40 (these slides)
- G1000 (different slides; see sources of information above)
- KAP140 (different slides; see sources of information above)
- Systems
- Performance
- Weight and Balance
- Normal and Emergency Procedures

Transition training

Training Tasks - Flight

- Preflight
- Engine start / Before takeoff check / Before takeoff briefing
- Normal takeoff and climb out
- Airwork
- Slow flight
- Power on / off stalls
- Steep turns
- Basic Attitude Instrument flying with Unusual Attitude recovery
    - With PFD and partial panel
- Simulated engine failure to an off field landing (no lower than 500 AGL)
- Systems and Equipment Malfunctions

Transition training

Training Tasks - Flight

- Pattern work
    - Normal / Crosswind / Soft takeoffs and landings
    - Go arounds
    - No flap landings
    - Simulated engine failure in the pattern
- Instrument approaches (if IFR rated)
        - With PFD and partial panel
- Shutdown
- Post flight
- Refueling

Notes for CFIs

Notes for CFIs

Simulating G1000 failures

- Three possible methods, one of which carries elevated risk
  - Cover up key parts of the PFD using a mask
    - Easy to reverse
    - Other parts of display available
- Create your own mask by printing the image in the resources section, applying to foam / soft cardboard, and cutting out areas to allow visibility to key nav data
- Commercially produced masks may also be available

Notes for CFIs

Simulating G1000 failures

Notes for CFIs

Simulating G1000 failures

- Three possible methods, one of which carries elevated risk
  - Dim display
    - Simulates PFD failure
    - A little harder to reverse via the PFD, but there is a trick:
      - Make sure revisionary mode is activated (red button bottom of audio panel)
      - Press menu on right panel (MFD) to bring up screen brightness menu.
      - Set left panel (PFD) back to Auto brightness mode.

Notes for CFIs

Simulating G1000 failures

- Three possible methods, one of which carries elevated risk
    - Hazard: Pull circuit breakers, which is not recommended by Garmin or FAA, nor is an approved procedure in the DA40 AFM for simulating G1000 failures:
    - “Pulling circuit breakers—or using them as switches—has the potential to weaken the circuit breaker to a point at which it may not perform its intended function. Using circuit breakers as switches is also discouraged in Advisory Circulars 120-80, 23-17B, and 43.13-1B. Additionally, a circuit breaker may be powering other equipment (such as avionics cooling fans) that could affect the safe operation of other equipment.” - Garmin DPE / CFI Guide

Questions?
Feedback?

cfi.erik@icloud.com