Aerobatic Safety

Aerobatic safety has multiple dimensions. Aerobatics is not just turning the airplane upside down. Some topics you want to be knowledgeable about include:

- The performance limitations of your airplane
- Getting to and from events safely without lots of fuel on board
- Having enough of the right kind of safety gear
- Taking care of your physiology under conditions that the human body was not really built for
- Staying legal. You have to practice in legal airspace at legal altitudes

This presentation is intended to start a discussion of the topics presented. The author hopes that the information provided here encourages a lively discussion of each topic that allows each participant to share their experiences. The goal is combine knowledge and experience to allow everyone to make better decisions and enjoy participation in this exciting and challenging sport.

Today's Topics

- Flying your fuel limited rocket ship to where the aerobatics are
- Emergency equipment
- Aerobatic Flight Hazards
- Physiology for aerobatics
- Regulations
- Everything else

Fly safe - Wes Liu

This presentation attempts to cover the topics that the most pilots who fly aerobatic aircraft need knowledge of. These are the topics that most often show up in the "there I was…" stories, and in accident or incident reports.

Running On Empty

- Power & speed vs fuel burn – maximizing gas mileage
  - Airplanes don't run out of gas – pilots do
- Coping with weather light on fuel
  - ATC can't put more gas in your tank – know your fuel burn
  - ATC can't move the hills out of your way – stay out of the granite filled clouds
- Knowing your destination – preflight preview
  - The internet is your friend

Fly safe - Wes Liu

Aerobatic airplanes never carry as much fuel as we would like.

Aerobatic airplanes generally don't have fancy electronics, autopilots, etc.

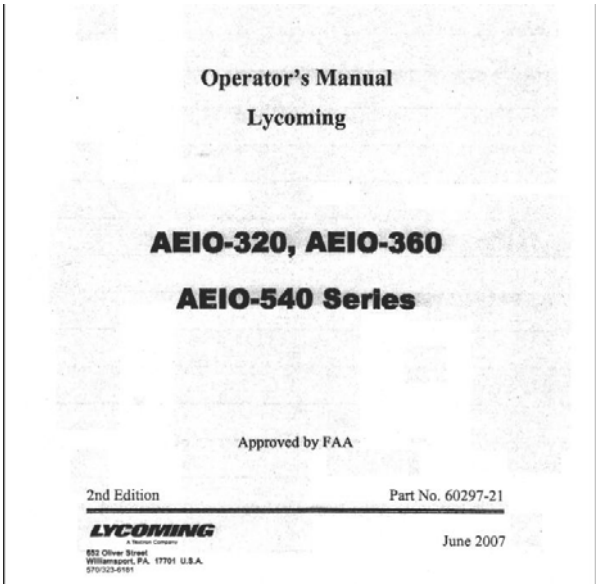
When the weather is less than perfect, in an aerobatic aircraft you have fewer tools and need to make better decisions.

FUEL MANAGEMENT

- Know your engine's fuel consumption performance. The airframe owner's manual often has little info. The engine manufacturer publishes a very detailed manual. You want to own that manual too.
- Know your airplane's fuel system. Did you know that:
  - Many airplanes have less usable fuel nose down descending than nose up climbing.
  - Airplanes that connect the aux fuel tank to the main fuel tank instead of directly to the engine take many minutes to transfer fuel. Most Pitts take 8 to 14 minutes for gravity to transfer fuel from the top wing to the main tank.

Fly safe - Wes Liu

Knowledge is power. The systems of an aerobatic airplane may look simple, but there are often quirks that will surprise you if you do not understand them before you launch. Don't let your airplane's fuel system give you a surprise engine burp because you did not know a detail of how it works.



Fly safe - Wes Liu

The engine manufacturer publishes a great book for understanding how to get the best distance and endurance from each gallon of gas.

The slides that follow offer some data that will help run your engine efficiently when going cross-country.

Lycoming Performance and Fuel Consumption Charts

The example data below has been derived from the charts in the Lycoming Operators Manual for the AEIO enginees (Rev Nov 2009). Each pilot should individually consult the Lycoming manual using the data for their specific airplane and calculate their own expected performance.

Lycoming AEIO-320 150HP Power Settings

3000' Pressure altitude

2500 RPM 22" 69% 8.2 GPH lean for econ
2500 RPM 20" 59% 7.2 GPH lean for econ
2400 RPM 23" 71% 8.2 GPH lean for econ
2400 RPM 21" 62% 7.2 GPH lean for econ
2300 RPM 25" 78% 9.8 GPH no leaning
2300 RPM 24" 71% 7.6 GPH lean for econ

Lycoming AEIO-320 160HP Power Settings

3000' Pressure Altitude

24" 2500 RPM 78% 10.4 GPH no leaning
23" 2600 RPM 75% 10.3 GPH no leaning
23" 2400 RPM 71% 8.2 GPH lean for econ
22" 2400 RPM 67% 7.8 GPH lean for econ

Fly safe - Wes Liu

These numbers give you options when going to or from an event. In bad weather speed is not your friend. A full tank of gas, or a power setting that gives best mileage is.

Lycoming AEIO-360-B&H 180HP Power Settings

3000' Pressure Altitude

24" 2600 RPM 83% 12.3 GPH no lean
25" 2500 RPM 82% 12.2 GPH no lean
23" 2600 RPM 76% 11.6 GPH no lean
23" 2400 RPM 71% 9.0 GPH lean for econ
22" 2300 RPM 65% 8.0 GPH lean for econ

Lycoming AEIO-360-A 200HP Power Settings

3000' Pressure Altitude

24.5" 2600 RPM 83% 13.2 GPH no leaning
25" 2500 RPM 82% 13 GPH no leaning

23.5" 2600 RPM 77% 12.8 GPH lean best pwr only

22" 2400 RPM 64% 9 GPH lean for econ
20" 2400RPM 57% 8.1 GPH lean for econ

9000' Pressure Altitude

18" 2400 RPM 53% 7.8 GPH
16" 2400 RPM 48% 7.3 GPH

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Lycoming AEIO-540 260HP Power Settings

3000' Pressure Altitude

25" 2500 RPM 82% 17.8 GPH
24" 2600 RPM 81% 17.9 GPH no lean
23" 2500 RPM 73% 16.5 GPH no lean
23" 2400 RPM 70% 13.4 GPH lean for econ
21" 2400 RPM 62% 12.3 GPH lean for econ
19" 2400 RPM 55% 11.3 GPH lean for econ

9000' Pressure Altitude

20" 2400 RPM 64% 12.5 GPH lean for econ
18" 2400 RPM 56% 11.5 GPH lean for econ

u

Lycoming AEIO-540 300HP Power Settings

3000' Pressure Altitude

25" 2500 RPM 79% 19 GPH no lean
24" 2600 RPM 78% 19.3 GPH no lean
23" 2400 RPM 67% 14.2 GPH lean for econ
22" 2300 RPM 62% 13.2 GPH lean for econ
20" 2200 RPM 54% 11.7 GPH lean for econ
18" 2200 RPM 47% 10.8 GPH lean for econ

9000' Pressure Altitude (300 HP)

23" 2400 RPM 72% 15.2 GPH lean for econ
22" 2300 RPM 66% 13.8 GPH lean for econ
20" 2400 RPM 61% 13.2 GPH lean for econ
20" 2300 RPM 60% 12.8 GPH lean for econ
20" 2200 RPM 57% 12.3 GPH lean for econ

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Weather and short range little airplanes

- Think – Plan – Fly – Stop – Repeat
- If you are not comfortable, stop, load fuel, think
- Fly from airport to airport. Follow highways.
- Clouds down, slow down
- Sectional charts show more than a GPS screen
- Don’t get caught on top
- Carry a cell phone, credit card, and a good book
- ATC can’t help you fly through clouds
- Don’t take a sick airplane into weather

Fly safe - Wes Liu

Always launch with a plan, and a backup plan, and if the weather is less than perfect, maybe a backup backup plan….

If you want to, you can fly your whole trip in advance using Google Earth.

With the internet, pilots have the world at their finger tips. Use it.

If you preview the route on Google Earth, when enroute and the clouds come down, you can already have a mental picture of the hills in an area you have never flown into before.

Destination Nationals

- Through Google Earth, see what the view will be as you dive into the box for your competition flight, including the box markers
- Through the FAA Digital AF/D get the airport info for your cross country arrival

Fly safe - Wes Liu

Been to Nationals yet? Why not? Its YOUR contest.

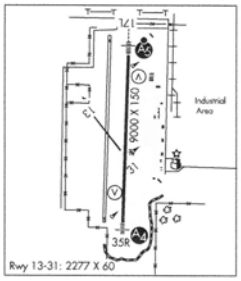
The photo and the AF/D page that follow are examples of free information available on the internet.

This is what the Nationals airport looks like as you dive into the box from the east. You can see in this Google Earth view that some box markers are permanently painted.

Created by Weston Liu

From the FAA Digital AF/D

SHERMAN/DENISON
NORTH TEXAS RGNL/PERRIN FIELD (GYI) 4 W UTC−6(−5DT) N33°42.85' W96°40.42' **DALLAS–FT. WORTH**
749 B S4 **FUEL** 100LL, JET A OX 3 TPA—1749(1000) NOTAM FILE GYI **H–6H, L–17C, A**
RWY 17L–35R: H9000X150 (ASPH–CONC) S–75, D–100, ST–127, DT–160 MIRL **IAP, AD**
RWY 17L: MALSR. VASI(V4L)—GA 2.5°TCH 39'.
RWY 35R: MALS. VASI(V4L)—GA 2.5°TCH 41'.
RWY 13–31: H2277X60 (ASPH)
AIRPORT REMARKS: Attended daylight hours. For fuel after hours call 903–786–2666. For assistance after hours, call 903–786–2904, or fire department 903–786–9841. Mowing ops on arpt Mar–Nov. Rwy 17L designated calm wind rwy. Rwy 17L–35R 5' high distance–to–go markers 150' on east side of rwy centerline—unlgtd. MIRL Rwy 17L–35R preset low ints, to increase ints and ACTIVATE MALSR Rwy 17L and MALS Rwy 35R—CTAF. VASI Rwy 17L and Rwy 35R continuous. NOTE: See Special Notices—Aerobatic Practice Area.
WEATHER DATA SOURCES: AWOS–3 (903) 786–7790.
COMMUNICATIONS: CTAF 120.575 **ATIS** 118.775 **UNICOM** 122.7
SHERMAN/DENISON RCO 122.3 (FORT WORTH RADIO)
Ⓡ **FORT WORTH CENTER APP/DEP CON** 124.75
TOWER 120.575 (1300–0100Z‡) **GND CON** 124.125
AIRSPACE: CLASS D svc 1300–0100Z‡ other times CLASS G.
RADIO AIDS TO NAVIGATION: NOTAM FILE FTW.
BONHAM (H) VORTACW 114.6 BYP Chan 93 N33°32.25' W96°14.05' 290° 24.4 NM to fld. 700/6E.
HIWAS.
DENISON NDB (MHW) 341 DNI N33°49.44' W96°40.18' 176° 6.6 NM to fld. NOTAM FILE GYI.
ILS 111.7 I–GYI Rwy 17L. LOC unusable byd 25° right of course.



SC, 08 APR 2010 to 03 JUN 2010

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Emergency Equipment

- ✓Parachute
- ✓Helmet
- ✓Canopy Breaker
- ✓Spot, PLB, Cell phone

Fly safe - Wes Liu

Great parachutes are not more expensive that just OK ones.

The parachute that you wear is better than the one that you left on the ground or did not bother to snap on when you climbed into the airplane. There have been a couple of accidents where pilots did not expect to need their parachute, so used it as a seat cushion rather than putting it on fully. When the airplane failed, they jumped out but fell away from their open parachute……

Always get out of your airplane with your parachute on. That way your muscle memory won't have you unsnapping the parachute harness out of unconscious habit if you have to leave a broken airplane in flight.

A helmet helps you keep going when something whacks you as your airplane comes apart. You can't use your parachute if you are unconscious. And it helps protect you if you are forced to make an unplanned off-airport landing.

A canopy breaker works 1000% better than your fists to get out of an airplane that stops rolling or tumbling upside down and starts to burn.

If you have to leave your airplane out in the woods or desert, there are now better tools available than yelling for help at the top of your lungs and sending up a smoke signal by burning your airplane.

Aerobatic Flight Hazards

- Weight and balance
- Inadvertent spins
- When the airplane breaks …
  and *EVERY AIRPLANE BREAKS!*

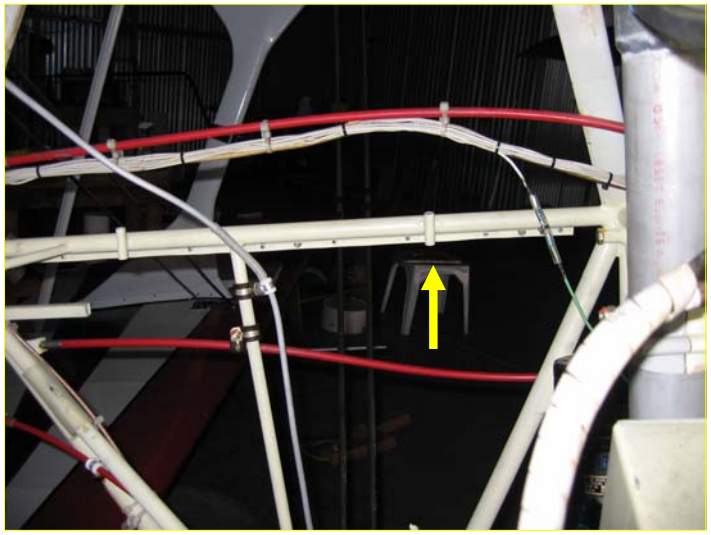
Fly safe - Wes Liu

Airplanes with the CG too far in any direction don't fly acro well. Ignorance is NOT bliss. Where is YOUR CG today?

Have you practiced inverted and upright spins this week?

The more you know about the nuts and bolts of your ship, the less likely that you are going to hear a surprising BANG! In the middle of an acro flight.

See the cracked longeron ready to drop the fuel tank onto the pilot's feet



Good to find this problem on the ground. Look hard at the fuel tank attachment above the yellow arrow. The longeron is cracking to allow the small vertical tube, that holds the bolt for the fuel tank straps, to peel away and soon break off.

Physiology For Aerobatics

- ✓ Your body likes +G
- ✓ Your body hates –G
- ✓ Strength training increases G tolerance
- ✓ Aerobic training may decrease G tolerance
- ✓ Dehydration decreases G tolerance
- ✓ Hydration and food increases G tolerance
- ✓ L1/M1 Anti-G Straining Maneuver
- ✓ G induced Loss Of Consciousness - GLOC

Fly safe - Wes Liu

Check out Peak Performance For Aerobatics by Fred DeLacerda

FAA Regulations For Aerobatics

- 14 CFR 91.303 Aerobatic FLight
- 14 CFR 91.119 Minimum Safe Altitudes
- 14 CFR 91.126 Operating … Class G Airspace
- 14 CFR 91.307 Parachutes
- FAA Hucker Letter – Surface Areas

Fly safe - Wes Liu

These are the rules that acro pilots should know by heart.

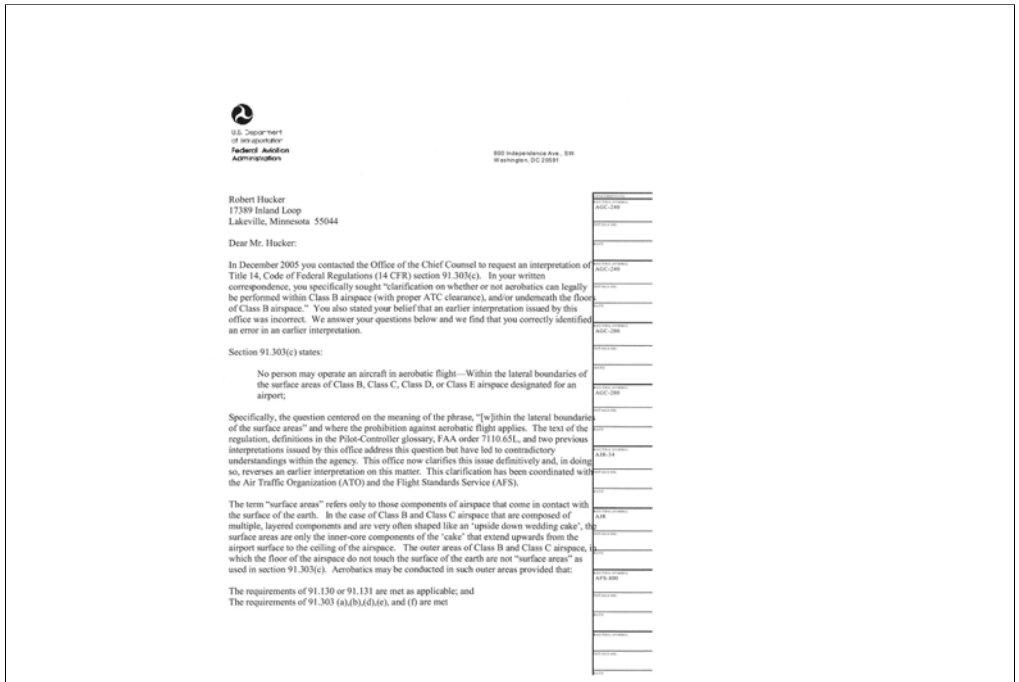
Read The FAR's like a lawyer

- Don't confuse 91.303 and 91.307
  - 91.303 defines what is and is not aerobatics
  - 91.307 does NOT define aerobatics
- Hucker letter clarifies 91.303(c)

Fly safe - Wes Liu

Do not read the rules to see how they allow you to do what you want. They were written by lawyers to say what you SHALL NOT do. Read them in that spirit if you want to avoid pain and hassle.

The FAA Office of the General Counsel is the final arbiter of what the rules say and how they will be interpreted all across the FAA Flight Standards organization. If you find a letter that applies to you, make a copy and keep it in your log book. You can use it if you find yourself having a challenging conversation with an Aviation Safety Inspector. ASI's must follow the guidance of the Chief Counsel.



U.S. Department of Transportation
Federal Aviation Administration

800 Independence Ave., SW.
Washington, DC 20591

Robert Hucker
17389 Inland Loop
Lakeville, Minnesota 55044

Dear Mr. Hucker:

In December 2005 you contacted the Office of the Chief Counsel to request an interpretation of Title 14, Code of Federal Regulations (14 CFR) section 91.303(c). In your written correspondence, you specifically sought "clarification on whether or not aerobatics can legally be performed within Class B airspace (with proper ATC clearance), and/or underneath the floor of Class B airspace." You also stated your belief that an earlier interpretation issued by this office was incorrect. We answer your questions below and we find that you correctly identified an error in an earlier interpretation.

Section 91.303(c) states:

> No person may operate an aircraft in aerobatic flight—Within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for an airport;

Specifically, the question centered on the meaning of the phrase, "[w]ithin the lateral boundaries of the surface areas" and where the prohibition against aerobatic flight applies. The text of the regulation, definitions in the Pilot-Controller glossary, FAA order 7110.65L, and two previous interpretations issued by this office address this question but have led to contradictory understandings within the agency. This office now clarifies this issue definitively and, in doing so, reverses an earlier interpretation on this matter. This clarification has been coordinated with the Air Traffic Organization (ATO) and the Flight Standards Service (AFS).

The term "surface areas" refers only to those components of airspace that come in contact with the surface of the earth. In the case of Class B and Class C airspace that are composed of multiple, layered components and are very often shaped like an 'upside down wedding cake', the surface areas are only the inner-core components of the 'cake' that extend upwards from the airport surface to the ceiling of the airspace. The outer areas of Class B and Class C airspace, for which the floor of the airspace do not touch the surface of the earth are not "surface areas" as used in section 91.303(c). Aerobatics may be conducted in such outer areas provided that:

The requirements of 91.130 or 91.131 are met as applicable; and
The requirements of 91.303 (a),(b),(d),(e), and (f) are met

Fly safe - Wes Liu

When the floor of Class D and certain Class E airspace (designated for an airport) begins at the surface and extends upward, aerobatics are prohibited in accordance with section 91.303(c). However it should be noted that there are other Class E airspace areas that extend upward from some altitude above the surface, such as transition areas that extend upward from 700 or 1,200 feet above ground level. Such areas are not surface areas and aerobatic flight in these areas is not prohibited by section 91.303(c).

This interpretation of section 91.303(c) reverses the interpretation issued on July 14, 1999 in a letter to Earl Lawrence from Donald Byrne, Assistant Chief Counsel which you cited as incorrect. That earlier interpretation addressed the following question:

> Can aerobatic flight be performed outside of, but under the rings of Class B airspace where, in the opinion of EAA, the surface areas of Class B airspace can "only refer to the inner ring" because it is the only ring that extends to the surface?

In response to this question, the FAA replied in relevant part:

> Your letter states that EAA considers the floor to the innermost ring of Class B airspace as surface area. This definition is incorrect…[T]he surface area includes airspace at each lateral boundary or floor area of Class B airspace, without considering whether the boundary contacts the surface of the earth. The definition does not therefore limit a "surface area" to airspace that contacts the surface of the earth, nor does it provide an alternative definition for the floor area of the outermost rings. By this definition, aerobatic flight is not permitted with the vertical or lateral confines of Class B airspace.

Upon review, we conclude that the EAA was indeed correct in its understanding of "surface areas." The question of the applicability of section 91.303(c) recently reemerged in the context of a redesign of Class B airspace for the Minneapolis-St. Paul International Airport. Among the issues that were confronted was where aerobatics could be conducted with respect to the newly-redesigned airspace. In responding to your inquiry, we concluded that our 1999 interpretation was inconsistent with the term "surface area" as used by ATO airspace planners to describe only airspace that touches the surface of the earth. We trust this interpretation answers your question. Thank you for your inquiry.

Sincerely,

Rebecca MacPherson
Assistant Chief Counsel, Regulations

Fly safe - Wes Liu

Everything Else

Open discussion