

RV-12 Service Ceiling

Home Index Safety Reader Comments Contact

Flying 3 miles high over Mt. Rainier in a Light Sport

A LSA (Light Sport Aircraft) like my Vans RV-12 has a number of regulatory limitations, in the USA, regarding speeds, weights, and features. One limitation is a pilot operational ceiling of 10,000 ft MSL (Mean Sea Level) for pilots who may have a higher certificate rating (like myself), but are exercising the privileges of a Light Sport Pilot Certificate. Importantly, this Limitation is modified by the phrase "or 2000 ft AGL, (Above Ground Level) whichever is greater" Obviously, there are mountains taller than 10,000 ft - in fact, some places, like Leadville, Colorado, have airports that are about 10,000 ft. It would clearly be hard to fly at all with that limitation.

During my flight testing, I climbed to 10,000 ft. as part of my Phase I flight testing. I noted at the time that the Rate of Climb was still a generous 500 fpm, and so assumed the little airplane had a lot more "climb" capability left in her.



Early test flight to 10,000 ft.

Nevertheless, to determine the *real* capability of the airplane would require flight testing to determine the true operational ceiling. In aviation parlance, that is known as the *Service Ceiling*. The Service Ceiling has a specific definition:

Service Ceiling is defined as the maximum altitude using max continuous or climb power when the ROC (Rate of Climb) falls to 100 fpm while flying at Vy (Best Rate of Climb Speed) (75 kts for the RV-12) at ISA Standard Day (Intl Standard Atmosphere) which defines a "normal" temperature for different altitudes.

Vans, the designer, lists the Ceiling as "Estimated 12,000 ft" in Section 3 of their Handbook.



I decided to find out what the Service Ceiling *really* was. Legally. No more *"estimated."* But - if you want get above 10,000 ft. - Legally, in the USA, if you are flying as a Light Sport pilot, you need to find some rocks that are 8000 ft or higher, so you can fly 2000 ft higher than they are. Turns out, we've got quite a few around here in Western Washington.



In service, when crossing the Cascades, I usually fly at 9500 ft eastbound and 10,500 westbound. This provides a little cushion between me and those rugged peaks.



Finally - if you're going to do this, flying over some of the "lower" peaks - like Mt. Baker at 10,778 doesn't get the job done. You might as well go <u>all-the-way</u> and fly over Mt. Rainier! It's 14,410 ft above MSL - and is defined aeronautically as 14,800 on the charts, to account for operational variables and clearances.



There were Bravo (Class B) airspace niceties to negotiate (meaning clearance is required into this positive control area) as well as military restricted areas. Also - at those altitudes, I would need supplemental oxygen - so I got my oxygen gear organized and tested. I flew the entire flight under ATC surveillance and control.



My Departure - Top LH of chart; Destination Lower RH

I listed my destination as Packwood (55S), deep in a valley just south of the mountain and asked ATC for a cruise altitude of 17,500 ft., took off and headed for *The Mountain*.



I used O2 above about 11,000 when my O2 saturation level fell to 90%; with a monitor, I maintained 99% blood oxygen saturation level throughout the flight.

More than a few traffic Bogeys whizzed by as I climbed and descended back through the Bravo airspace. Seattle Approach were extremely helpful - as usual. Love those guys.



An Alaska 737 inbound to Sea-Tac and a USAF C-130J heading east out of McChord AFB.



Well, we're above 10,000 now and on our way!



My Destination, off in the distance, with the Port of Tacoma in the foreground



Passing 12.5, I've now selected 17,500 ft in the Autopilot V-Nav window N737G is "Go for Lift-off"



Passing 14,000 ft, you can see some features of my Dynon Skyview.

Across the top, the Autopilot is selected to Nav with a Heading of 124 and a Vertical Speed of 200 fpm.

4723 is my ATC Transponder Squawk Code; 126.6 is the Seattle Approach frequency that I'm working.

Although my IAS is 70 kts, my TAS (True Airspeed) is actually 87 kts due to altitude and temperature.

My Density Altitude corrected for temperature is 14,593 with an OAT of 24 deg F. I'm 24.3 NM from Packwood (55S)

Here's the important thing - the winds are "Light and Variable" - critical for flying near the Mountain.



Getting closer



Passing 15,000 ft.

Skyview offers a traditional "Six-Pack" instrument display - which I use most of the time. The magenta "Cross" is the Flight Director - available also as Wedge Bars. The vertical chevron is the AOA (Angle of Attack) Indicator In the background is Synthetic Vision



Hey! Did I say the view was pretty good too!



Here's the other EFIS view (Electronic Flight Instrument System) with vertical tape displays. The Bullseye is a Flight Path Projection marker showing where the airplane is headed. The black panel on the left are engine and system indicators. Density Altitude has passed 16,000 ft.



Skyview is incredibly versatile and adaptable.

Here - I've brought up the Map screen.

Terrain above me or within 1000 ft is shown as red - there is no red - I'm well above the mountain. I'm 10.8 miles from Packwood and about 5 or 6 miles from Mt. Rainier.



The view from about 3 miles Almost time to turn around and head for home. What's that word they overuse these days? AWESOME!



My Round-trip was 2:24 - here's the Track

After my Return

After I returned, I down-loaded my data and analyzed everything on my computer





These graphs are from an on-line analysis service called Savvy Analysis

I also analyzed the data on an Excel spreadsheet. Skyview meaures about 75 parameters at sampling rates of up to 16 samples per second.

Longitude (deg)	Latitude (deg)	GPS Date & Time	Pressure Altitude (ft)	GPS Altitude (feet)	Density Altitude (ft)	Indicated Airspeed (knots)	True Airspeed (knots)	Vertical Speed (ft/min)	OAT (deg C) Gro
-121.76051	46.70835	1/14/2015 23:14	15364	15636	16204	72.9	93.8	157	-8
-121.76059	46.7084	1/14/2015 23:14	15364	15636	16204	72.9	93.8	146	-8
-121.76077	46.7085	1/14/2015 23:14	15364	15635	16204	73.1	94	108	-8
-121.76077	46.7085	1/14/2015 23:14	15364	15635	16204	73	93.9	103	-8
-121.76095	46.7086	1/14/2015 23:14	15364	15635	16204	73.1	94.1	64	-8
-121.76103	46.70865	1/14/2015 23:14	15364	15634	16204	73.2	94.2	103	-8
-121.76122	46.70875	1/14/2015 23:14	15364	15633	16204	73.2	94.1	76	-8
-121.76122	46.70875	1/14/2015 23:14	15364	15633	16204	73.2	94.2	55	-8
-121.76139	46.70885	1/14/2015 23:14	15364	15632	16204	73.3	94.3	8	-8
-121.76148	46.7089	1/14/2015 23:14	15364	15631	16214	73.4	94.4	-3	-8
-121.76167	46.709	1/14/2015 23:14	15364	15631	16214	73.5	94.6	-44	-8
-121.76167	46.709	1/14/2015 23:14	15364	15631	16214	73.5	94.5	-53	-8
-121.76184	46.7091	1/14/2015 23:14	15364	15630	16214	73.7	94.8	-93	-8
-121.76193	46.70914	1/14/2015 23:14	15364	15628	16214	73.8	95	-73	-8
-121.76212	46.70924	1/14/2015 23:14	15364	15628	16214	73.8	94.9	-73	-8
-121.76212	46.70924	1/14/2015 23:14	15364	15627	16214	73.9	95.1	<mark>-7</mark> 9	-8
-121.7623	46.70934	1/14/2015 23:14	15364	15626	16214	73.9	95.1	-91	-8
-121.76239	46.70938	1/14/2015 23:14	15364	15625	16214	73.9	95.1	-87	-8
-121.76257	46.70948	1/14/2015 23:14	15364	15625	16214	74.1	95.3	-111	-8
-121.76257	46.70948	1/14/2015 23:14	15364	15624	16214	74.3	95.6	-95	-8
-121.76276	46.70958	1/14/2015 23:14	15363	15624	16214	74.4	95.7	-115	-8
-121.76285	46.70963	1/14/2015 23:14	15363	15623	16213	74.4	95.7	-98	-8
-121.76304	46.70973	1/14/2015 23:14	15361	15623	16213	74.4	95.7	-151	-8
-121.76304	46.70973	1/14/2015 23:14	15361	15623	16213	74.4	95.7	-127	-8

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Density Altitude (ft)	Indicated Airspeed (knots)	True Airspeed (knots)	Vertical Speed (ft/min) O.
16204	72.9	93.8	157
16204	72.9	93.8	146
16204	73.1	94	108
16204	73	93.9	103
16204	73.1	94.1	64
16204	73.2	94.2	1 03
16204	73.2	94.1	76
16204	73.2	94.2	55
16204	73.3	94. <mark>3</mark>	8
16214	73.4	94.4	-3

Here's my peak - 16214 feet DA.

I am climbing at about 75 kts (Vy) at about 100 fpm - the Service Ceiling Not bad for a Light Sport with 100 ponies under the hood. Was hoping for at least 16,800.

But - you can't do this in Kansas!

The Density Altitude (DA) stood in as the "True Altitude", since it normalizes for ISA temperature and pressure. (There are many "altitudes" - too many to discuss here, including Standard, Pressure, and GPS. Density Altitude is basically the altitude the airplane "thinks" it is operating at.) So the airplane felt and performed as if it was at 16,214 ft even if the Altimeter read 15364 ft.

A detailed description of the International Standard Atmosphere can be found here.

On this day, it was warm for the altitude, meaning the airplane measured temperature of +17 deg. F. was ISA + 15 deg F. --- ISA was +1.4 deg F. [OAT = -8 C; ISA = -17 C Delta = +9 C] At ISA - the Indicated Altitude would have been the same as the Density Altitude.

Time to climb

= 714 fpm
= 400 fpm
= 167 fpm
= 125 fpm

I could have held on for 17,500, but that would have probably taken another 10- 20 minutes - and at less than Vy.

That would likely be the Absolute Ceiling - the Maximum Altitude the airplane can achieve at any speed when the Rate of Climb goes to Zero.

I didn't want to get into that part of the flight envelope - my goal was the Service Ceiling.

I calculated my weight as 1070 lbs - max weight is 1320 lbs.

I figure I determined the Service Ceiling with some degree of accuracy - it's about 16,500 feet at ISA at a "typical" solo operational weight of 1050 lbs.

The Service Ceiling is no longer "estimated."

I'm pretty sure I've now flown the RV-12 higher than anyone in the world - including Vans!

Old Boeing Flight Test habits die hard.....

After my return - I looked up my flight on <u>Flight Radar 24</u> - a website that allows tracking of any airplane in the world.

N737G - Aircraft info and flight history

Home → ■Data / History → XAirline

Full flight information and flight history for Private aircraft N737G

It's main use is tracking airline flights - but as you can see, it tracks appropriately equipped private aircraft as well.

These sites track everything you do and everywhere you go - but in this case, they provided an independent validation my flight

