Performance Effects of Landing Gear Retraction in Short Body MU-2 Aircraft
By Rick Wheldon

One of the ongoing controversies in the MU-2 community is when to retract the landing gear after takeoff. I have been able to identify 3 schools of thought on this process.

1. Many pilots retract the landing gear when a positive rate of climb is established.
2. Another group of pilots retract the gear when they can no longer land on the remaining available runway.
3. A significant group of pilots elect to keep the gear down until reaching 400 feet AGL.

The differences in technique result from a belief among some pilots that the landing gear retraction process causes an increase in drag as compared to leaving the gear down.

First off, what does the Flight Manual say about the issue? The POM states “after the airplane is safely airborne, gear retraction can be completed.” In the AFM, AFTER TAKEOFF procedures call for gear up “when positive rate of climb is established.” Some would argue that this guidance does not preclude any of the options above.

When reflecting these various techniques, it occurred to me that an increase in drag can easily be measured, and a fair estimation of the performance loss can be obtained. To investigate, I flew our Solitaire to approximately 6000 feet and shut down the right engine. I selected the Solitaire because the landing gear in short body MU-2 aircraft retract aft and up, and the wheels actually turn somewhat perpendicular to the airflow during the cycle. My assumption was that this would cause more drag than in the long body MU-2, where the wheels remain roughly parallel with the airflow during retraction. (It is important to understand that I have no actual data for the long body and my hypothesis remains unproven.)

My plan was to determine climb or descent rates at gear up, gear down, and a number of intermediate gear positions. I would take the data over a short period of time, so weight differences affecting climb performance would be negligible. Likewise, because climb and descent rates were close to zero at this altitude and configuration, there would be little changes in altitude or temperature to skew the data. In the actual tests, all data points were within 100 pounds and 1500 feet of each other. Finally, all data was taken at 130 knots IAS, and airspeeds were held within plus or minus one knot.

Intermediate landing gear positions could be controlled by cycling the landing gear control circuit breaker. The complete gear cycle took approximately 10 seconds, and the gear doors opened and closed in one second. Therefore, I elected to take data points at 1 second elapsed time (thus opening the gear doors without raising the gear),then at approximately 2 second intervals until 9 seconds total time (at which time the gear were up but the doors remained open), then finally with the doors closed.

With 100% torque set on the left engine, I lowered the landing gear and noted the climb (descent) performance. This performance was the standard against which all other data points were measured. At my particular weight, I was descending at 250 fpm, gear down, single engine.

My next data point (#2) was with the gear doors open. I found that the descent rate in this configuration was 300 fpm, so the increase in drag had caused a 50 fpm decrease in performance.

With the third data point, I started the gear retraction. Data point #3 was taken with the gear doors open and an additional 2 seconds of gear retraction. The descent rate in this configuration was 350 fpm.

Table 1 shows the performance for the remaining data points. Note that the highest descent rate was only 400 fpm.

Data Point #	Seconds in this configuration	Climb (descent) Rate
1 (gear down)	10	(250 fpm)
2 (doors open, gear down)	1	(300 fpm)
3 (doors open, 2 more seconds of retraction)	2	(350 fpm)
4 (doors open, 4 more seconds of retraction)	2	(400 fpm)
5 (doors open, 6 more seconds of retraction)	2	(50 fpm)
6 (doors open, 8 more seconds of retraction)	2	350 fpm
7 (doors closed, gear up)	1	400 fpm

Table 1

With this data in hand, it became a simple matter to calculate the altitude lost over the one or two second time intervals. By looking at the cumulative altitude lost, a flight profile was approximated. Table 2 shows the altitude lost and cumulative altitude lost when leaving the gear down and when retracting the gear.

Seconds after beginning gear retraction	Altitude lost in this interval with gear remaining down	Cumulative altitude lost with gear remaining down	Altitude lost in this interval during retraction cycle	Cumulative altitude lost during retraction cycle
1 sec	-4.17 ft	-4.17 ft	-5 ft	-5 ft
3 sec	-8.33 ft	-12.5 ft	-11.67 ft	-16.67 ft
5 sec	-8.33 ft	-20.83 ft	-13.33 ft	-30 ft
7 sec	-8.33 ft	-29.17 ft	-1.67 ft	-33.33 ft
9 sec	-8.33 ft	-37.5 ft	+11.67 ft	-21.67 ft
10 sec	-4.17 ft	-41.67 ft	+6.67 ft	-15 ft

Table 2

Figure 1 shows graphically the approximate flight profiles with the gear remaining down and being raised. It is easy to see that additional drag was created at early stages of the retraction cycle. However, the extra drag caused less than ten feet of altitude loss when compared to leaving the gear down. Even more important, after completion of the 10 second cycle, the aircraft was climbing at 400 fpm instead of descending at 250 fpm! That's a lot of benefit and very little penalty for getting rid of the gear drag early.

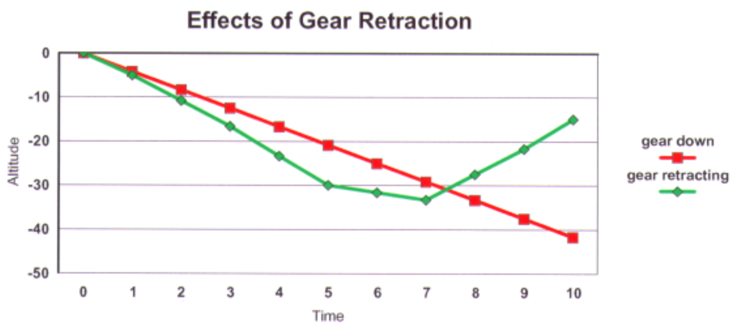

Figure 1

Based on what I saw, I cannot justify leaving the gear down after takeoff to 400 feet. If the gear is left down until 400 feet, and an engine failure occurs at 300 feet, then there is the very real possibility that the airplane will not be able to climb and accelerate. Moreover, many pilots might try to maintain altitude in this scenario. The additional gear drag could slow the airplane and contribute to a stall/spin type of accident. One can argue the case where the pilot elects to keep the gear down until he can no longer land on the remaining runway. He is, in effect, making a "GO/NO GO" decision after becoming airborne, and the MU-2 AFM has a procedure for this. However, in that case, once the "GO" decision is made, the gear should immediately come up. The "positive rate – gear up" technique is most in line with language in the AFM. While I hesitate to say that the difference in climb rate between gear up and down would be 650 fpm in all cases, and all flap settings, for all MU-2 models, I strongly suspect that the order of magnitude will be similar. It's just better generally, in my opinion, to get rid of the drag early.