3. Performance

The basic GV aircraft performance guarantees per the *Gulfstream V Product Specification*, April 2002, Section 2, are as follows:

1. Cruise Speed (TAS; Maximum Cruise Power):

   510 knots +0% -2% (Mach= 0.885) at 60,000 pounds at 35,000 feet

2. Specific Range:

   187 nautical air miles per 1,000 pounds of fuel burned; ±5% at 45,000 feet altitude, 0.80 Mach, and 65,000 pounds

3. FAA Takeoff Distance:

   5,990 feet ±8% at 90,500 pounds, sea level, and International Standard Atmosphere (ISA) conditions

4. FAA Landing Distance:

   2,775 feet ±8% at 75,300 pounds, sea level, and ISA conditions

The data above are based on a typically equipped airplane (49,600 pounds zero fuel weight), including antennae, pitot heads, and anti-collision light installations.

The NSF/NCAR GV will not be typically equipped for research missions. Thus, where applicable, the following sections provide estimated performance information for the NSF/NCAR GV assuming the following conditions:

1. ISA conditions
2. 3,400 pound research payload (49,600 pounds zero fuel weight)
3. 1,600 pound fuel reserve (51,200 pounds landing weight)
4. Take off at maximum gross takeoff weight (90,500 pounds)
5. Max ramp weight of 90,900 pounds (takeoff fuel weight of 400 pounds)
6. Max fuel capacity of 41,300 pounds
7. 15 additional drag counts to account for externally mounted equipment

3.1 Operational Limits

The following operational limits are taken from the *Gulfstream V Airplane Flight Manual*, Rev. 15, November 13, 2000.

The basic aircraft is certified for instrument and night flying, all-weather operation (flight into known icing and turbulence penetration), extended over-water flight, and flight at altitudes up to 51,000 feet.

Flight to the service ceiling for the NSF/NCAR GV will be possible only for low drag configurations (< 15 drag counts) and after the aircraft has reached a light weight condition (approximately 55,000 pounds).

The flight load accelerations for flaps up (0 deg) are +2.5 G and –1.0 G.

3.2 Speed Envelope

The speed envelope for the basic aircraft is taken from the *Gulfstream V Airplane Flight Manual*, Rev. 15, November 13, 2000.

The following table shows the minimum (stall reference speed, Vsr) and the maximum operating speed (Vmo, Mmo) in knots calibrated for the basic aircraft. Reference stall speeds are based on the maximum takeoff gross weight of 90,500 pounds.

Altitude, feet	Minimum (Vsr), KCAS	Maximum (Vmo), KCAS	Maximum, Mmo
0	143	300	0.454
10,000	154	340	0.612
20,000	172	340	0.733
30,000	186	332	0.867
40,000	189	271	0.885
45,000	NA	240	0.880
50,000	NA	209	0.863

Table 3.1. GV stall reference speed and maximum operating speed information.

For preliminary planning purposes, a research speed for NSF/NCAR GV of 240 KCAS up to 40,000 feet and Mach number 0.77 above 40,000 feet should be considered. The true airspeed (KTAS) and Mach number for these speeds are shown in the table below.

Altitude, feet	KCAS	KTAS	Mach No.
0	240	240	0.36
10,000	240	277	0.43
20,000	240	323	0.52
30,000	240	379	0.63
40,000	232	442	0.77
45,000	206	442	0.77
50,000	184	442	0.77

Table 3.2. GV calibrated airspeed, true airspeed, and mach number versus altitude.

3.3 Takeoff Field Length

The following takeoff data were obtained from the *Gulfstream V Quick Reference Handbook*, Rev. 15, November 13, 2000.

The following table shows the effective runway length required for the basic aircraft at different airport pressure altitudes (APAs) and gross takeoff weights (GTWs). The outside air temperature was assumed to be 15 ^{o}C (standard day at sea level) with a hard surface, level runway, zero wind, and 20 ^{o} flaps.

APA, feet	GTW: 90,500 lb	GTW: 80,000 lb
0	6,110 ft	4,570 ft
4,000	8,290 ft	5,910 ft
6,000	9,800 ft	6,910 ft

Table 3.3. Effective runway length information for GTWs versus APAs.

Since a number of factors influence the required runway length, investigators should contact the RAF Flight Operations Group (boynton@ucar.edu) for specific airport runway length planning information.

3.4 Cruise Altitude

The following cruise altitude information has been estimated from information supplied by Gulfstream Aerospace Corporation.

The initial cruise altitude is dependent on a number of factors including atmospheric conditions, aircraft weight, and aircraft external configuration. Under the previous assumptions, at maximum gross takeoff weight (90,500 pounds), the NSF/NCAR GV can climb directly to 41,000 feet. The following chart shows the aircraft climb performance from sea level.

To, feet	Time, min	Fuel, lb	Distance, NM
10,000	3	500	15
20,000	7	1,100	35
30,000	14	1,700	75
40,000	24	2,500	145

Table 3.4. GV climb performance from sea level to various altitudes.

Higher initial cruise altitudes (> 41,000 feet) require a lower takeoff weight. If higher altitudes are required during a mission than can be achieved at a given gross takeoff weight, a step climb can be performed after aircraft weight has been reduced by fuel burnoff. The following table gives the maximum aircraft weight capable of cruise at a specific altitude for the NSF/NCAR GV. Cruise altitudes are based on a drag increment of 15 counts (.0015), the use of maximum cruise thrust, and a rate of climb of 200 feet per minute (fpm).

Altitude, feet	Weight at Altitude, lbs	Takeoff Weight, lbs
40,000	88,000	90,500
45,000	71,600	73,800
50,000	54,700	56,200

Table 3.5. Maximum aircraft weight capable of cruise versus altitude.

For comparison, the above data is presented in the following chart with a clean aircraft configuration for comparison:

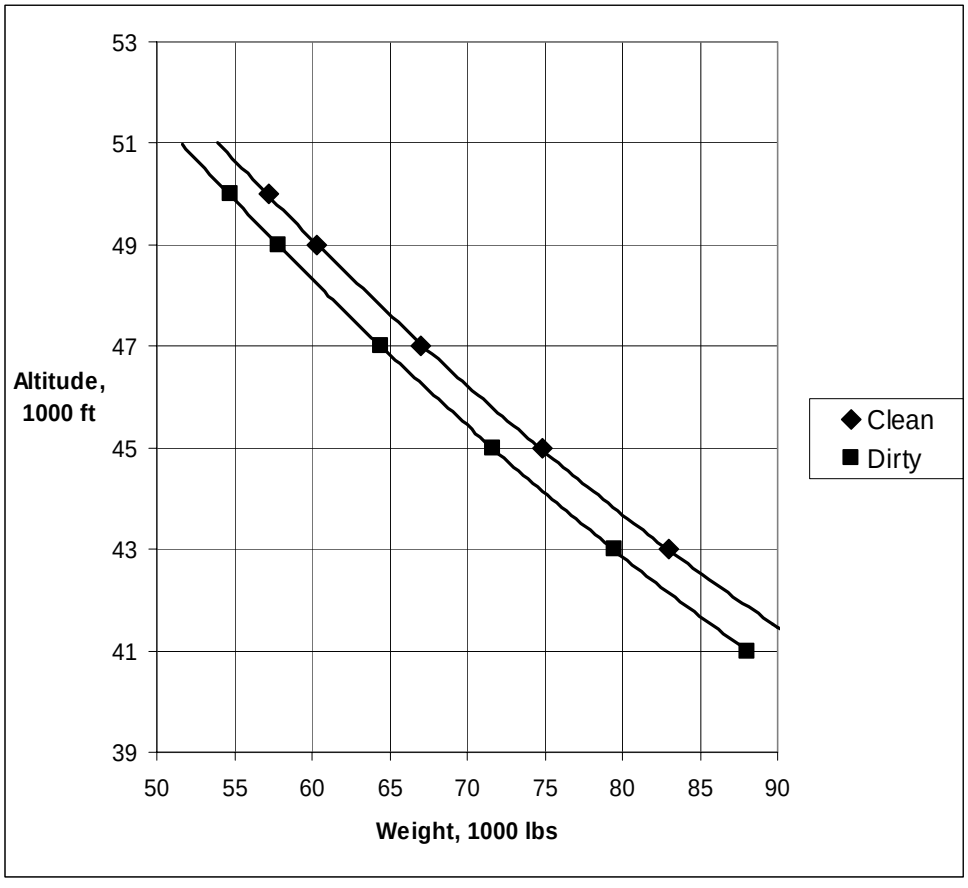

Figure 3.1. Clean versus dirty aircraft configuration chart.

3.5 Range and Endurance

The following range and endurance information has been estimated from Gulfstream Aerospace Corporation supplied information.

The following table shows the range and endurance for the NSF/NCAR GV based on the previous assumptions. The need for additional fuel reserve in remote areas will shorten the distance covered and time at altitude. Fuel loads are subject solely to the Pilot-in-Command's (PIC) discretion and exceptions to the reserve fuel requirement to prolong experiment time will not be made.

Altitude, feet	Takeoff Weight, lbs	Range at Altitude, NM	Endurance at Cruise and at Altitude, hrs	Endurance at Loiter Speed and at Altitude, hrs
0	90,500	2,616	11.0	13.4
10,000	90,500	3,289	11.9	14.6
20,000	90,500	4,051	12.4	15.4
30,000	90,500	4,952	12.8	15.8
40,000	90,500	5,950	13.0	15.4
45,000	73,800	3,959	8.4	9.2
50,000	56,200	897	1.4	1.5

Table 3.6. GV range and endurance information.

As mentioned previously, high altitude operations (> 41,000 feet) at a specific altitude can be achieved only when the aircraft reaches a certain weight. With the aircraft at a lower weight, less fuel is available for the mission. This effectively requires high altitude operations to be conducted close to the landing destination. Additional time at higher altitudes can only be achieved with lower payload weights. Conversely, higher payload weights (less fuel) will reduce the maximum cruise altitude attainable in addition to the maximum range and duration at all altitudes.

The following chart shows the maximum range attainable for different zero fuel weights for a clean aircraft and a data point for a dirty (15 additional drag counts) configuration.

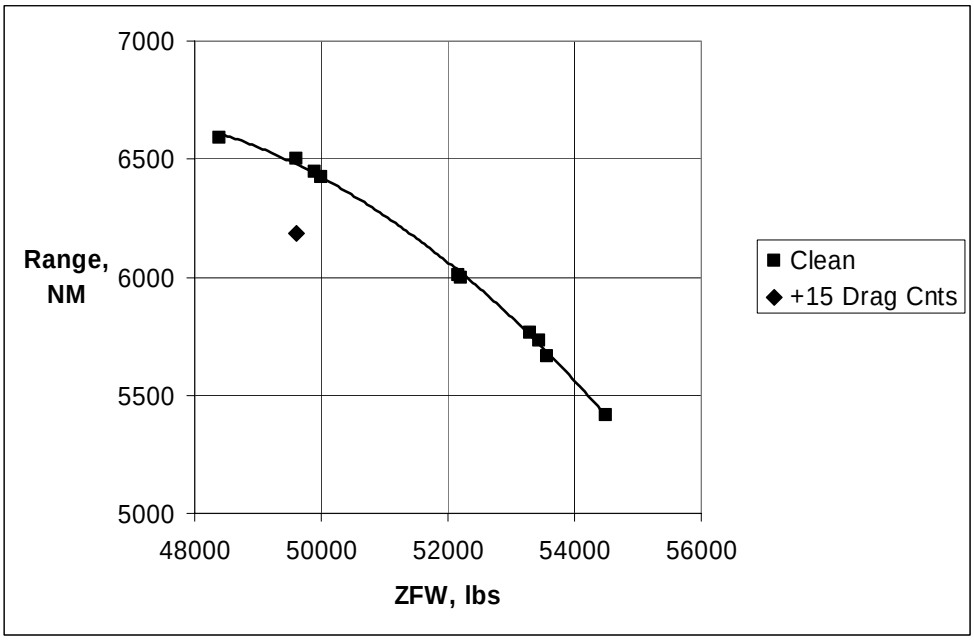

Figure 3.2. Maximum range attainable for different zero fuel rates chart.

3.6 Flight Planning Guidelines

The following flight planning information has been estimated from Gulfstream Aerospace Corporation supplied information.

The following table shows the average specific range and fuel flow for the NSF/NCAR GV aircraft at typical research speeds (240 KCAS below 40,000 feet, Mach 0.77 above 40,000 feet) and average weight at altitude (71,000 pounds up to 40,000 feet, 62,000 pounds at 45,000 feet, and 53,000 pounds at 50,000 feet). For altitudes between 0 and 40,000 feet, max fuel = ((90,500 - 49,600) - climb fuel). For altitudes above 40,000 feet, max fuel = (max wt @ alt – 49,600). Max fuel includes 1,600 pounds reserve fuel.

Altitude, feet	Maximum Fuel, lbs	Specific Range, NM/1000 lbs fuel	Fuel Flow, lbs/hr
0	40,900	66	3,610
10,000	40,400	84	3,310
20,000	39,800	104	3,110
30,000	39,200	128	2,970
40,000	38,400	155	2,850
45,000	22,000	184	2,400
50,000	3,800	215	2,050

Table 3.7. Average specific range and fuel flow for the GV at typical research speeds.

For more detailed flight planning to account for deployment location, local climate, specific payload, specific flight profiles and ATC considerations, contact RAF Flight Operations.

3.7 External Configuration Considerations

The previous range and endurance data consider an additional drag count of 15. This additional drag should approximate typical research configurations (i.e., cooling scoops, several moderately sized wing pods, and several inlets). For more detailed flight planning information to account for specific external configurations, contact the RAF Senior Aeronautical Engineer (lord@ucar.edu).