



Ground Pattern Performance of the Griffith Big Dipper Model 100 Helibucket

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The Wildland Fire Chemical Systems (WFCS) program tests a variety of fixed- and rotary-wing tankers to determine the parameters for optimal ground pattern coverage over a wide range of fuel and fire conditions. The Griffith Big Dipper Model 100 helibucket (referred to as the Griffith 100-gallon helibucket) is one of a family of helibuckets with different volumes designed for use with a variety of helicopters. The Griffith 100-gallon helibucket is designed for use with Type III helicopters.

The Missoula Technology and Development Center tested the Griffith 100-gallon helibucket with a series of drops over an array of plastic bowls much like Cool Whip containers. The quantity of material in each bowl was measured and the data were used to determine the drop pattern.

The helibucket is constructed of “double bond” polyurethane mounted to a steel-

reinforced rim and bottom (Figure 1). A round door seals the bottom opening from the inside. The bucket is emptied by activating a hydraulic cylinder that pulls the door up. The inside diameter is 31 inches at the top and 25 inches at the bottom. The bucket is 38.5 inches tall. The door is 16 inches in diameter. The bucket’s maximum volume is 100 gallons. Because of helicopter limitations, the bucket’s volume was reduced to 70 gallons for testing.

The standard Griffith 100-gallon helibucket was tested using a Type III helicopter. Tests included air speeds from 30 to 60 knots (35 to 69 mph) and drop heights from 40 to 99 feet from the bottom of the helibucket to ground. The drops were made with three different materials: water, foam, and gum-thickened retardant.

Drop height and airspeed both have an effect on the drop pattern. Increasing drop height gradually widens the drop



Figure—1 Griffith 100-gallon helibucket.

at the expense of higher coverage levels. This effect is modified by the ambient wind. Increasing wind speed widens the drop and decreases coverage levels. Airspeed has a much

greater effect on the drop pattern. Figures 2, 3, and 4 show the effect of increasing the air speed from 40 to 60 knots (46 to 69 mph). Drop heights ranged from 42 to 85 feet.

Table 1—Retardant coverage levels needed for specific fuel models.

Fuel Model		Coverage Level (gal/100 sq. ft)	Description
National Fire Danger Rating System (NFDRS)	Fire Behavior		
A,L,S	1	1	Annual and perennial western grasses, tundra
C	2		Conifer with grass
H,R	8	2	Shortneedle closed conifer; summer hardwood
E,P,U	9		Longneedle conifer; fall hardwood
T	2		Sagebrush with grass
N	3		Sawgrass
F	5	3	Intermediate brush (green)
K	11		Light slash
G	10	4	Shortneedle conifer (heavy dead litter)
O	4		Southern rough
E,Q	6	6	Intermediate brush (cured), Alaska black spruce
B,O	4		California mixed chaparral, high pocosin
J	12	Greater than 6	Medium slash
I	13		Heavy slash

The proper amount of gum-thickened retardant (expressed as coverage levels in gallons per 100 square feet) differs depending on the fuel model. Table 1 shows the coverage needed for specific fuel models using both the National Fire Danger Rating System (NFDRS) and the Fire Behavior Fuel Model.

The results of drop tests allow managers to estimate the air speed and height that provide the retardant coverage level required for the fire intensity represented by the appropriate fuel model. Table 2 or Figure 5 can be used to estimate the airspeed of a water drop required to obtain the longest line of the desired coverage level. Table 3 or Figure 6 can be

Table 2—Water tests producing the longest line at various coverage levels.

Coverage Level (gal/100 sq. ft)	Airspeed (knots)	Line Length (feet)
0.5	56	239
1.0	40	157
2.0	36	51
3.0	0	0
4.0	0	0
6.0	0	0
8.0	0	0
10.0	0	0

Table 3—Foam tests producing the longest line at various coverage levels.

Coverage Level (gal/100 sq. ft)	Airspeed (knots)	Line Length (feet)
0.5	58	210
1.0	31	118
2.0	31	66
3.0	31	46
4.0	0	0
6.0	0	0
8.0	0	0
10.0	0	0

used to estimate the air speed of a foam drop to obtain the longest line of the desired coverage level. Table 4 or Figure 7 can be used to estimate the air speed of a gum-thickened retardant drop to obtain the longest line of the desired coverage level. The line length graphs predict line length (in feet) as a function of airspeed (in knots). The

tables are constructed by selecting the drop producing the longest length of line (on the ground) at each coverage level. Either the graphs or tables may be used to estimate the air speed required to produce the maximum length of line for a given coverage level. The tables show an ideal case, while the graphs represent an average.

Table 4—Gum-thickened retardant test producing the longest line at various coverage levels.

Coverage Level (gal/100 sq. ft)	Airspeed (knots)	Line Length (feet)
0.5	48	214
1.0	48	145
2.0	37	32
3.0	37	2
4.0	0	0
6.0	0	0
8.0	0	0
10.0	0	0

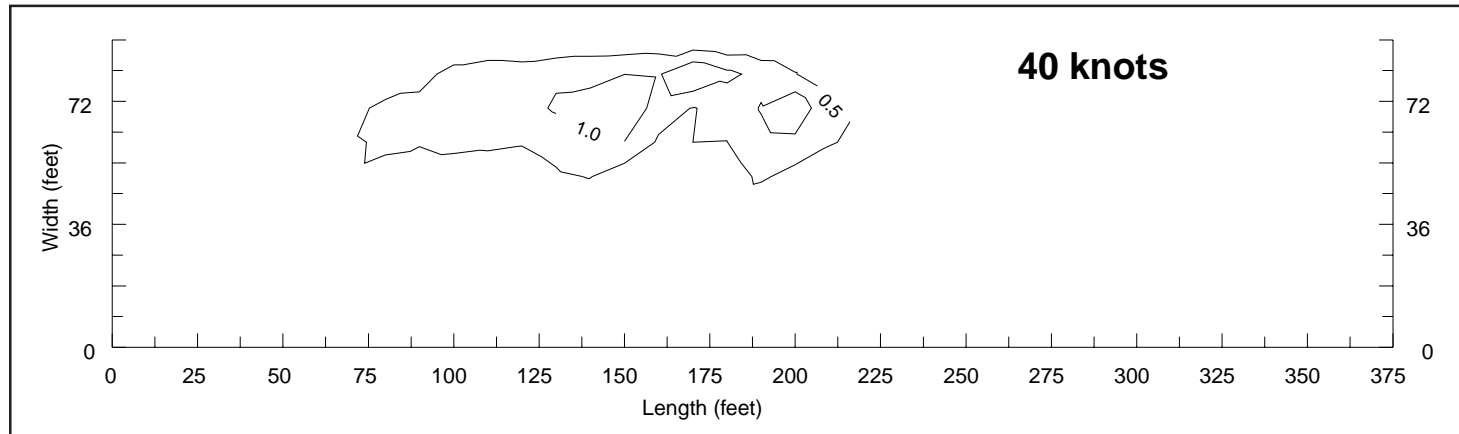


Figure 2—Drop pattern characteristics for the Griffith 100-gallon helibucket with an airspeed of 40 knots and a drop height of 85 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

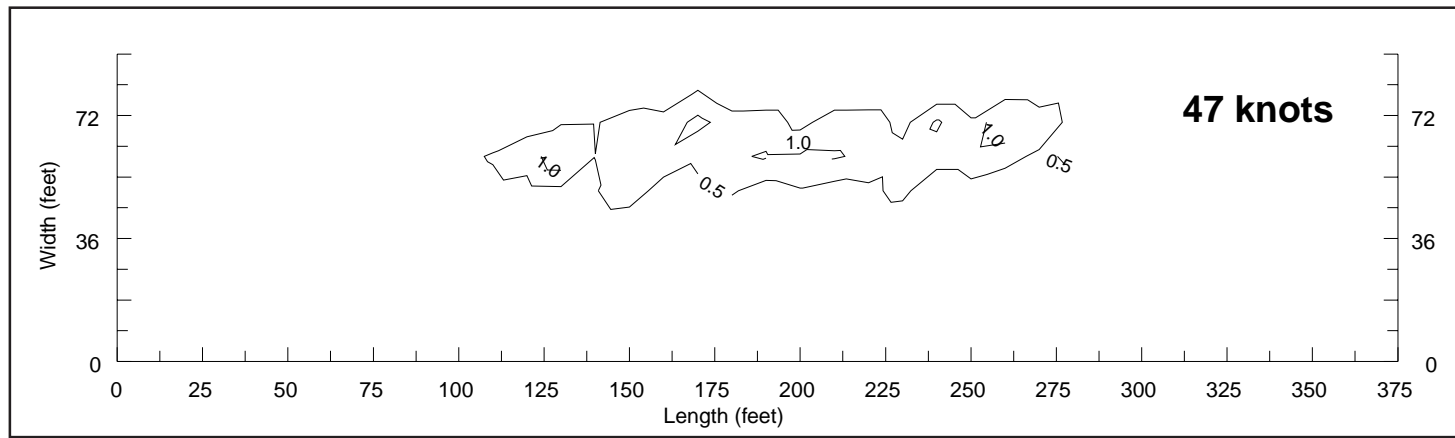


Figure 3—Drop pattern characteristics for the Griffith 100-gallon helibucket with an airspeed of 47 knots and a drop height of 42 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

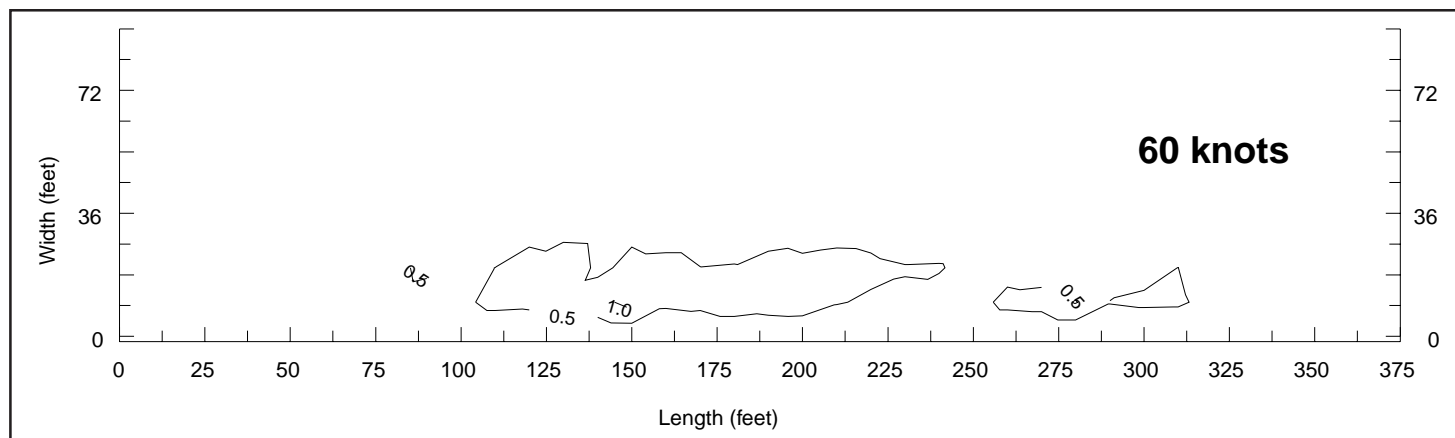


Figure 4—Drop pattern characteristics for the Griffith 100-gallon helibucket with an airspeed of 60 knots and a drop height of 64 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

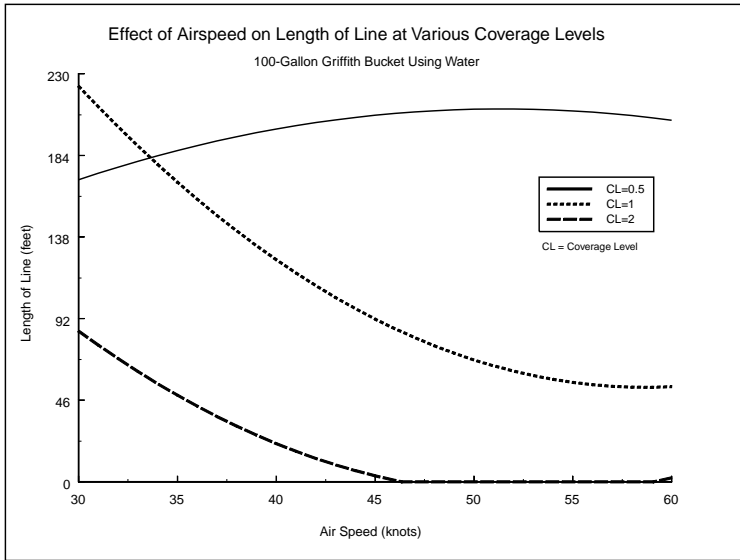


Figure 5—Use this graph to estimate the speed needed to produce the longest line of water at various coverage levels.

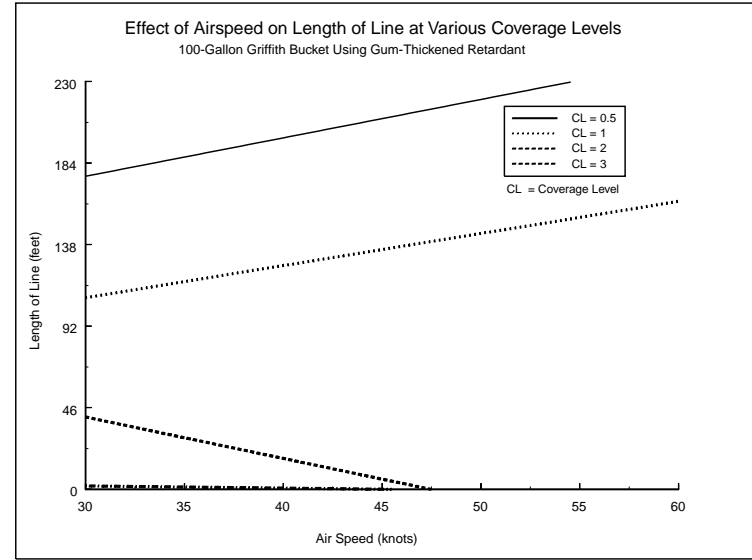


Figure 7—Use this graph to estimate the speed needed to produce the longest line of gum-thickened retardant at various coverage

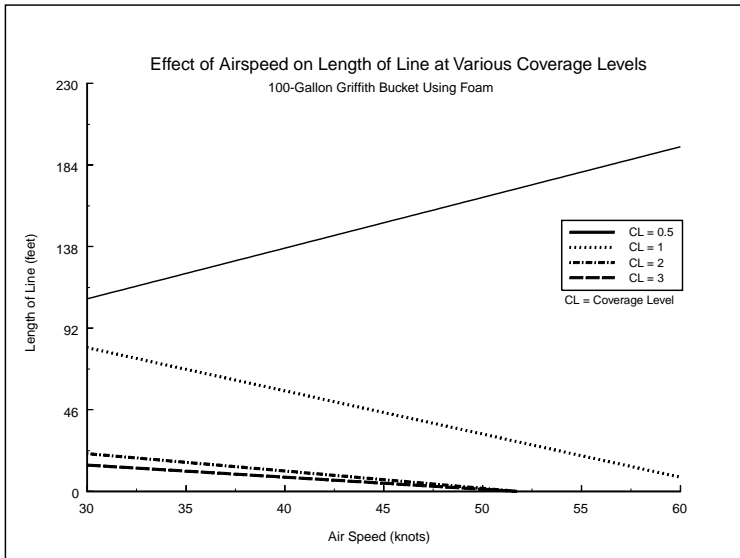


Figure 6—Use this graph to estimate the speed needed to produce the longest line of foam at various coverage levels.

To select the proper helicopter speed, use Table 1 to determine the coverage level required by the NFDRS or Fire Behavior Fuel Model. The coverage levels in Table 1 represent the coverage level required for the average fire intensity for each fuel model. The required coverage level can be adjusted up or down depending on the actual fire intensity. Once the required coverage level is determined, the airspeed can be found. Use the graph for the material dropped (water, foam, or gum-thickened retardant) to find the speed that produces the longest line for the desired coverage level. The same information can be found in the appropriate drop table.

For example, if a fire is burning in NFDRS

Fuel Model C (Fire Behavior Model 2), represented by conifer with grass, Table 1 shows that a coverage level of 2 is required. The graph for water shows that for coverage level 2, an airspeed of about 36 knots produces the longest line.

The ground drop characteristics for the Griffith 100-gallon helibucket were derived through controlled drop test procedures on flat ground (Figure 8). This information is to serve only as a guide in assisting field personnel to determine the proper drop height and airspeed for delivering water, foam, or gum-thickened retardant. Actual coverage may vary depending on terrain, wind, weather, and pilot proficiency.



Figure 8—Drop test of the Griffith 100-gallon helibucket.

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