Airtanker Drop Guides

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Forest Service
Technology & Development Program

Ground Pattern Performance of the Forest Service Bell 206 Helicopter With the 100-Gallon SEI Industries Bambi Helibucket

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The Wildland Fire Chemical Systems (WFCS) Program tests a variety of fixed- and rotary-wing airtankers to determine the parameters for optimal ground-pattern coverage over a wide range of fuel and fire conditions. The Forest Service Bell 206 helicopter with the 100-gallon SEI Industries Bambi helibucket (referred to as the Forest Service Bell 206 with 100-gallon Bambi helibucket) is one of a family of helicopters designed for fire suppression with the use of a helibucket. It is qualified as a Type 3 helicopter (figure 1).

The Bambi helibucket is constructed of a heavy, coated fabric mounted to a collapsible frame. The dump valve is electrically actuated from the helicopter using 28 volts dc aircraft power. The helibucket's maximum volume is 100 gallons. The volume of a given drop can be controlled by the rate at which the helibucket is lifted from the water (a faster lift produces more volume) or by adjusting a cinch strap inside the helibucket. The drops in these tests were made with the cinch strap adjusted at the maximum opening of 75 gallons.

The Missoula Technology and Development Center tested the Forest Service Bell 206 with 100-gallon Bambi 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.

Tests included airspeeds from 24 to 66 knots (28 to 76 miles per hour) and drop heights from 37 to 100 feet from the bottom of the tank to the ground. The drops were made with three different materials: water, foam, and gum-thickened retardant.

Flow rate, drop height, and airspeed all affect the drop pattern. Because this type of helicopter is normally used over a narrow range of heights and speeds and because this system produces a single flow rate, information about an average drop is presented. Figures 2, 3, and 4 show the effect of increasing drop height from 39 to 66 feet with an airspeed of 44 to 51 knots (50 to 59 miles per hour) using gum-thickened retardant.

Figure 1—The Forest Service Bell 206 with 100-gallon Bambi helibucket.

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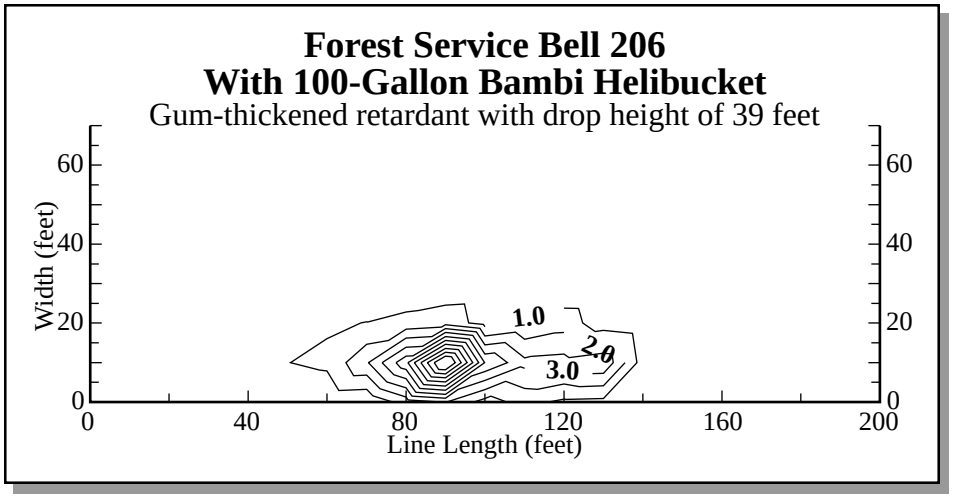

Figure 2—Drop pattern characteristics for the Forest Service Bell 206 with 100-gallon Bambi helibucket using gum-thickened retardant at an airspeed of 44 knots (51 miles per hour) and a drop height of 39 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

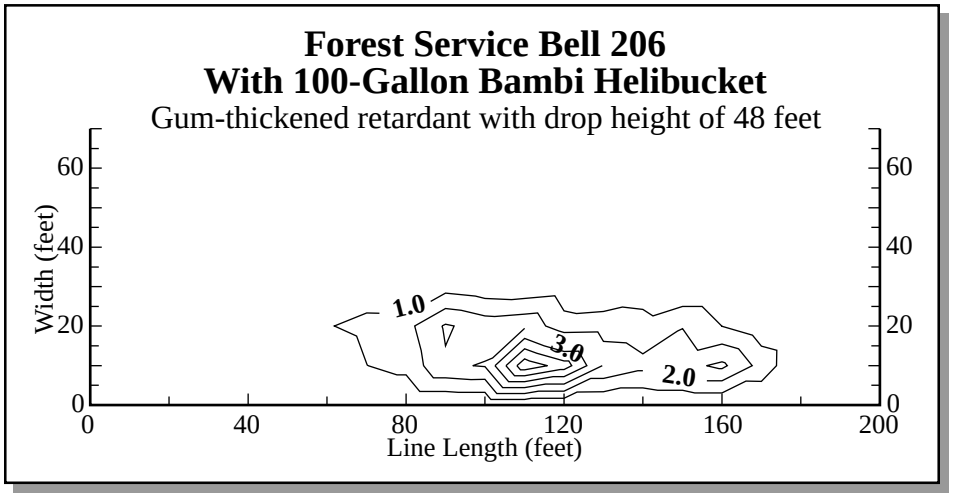

Figure 3—Drop pattern characteristics for the Forest Service Bell 206 with 100-gallon Bambi helibucket using gum-thickened retardant at an airspeed of 51 knots (59 miles per hour) and a drop height of 48 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

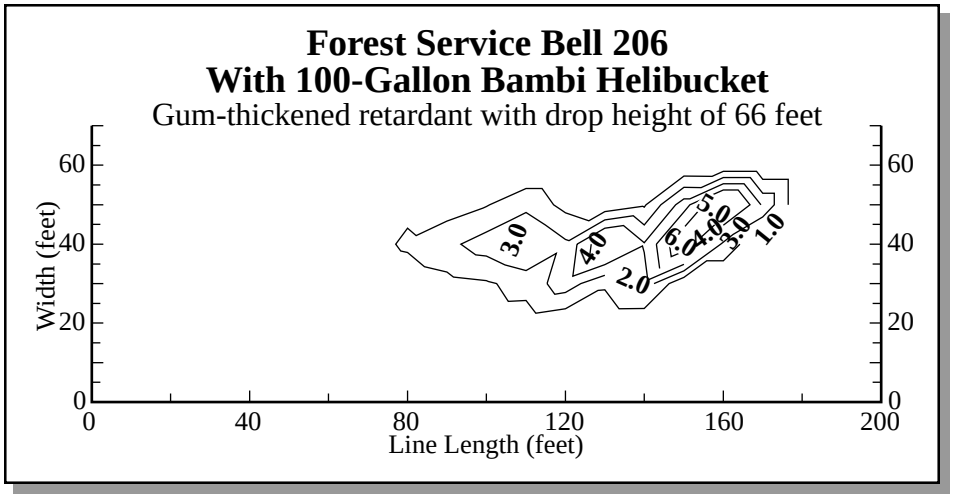

Figure 4—Drop pattern characteristics for the Forest Service Bell 206 with 100-gallon Bambi helibucket using gum-thickened retardant at an airspeed of 47 knots (54 miles per hour) and a drop height of 66 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

The proper amount of fire-retarding materials to be applied (expressed as coverage level 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 Fire Behavior Fuel Model descriptions.

The results of drop tests allow managers to estimate the length of line a specific helitanker produces at various coverage levels. Table 2 or figure 5 can be used to determine the drop height required to obtain the longest line of water at each coverage level. Table 3 or figure 6 can be used to determine the drop height required to obtain the longest line of foam at each coverage level. Table 4 or figure 7 can be used to determine the drop height required to obtain the longest line of foam at each coverage level.

The line-length graphs predict line length (in feet) as a function of drop height (in feet). The tables are constructed by selecting the drop producing the longest line at each coverage level. Either the graphs or tables may be used to estimate the drop height required to produce the longest line for a given coverage level. The tables show an ideal case, while the graphs represent an average.

Table 1—The retardant coverage needed for specific fuel types.

Fuel Model		Coverage Level (gal/100 ft²)	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
F, 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

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

Coverage Level (gal/100 ft²)	Line Length (feet)	Drop Height (feet)
0.5	135	58
1	115	58
2	85	47
3	52	58
4	39	39
6	32	39
8	21	39
10	6	39

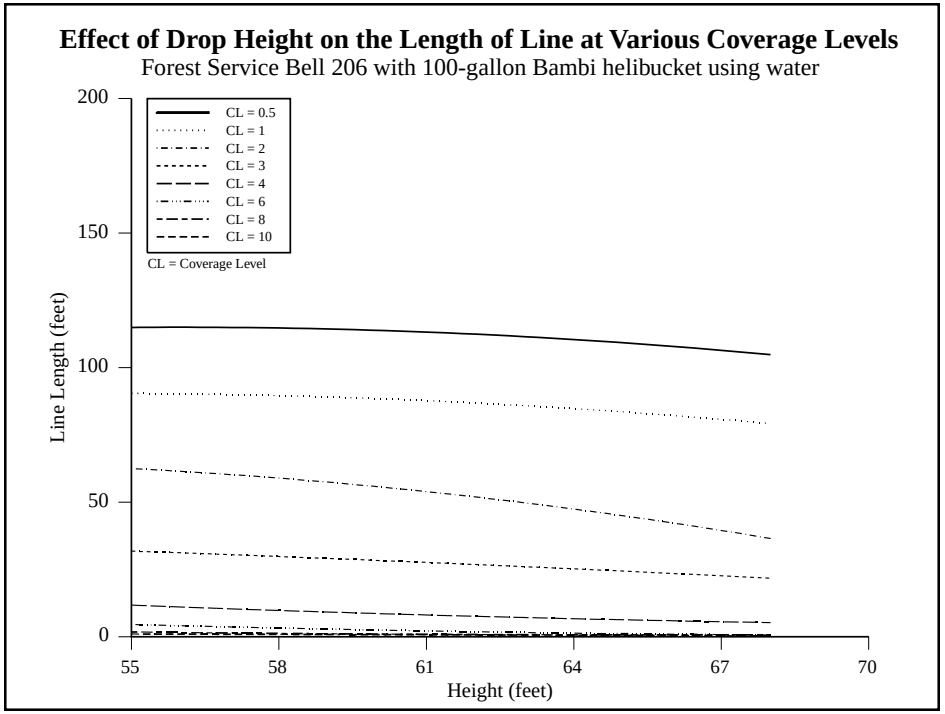

Figure 5—Use this graph to estimate the drop height needed to produce the longest line of water at various coverage levels.

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

Coverage Level (gal/100 ft²)	Line Length (feet)	Drop Height (feet)
0.5	152	81
1	113	81
2	84	69
3	57	57
4	41	57
6	23	57
8	7	57
10	-	-

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

Coverage Level (gal/100 ft²)	Line Length (feet)	Drop Height (feet)
0.5	177	39
1	153	39
2	125	39
3	100	39
4	59	43
6	30	43
8	12	100
10	6	5

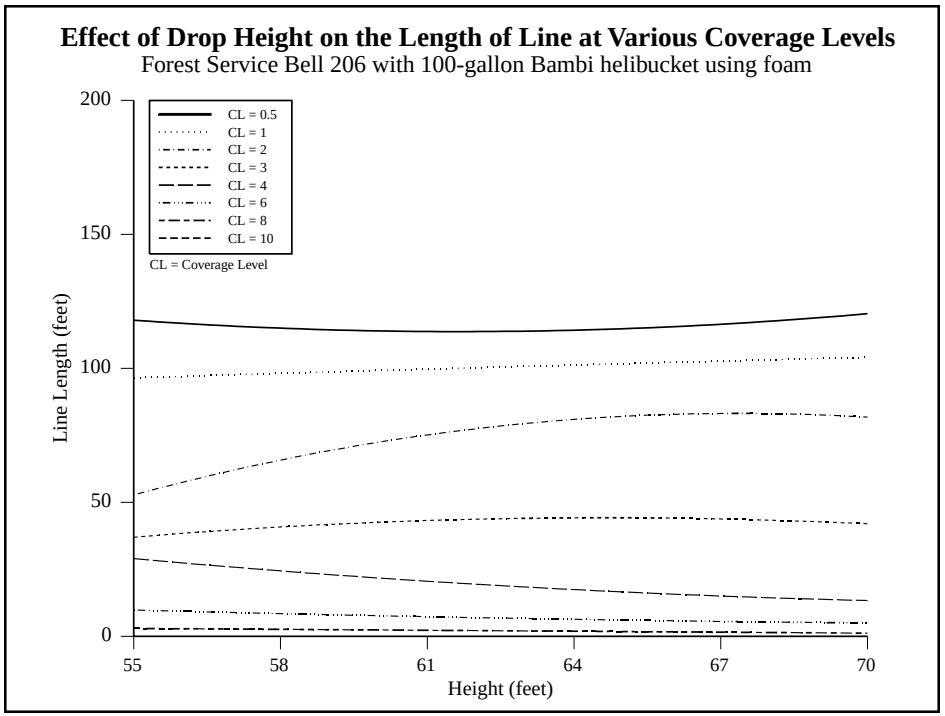

Figure 6—Use this graph to estimate the drop height needed to produce the longest line of foam at various coverage levels.

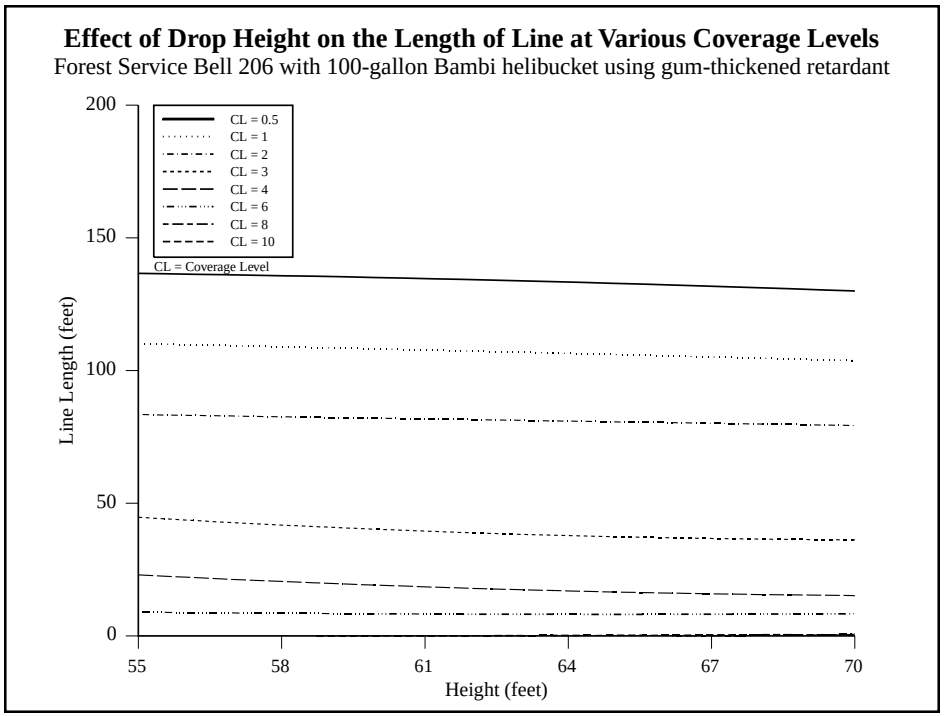

Figure 7—Use this graph to estimate the drop height needed to provide the longest line of gum-thickened retardant at various coverage levels.

To select the proper drop height, first use table 1 to determine the coverage level required by the NFDRS or Fire Behavior Fuel Models. The coverage levels in table 1 represent the coverage level required for 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 drop height can be found. Use the table for the material dropped (water, foam, or gum-thickened retardant) to find the drop height 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 H, R (Fire Behavior Model 8), represented by shortneedle closed conifer or summer hardwood, table 1 shows that a coverage level of 2 is required. The table for gum-thickened retardant (table 4) shows that for coverage level 2, a drop height of about 39 feet produces the longest line (125 feet).

The ground drop characteristics for the Forest Service Bell 206 with 100-gallon Bambi helibucket were derived through controlled test drop 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 Forest Service Bell 206 with 100-gallon Bambi helibucket.

About the Authors...

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