0157-2805-MTDC
January 2001
5100/5700

Airtanker Drop Guides

United States Department of Agriculture
Forest Service
Technology & Development Program

Ground Pattern Performance of the Forest Service Bell 206 Helicopter With the 100-Gallon Sims Rainmaker 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 Sims Rainmaker helibucket (referred to as the Forest Service Bell 206 with 100-gallon Sims helibucket) is one of a family of helicopters designed for fire suppression with a helibucket. It is qualified as a Type 3 helicopter.

The helibucket is constructed with a single piece of hard-sided fiberglass. The bottom of the tank is flat and round with two semicircular doors. The doors are hinged along the straight side of the semicircle and open inward when a telescoping cylinder is activated. The helibucket is emptied by activating an electric hydraulic system using 28 volts dc aircraft power. The system opens both doors, providing one flow rate. The helibucket is 46 inches wide and 23 inches high. The door opening is 24 inches wide.

The Missoula Technology and Development Center tested the Forest Service Bell 206 with 100-gallon Sims 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 drops in these tests were made with a maximum volume of 75 gallons. Tests included airspeeds ranging from 40 to 51 knots (46 to 59 miles per hour) and drop heights from 34 to 48 feet from the bottom of the tank to the ground. The drops were made with two different materials: water and foam.

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 1 and 2 show the effect of dropping water and foam with the airspeed ranging from 44 to 45 knots (51 to 52 miles per hour) and drop heights ranging from 37 to 48 feet.

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

The results of drop tests allow managers to estimate the length of line a specific airtanker produces at various coverage levels. Table 2 can be used to determine the airspeed required for the longest line of water at each coverage level. Table 3 can be used to determine the airspeed required for the longest line of foam at each coverage level. Figure 3 can be used to determine the airspeed needed to provide the longest line of water or foam at various coverage levels.

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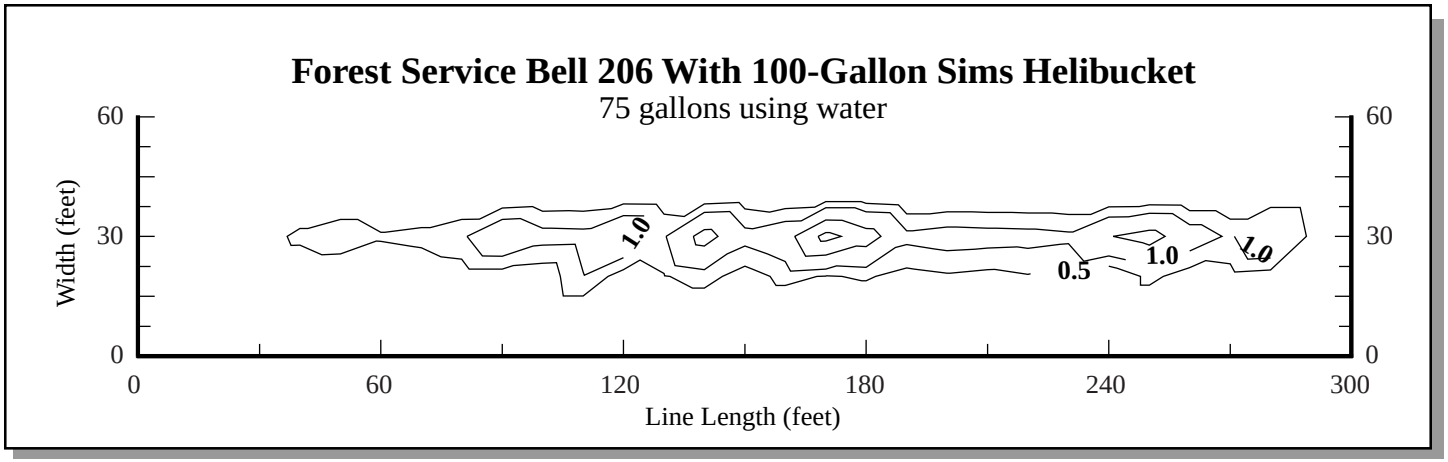

Figure 1—Drop pattern characteristics for the Forest Service Bell 206 with 100-gallon Sims helibucket using water at an airspeed of 44 knots (51 miles per hour) and a drop height of 37 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

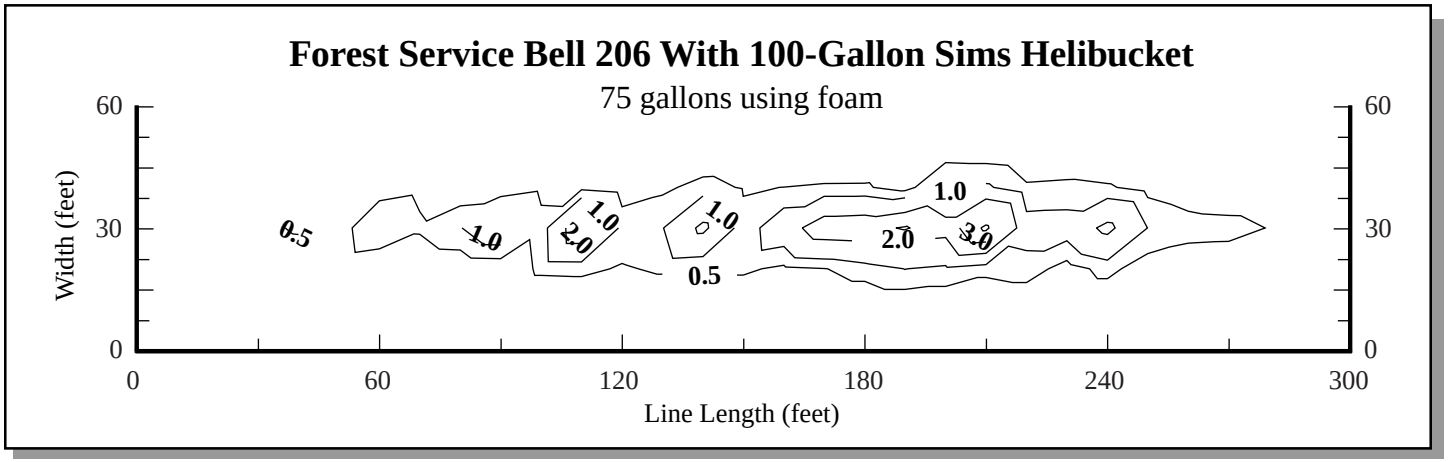

Figure 2—Drop pattern characteristics for the Forest Service Bell 206 with 100-gallon Sims helibucket using foam at an airspeed of 45 knots (52 miles per hour) and a drop height of 48 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

To select the proper airspeed, first 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 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 table for the material dropped (water or foam) to find the airspeed that produces the longest line for the desired coverage level.

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 table for water shows that for coverage level 2, an airspeed of about 45 knots produces the longest line (69 feet).

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)	Airspeed (knots)
0.5	252	44
1	200	44
2	40	44
3	6	44
4	-	-
6	-	-
8	-	-
10	-	-

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

Coverage Level (gal/100 ft²)	Line Length (feet)	Airspeed (knots)
0.5	235	43
1	187	43
2	69	45
3	14	45
4	2	45
6	-	-
8	-	-
10	-	-

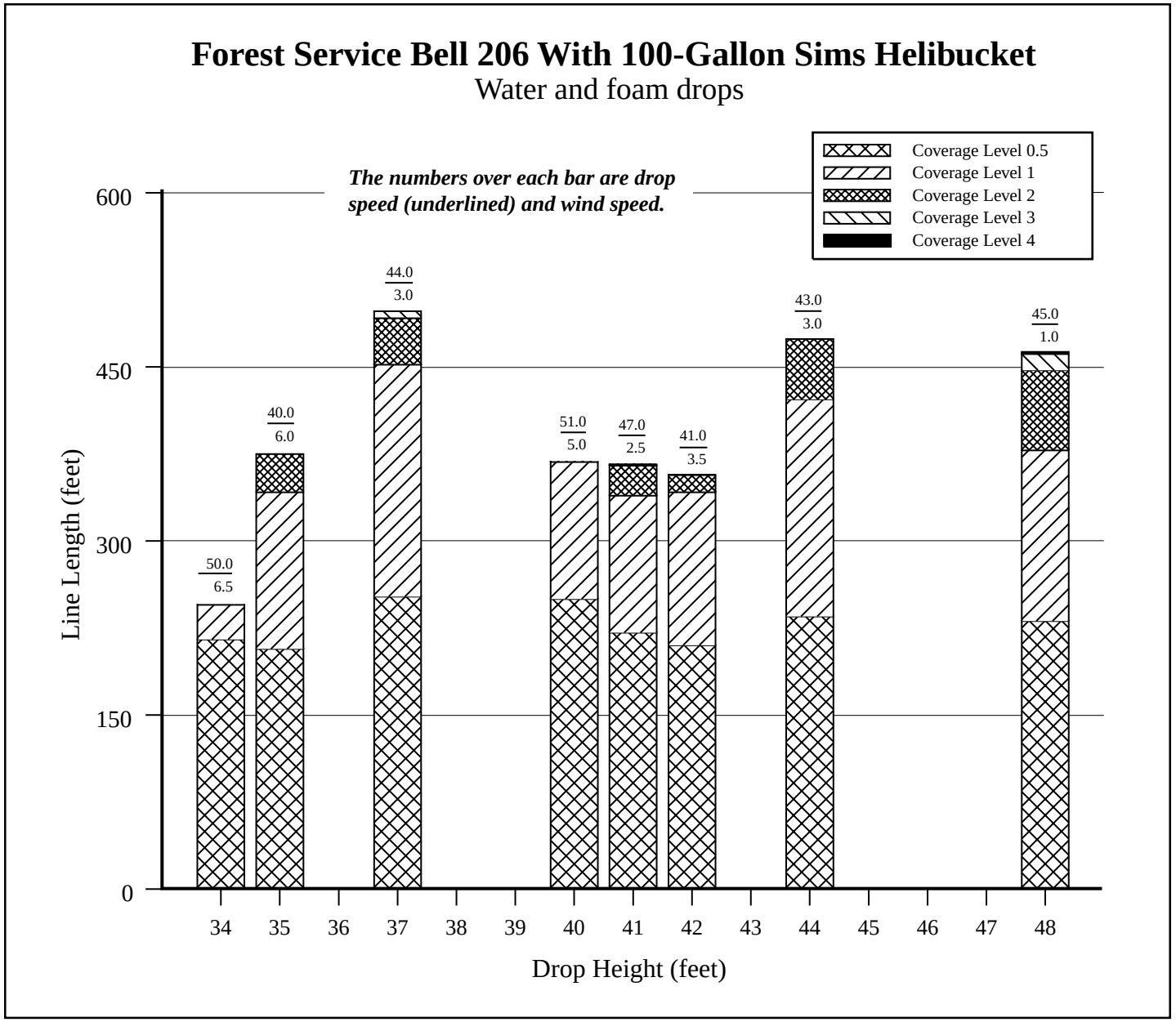

Figure 3—Use this graph to determine the airspeed needed to provide the longest line of water or foam at various coverage levels.

The ground drop characteristics for the Forest Service Bell 206 with 100-gallon Sims helibucket were derived through controlled test drop procedures on flat ground (figure 4). This information is to serve only as a guide in assisting field personnel to determine the proper drop height and airspeed for delivering water or foam. Actual coverage may vary depending on terrain, wind, weather, and pilot proficiency.

Figure 4–Drop test of the Forest Service Bell 206 with 100-gallon Sims helibucket using water.

About the Authors...

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