0057-2863-MTDC
October 2000
5100/5700

Airtanker Drop Guides

United States Department of Agriculture
Forest Service
Technology & Development Program

Ground Pattern Performance of the LA County Bell S205 Helicopter With Sheetcraft Fixed Tank

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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 LA County Bell S205 (owned and operated by Los Angeles County, CA) with the Sheetcraft fixed tank (designed by Sheetcraft, Inc.) is one of a family of helitankers designed for fire suppression with the use of a fixed tank.

The fixed aluminum tank (Figure 1) consists of two compartments that hold 160 gallons each. The tank is evacuated by activating a pneumatic system that opens two doors (one for each compartment) producing one flow rate. The door opening is $7^1/_2$ by 78 inches with tank dimensions in the front measuring 94 inches wide and 15 inches deep, decreasing to 44 inches wide and $9^1/_2$ inches deep. The drops in these tests were made with a maximum volume of 320 gallons. Tests included airspeeds from 17 to 69 knots (20 to 79 mph) and drop heights from 33 to 82 feet (from the bottom of the tank to the ground). The drops were made with three different materials: water, foam, and gum-thickened retardant.

The Missoula Technology and Development Center tested the LA County Bell S205 with the Sheetcraft fixed tank 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.

Flow rate, drop height, and airspeed all have an effect on the drop pattern.

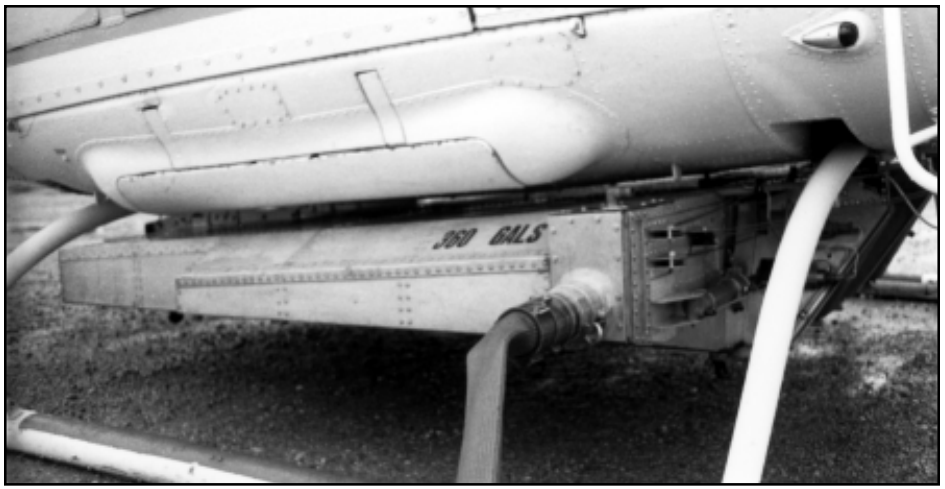

Figure 1—The LA County Bell S205 helicopter with the Sheetcraft fixed tank.

Since 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. Figure 2 shows the effect of opening one compartment containing 160 gallons. Figure 3 shows the effect of opening both compartments containing 320 gallons with an airspeed of 68 knots (78 mph) and drop heights ranging from 60 to 79 feet.

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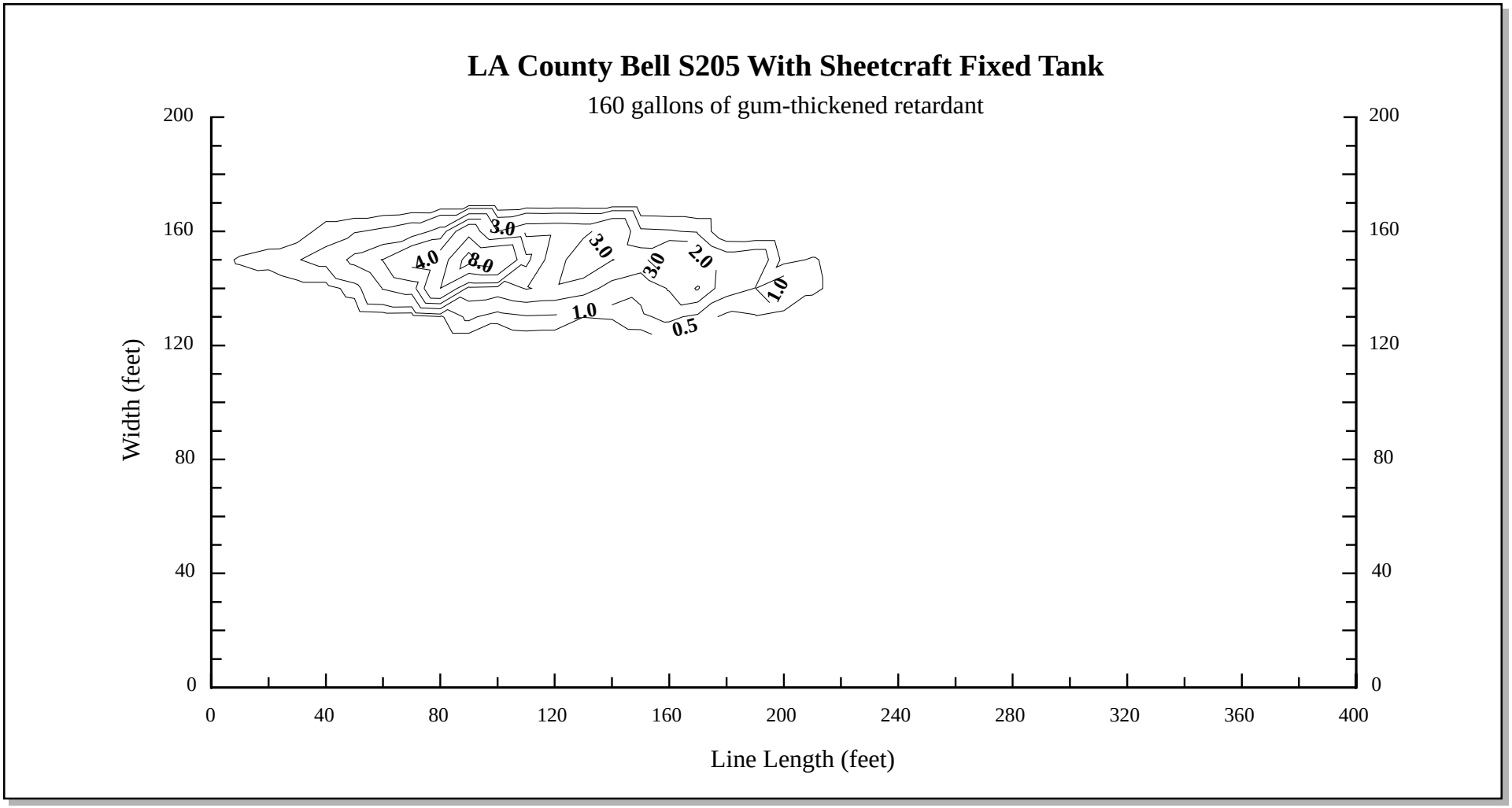

Figure 2—Drop pattern characteristics for the LA County Bell S205 helicopter with the Sheetcraft fixed tank opening compartment one to release 160 gallons of gum-thickened retardant at an airspeed of 68 knots (78 mph) and a drop height of 60 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

The proper amount of fire-retarding materials to be applied (expressed as coverage 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 helitanker produces at various coverage levels. Using computer simulation and drop test data, the following time intervals between simultaneous releases of two compartments were determined, which produced the maximum length of line of the desired coverage level. Drop

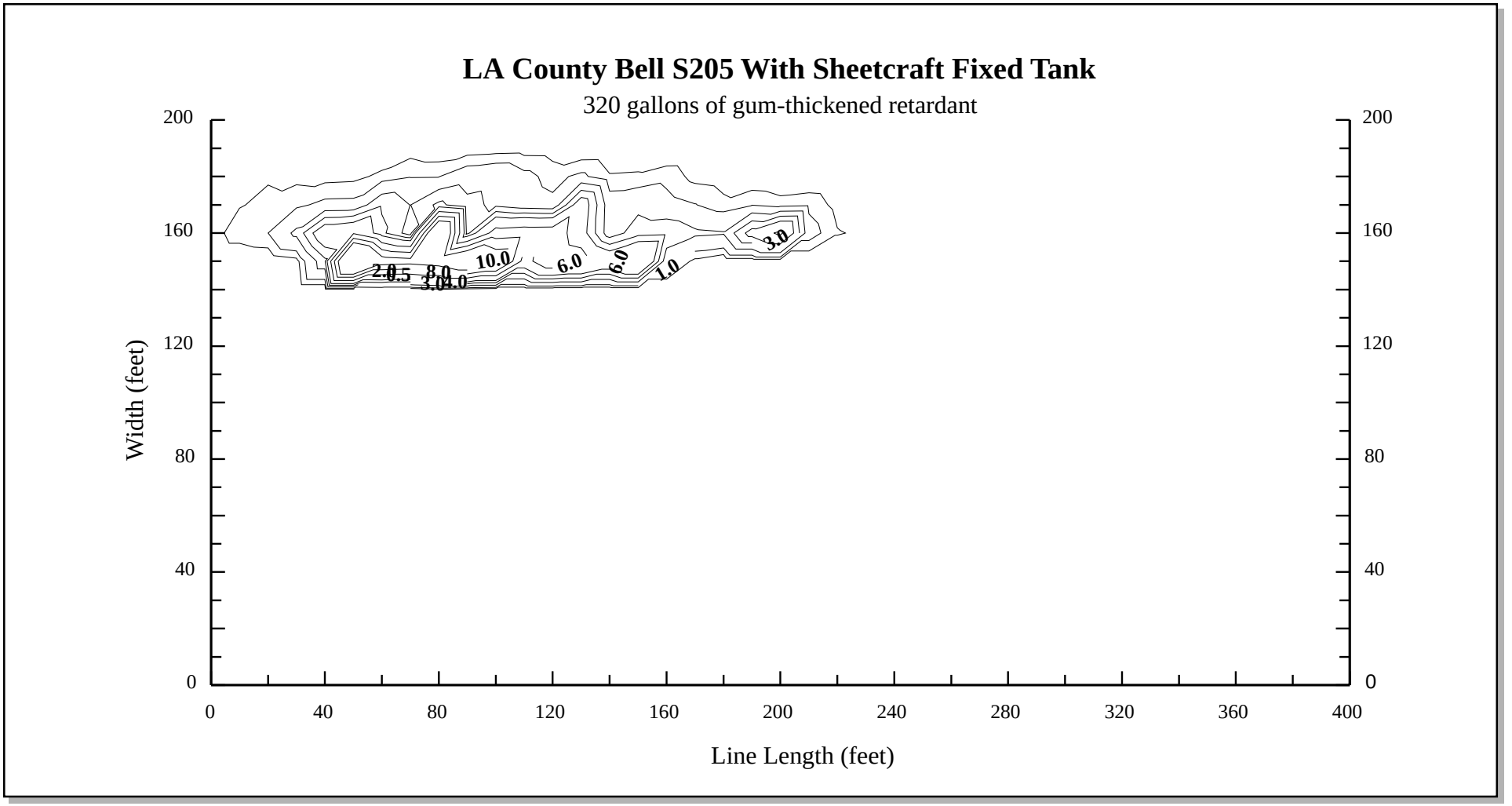

Figure 3—Drop pattern characteristics for the LA County Bell S205 helicopter with Sheetcraft fixed tank opening both compartments to release 320 gallons of gum-thickened retardant at an airspeed of 68 knots (78 mph) and a drop height of 79 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

height, airspeed, and wind speed affect the drop pattern as well as time interval. Table 2 can be used to determine the maximum line length of water at each coverage level based on the time interval of a trail drop of one compartment holding 160 gallons followed by another compartment holding 160 gallons. Table 3 can be used to determine the maximum line length of foam at each coverage level based on the time interval of a trail drop of one compartment holding 160 gallons followed by another compartment holding 160 gallons using the LA County Bell S205 with

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

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
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 based on a computer-simulated trail drop of one compartment followed by another compartment.

Coverage Level (gal/100 sq. ft)	Line Length (feet)	Time Interval Between Releases (seconds)
0.5	440	2.33
1	340	1.91
2	190	1.16
3	140	0.85
4	100	0.11
6	40	0.11
8	20	0.11
10	10	0.21

Table 3—Foam tests producing the longest line at various coverage levels based on a computer-simulated trail drop of one compartment followed by another compartment.

Coverage Level (gal/100 sq. ft)	Line Length (feet)	Time Interval Between Releases (seconds)
0.5	330	2.37
1	240	1.93
2	190	1.48
3	140	1.19
4	110	0.74
6	60	0.15
8	20	0.15
10	10	0.15

Sheetcraft fixed tank. Table 4 can be used to determine the maximum line length of gum-thickened retardant at each coverage level based on the time interval of a trail drop of one compartment holding 160 gallons followed by another compartment holding 160 gallons. Figures 4, 5, and 6 demonstrate the ideal drop pattern produced by a trail drop using water, foam, and gum-thickened retardant.

The tables are constructed by selecting the simulated trail drop producing the longest length of line (on the ground) at each coverage level. The tables may be used to estimate the time interval required to produce the maximum length of line for a given coverage level. The tables show an ideal case.

To select the proper time interval, first use Table 1 to determine the coverage

Table 4—Gum-thickened retardant tests producing the longest line at various coverage levels based on a computer-simulated trail drop of one compartment followed by another compartment.

Coverage Level (gal/100 sq. ft)	Line Length (feet)	Time Interval Between Releases (seconds)
0.5	410	2.77
1	320	2.50
2	320	1.84
3	160	1.32
4	140	0.40
6	90	0.26
8	50	0.26
10	30	0.26

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 time interval can be found. Use the table for the material dropped (water, foam, or gum-thickened retardant) to find the time interval 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 B, O (Fire Behavior Model 4), represented by California mixed chaparral or high pocosin, Table 1 shows that a coverage level greater than 6 is required. The table for gum-thickened retardant (Table 4) shows that for coverage level 6, a time interval of 0.26 seconds produces the longest line (90 feet) at an airspeed of 45 knots.

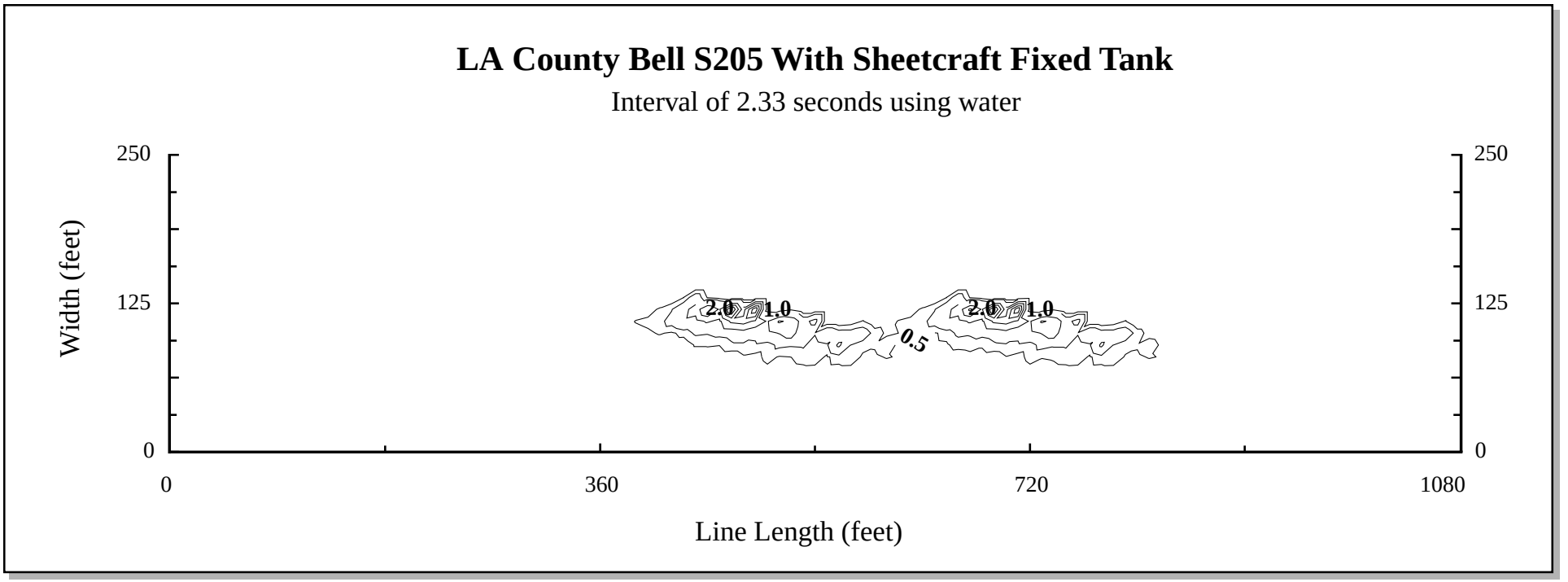

Figure 4—Drop pattern characteristics for the LA County Bell S205 helicopter with Sheetcraft fixed tank using a total of 320 gallons of water with a computer-simulated trail drop (dropping compartments 1 and 2 with a time interval of 2.33 seconds) at a drop height of 57 feet, an airspeed of 56 knots (64 mph), and wind speed of 11.5 mph.

The ground drop characteristics for the LA County Bell S205 with Sheetcraft fixed tank were derived through controlled test drop procedures on flat ground (Figure 7). This information is to serve only as a guide in assisting field personnel to determine the proper drop height, airspeed, and time interval to produce the longest line for delivering water, foam, or gum-thickened retardant. Actual coverage may vary depending on terrain, wind, weather, and pilot proficiency.

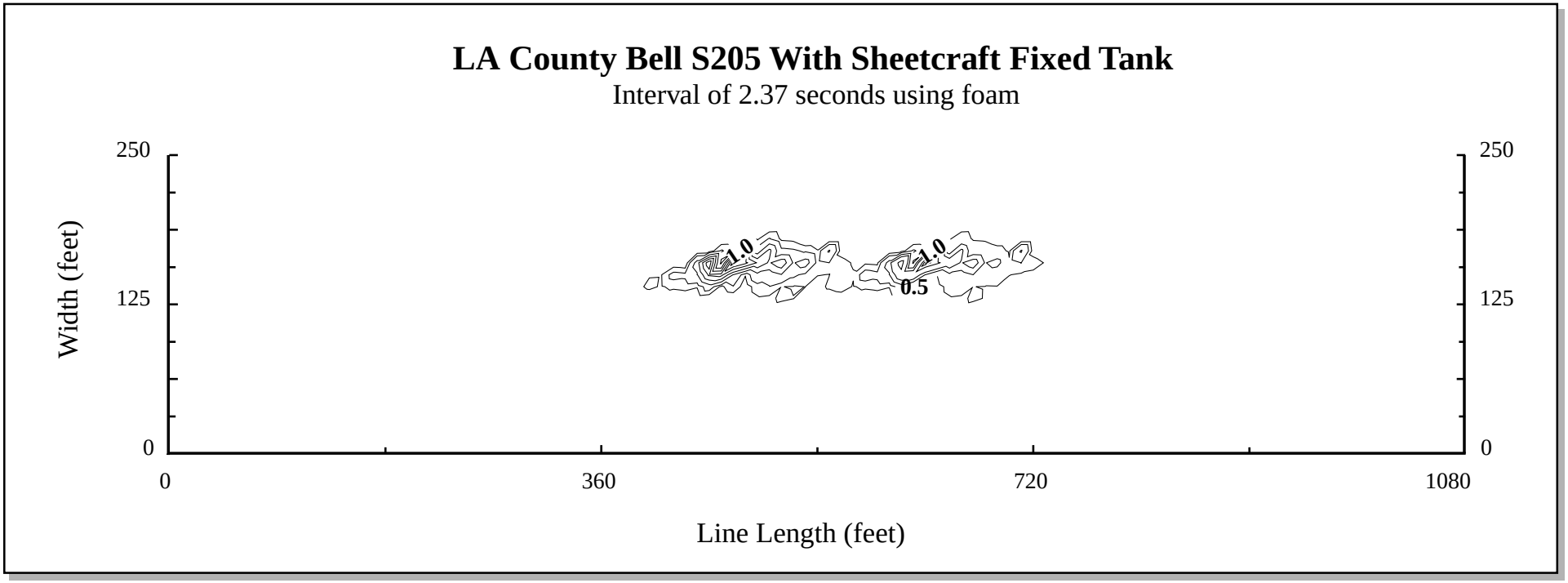

Figure 5—Drop pattern characteristics for the LA County Bell S205 helicopter with Sheetcraft fixed tank using a total of 320 gallons of foam with a computer-simulated trail drop (dropping compartments 1 and 2 with a time interval of 2.37 seconds) at a drop height of 61 feet, an airspeed of 40 knots (46 mph), and a wind speed of 2.0 mph.

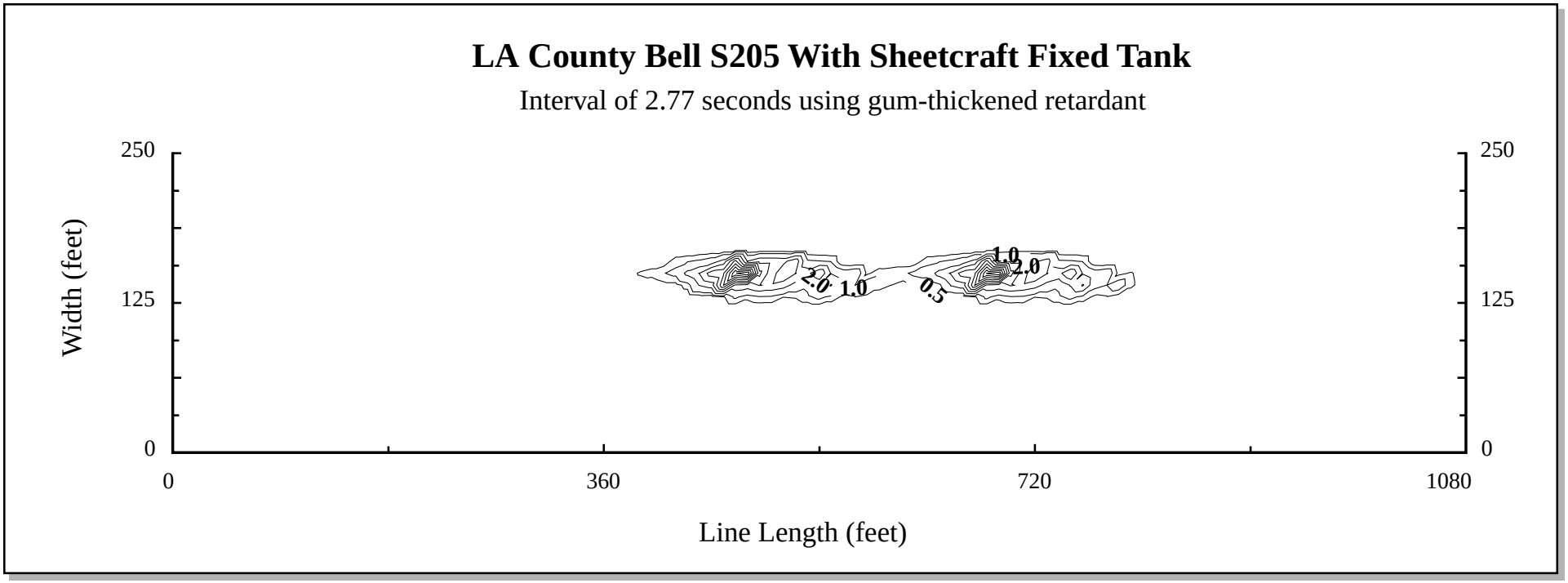

Figure 6—Drop pattern characteristics for the LA County Bell S205 helicopter with Sheetcraft fixed tank using a total of 320 gallons of gum-thickened retardant with a computer-simulated trail drop (dropping compartments 1 and 2 with a time interval of 2.77 seconds) at a drop height of 74 feet, an airspeed of 45 knots (52 mph), and a wind speed of 1.5 mph.

Figure 7—Drop test of the LA County Bell S205 helicopter using the Sheetcraft fixed tank to drop water.

About the Authors...

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