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Airtanker Drop Guides

United States Department of Agriculture
Forest Service
Technology & Development Program

Ground Pattern Performance of the Ayres Turbo Thrush with Standard Fire Door

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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 Ayres Turbo Thrush, operated by Pierce Aviation, is an aircraft designed for use as an agricultural sprayer. It is converted for fire suppression by using the standard fire door.

The Missoula Technology and Development Center tested the Ayres Turbo Thrush (Figure 1) 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 mechanically operated standard fire door used on the Ayres Turbo Thrush provides only one flow rate with a maximum volume of 450 gallons, all of which is released at one time. Tests included airspeeds from 79 to 100 knots (91 to 115 mph) and drop heights from 15 to 34 feet from the bottom of the door to the ground. The drops were made with three different materials: water, foam, and gum-thickened retardant.

Flow rate, drop height, and airspeed all have an effect on the drop pattern. Because this type of airtanker is normally used over a narrow range of heights and speeds and has a single flow rate, information about an average drop is presented (Figure 2). The figure represents the drop pattern from a water drop with a full flow rate.

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 Fire Behavior Fuel Model descriptions.

Figure 1—View of the gate on an Ayres Turbo Thrush.

The proper amount of gum-thickened retardant (expressed as coverage levels in gallons per 100 square feet) differs depending on the fuel model.

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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
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 drops producing the longest line at various coverage levels. All tests were conducted at airspeeds of 79 to 100 knots (91 to 115 mph).

Coverage Level (gal/100 sq. ft)	Airspeed (knots)	Line Length (feet)
0.5	80	1188
1.0	86	661
2.0	72	102
3.0	58	26
4.0	58	5
6.0	39	0
8.0	39	0
10.0	25	0

Table 3—Foam tests producing the longest line. All tests were conducted at airspeeds of 79 to 100 knots (91 to 115 mph).

Coverage Level (gal/100 sq. ft)	Airspeed (knots)	Line Length (feet)
0.5	80	1103
1.0	86	511
2.0	72	100
3.0	58	0
4.0	58	0
6.0	39	0
8.0	39	0
10.0	25	0

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 maximum line length for water at each coverage level.

Table 3 can be used to determine the maximum line length for foam at each coverage level. Table 4 can be used to determine the maximum line length for gum-thickened retardant at each coverage level.

The ground drop characteristics for the Ayres Turbo Thrush were derived through controlled test drop procedures on flat ground (Figure 3).
This information is to serve only as a guide in assisting field personnel to determine the proper drop height, airspeed, and door opening for delivering water, foam, or gum-thickened retardant. Actual coverage may vary depending on terrain, wind, weather, and pilot proficiency.

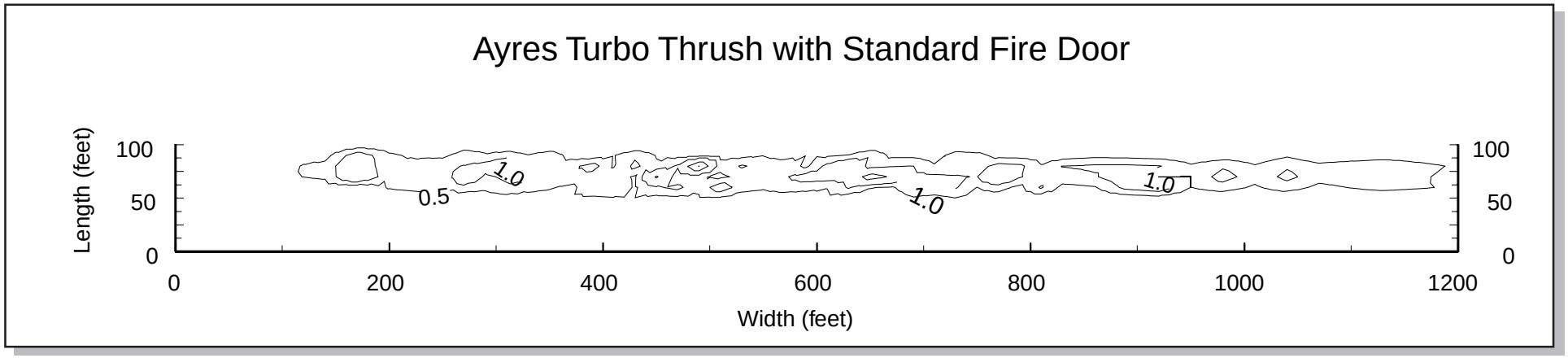

Figure 2 – Drop pattern characteristics for the Ayres Turbo Thrush with an airspeed of 96 knots (110 mph) and a drop height of 21 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

Table 4—Gum-thickened retardant test producing the longest line. All tests were conducted at airspeeds of 79 to 100 knots (91 to 115 mph).

Coverage Level (gal/100 sq. ft)	Airspeed (knots)	Line Length (feet)
0.5	80	1165
1.0	86	869
2.0	72	103
3.0	58	33
4.0	58	13
6.0	39	0
8.0	39	0
10.0	25	0

Figure 3—Drop test of the Ayres Turbo Thrush.

About the Authors...

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