DROP PATTERN FOR TWIN OTTER

MEMBRANE TANK SYSTEM

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ABSTRACT

An assessment of air-drop performance of the membrane tank-twin Otter DHC6 airtanker system is given. The system has considerable potential with its capabilities for variable drop patterns and STOL performance. Improvements are needed in some portions of the system.

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INTRODUCTION

The membrane tank-twin Otter DHC6 airtanker system (Fig. 1) is a recently developed system[2] utilizing a new concept of load release. The membrane tank system was developed by J. K. Hawkshaw, Chief Aeronautical Engineer, Field Aviation Company.

The system is designed to utilize the slow speed of the aircraft; provide an efficient pay load of fire retardant; and form a retardant pattern characterized by a long narrow uniform wetness coverage. The system contains two 12 ft. by 28 in. rectangular tanks, each with a capacity of 250 imperial gallons. The tanks are fabric-plastic membrane and have a "sausage-like" appearance when filled and viewed from below. The plastic is pulled from rolls positioned in the rear of the aircraft; one roll

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[2]The Forest Fire Research Institute, Canadian Forestry Service, provided funds for updating of the prototype membrane tank and preparation of engineering drawing under contract with Field Aviation Company. The Twin Otter aircraft was provided for demonstration purposes by the Ontario Department of Lands and Forests. The Alberta Forest Service funded the air time for the air drops recorded here.

supplies each tank. Clamps secure and lock into position the stretched membrane following its being pulled from the roll. The membrane thus forms both the bottom and a portion of the sides of each tank.

The loads are jettisoned by use of eight knives, four per tank, which are drawn along the entire perimeters at a speed selected by the pilot. Tanks can be jettisoned individually or in any combination of rates. Loads can be dropped instantaneously as a dump, or over a longer period covering up to 1500 ft. on the ground and referred to as a trail drop.

This report describes observation on the performance of that system made during demonstration drops at Cooking Lake, Alberta, August 5, and at Edson, Alberta, August 6. The demonstration at Cooking Lake was principally to familiarize Alberta Forest Service and Canadian Forestry Service staffs with the system; measurement of air drop patterns were made over a previously established grid near Edson. This report is not intended to represent a comprehensive assessment of the membrane tank-twin Otter system.

METHODS AND RESULTS

Four drops of 350 gallons each were made using Fire-Trol 100 retardant having a viscosity of 2300 centipoise units. Two drops were made over an open field and two drops over an adjacent lodgepole pine site. The stand averaged 5.9 in. d.b.h., 63 ft. in height, and had a basal area of 166 sq. ft./acre. Crown closure was estimated at 40 per cent.

Drop 1 -- short dump in open field (Figs. 2 and 3)

This drop was flown at 75 knots and at 200 feet altitude. Very little erosion by airflow took place and the Fire-Trol 100 retardant fell in one long narrow mass. The size of the pattern was 315 ft. by 30 ft.; retardant depth on the outside perimeter was .01 in. (0.5 gals./100 sq. ft.). The area covered by the drop at an application rate of .04 - .07 in. depth[3] (2.1 - 3.6 gals./100 sq. ft.) was 100 ft. by 30 ft.

Drop 2 -- short dump in lodgepole pine stand (Fig. 4)

This drop was flown at 75 knots and 200 feet altitude. Good penetration resulted with the bulk of the load reaching the ground. The surrounding trees were well coated by the fire retardant on the drop side. Total area covered was 235 ft. by 27 ft. at .01 - .02 in. concentration. The main area of drop on the ground was 105 ft. by 27 ft. at an application rate between .02 in. and .04 in. depth (1.0 - 2.1 gals./100 sq. ft.).

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[3]All retardant concentrations are estimated.

Figure 1. Twin Otter DHC 6 with membrane tank support structure.

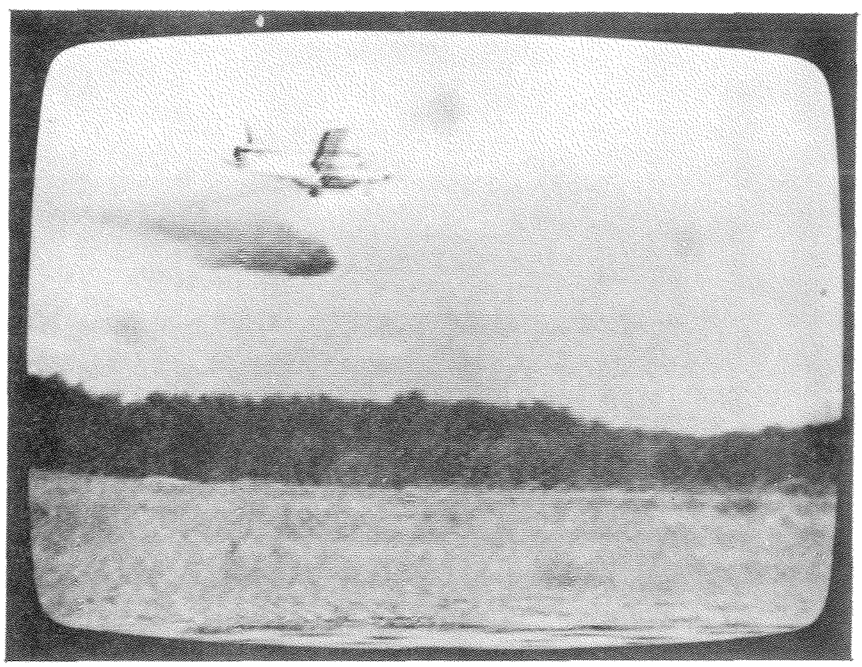

Figure 2. Short dump at 75 knots, aircraft at 200 ft. elevation.

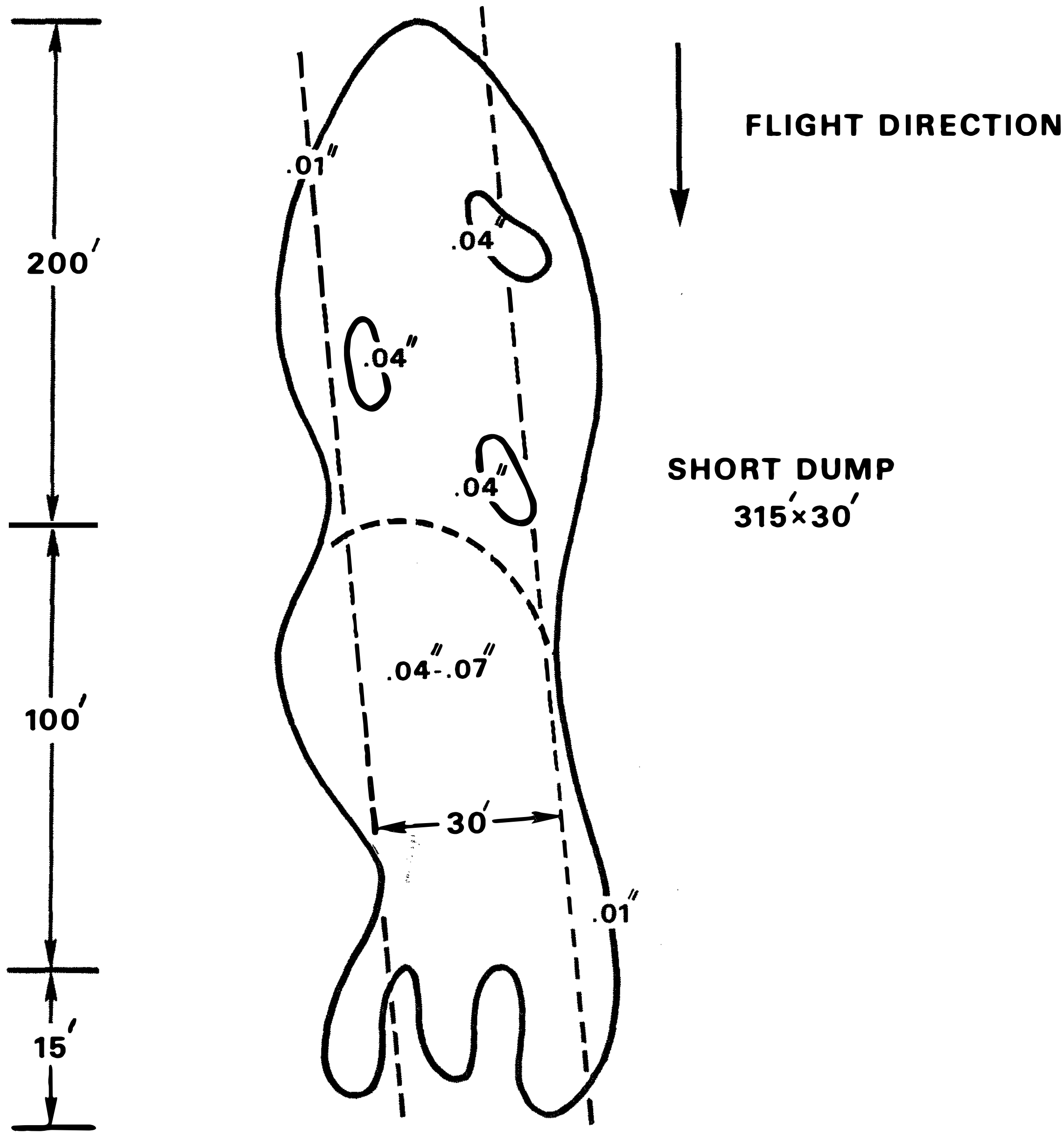

Figure 3. Drop 1. Ground distribution of short dump over open field flown at 75 knots and 200 foot elevation. Depth of retardant estimated in inches and dimension of drop in feet (0.01 in. depth = 0.5 gal./100 sq. ft.)

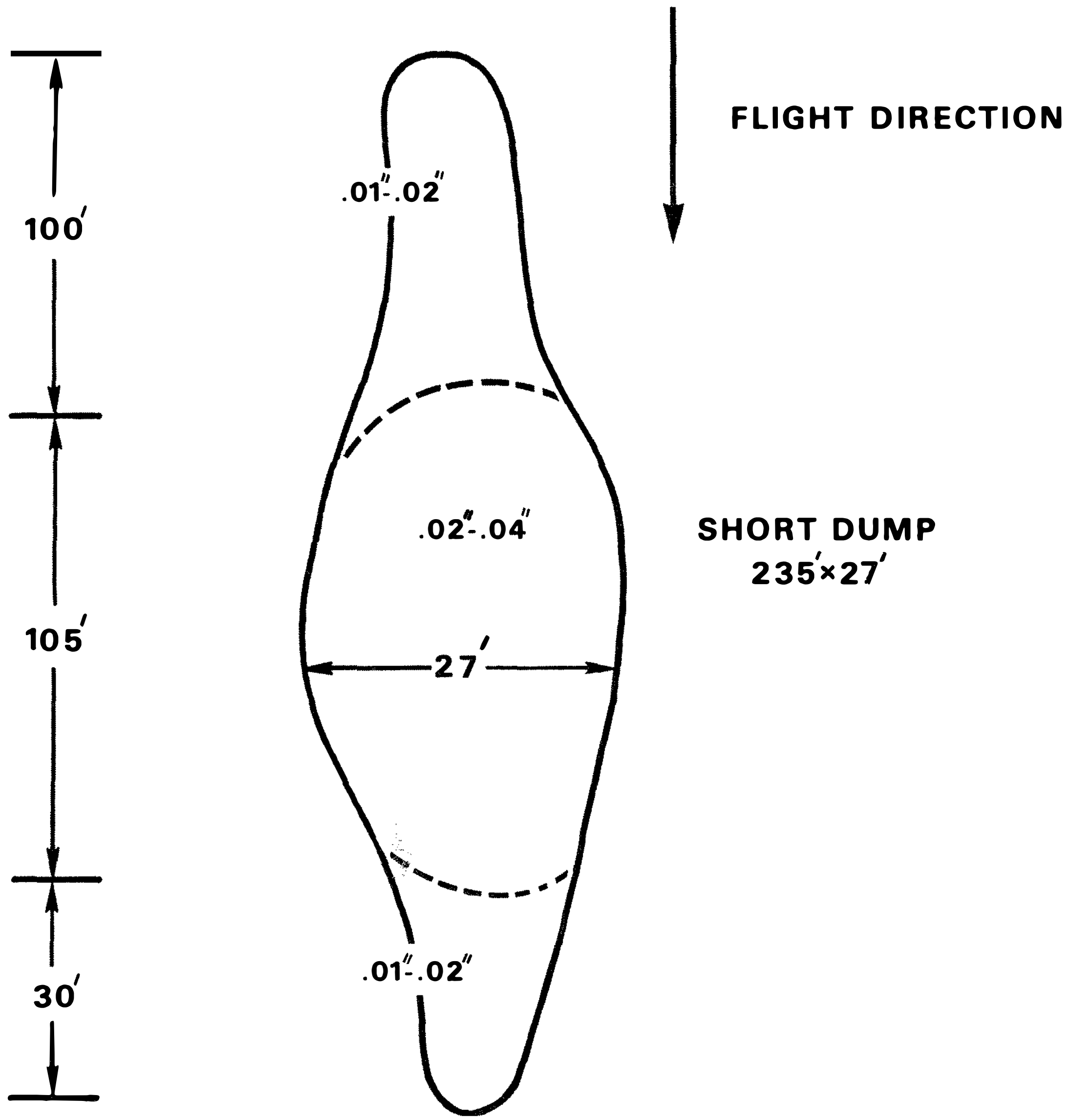

Figure 4. Drop 2. Ground distribution of short dump over lodgepole pine stand flown at 75 knots and 200 foot elevation. Depth of retardant estimated in inches and dimension of drop in feet (0.01 in. depth = 0.5 gal./100 sq. ft.)

Drop 3 -- long dump in open field (Figs. 5 and 6)

This drop was flown at 85 knots, 120 feet altitude and dialed in the aircraft for a 500 ft. trail. The ground pattern exhibited an uneven longitudinal wetness. We were informed this can be corrected by adjusting the cutting sequence. The overall area covered by the drop was 425 ft. by 32 ft. (.01 - .02 in. concentration). The main drop area measured 307 ft. by 32 ft. with retardant depth on the ground of between 0.04 - 0.07 in.

Drop 4 -- long dump in lodgepole pine stand (Fig. 7)

This drop was flown at 85 knots, 75 feet above the ground, and dialed in the aircraft for 500 ft. trail. Uniform penetration underneath the canopy was visible except for about 20 ft. in the middle of the drop at which point the second tank had been triggered. There should have been more of an overlap between the end of the first tank and the beginning of the second tank. We were told that this can be corrected by adjusting the knives. The drop area measured 330 ft. by 32 ft. with a retardant depth of between .01 - .02 in. (0.5 - 1.0 gals./100 sq. ft.).

Figure 5. Long (trail) dump flown at 85 knots at 120 ft. above tree top.

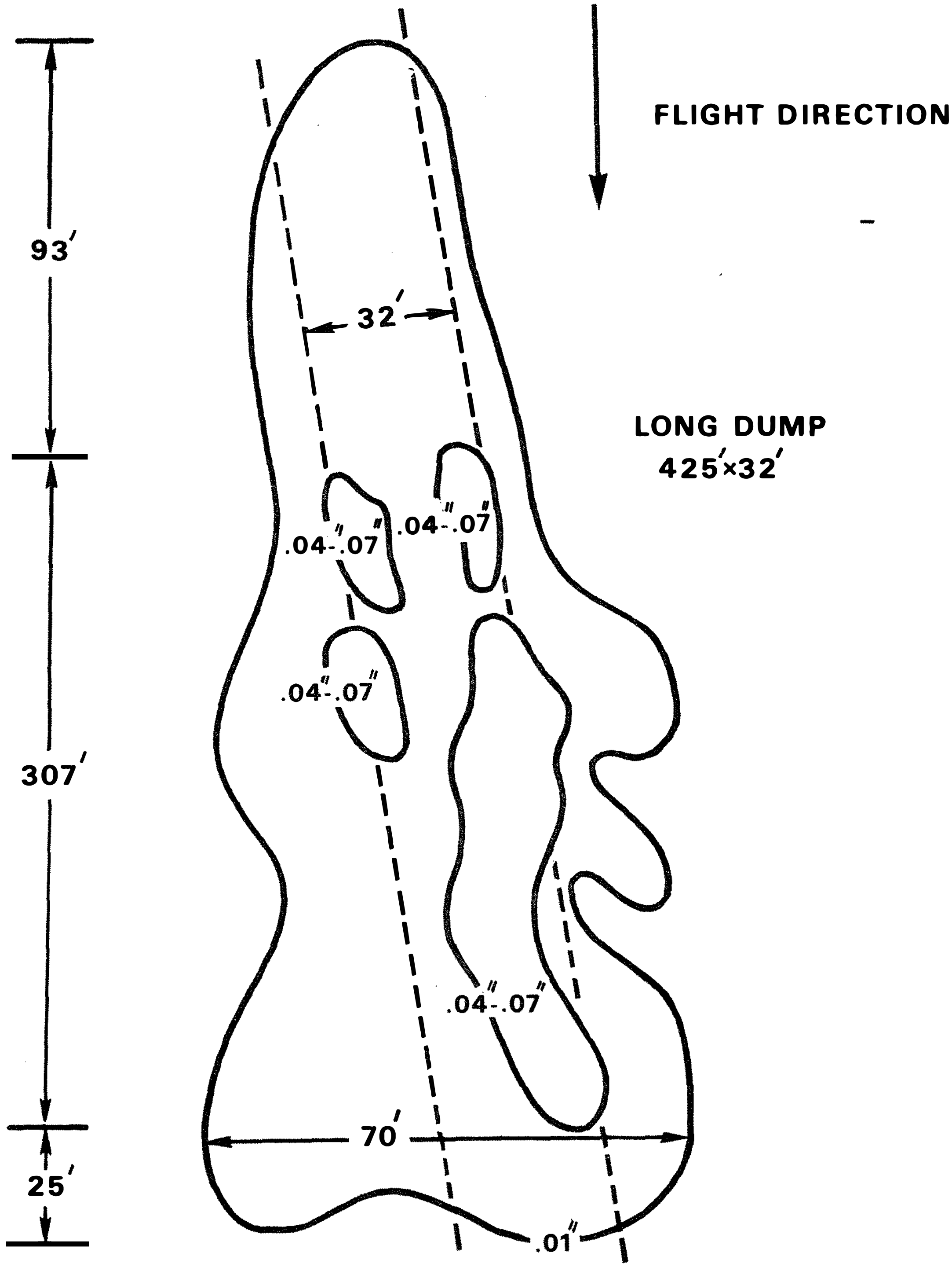

Figure 6. Drop 3. Ground distribution of long (trail) dump over open field flown at 85 knots and 120 foot elevation and dialed for 500 foot trail. Depth of retardant estimated in inches and dimension of drop in feet (0.01 in. depth = 0.5 gal/100 sq. ft.)

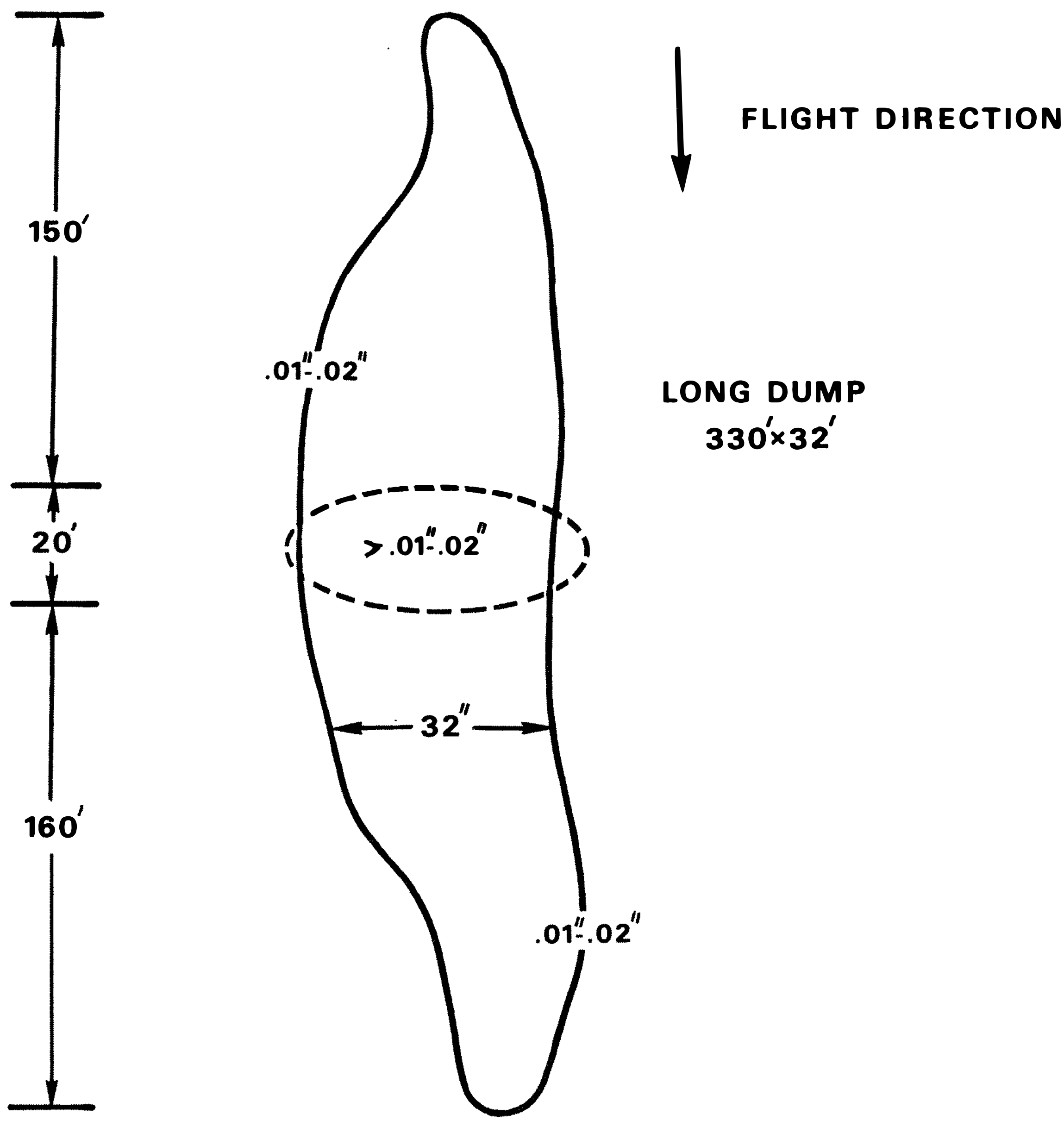

Figure 7. Drop 4. Long (trail) dump over lodgepole pine stand flown at 85 knots and 75 feet above the ground and dialed for 500 foot trail. Depth of retardant estimated in inches and dimensions of drop in feet (0.01 in. depth = 0.5 gal./100 sq. ft.)

CONCLUSION

The variable load dropping ability and generally excellent ground coverage by the drops, together with the STOL capability of the aircraft indicate a water bombing system of considerable potential. As recognized by the designers, some important changes are required. Specifically, manual operation of the membrane loading mechanism following each drop is too slow; having to load each tank separately and from different sides of the aircraft is also too slow. Fabric for the membrane tanks, at this date, costs near $15 and is lost with each drop. Reliability of the cutting or releasing mechanism requires improvement to ensure specifications dialed for each load are realized on the actual drop.