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AN INJECTOR FOR MIXING GELGARD FIRE RETARDANT
ON LAND-BASED AIRTANKER OPERATIONS

by

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INTRODUCTION

The presence of numerous small airstrips throughout the forested regions of southern Alberta permits the utilization of small airtankers for aerial fire suppression. These aircraft, because they can move to and operate from an airstrip(s) situated close to a wildfire, are valuable firefighting tools, especially in a support-action role. There is a need for a fire retardant that can be quickly and easily mixed for use with the airtankers.

The characteristics of GELGARD fire retardant² favor its use in the province. During the 1966 fire season, the Alberta Forest Service introduced this short-term retardant into its airtanker operations. Difficulties were experienced in preparing satisfactory GELGARD F mixtures during trials with several mixing methods. As a result, the Alberta Forest Service Equipment Development Center developed a mixing injector for use primarily with the 250-gallon-capacity Snow Commander airtanker. The injector was field-tested at Edson, Alberta, and evaluated on wildfire operations during the 1967 fire season. A mixing system using the injector was developed prior to and evaluated during the 1968 fire season. This report describes and evaluates the injector and the mixing system.

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² GELGARD is a synthetic organic polymer in insoluble powder form. Each particle of powder can absorb 100 to 1000 times its weight in water. When mixed with water, the powder produces either a viscous water or a gel, depending on the amount of powder applied. Approximately 80 per cent of final viscosity is reached within 2 minutes, and virtually full viscosity is attained within 5 minutes of mixing. The viscosity of mixture varies with water temperature and salt content. GELGARD F, which is used for aerial application, contains a fluorescent pink dye to make air drops visible.

THE INJECTOR

The injector uses the vacuum produced by water entering through an orifice and around the outside of a venturi tube to entrain or suck in GELGARD F powder. The high-pressure stream of water mixes the powder and carries the mixture into an outlet pipe. A scale drawing of the $1\frac{1}{2}$ -inch plastic injector is shown in Figure 1. The injector was developed for use primarily with Wajax pumps.

THE MIXING SYSTEM

A side view of the GELGARD F mixing system is shown in Figure 2. The feed-in apparatus includes a clear plastic funnel with an 18-pound capacity (1), a screen (2), and a GELGARD F flow meter (3). The removable screen prevents impurities, e.g., grass and balls or flakes of dye, from restricting or stopping flow of GELGARD F into the injector. The flow meter, which consists of one of two movable brass discs (each containing four holes), regulates the amount of GELGARD F powder being entrained. Disc "A" has holes of drill size Nos 37, 36, 34, and 33; disc "B" has drill size Nos 32, 31, 30, and 29. These eight holes cover the range of GELGARD F application rates. For example, with Disc "A" set on the No 3 opening, or No 34 drill size, about 15 pounds of GELGARD F powder is entrained in the $4\frac{1}{2}$ minutes required to fill the 250-gallon tank with a Wajax pump. The check valve (12) prevents mixed material from being forced back into the injector should excessive back-pressure develop in the loading hose.

The mixing system is mounted on a tripod situated about 50 feet from the aircraft. GELGARD F mixture is transported to the airtanker through a 50-foot-long, 2-inch fire hose. KAM-LOC connectors are used for all fittings to facilitate assembly and disassembly. Wajax pumps supply the water for the $1\frac{1}{2}$ -inch injector¹.

¹ A two-inch injector was tested operationally with two Wajax Mark 1 pumps in series and a Coventry Climax pump. The two-inch model performed satisfactorily and reduced the loading time.

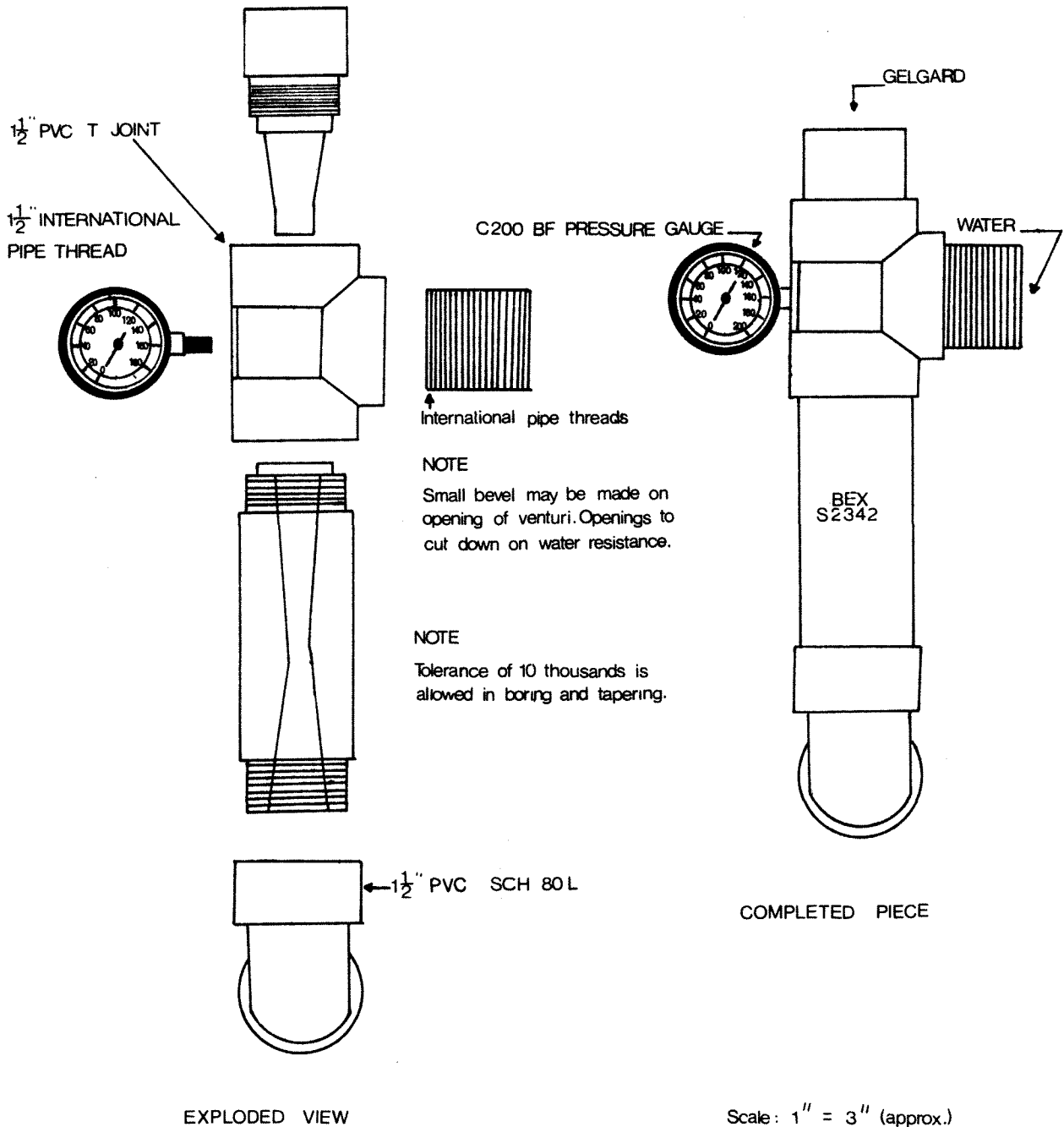


Figure 1. Scale drawing of 1 1/2-inch injector.

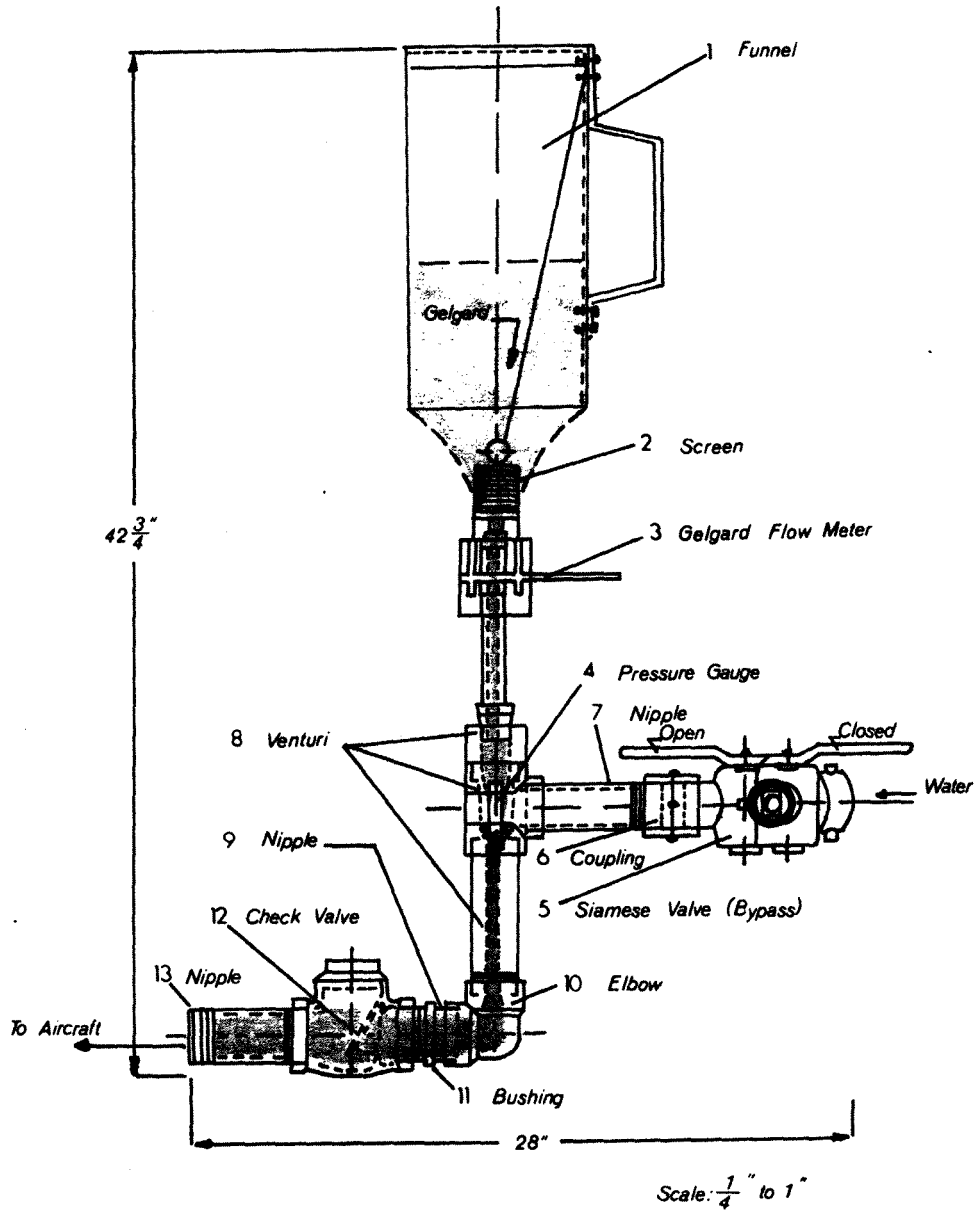


Figure 2. Side view of GELGARD F injector mixing system.

The general layout for the mixing operation is illustrated in Figure 3; a view of the same operation is shown in Figure 4.

MIXING PROCEDURE

1. The amount of GELGARD F powder required for every load of retardant mixture is determined either through a series of field tests or during the early stages of the wildfire operation for each airstrip. The flow meter is set on the hole which produces a desirable mixture with the existing water conditions. An experienced mixmaster can determine the amount of GELGARD F required after the first three loads². Requests by the bird-dog officer or fire-line personnel for either a thinner or thicker mixture may change this application rate. A desirable GELGARD F mixture is shown in Figure 5.
2. Adequate vacuum is created at the injector when the Wajax pump is operated at normal throttle. Water pressure at the injector must be at least 55 psi to ensure that the vacuum is sufficient to entrain the powder and prevent plugging.
3. A spurt of water is emitted through the top of the injector when water flow is both initiated and terminated. This necessitates cleaning of the injector orifice with a bottle brush after each load. Care not to place the feed-in apparatus into the injector before the initial spurt, and to remove it before the final spurt, must be exercised in order that plugging of the flow meter might be prevented. The 50-foot hose leading to the aircraft should be kept free of kinks to prevent restriction of GELGARD F mixture flow and subsequent kick-back out of the injector top.

² In Alberta, between 4 and 6 pounds of GELGARD F/100 gallons (1b / 100 gal) water are required for a desirable gel on land-based operations.

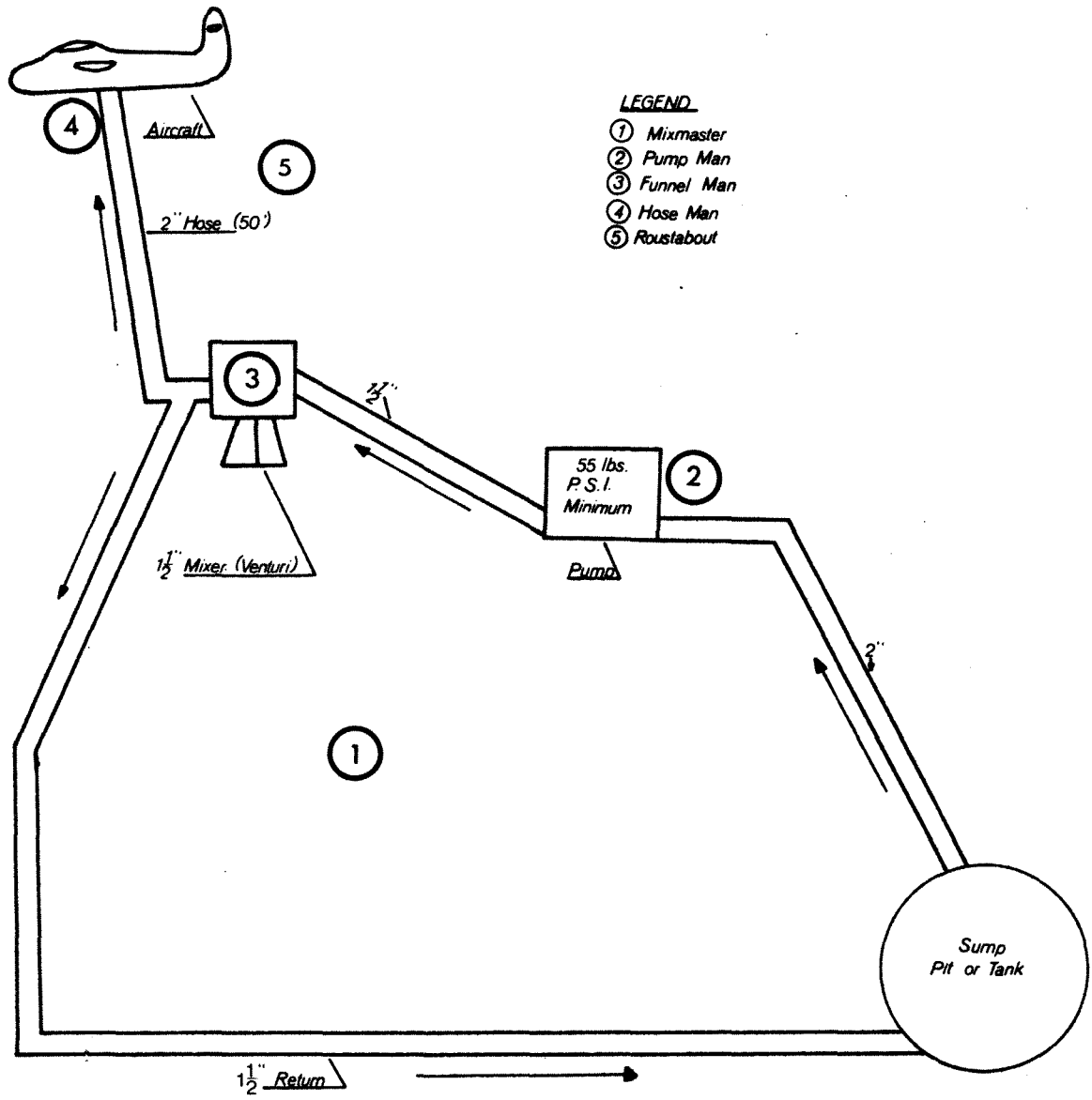


Figure 3. General layout for GELGARD F injector mixing system.

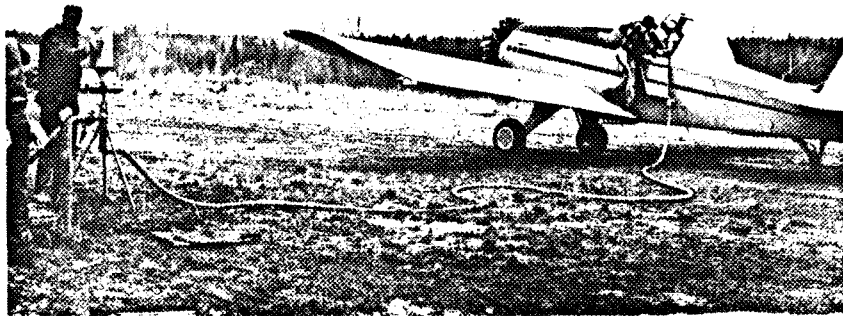


Figure 4. A Thrush Commander airtanker is loaded by the GELGARD F injector mixing system.

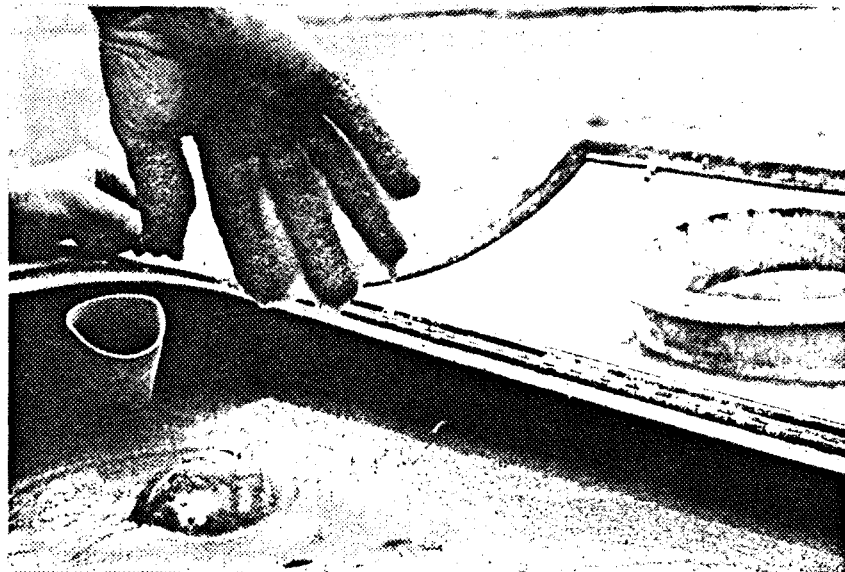


Figure 5. A desirable GELGARD F mixture prepared with $4\frac{1}{2}$ lb./100 gal. water.

4. The screen in the funnel should be cleaned after each load. Failure to do so results in irregular flow of GELGARD F powder, thus in inconsistent mixtures. Impurities present in the retardant can be removed by pre-screening all powder. However, balls of dye still accumulate at the screen.

PERSONNEL AND DUTIES

Five persons are usually required for a single-outlet loading operation, although the size of the crew may vary with the type and duration of the operation. The mixing crew includes the mixmaster, pump man, funnel man, roustabout, and time-keeper-radio operator. Duties of each of the crew members are listed below:

Mixmaster - oversees complete loading operation; recognizes problems arising and corrects them immediately; checks for quality control; should be able to take over any position.

Pump man - sets up Wajax pump; has fuel on hand, mixes fuel and operates fire pump; assists in setting up loading operations; assists funnel man when necessary.

Funnel man - sets up GELGARD F mixing system and lays out hose; handles three-way siamese valve at injector to control water flow; places funnel and flow meter on injector; removes funnel and flow meter when signalled by hose man; fills or assists in filling funnel to pre-determined mark on funnel (if two funnels used, is assisted by either pump man or roustabout); ensures that proper amount of GELGARD F powder is flowing from funnel; keeps injector and funnel(s) clean.

Hose man - checks to ensure that drop gate of airtanker is closed; connects two-inch loading hose into airtanker and checks hose for kinks; checks flow of GELGARD F mixture into tank to ensure proper amount of powder is being entrained;

cleans airtanker windshield (assisted by roustabout); assists in fueling of airtankers; signals funnel man when GELGARD F mixture is within one inch of pre-determined full level; removes two-inch loading hose from airtanker.

Roustabout - assists funnel man in filling funnels; cleans airtanker windshield; assists in fueling of airtankers; keeps adequate supply of GELGARD F on hand; maintains loading area in a tidy condition.

Timekeeper - radio operator - keeps times on aircraft (including bird-dog plane), loading crew, aircraft fuel tanker and water-truck(s); operates radio; handles and relays written messages and instructions from Fire Control Officer.

DISCUSSION

The characteristics of GELGARD F necessitate that a mixmaster who is completely familiar with the retardant and the mixing system and procedure be employed. Utilization of personnel who have no knowledge of the mixing operation further necessitates a good mixmaster.

The injector and mixing system perform well when the procedure established is followed. Although deviation from the recommended procedure is necessary in isolated incidents, failure to comply with it usually results in the preparation of inconsistent mixtures, or in the disruption of the loading operation. Any disruption is especially critical when only one loading outlet and a number of airtankers are utilized, and when turn-around time is short.

ACKNOWLEDGEMENTS

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