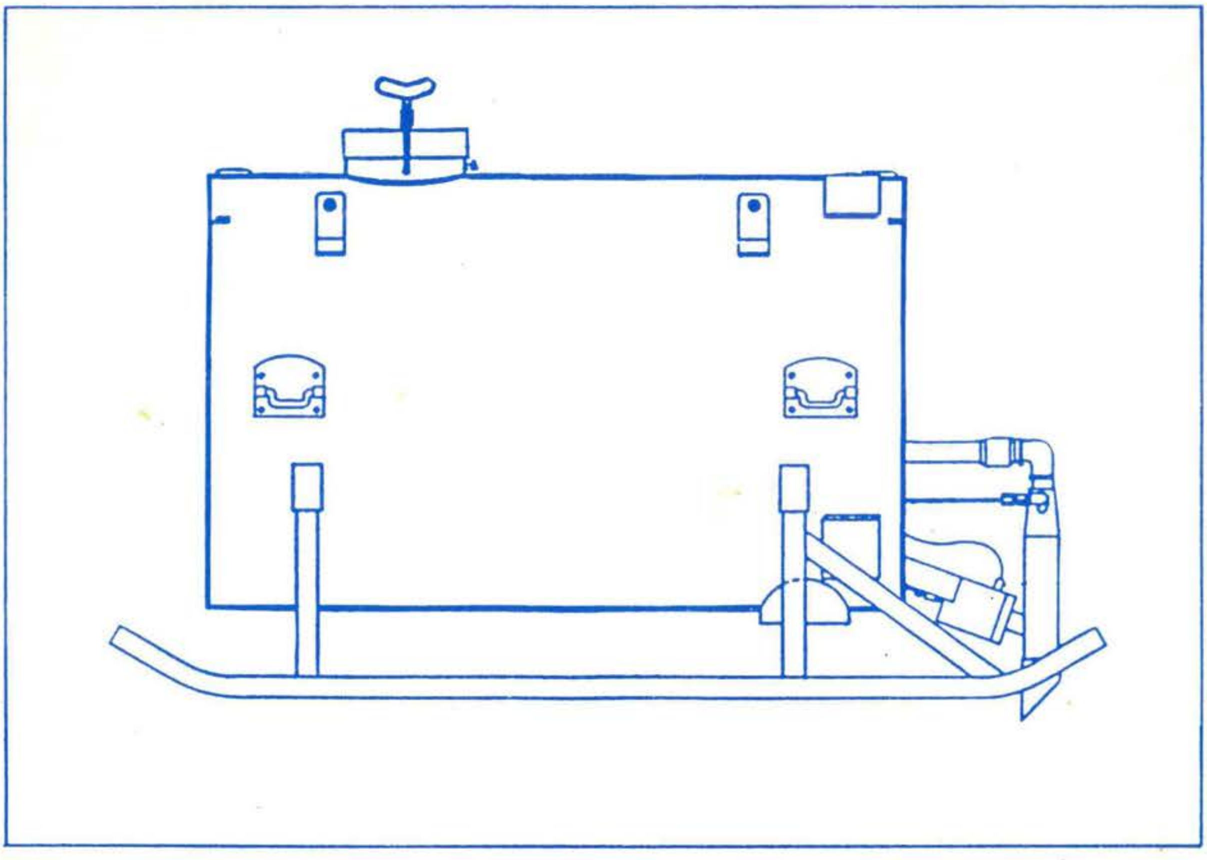
REPORT ON
AERIAL DRIPTORCH OPERATIONS
IN TASMANIA
MARCH 1987

by G.W. VAN DIDDEN



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SUMMARY

This report describes the operation of the APHID Helitorch as used by the Tasmanian Forests Commission during their control burning operations, March 1987. The operational feasibility and applications of the Helitorch to Western Australian control burning operations are evaluated.

The technique is cost effective and has considerable potential in this State. The following applications are recommended:

- constructing buffer zones in coastal heathlands;
- removing logging slash in preparation for pine planting; and
- lighting regeneration burns in the southern Karri Forest.

The study recommends that: two units are built locally; a suitable ground mixing system is purchased or is incorporated into the Helitorch system; and suitable training courses are developed. Helitorch development will extend the existing range of fuel structures that can be ignited using aerial techniques.

FIGURE 1. HELITORCH IGNITION OPERATIONS

INTRODUCTION

The purpose of this report is to describe the Helitorch used in Tasmania during March 1987. The report is part of a study undertaken to evaluate and introduce new aerial ignition techniques and their potential application to Western Australia's control burning operations.

In Tasmania aerial ignition systems are used for a variety of forest and land management objectives (Bennett 1987). This report deals with the modified ASHLEY APHID HELITORCH operated by the Tasmanian Forests Commission.

The Commission carries out a regeneration burning programme over some 7000 hectares each year. The aim of this burning is to generate high intensity fires with a strong central convection column (Gellie 1983).

The Western Australian Department of Conservation and Land Management has similar needs: that is, to generate high intensity fires. Current requirements are 2600 hectares per annum of Karri regeneration and 2700 hectares per annum of pine clearing burns (Annual Reports, 1979 to 1985). This trend is likely to continue.

BACKGROUND

The ASHLEY APHID HELITORCH was designed by the New Zealand Forest Service and manufactured to meet the standards set by their Ministry of Transport — Civil Aviation Division (Hildreth 1985). The unit received its certificate of type approval on August 18th, 1982 (New Zealand Forest Service, 1983).

The Tasmanian Forests Commission purchased a unit from New Zealand and eventually succeeded in obtaining clearance to operate their modified Helitorch, since renamed the "Red Dragon", in February 1987 (Bennett, personal communication, 1987). This is some three years after initial attempts were made to introduce the unit into Australia.

In its early developmental stages a number of companies and Government Departments were approached to give advice and obtain clearance for safety standards and operational approvals (Tasmanian Forestry Commission, 1985). This approach met with little success until a seminar was held in Tasmania during June 1985. This demonstration dispelled a number of misconceptions that were held about the project.

DESCRIPTION

ASHLEY APHID FIRELIGHTING SYSTEM

The Tasmanian modified ASHLEY APHID firelighting device is designed to dispense ignited gelled-petrol in large droplet form at constant regular intervals (Bennett, 1987).

The unit is designed to:
(a) give simple operator control with positive flow fuel rate selection;
(b) give a wide range of fuel delivery rates controlled through adjustments made on the ground;
(c) comply with Commonwealth Department of Aviation safety requirements;
(d) operate as a pressure vessel with State Department of Labour and Industry authorisation (Tasmanian Forestry Commission, 1986);
(e) be carried and operated as a helicopter sling load, which can be jettisoned in an emergency;
(New Zealand Forestry Service, 1982).

SYSTEM DESCRIPTION

The Helitorch consists of three major components attached to the fuel storage tank. They are:
- fuel delivery system;
- ignition system; and
- fire extinguishing system.

Fuel Storage Tank

Fuel for the operation is stored in a steel container with a useable capacity of 135 litres. By altering the fuel flow setting, the endurance can be varied from 32 through to 108 minutes.

The fuel is lightly pressurised with an inert gas to prevent an explosive gas build-up and assist with the fuel flow delivery.

Fuel Delivery System

Gelled fuel is drawn from the tank by a positive displacement pump. Any lumps and impurities are filtered out through an in-line strainer.

In flight, the Helitorch technician controls the fuel flow rate by a two position toggle switch. Further mechanical adjustments are made on the ground. This is done by varying stroke length to deliver from 20 to 49 cubic centimetres of gelled petrol per stroke. A positive one-way mechanical shut-off valve is located near the burner nozzle to prevent fuel from dripping out when the pump is turned off.

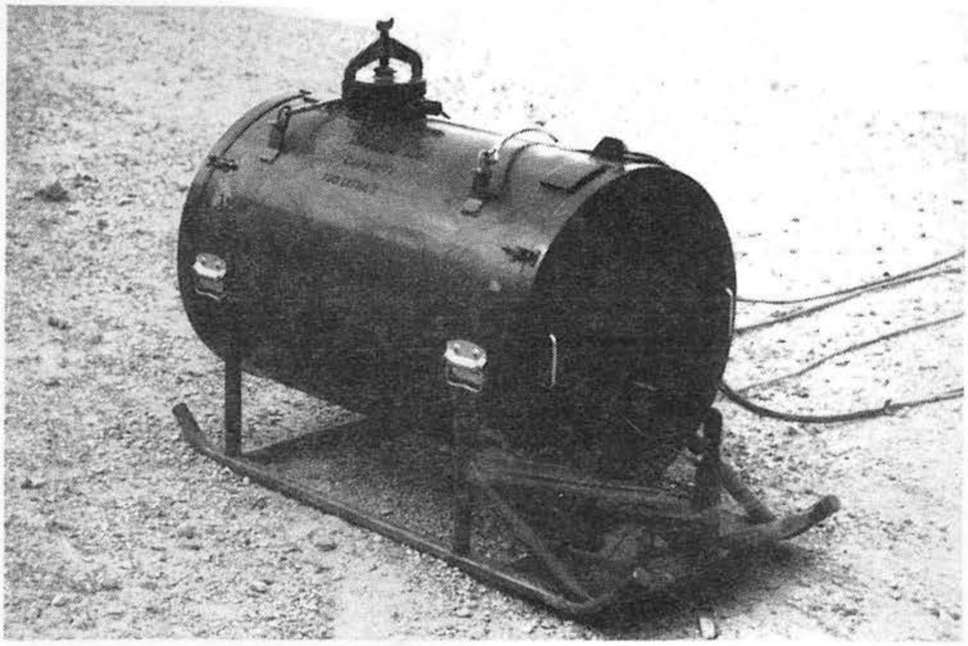

FIGURE 2. FUEL STORAGE TANK.

Ignition System

The fuel ignition system consists of a propane torch in which the flame is initiated by means of an automotive type ignition system (Bennett 1987). The burning propane ignites the gelled petrol as it comes through the burner nozzle.

FIGURE 3. BURNER NOZZLE AREA.

The Helitorch technician controls the propane and ignition circuit by a master switch on a hand control unit. With continuous usage propane endurance is estimated at 180 minutes for a 0.34 kg (12 oz.) bottle (New Zealand Forest Service, 1982).

FIRE EXTINGUISHING SYSTEM

Several features are built into the system to ensure that maximum safety levels are maintained. They are:

- burner nozzle extinguisher;
- automatic jettisoning discharge; and
- CO_2 pressurized fuel storage.

Burner Nozzle Extinguisher

This system is designed to extinguish the burner at the outlet nozzle during flight.

The technician activates the fire extinguisher by pressing a pushbutton on the control box. With normal usage of about one second per blast, the 3.5 kg CO_2 bottle will last for 5 hours.

Automatic Jettisoning Discharge

Should an emergency arise and the unit need to be jettisoned, the fire extinguisher will automatically discharge. The unit is mechanically activated when the Helitorch is released while the safety line is still attached.

The same action can occur if the safety line becomes tangled during lift-off resulting in the bottle being accidentally discharged. Unfortunately bottles are a non-standard size with filling facilities not readily available in country centres.

CO_2 Pressurized Fuel Storage

After each re-fuelling operation, any air remaining in the tank is dispelled by purging and re-pressurizing the system with carbon dioxide at 24 Kpa. This action prevents explosive gases from building up inside the tank.

FUEL MIXING PROCEDURES

To ensure successful, incident-free operation, requires considerable and detailed planning. Safety procedures and standards developed for this operation must be strictly adhered to (Bennett, 1987).

A three man ground team prepares and loads the gelled fuel. The team consists of a Helipad Marshall, Mixing Operator and Loading Master. The Helipad Marshall is appointed to control the ground activities and to uphold safety standards.

To make the system operationally feasible, the fuel is mixed in a 200 litre open-ended drum, carried in the back of a utility. The gel is made by adding dry gelling powder while the petrol is pumped into the drum. At the same time, the mixture is gently stirred with a plastic paddle for 5 to 10 minutes, until the mixture gels and reaches the correct consistency. The "brew" is then left to set until ready to use.

The "Sure-Fire" gelling agent used is mixed at the rate of 700 gm to 130 litres of straight petrol. As at November 1986, "Sure-Fire" was Can.$5.50 per lb or Can.$2.49 per kg excluding freight. "Sure-Fire" is available from H.L. Blanchford Ltd., 2323 Royal Windsor Drive, Mississauga, Ontario, Canada, L5J 1K5.

FIGURE 4. MIXING FUEL ON THE BACK OF THE UTILITY.

The gelled petrol is transferred from the mixing drum and poured into the Helitorch using 8 litre plastic buckets. The mixing and transfer facilities are the most rudimentary components of the operational system and could be improved.

There are a number of mixing systems available on the market in Canada and the United States. Alternatively the mixing system could be included in the Helitorch itself.

FIGURE 5. TRANSFERRING FUEL IN 8 LITRE BUCKETS.

HOOKING UP PROCEDURES

Immediately prior to helicopter arrival and departure, the Helipad Marshall ensures that the helipad area is cleared of non-essential personnel and equipment. Both the Helipad Marshall and the Loading Master must be competent in using standard hand signals to direct the helicopter.

Upon helicopter arrival, the Helipad Marshall directs the pilot to hover over the torch. During this phase the Loading Master must stand beneath the helicopter and hook the lifting strap onto the cargo hook. This task requires a great deal of both skill and nerve.

FIGURE 6. LIFTING STRAP BEING HOOKED TO HELICOPTER.

PRODUCTION RATES AND COSTS

Logging slash is most effectively reduced by burning and using a Helitorch. Provisional performance data from Tasmania (Bennett, 1987) reports production rates of 5 to 10 hectares per minute in the larger coupes of 100 hectares plus. This figure compares well with the generic production rates calculated of 6.8 hectares per minute. It assumes a flying speed of 55 knots (102 km/hr) and 40 metre strip-width. See Appendix 1 for details of formulae for calculation of production rates.

Productivity can be further increased by increasing either airspeed and/or distances between flight lines. See Figure 7 below for details.

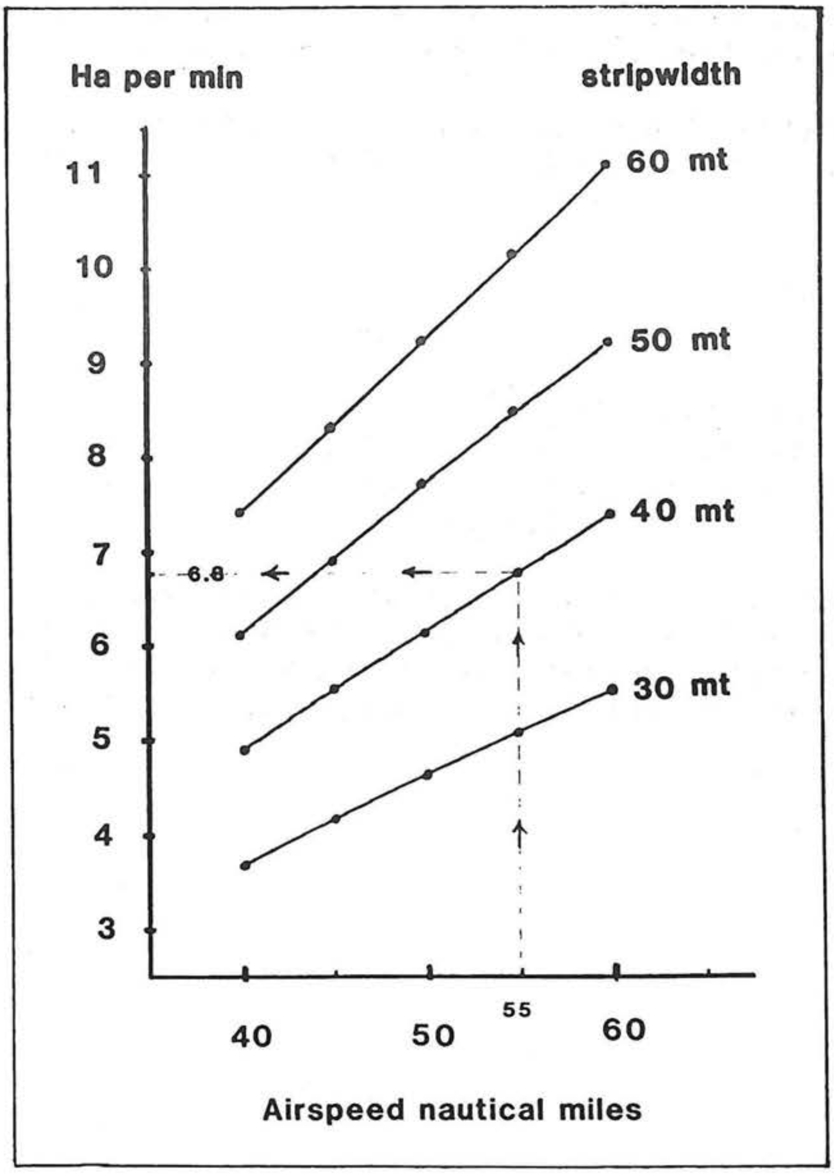

FIGURE 7. GENERIC PRODUCTION RATE.

Production Rates

In order to compare ignition costs between the Helitorch and incendiary machine, it is necessary to make a number of assumptions about the speed at which the helicopter is flown and the stripwidth distance between flightlines.

For both operations, 55 knots is considered to be a comfortable safe speed well above the 40 knots minimum recommended.

Stripwidth distance between flightlines of 40 metres is regarded as optimum for a number of operations requiring an intensive ignition pattern, e.g. regeneration and clearing burns. A widening of stripwidth by 10 metres, from 40 to 50 metres, will increase productivity by 25 per cent from 6.8 ha/min to 8.5 ha/min. See Appendix 1 for formulae for calculation of production rates.

The role of the Helitorch technician is to judge fire behaviour and adjust stripwidth and airspeed accordingly to obtain maximum productivity.

Costs

Material costs are less than one-third those incurred using incendiary balls. Material costs are 40¢ per hectare or $1.63 per line kilometre, assuming a 6.8 hectare/minute production rate, maximum fuel flow rate, fuel costs of 65¢ per litre and "Sure-Fire" cost of $6.42 per kilogram.

By comparison, incendiary balls ejected at the maximum speed of one per second, under the same conditions, would cost $1.49 per hectare or $6.12 per line kilometre, based on an incendiary ball cost of 17¢ each. Helicopter costs are about the same for Helitorch and incendiary dropping operations.

POTENTIAL APPLICATIONS

Buffer Zones

The technique has special application for the construction of fuel reduced buffer zones in coastal heaths. Buffer zones could prevent these areas being devastated by a single fire.

Duxbury reports that fires have been successfully lit during the winter months under the influence of strong wind conditions to form safe wind-driven fires in coastal heaths. Operational trials to simulate these methods using an aircraft with incendiary capsules have been only partially successful.

Part of the problem lies with the vegetative structure of coastal heaths; a lack of continuous ground fuel prevents a ground fire being carried except under conditions of high fire hazard. Gelled petrol on the other hand will stick to and ignite the aerial portion of the heath fuels, thus creating a more continuous and reliable ignition source.

Regeneration and Clearing Burns

The Helitorch will complement the range of fuels that can be ignited by aerial ignition methods. Specifically, each blob of gelled petrol breaks up to form a number of individual ignition sources which will adhere to any fuel. Incendiary balls do not have this advantage and rely heavily on chance to land on suitable fuel for propagating the fire.

The technique is particularly suited to regeneration and clearing burns for generating high intensity fires with a strong central convection column. The convection effect provides a safety measure by keeping sparks and embers inside the burn, while the high intensity fire removes logging debris and produces a competition-free seedbed ready for planting eucalypt or pine seedlings.

By burning under marginal Surface Moisture Content (SMC) conditions, gelled petrol is considered to be a more reliable and effective means of igniting logging slash than incendiary capsules. Secondly by operating under these lower burning conditions, the risk to adjacent areas is significantly reduced.

DISCUSSION

It is recommended that a Helitorch be used in addition to standard ignition as a fire-lighting tool in this State. The Department of Conservation and Land Management will benefit from this technique in that it will:

- produce material cost savings;
- increase productivity compared to manual methods; and
- extend the range of fuels that can be ignited by aerial ignition methods.

The technique is cost effective and has considerable potential in this State. In particular the Helitorch would be advantageous in the following applications:

- buffer zone construction in coastal heathlands;
- logging slash removal for planting seedlings; and
- lighting regeneration burns.

For these applications the Helitorch is better than incendiary balls because:

- the number of ignition sources per unit area is greater;
- gelled petrol adheres to aerial or ground fuels;
- the ignition source intensity can be varied to suit fuel moisture conditions, by altering the volume of gelled petrol ejected.

Building Helitorch

Recommendation No.1:
That the Department design and manufacture its units based on the New Zealand ASHLEY APHID HELITORCH design. In order to avoid delays experienced in Tasmania, the unit would be specifically designed and operated to meet the Australian Department of Aviation regulations.

The Tasmanian Forests Commission experienced delays because of operating approval hold-ups from both State and Commonwealth authorities. These delays can be avoided by designing and building the unit as part of the aircraft, to aviation standards.

Purchasing a unit from New Zealand is not recommended because several modifications would be required to meet Australian airworthiness standards.

A preliminary cost estimate of manufacturing a unit according to existing plans is $5,500 each. Two units should be built, to provide a backup system and ensure operational efficiency.

Because the units are able to be jettisoned in an emergency, the dropping of one unit would bring the program to a halt. Further, while one unit is being used, the next unit could be refuelled, to improve efficiency and turnaround time during refuelling operations. This will save helicopter waiting time during the turnaround (helicopter costs are $9 to $10 per minute).

Fuel Mixing

Fuel mixing facilities used in Tasmania were in the very early stages of development. In the USA and Canada a number of mixing systems have been developed and are available on the market.

Recommendation No.2:
That a high priority be placed on locating and purchasing a suitable mixing system to complement the "Red Dragon" Helitorch.

Or, alternatively, that the mixing facility be incorporated inside the Helitorch. The feasibility of this option is being investigated.

Training

The importance of safety in fuel handling combined with helicopter safety requirements cannot be overstressed. Safety procedures and standards already developed must be strictly adhered to (Bennett, 1987).

Recommendation No.3:
That a nationally recognised training course be developed for training: Helipad Marshalls, Loading Masters, Mixing Crews and Helitorch Technicians.

CONCLUSIONS

1. Helitorch operations would provide an additional firelighting tool, extending the existing range of fuels that can be ignited by aerial ignition methods. The technique will benefit this Department by increasing productivity over manual methods.

2. The development of Helitorch operations will require the training of manpower resources in a number of new skills.

3. There is a cheaper, simpler and less sophisticated way of igniting fuels and that is by hand, however the method is not as effective and is considered hazardous to ground crews where access and terrain are difficult.

4. The existing skills of hand lighting would not be rendered obsolete by the development of this project. Hand lighting is still required for small areas with easy access.

5. The preliminary work for this project has already been carried out in Tasmania over the last three years, and CALM can build on their experiences.

ACKNOWLEDGEMENTS

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APPENDIX I

Formulae for Calculation of Production Rates

1. To convert knots to metres per minute to determine generic speed:

kilometres per minute = (KNTS ÷ CONV) ÷ TIME

where
KNTS = nautical miles per hour
CONV = to change KNTS to KPH 0.539553
TIME = 60 minutes.

Metres per minute = KM PM × M

where
KM PM = kilometers per minute
M = 1000

2. To convert metres per minute and flightline stripwidth to generic production rate in hectares per minute:

HA PM = (MTPM × STWH) ÷ 10,000

where
HA PM = hectares per minute
ST WH = flightline stripwidth in metres