Fire Research Note No 1067

COMPARISON OF AVGAS, N-HEPTANE AND N-HEXANE AS FUEL FOR 0.25 m^2 AREA LABORATORY TEST FIRES FOR FOAM

by

J G Corrie

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FIRE RESEARCH STATION

Fire Research Station
BOREHAMWOOD
Hertfordshire WD6 2BL
Tel: 01 953 6177

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SUMMARY

AVGAS, n-heptane and n-hexane were compared as fuels for the 0.25 m^2 test fires, using three different types of foam liquid.

As a result of the tests, it is recommended that AVGAS be retained as the reference fuel for Defence Standard tests of foam liquids.

Key words: Foam, gasoline, n-heptane, n-hexane.

Department of the Environment Fire Research Station of the Building Research Establishment

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INTRODUCTION

The Defence Standard tests for foam liquids, require the use of aviation gasoline (AVGAS) conforming to D ENG RD 2485. In January 1977 aviation gasoline to this specification was not available and material conforming to D ENG RD 2475 was supplied as an alternative. One laboratory reported anomalous results when testing a fluorochemical foam which coincided with the change of gasoline quality.

The D ENG RD specifications for aviation gasoline specify its quality for performance in internal combustion engines. The principal requirement is the octane rating, and stated maximum lead contents are permitted in several different grades, with different octane ratings. The boiling range requirements are not precise. There have been several changes in gasoline specifications in recent years, reducing the number of grades available and generally reducing the permitted lead content for environmental reasons. Further such changes will probably arise. Reduction in the lead content is offset by increasing the content of aromatic, unsaturated, and branched chain hydrocarbons to maintain the octane rating. The suppliers state that considerable differences in the content of these hydrocarbons will occur between different batches which conform to the same RD ENG specification.

The report gives comparative test data on the two grades of gasoline and also test data using n-hexane and n-heptane. The latter two fuels would have the advantage of being essentially pure compounds of defined quality, which cannot change significantly.

MATERIALS USED

Aviation gasoline 100L (green) (D ENG RD 2485)
" " 100LL (blue) (D ENG RD 2475)
n-hexane Esso EXON 66-70°C
n-heptane Carless 95-100°C
Protein foam concentrate
Fluoroprotein foam concentrate } conforming to UK Defence Standards
Fluorochemical foam concentrate

EXPERIMENTAL

0.25 m^2 area test fires were conducted as described in UK Defence Standard 42/22. Protein and fluoroprotein liquids were used at 4 per cent concentration and fluorochemical liquid at 6 per cent concentration. The two grades of AVGAS were first compared using fluorochemical foam.

AVGAS 100L (green) was then compared with n-hexane and with n-heptane using protein, fluoroprotein, and fluorochemical foam.

Duplicate tests were made, close agreement being obtained in all cases.

In all the tests AVGAS 100L was used as the 1 litre of fuel in the burn-back pot.

RESULTS

Table 1

Comparison of two grades of AVGAS with 6 per cent fluorochemical foam

	Average of duplicate tests	
	AVGAS 100L (green)	AVCAS 100LL (blue)
Application rate l/m^2 min	3.02	3.06
Foam temperature °C	19	19
Air temperature °C	15	16
90 per cent control time - s	27.5	29.5
Extinction time - s	40	38.5
Burn-back time - min	13.8	12.35

Figures 1-3 show the comparisons between AVGAS 100L (green), n-hexane and n-heptane.

DISCUSSION

The results in Table 1 show that the two grades of AVGAS, extinguished with fluorochemical foam, gave almost identical control and extinction times and a slight difference in burn-back time.

The results in Figs 1-3 comparing AVGAS 100L (green) with hexane and heptane show that hexane was marginally more difficult to control and extinguish, while heptane was more easily controlled and extinguished.

The effect of the fuel on the burn-back time depends upon the foam liquid used.

With all three types of foam hexane gave shorter burn-back times than heptane.

Hexane gave equal or shorter times than AVGAS, while heptane gave longer burn-back times than AVGAS with protein and fluoroprotein foams, and a slightly shorter time when fluorochemical foam was used.

If hexane was adopted as a replacement of AVGAS some revision of the Defence Standard requirements for extinction and burn-back would have to be considered. For this to be done results on a representative number of batches would have to be obtained.

Heptane could reasonably be adopted without any change in the requirements and they could be reviewed at a future date when routine test data has accumulated. However heptane must be ruled out at present, because it has only been available from one supplier in UK, and at present is not obtainable.

CONCLUSION

AVGAS should be retained as the Defence Standard fuel, either AVGAS 100L (green) or AVGAS 100LL (blue) being permitted.

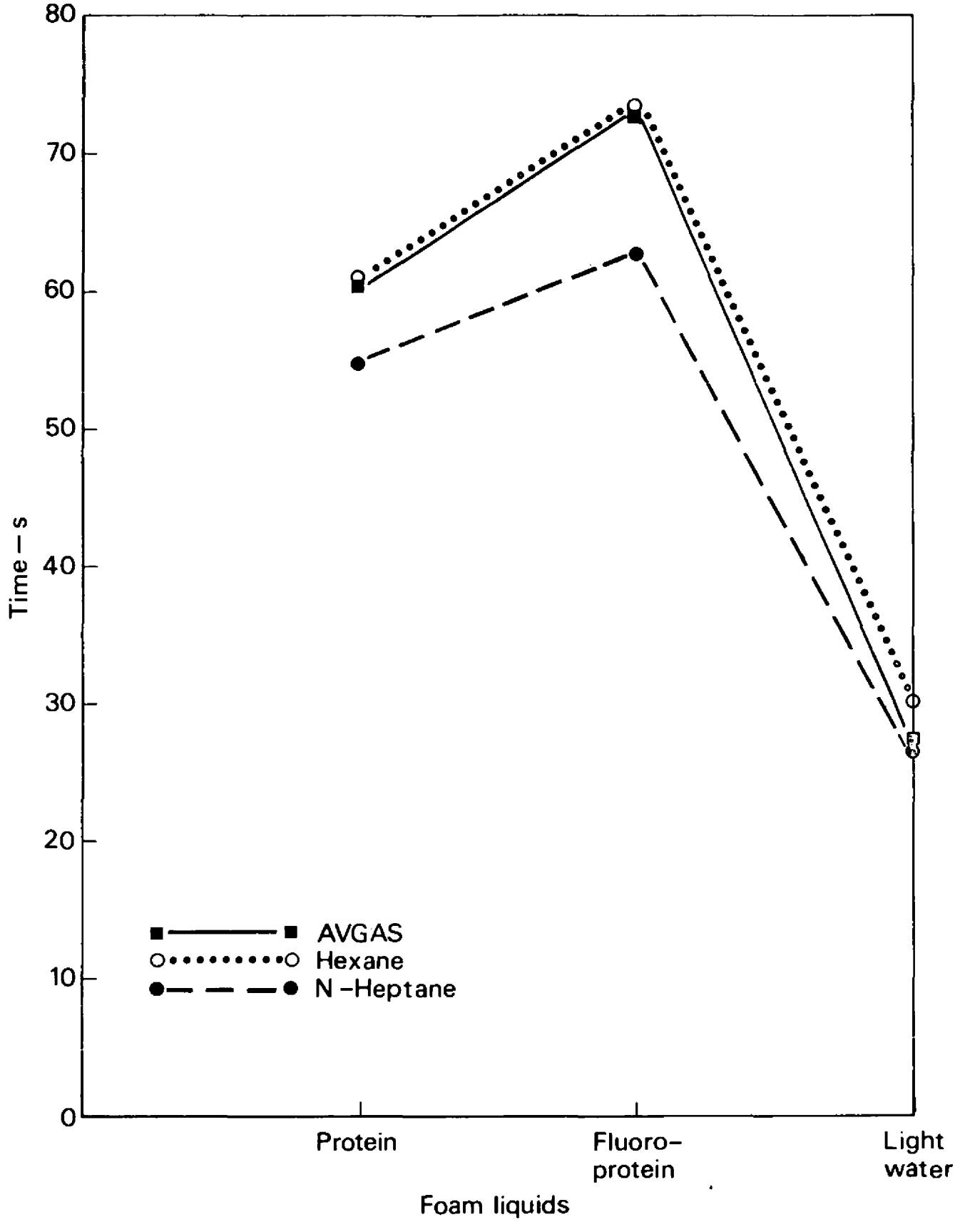

Figure 1 Control times of 0·25m^2 area. fires of three fuels

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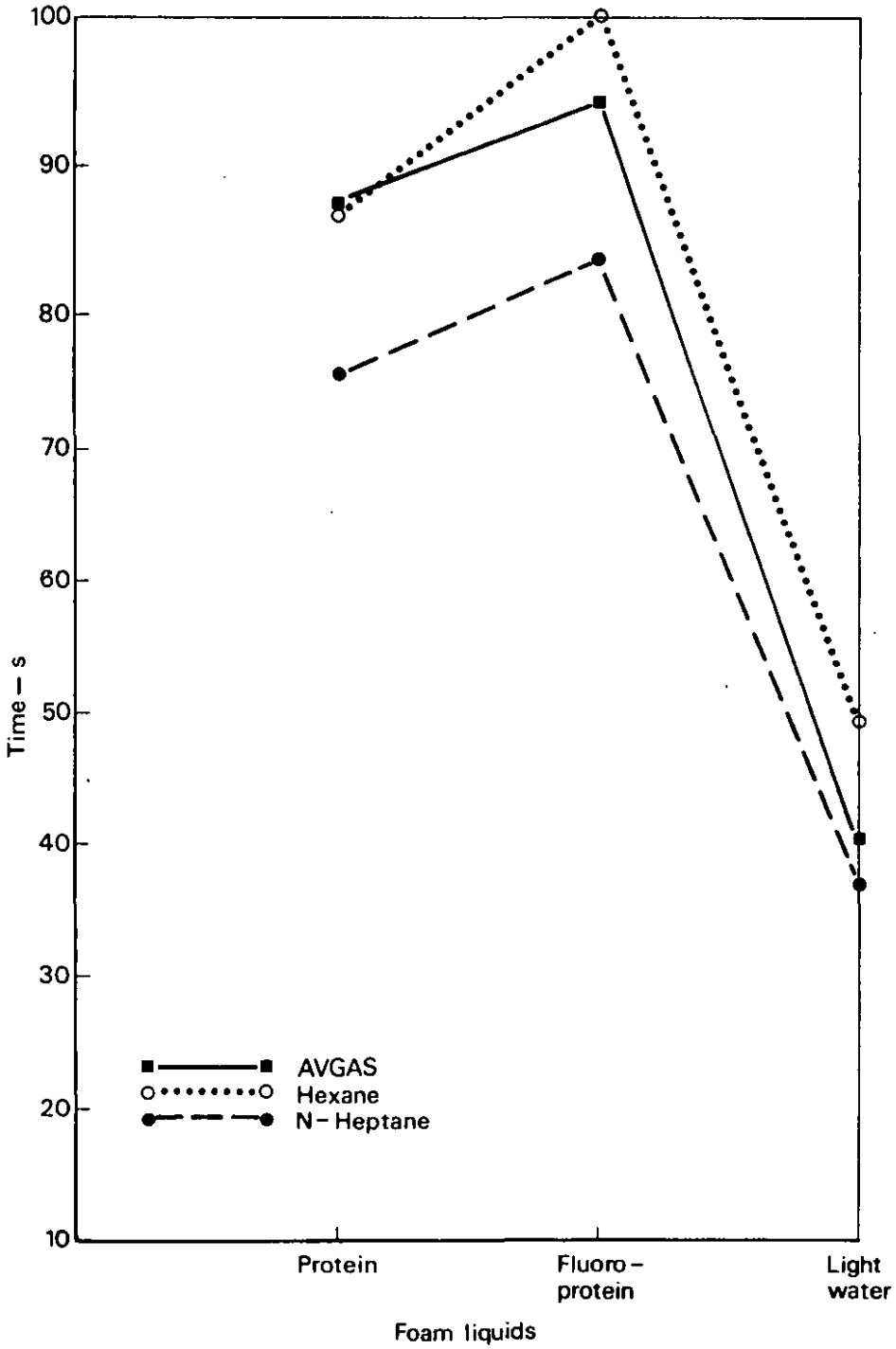

Figure 2 Exinction times of 0·25m^2 area fires of three fuels

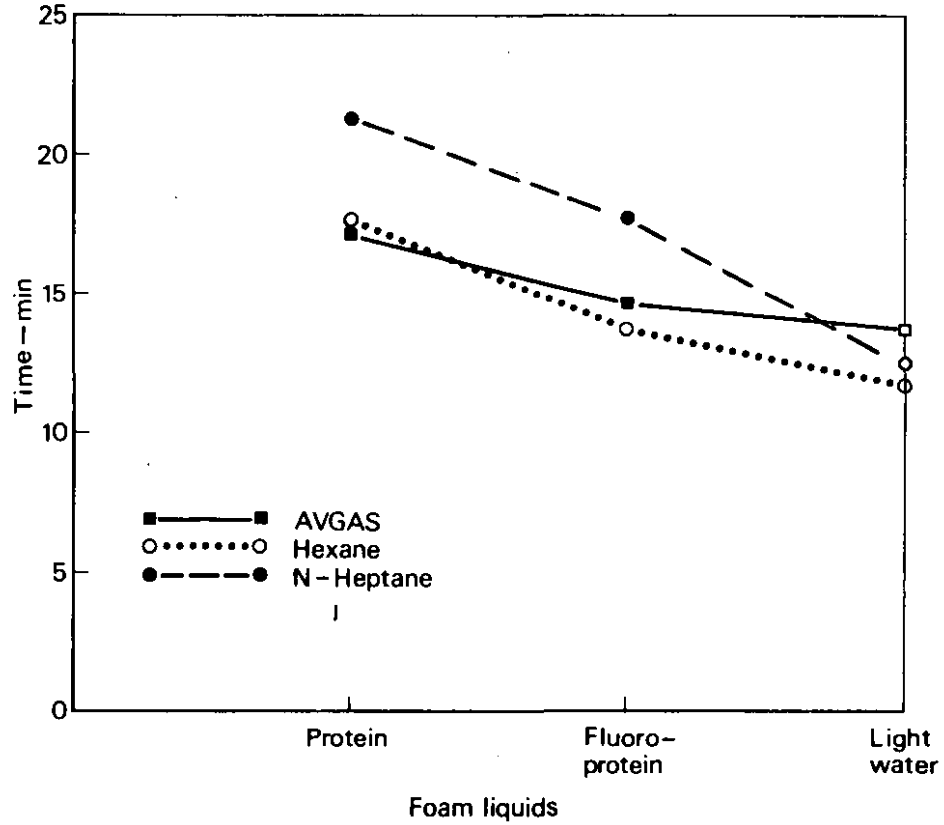

Figure 3 Burn back times of 0·25m^2 area fires of three fuels