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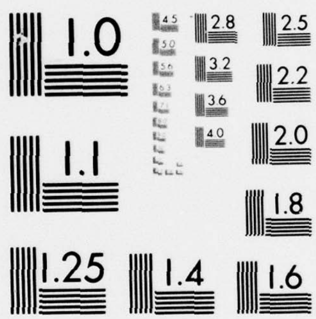

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TECHNICAL REPORT ARLCD-TR-77050

THE EFFECT OF FLARE FLICKER ON THE RECOGNITION PROBABILITY OF VEHICULAR SIZE TARGETS

ROBERT B. DAVIS

APRIL 1978

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
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WEAPON SYSTEMS LABORATORY
DOVER, NEW JERSEY

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER
Technical Report ARLCD-TR-77050

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
The Effect of Flare Flicker on the Recognition Probability of Vehicular Size Targets

5. TYPE OF REPORT & PERIOD COVERED
Final rept.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Robert B. Davis

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Explosives Division
Feltman Research Laboratory
Picatinny Arsenal, Dover, NJ 07801

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
PA73-016

11. CONTROLLING OFFICE NAME AND ADDRESS
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ATTN: DRDAR-TSS
Dover, NJ 07801

12. REPORT DATE
April 1978

13. NUMBER OF PAGES
20

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
Commander, US Army ARRADCOM
Large Caliber Weapon Systems Laboratory
Dover, NJ 07801

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)
SBIE AD-E400 156

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Flare flicker
Target recognition
Illumination
Terrain model

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
The present specifications on flare production are set without any quantitative information on how the various parameters of flare light influence an observer's ability to recognize targets. A study was conducted using the Picatinny Arsenal Pyrotechnic Terrain Model to examine one of these parameters, flare flicker, and its effect on target recognition. Illumination necessary for recognition at selected frequencies and at one frequency and several levels of modulation imposed upon a steady illumination level were examined.

410 163

20. Abstract (Continued)

The study concludes that the average illumination required for recognition is not affected significantly by flicker.

ACKNOWLEDGMENT

The guidance and advice of Mr. Jesse F. Tyroler and the assistance of Mr. Henry Widmann in the collection and reduction of the data used in this report are sincerely appreciated by the author.

TABLE OF CONTENTS

		Page No.
Introduction		1
Method		1
Experimental		2
Results		3
Conclusions		3
Figures		
1	Actual shape of light transient from simulated flare as measured at 5 Hz	5
2	Illumination requirements for recognition of vehicular size targets at selected frequencies and 100% flicker level	6
3	Typical signal with components for determining percent flicker	7
4	Average illumination requirements for recognition of vehicular size targets at a frequency of 5 Hz as a function of the percent flicker	8
Distribution List		9

INTRODUCTION

The effect of the various parameters of flare light on target recognition has been the subject of an investigation conducted by the Feltman Research Laboratory, Picatinny Arsenal. A terrain model based on Southeast Asian-type terrain was constructed on a scale of 160:1 for use in the investigation.

Previous work on this subject is described in the following reports:

Picatinny Arsenal Technical Report 4075, "Pyrotechnic Terrain Model, A New Dimension in Pyrotechnic Evaluation, Description and Initial Results," Dec 1970, by Jesse F. Tyroler

Picatinny Arsenal Technical Report 4184, "Results of an Illumination Requirement Study Using a Pyrotechnic Terrain Model," Nov 1971, by Robert B. Davis

Pyrotechnics Division Information Report 5-72, "An Investigation of the Effect of Changes in Flare Intensity on the Recognition Probability of Vehicular Size Targets," Dec 1972, by Robert B. Davis and Jesse F. Tyroler.

The purpose of the work described in this report was to determine the effect of "flicker", one of the parameters of flare illumination, on an observer's ability to recognize vehicular-size targets. This information was developed at the request of the Army Materials and Mechanics Research Center, Watertown, MA.

METHOD

The observers used for this test were US Army and civilian personnel stationed or employed at Picatinny Arsenal. All observers had normal vision, either natural or corrected by eyeglasses. The observers were given an orientation of the terrain model and of the targets to be recognized, the method of target presentation, and the type of response desired ("Large truck, side", "Jeep, front", etc.). Subsequently, they were dark-adapted for at least 30 minutes, and stationed at the proper distance for the test. The simulated flare was positioned in the desired orientation with respect to the observer and target. The observer was allowed to control the intensity of the simulated flare so that, as the level of illumination slowly increased, he could stop the test at the instant of recognition.

The illumination was provided by a [illegible] watt tungsten-filament lamp spectrally corrected by a special translucent paint to duplicate the wavelength distribution of a visible flare. The power to operate the simulated flare was taken from a programmable DC supply and fed through a heavy-duty rheostat which was driven by a motor geared to turn at 0.1 rpm and controlled by the observer. The flicker was produced by a square-wave signal introduced to the programming section of the power supply. The illumination was measured with a Weston Model 1979 Illumination Meter, which was modified for greater sensitivity, and a Consolidated Electrodynamics Oscillograph which monitored and recorded the signal generated by the simulated flare.

EXPERIMENTAL

The first experiment was to determine the required illumination for target recognition using a signal of 100% flicker, i.e., on-off mode, at various frequencies. The frequencies examined were 1, 3, 5, 10, 15, and 25 Hz. The wave shape of a 5-Hz signal is shown in Figure 1.

Figure 2 illustrates the average illumination required for 100% flicker at each frequency (using six observers) as compared to that required from a steady state source.

The specific conditions of this test were:

1. Flare, target, observer angle 117°.

2. Simulated range 640 m (2100 ft).

3. Background, medium green, grassy area.

4. Observation from ground level.

The method used to determine the percentage of flicker in the signal for this and the following experiment is shown in Figure 3.

The second portion of this experiment was to determine the illumination requirements for target recognition as a function of the amount of flicker, i.e., an illumination level with a flickering light superimposed on it, at a frequency of 5 Hz, the frequency shown to have the most adverse effect on recognition. The test conditions were the same as those of the previous test. However, only two observers, whose performance in target recognition tests was well established, were used for this test. The results of this experiment are shown in Figure 4.

RESULTS

The results of the first experiment (Fig 2) indicate that, at a 100% flicker level, more illumination than that of the steady state is necessary for target recognition at frequencies in the 2 to 10 Hz range. The second experiment was conducted at 5 Hz, the frequency at which the greatest detrimental effect was noted. However, results of the second experiment (Fig 4) show that at reasonable levels of flicker (which, in an actual flare, can only occasionally go as high as 40%) virtually no difference exists from the average illumination level necessary for target recognition from both constant and flickering sources.

CONCLUSIONS

On the basis of this limited study, the pyrotechnic design engineer or specification writer should not be overly concerned with the problem of flare flicker and the resulting effect on target recognition. With modulation or percentage of flicker as high as 50%, the increase in illumination necessary for target recognition is negligible.

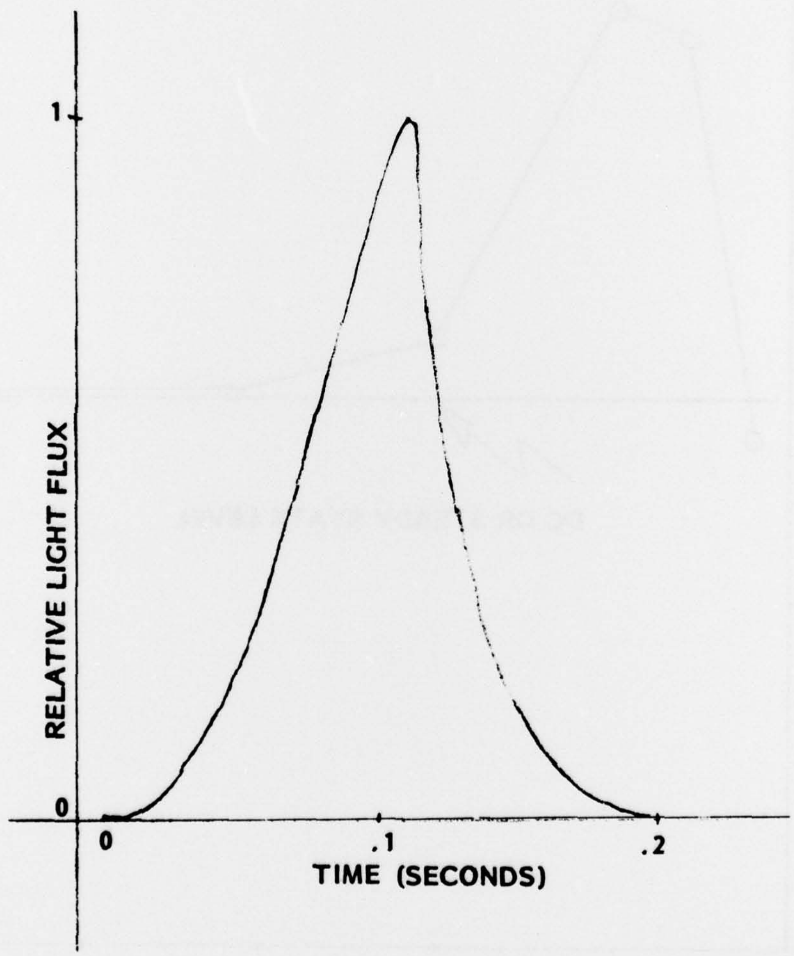

Fig 1 Actual shape of light transient from simulated flare as measured at 5 Hz

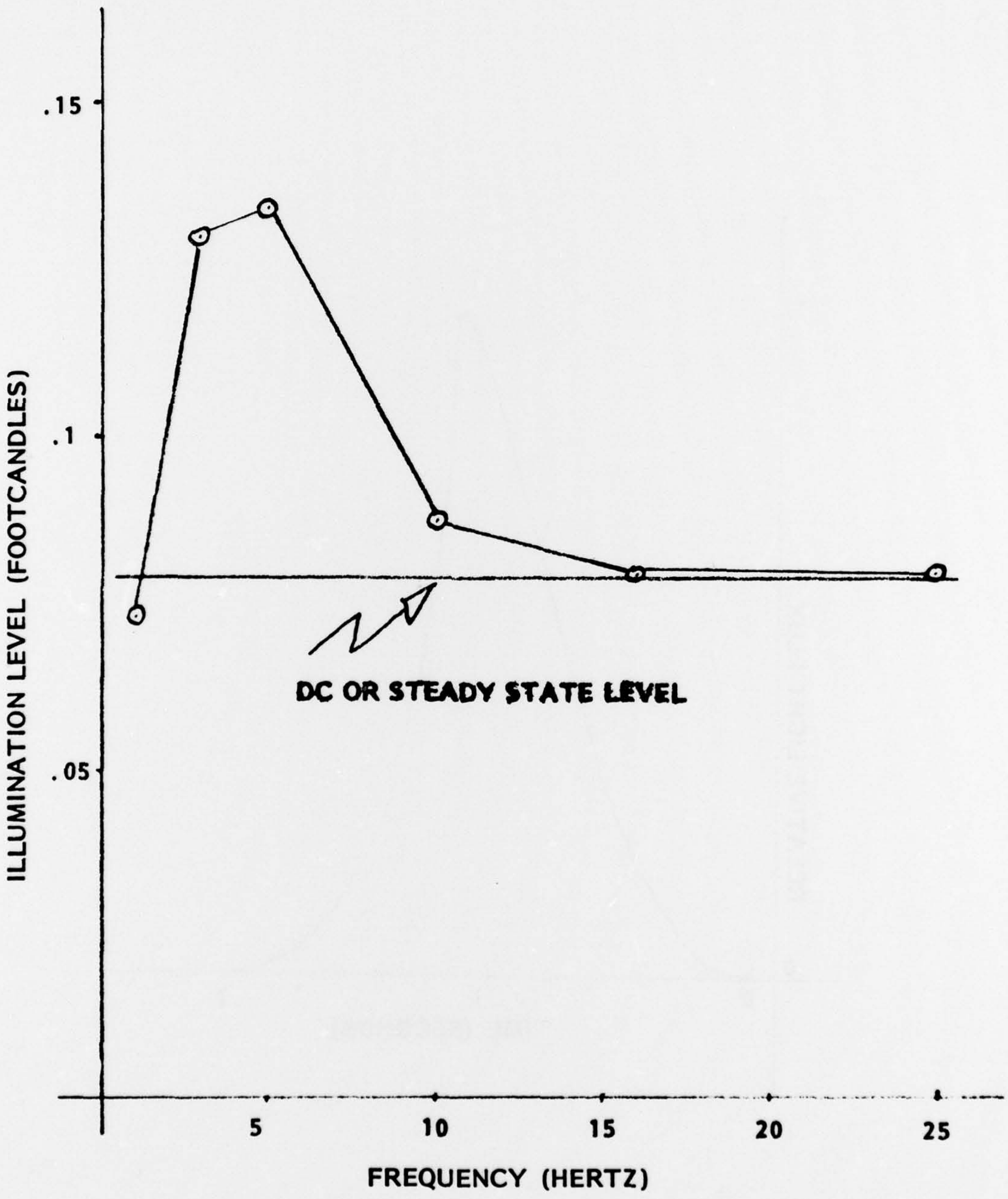

Fig 2 Illumination requirements for recognition of vehicular size targets at selected frequencies and 100% flicker level

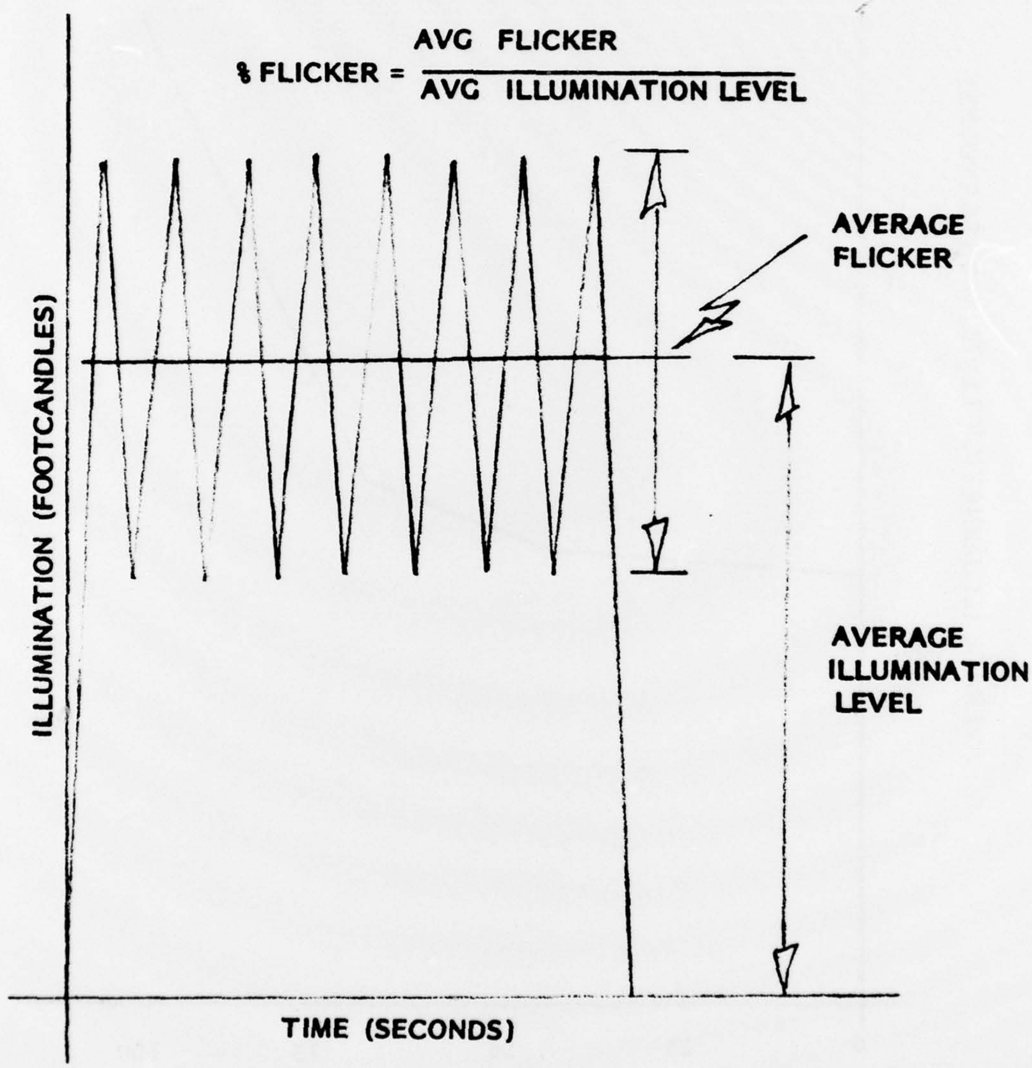

Fig 3 Typical signal with components for determining percent flicker

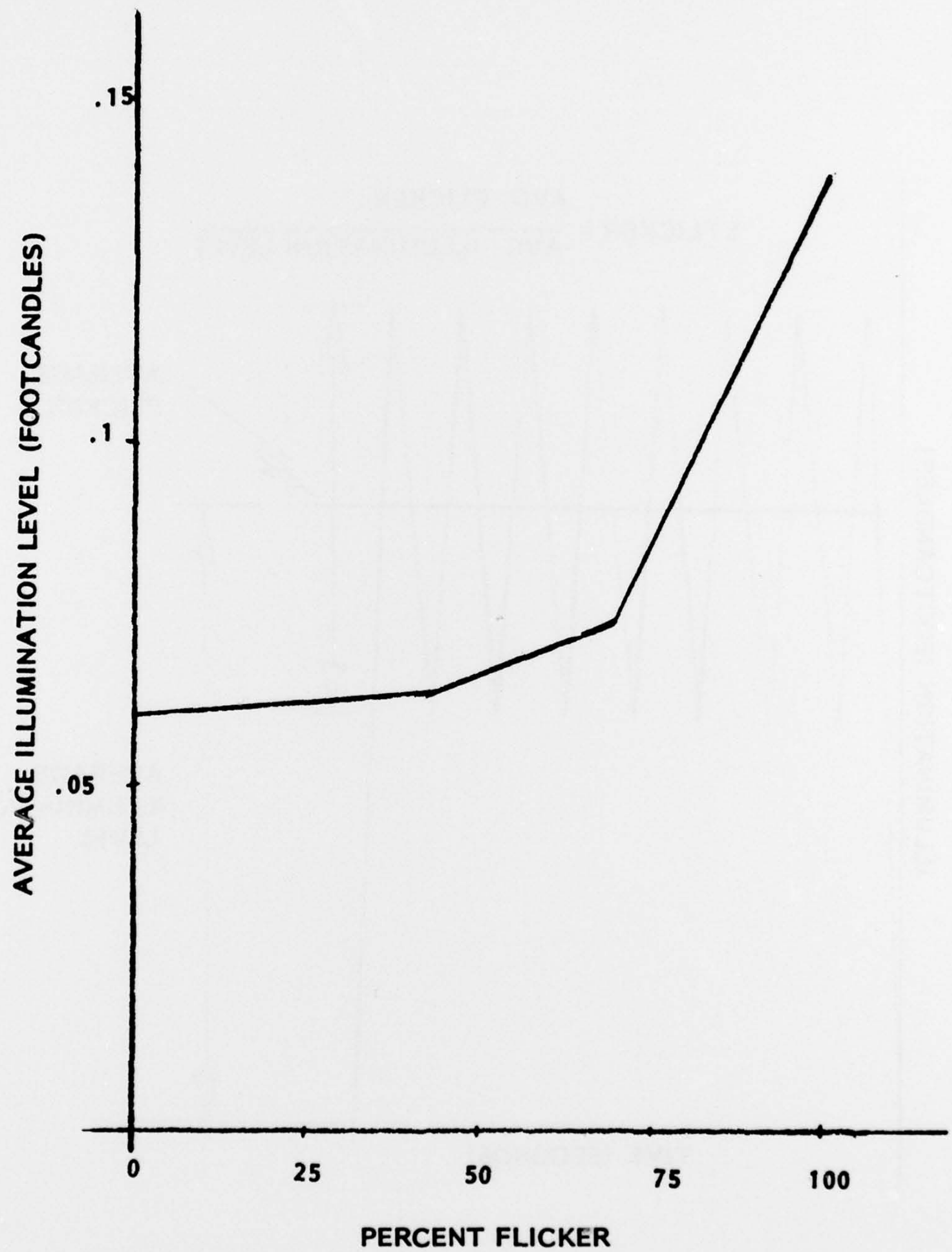

Fig 4 Average illumination requirements for recognition of vehicular size targets at a frequency of 5 Hz as a function of the percent flicker

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