

B 31-136-

ARGON FLASH CANDLE

This project has as its purpose the evaluation of argon flash components and factors which effect candle light output. This is done by measuring the intensity of the light output simultaneously as a function of wave length and time.

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ABSTRACT

Several additional argon flash candles have been fired during the quarter. Several shots both straight-in and at 45° with and without the prism were fired. Some interesting data were obtained from pseudo-spectrograph shots performed by interposing filters in the light path of the camera and using both glass and Plexiglas simultaneously on the candle front. From these shots, we were able to better illustrate some of the differences in glass and Plexiglas with regard to diffusion and light scattering, as well as spectral transmission characteristics.

DISCUSSION

Efforts to further investigate certain interesting properties of argon flash candle components have continued during the last quarter, FY 64. Several argon candles have been fired.

One glass fronted and one Plexiglas fronted shots were fired to observe the light in an integrated form (less reflection losses) from a white card as opposed to viewing the candle straight in. The slit widths chosen were too narrow for this type of low level intensity shot; the shots may be repeated in the future.

Two other time-resolved spectrographic shots were fired. Again, both glass and Plexiglas were used as front materials. These shots represent a modified version of earlier black card experiments in that a black void or black box was adapted to one side of a standard argon flash candle (see Figure 1). This technique should allow the observation of candle light through the front materials without some of the effects of light directly reflected by the candle walls.

When a candle of this type is viewed at 45° with the front and into the black void,

Plexiglas begins to diffuse and/or scatter light through this angle an appreciable time before glass. In fact, there is no appearance of light at 45° as seen through glass until the luminous front moves into the field of view of the camera (see Figures 2 and 3). The occurrence of this early light through Plexiglas as opposed to glass was further investigated by firing candles with a combination glass and Plexiglas front. The candles again used the black box as in Figure 1. No prism was used; angle of view was 45° .

A typical test arrangement is shown in Figure 4. Figure 5 is a smear camera record of this type of shot. Of major interest in this record is (a) the early presence of light through Plexiglas as opposed to glass, and (b) the lack of any film density discontinuity on the Plexiglas portion of the trace when the luminous front moves across the camera field of view. Film densities are 1.5 for glass and .90 for Plexiglas. Framing camera pictures of this shot also illustrate the differences. For example, the Plexiglas face begins to light up on frame 7 and is entirely lit by frame 10; the glass face begins to light up on frame 14 and the luminous front has passed across the face by frame 23 (inter-frame time was 2.78 μsec). The time sequence in itself is not significant, and is a function of the geometry involved.

The use of this candle configuration was extended to perform a pseudo-spectrographic shot. The shot described immediately above was modified to incorporate the addition of non-overlapping red and blue filters over the image of both glass and Plexiglas on the smear camera slit plane. Again, as above, the shot was viewed at 45° to the candle front. Figure 6 is a record of this shot. This record is characteristically the same as Figure 5 with the exception that the light from the two front materials is divided into red and blue spectral regions.

Figure 7 is a record of a similar shot except that the camera view was straight in.

The purpose of these shots was twofold. First, it was designed to aid, at least semi-quantitatively, in the data reduction of the prism shots, and secondly, to investigate the feasibility of using a series of spectral interference filters as opposed to a prism in some future tests. This method has been used by others, although in a different arrangement.¹ Although this technique would not reproduce the spectral continuity attained by using a prism, it was felt that the ease of data reduction and over-all versatility of this method might offset this disadvantage in a majority of the experiments.

While the filters used in this test were such that the red and blue spectral region were fairly wide, the spectral range of the film used cuts off rapidly in the red region. Figure 8 is the spectrophotometer transmission curves of the filters used. The cut-offs for Ansco Super Hypan are indicated. Referring to the filter spectral transmission curves, it is apparent that wave lengths extending down to the blue film cut off region were contributing to the exposure through the red filter; this contribution amounted to approximately 18% of the total. Considering the differences in percent spectral transmission for the two filters used and by use of the response curve for the film, one may compare the amount of red and blue light from the candle. Both 45° angle and straight-in shots were made. These data are presented in Table I. This result indicates that there exists some difference in the amount of blue and red light from different windows. Using glass as a front material, and viewing straight-in, film density is almost twice as high with blue

¹ J. Roth, Stanford Research Institute, "Measured Temperature of Strong Shock Waves in Argon", Journal of Applied Physics, May 1964.

light as red. Through Plexiglas, straight-in, it is about equal for red and blue. At the 45° angle of view, through both glass and Plexiglas, the film density is about one and one-half times as high for blue as red.

Some error, not enough to grossly affect the results, undoubtedly exists in the data presented in Table I due primarily to the densities reported. These densities represent an average of several readings along the film trace, where gradients are evident.

As was previously stated, however, this was a technique test for the most part. Were this test performed with a series of calibrated narrow band pass filters encompassing the desired spectral range, and with more painstaking microdensitometer density readings, one could easily and quickly determine wave length versus time and density versus wave length, without some of the difficulties introduced by using a prism.

FUTURE WORK; COMMENTS; CONCLUSIONS

This program is at the present time not included in the SANL of R & D work for next fiscal year for LRL. Completion of the existing experiments, as well as a few other tests, may still be carried out, however, and if so, will be reported here.

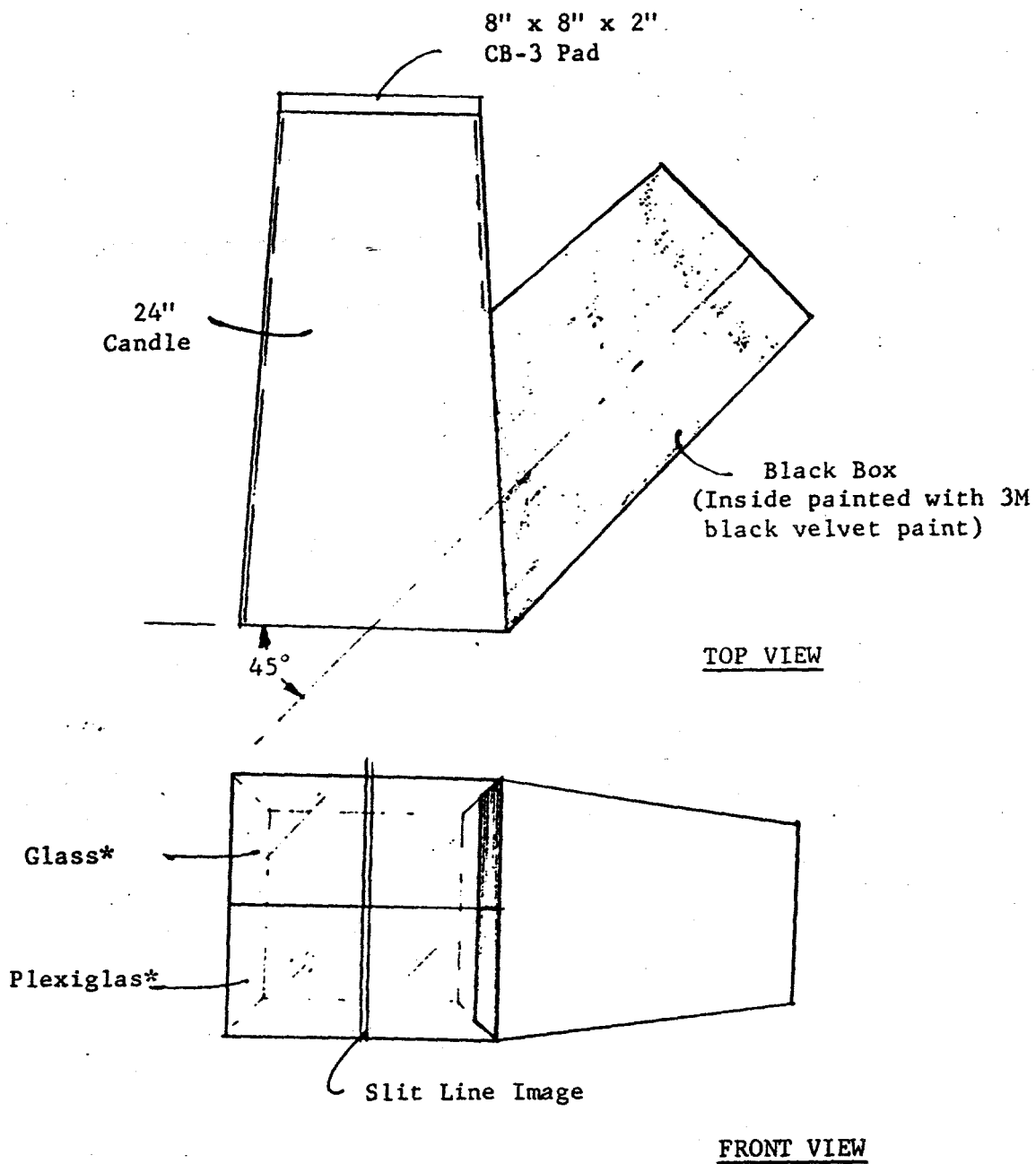
This last series of shots suggests that the "scattering" effect in Plexiglas might be the well known peculiarities of internal transmission which has made it and lucite useful for edge-lighting and engraved signs, for example, though this phenomenon is simpler than some photolytic theories. There are still some dynamic responses unaccounted for, such as the appearance of absorption bands not seen in static photometry.

T A B L E I

| | | G L A S S | | P L E X I G L A S | |
|-------|--------------|-------------------|--|-------------------|--|
| ANGLE | FILTER COLOR | FILM DENSITY READ | CORRECTED RELATIVE INTENSITIES $\frac{I_{blue}}{I_{red}}$ | FILM DENSITY READ | CORRECTED RELATIVE INTENSITIES $\frac{I_{blue}}{I_{red}}$ |
| 0° | RED | .59 * | 1.88 : 1 | .38* | .94 : 1 |
| | BLUE | 1.28 * | | .84* | |
| 45° | RED | .93 | 1.39 : 1 | .63 | 1.64 : 1 |
| | BLUE | 1.68 | | 1.50 | |

* The straight-in candle had the addition of a 1.0 N.D. filter for added attenuation.

Figure 1



MODIFIED ARGON FLASH CANDLE

*The position of these materials were alternated for some shots.

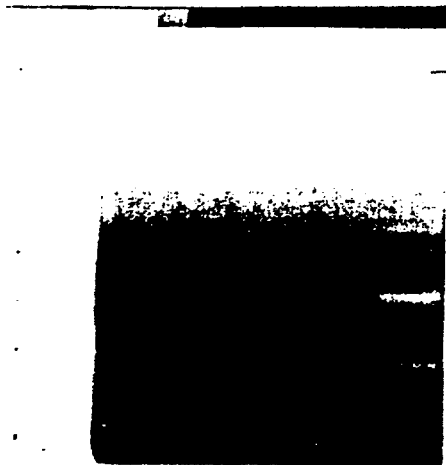


Figure 2

Shot No. 10-4-8-1
Front Material - 1/8" Plexiglas
Candle Length - 2 feet
View - 45° to front window
Camera Writing Speed - 0.911 mm/ μ sec.



Figure 3

Shot No. 10-4-7-2
Front Material - 1/4" Glass
Candle Length - 2 feet
View - 45° to front window
Camera Writing Speed - 0.912 mm/ μ sec.

Figure 4

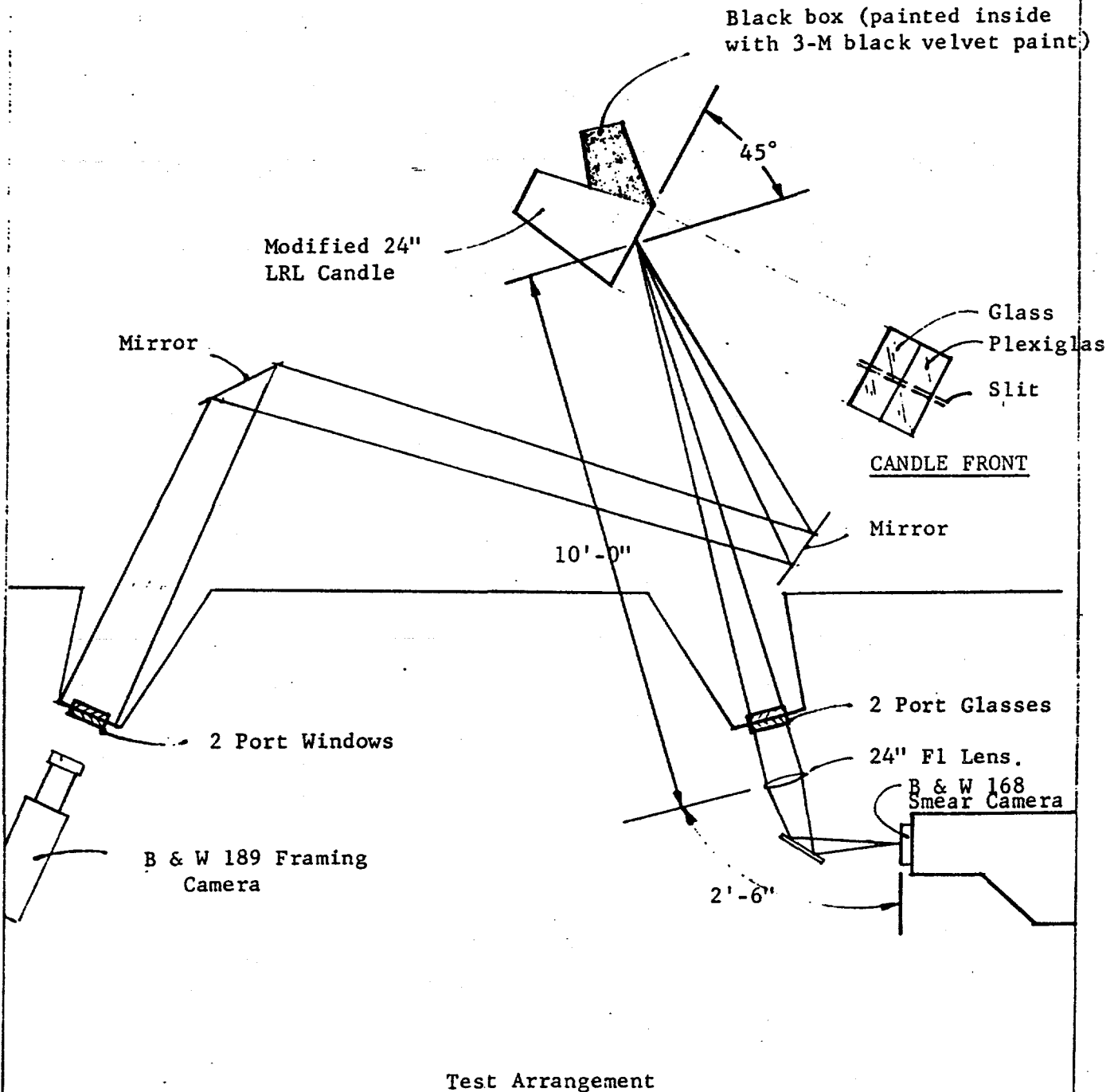


Figure 5

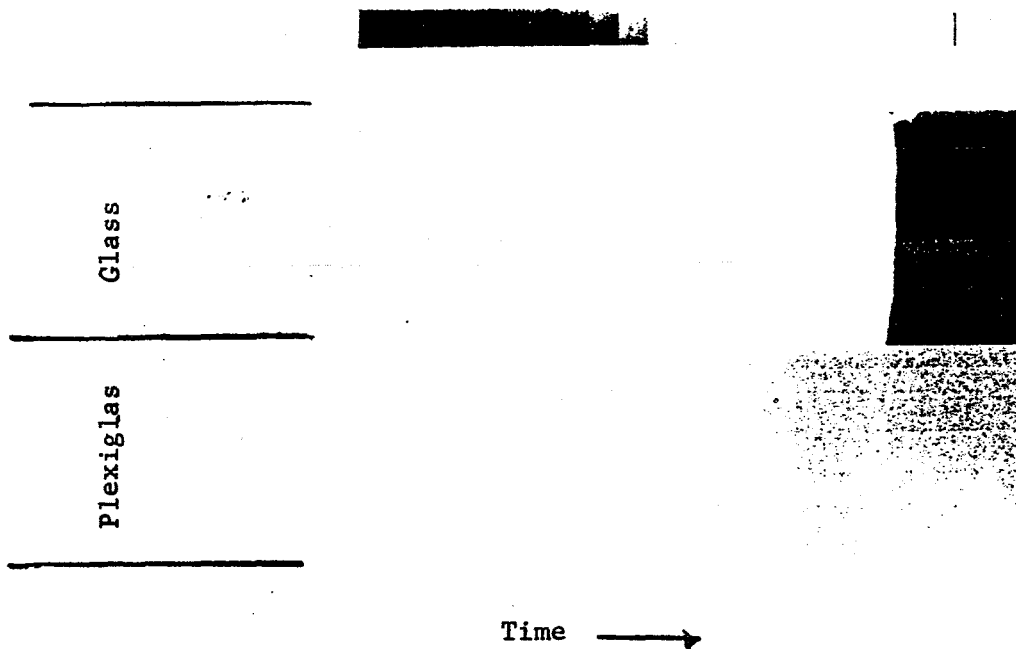
Shot No. 10-4-22-1

Front Material - Glass & Plexiglas

Candle Length - 2 feet

View - 45° to front window

Camera Writing Speed - 0.909 mm/ μ sec.



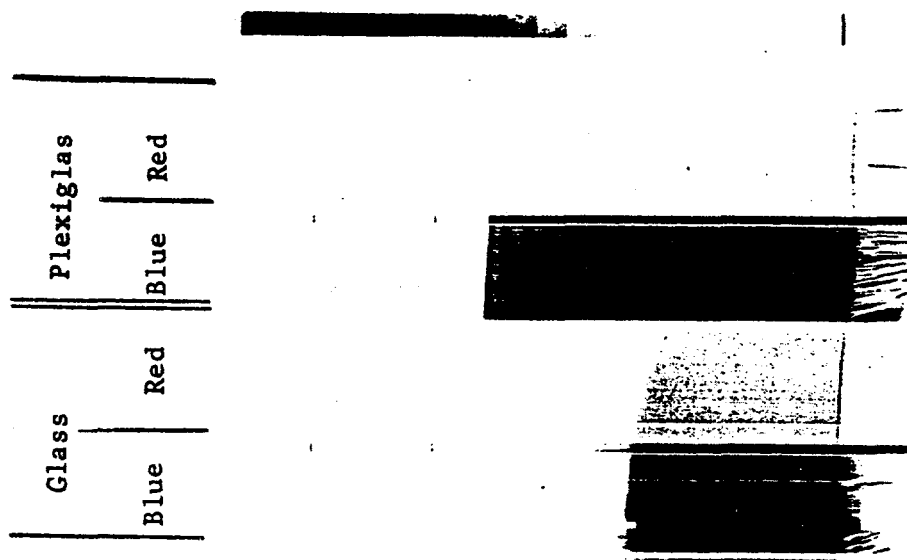


Figure 6

Shot No. 10-5-7-1
Front Material - Glass & Plexiglas
Candle Length - 2 feet
View - 45° to front window
Camera Writing Speed - 0.910 mm/μsec

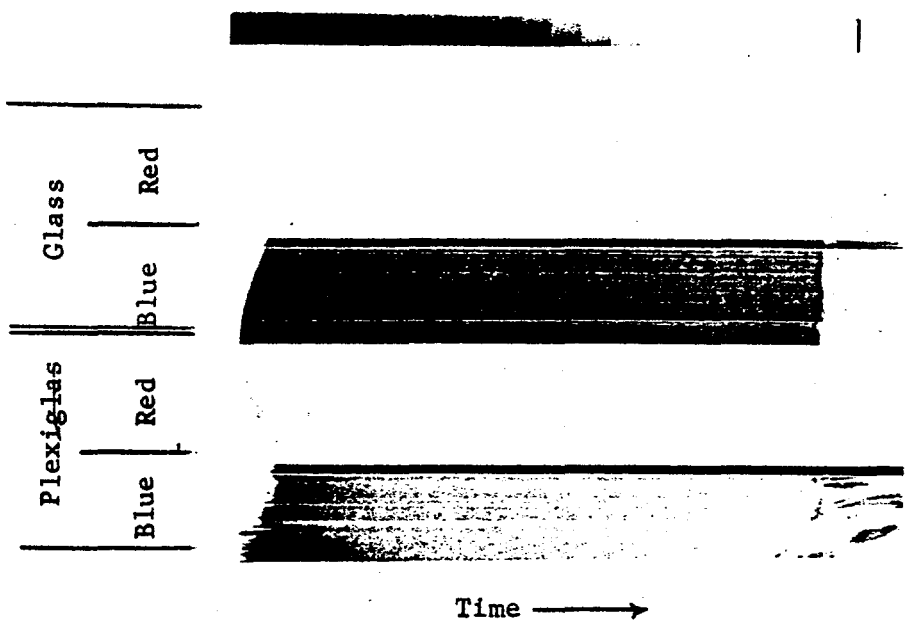


Figure 7

Shot No. 10-5-5-1
Front Material - Glass & Plexiglas
Candle Length - 2 feet
View - Straight-in
Camera Writing Speed - 0.910 mm/μsec

