F.R. Note No. 321/1957
Research Programme Objective F.5

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

[illegible]

PART VIII: A THERMOSETTING PLASTIC ... MATERIAL

by

P. L. Hinkley and D. I. Simms

> This report describes the work carried out by the Fire Research Station for the Ministry of Supply under contract 7/exptl/745/PR3.

Summary

Tests have been carried out on a thermosetting plastic suggested for use in visors on helmets used in aircraft fire crash rescue work. The transmission coefficient in the visible and infra-red regions have been determined and the possible hazards of the material examined.

July, 1957.
F.1/...

Fire Research Station,
Boreham Wood,
Herts.

MATERIALS [illegible] FOR [illegible] AIRCRAFT FIRE CRASH
[illegible]

PART VIII : A THERMOSETTING PLASTIC AS A VIZOR MATERIAL

by

[illegible] Hinchley and D. [illegible]

1. Introduction

The suitability of perspex and glass as vizors for aircraft fire crash rescue workers has been examined in a previous report.[1] The present design of helmet necessitates a vizor which is curved in two dimensions and this can only be made of a plastic material. A vizor made of thermoplastic material such as perspex is liable to deform in use and a thermosetting plastic might be thought to be a more suitable material.

The Ministry of Supply (P.D.A.E.1) supplied several samples of a transparent colourless thermosetting material ('Avialite') for examination. Their reference numbers and thicknesses are given in Table 1.

TABLE 1

Details of Avialite samples

Ref. No.	Thickness mm.
E/757	5.4
E/822	4
E/822 (cured)	4
E/819	4
E/819 (cured)	4

2. Experimental procedure and results

2.1 Transmission of Vizors

The source of radiation was a gas fired panel[2] operating at about 850°C and the radiant intensity was measured by a water cooled Moll type thermopile.[3] The vizor was placed $\frac{1}{4}$ in. in front of the thermopile at a point where the intensity of radiation was 0.5 $cal.cm^{-2}s^{-1}$ (2 w/cm^2).

The transmission of light by the vizors was measured using a photoelectric cell, with a spectral response approximately the same as that of the eye. The instrument was directed at a window and readings were taken with and without the vizor in front of it.

TABLE 2

Transmission of radiation by the vizors

Vizor	Gas fired panel radiation transmittance per cent	Visible radiation transmittance per cent	Ratio of visible Transmittance to infra-red transmittance
E/757	8.5	90	10.6
E/822	10.9	91	8.4
E/822 (cured)	10.2	91	8.9
E/819	10.6	91	8.6
E/819 (cured)	10.9	91	8.4

2.2 Effect of prolonged irradiation

Vizor E/822 was used for these tests. Half of the vizor was exposed to radiation of an intensity of 0.5 $cal.cm^{-2}s^{-1}$ ($2w/cm^2$), the second half being shielded. This second half was then exposed to an intensity of 0.25 $cal.cm^{-2}s^{-1}$ ($1w/cm^2$). The results are given in Table 3.

TABLE 3

Effect of prolonged irradiation on vizor

Intensity $cal.cm^{-2}s^{-1}$	Time sec	Observations
0.5	20	Slight distortion of vizor.
	90	Vizor surface becoming 'crazed'.
	120	Vizor opaque. Vizor starting to break up.
	155	Vizor broke in half.
0.25	230	Crack appeared in surface of vizor.
	240	Surface becoming crazed.
	270	Vizor opaque.

2.3 Ignition of Avialite by radiation

The test method is described in detail elsewhere.(4) Specimens 2 in. square were tested in front of the gas-fired radiant panel. The times for them to ignite spontaneously when exposed to radiation of different intensities were noted. The results are shown in Table 4.

Once ignited, Avialite continued to burn slowly but persistently in the absence of supporting radiation. Pieces of the burning material broke off and continued to burn on the floor.

TABLE 4

Ignition times of Avialite

Intensity cal. $cm^{-2}s^{-1}$	Ignition time sec
2.0	10
1.8	19
1.35	90
0.9	No ignition

3. Discussion and conclusions

3.1 Transmission of radiation by Avialite

The transmission characteristics appear to be similar to those of perspex.

3.2 Hazards

3.2.1 Ignition of Avialite

At the intensities to which rescue workers are likely to be exposed Avialite does not ignite.

3.2.2 Deterioration when exposed to radiation

Although the distortion of Avialite is very much less than that of perspex, serious deterioration takes place after an exposure time less than that likely to be experienced in a fire. This could result in a complete loss of transparency while fighting the fire or effecting a rescue, and in the breaking up of the vizor. The loss of transparency with Avialite occurs much more rapidly than with perspex; there bubbles form slowly enough to be a warning signal.

4. References

(1) Hinkley, P. L. and Simms, D. L. Materials suitable for clothing aircraft fire crash rescue workers. Part IV Vizors. JOINT FIRE RESEARCH ORGANIZATION F.R. NOTE No. 228, 1956.

(2) Simms, D. L. and Miller, J. Radiation characteristics of a gas fired panel. JOINT FIRE RESEARCH ORGANIZATION F.R. NOTE No. 217, 1955.

(3) Simms, D. L. and Pickard, R. W. Thermopiles for measuring high intensity radiation. JOINT FIRE RESEARCH ORGANIZATION F.R. NOTE No. 83, 1954.

(4) Lawson, D. I. and Simms, D. L. The ignition of wood by radiation. Brit. J. App. Phys., p.288-292, 3, 1951.