

# Burn-Through Fire Testing of Hardwire Panels Conducted November 2007 at UAB

To: Skip Ebaugh, Hardwire LLC

## Background

Skip Ebaugh, Hardwire provided UAB with 4 panels for burn-through fire testing in Nov 2007. The panels were labeled 1A, 1B, 3A and 3B. Samples 1A & 1B appeared to be of similar configuration as samples 3A & 3B. Presently 3 panels have been tested - 1A, 3A and 1B. Panel 3B has been saved for any future testing need(s). This report summarizes the test results and observations made during testing.

## Experimental Conditions

The experimental conditions were set based on the David Taylor Research Center [DTRC] Burn-Through Test, MIL-STD-2031(Navy adopted standard). These conditions are as follows:

- Ambient Temperature Surrounding the Panel = 22° C
- Torch Fuel = Propane
- Torch Diameter = 38.1 mm
- Torch Distance = 160.0 mm
- Flame spread at the surface = 100mm diameter
- Temperature at the Surface of the Panel ~ 970° C
- Heat Flux at the Surface of the Panel = 145+/- 10 kW/m<sup>2</sup>
- Duration of the Test = 60 minutes
- Temperature Measurement = 4 K-type thermocouples, three of which were placed in the back face of the exposed panels and 2 placed in a witness aluminum plate placed 101 mm (4") offset from the back face of the panel.

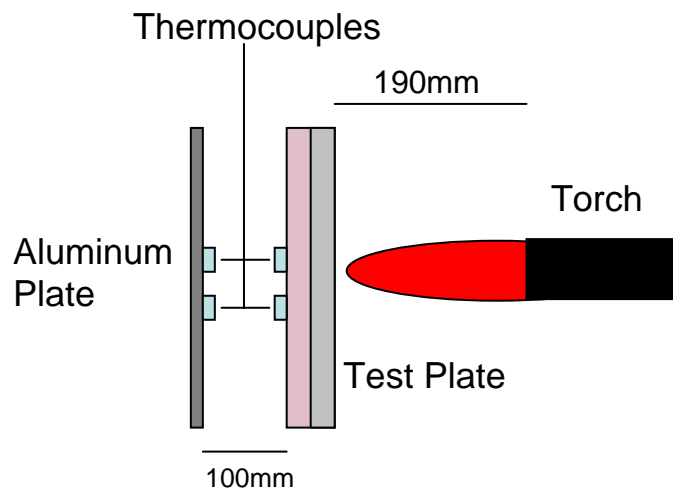


Figure 1. Experimental layout during burn through

## Results and Discussion

The results and discussion for each of the panels tested is presented below.

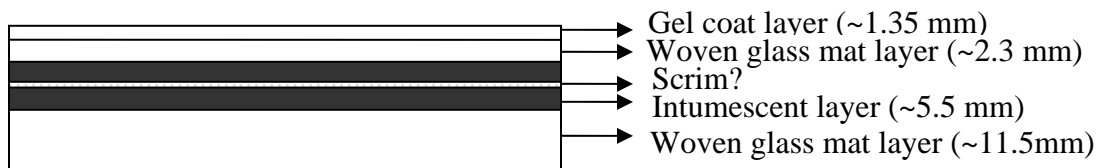
### Panel 1A

The panel was subjected to a heat flux of  $145 \pm 10 \text{ kW/m}^2$  from a propane gas torch at a distance of 160 mm with a flame spread of 100 mm diameter. The front surface of the panel was at a temperature of  $\sim 970^\circ \text{C}$ . The test was carried out for duration of 60 minutes. Figure 2 describes the structure and composition of the panel. Figures 3 a & b show the progressive increase in charred area in the fire affected surface and the final visual appearance of the panel's fire side and back face after the test. The plate experienced localized blistering on the fire side as the fire developed.

### Panel 1B

Burn through testing was also conducted on Panel 1B. It showed similar burn behavior as Panel 1A. The time versus temperature progression of the back face of this panel is shown in Fig 8.

**(Average thickness for 1A and 1B: 20.67 mm)**



**Figure 2. Type - 1 Structure of Panel 1A**

### Observations:

On completion of 60 minutes of burn-through testing, the temperature on the back face of the panel was found to be at  $218 \pm 2^\circ \text{C}$ . The temperature progression with time measured from the thermocouples attached to the back face of the panel is shown in Figure 4. The backside of the panel showed signs of visible damage, including some discoloration and delamination. The aluminum witness plate located 100mm from the back face registered temperature of  $43.1^\circ \text{C}$ . There was a mass loss percentage of 17.55 % on completion of the burn through test.



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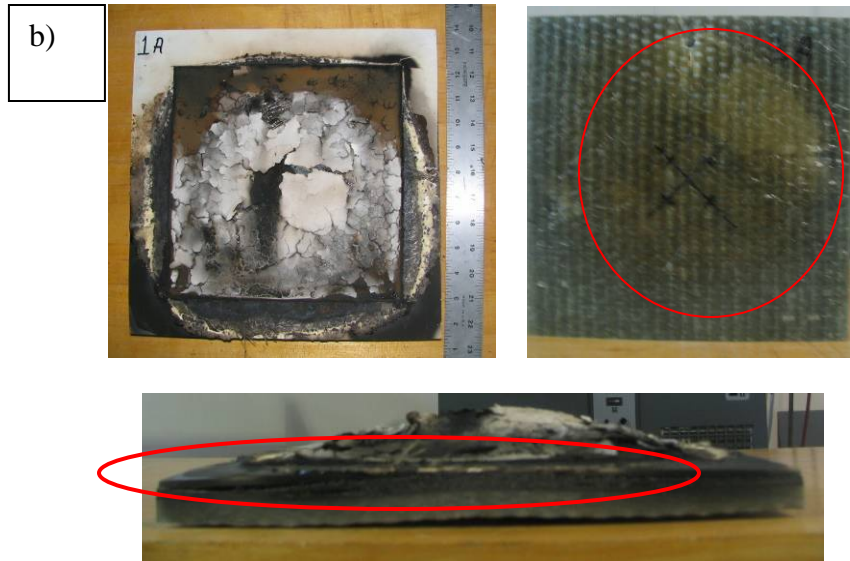


Fig. 3. a) Panel 1A Burn-Through progression (5 min intervals). b) Panel 1A, after burn through test. Back face and fire exposed side with delamination and damage

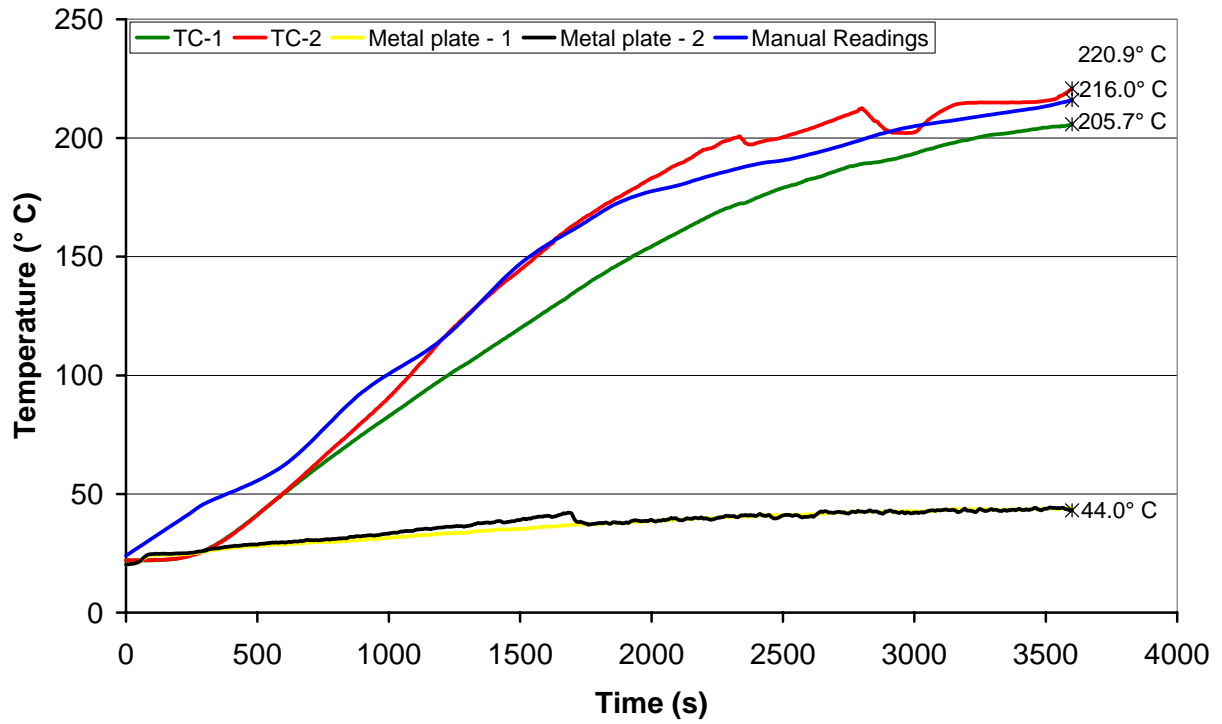
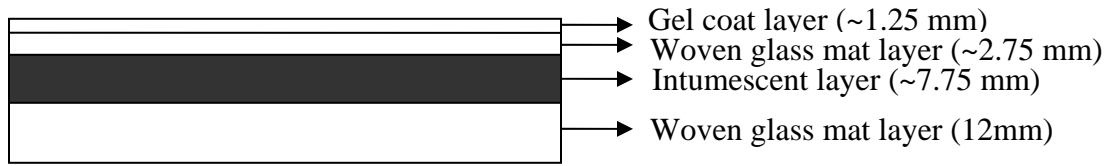


Figure 4. Temperature versus time for the burn-through test of Panel 1-A

### Panel 3-A

The panel was subjected to a heat flux of  $145 \pm 10 \text{ kW/m}^2$  from a propane gas torch at a distance of 160 mm with a flame spread of 100 mm diameter. The front surface of the panel was at a temperature of  $\sim 970^\circ \text{C}$ . The test was carried out for duration of 60 minutes. Fig 5 shows the structure and composition of panel type - 3. Figs 6 a & b show the progressive increase in charred area in the fire affected surface and the final visual appearance of the panel's fire side and back face after the test.

**Average thickness of the panel: 23.90 mm**

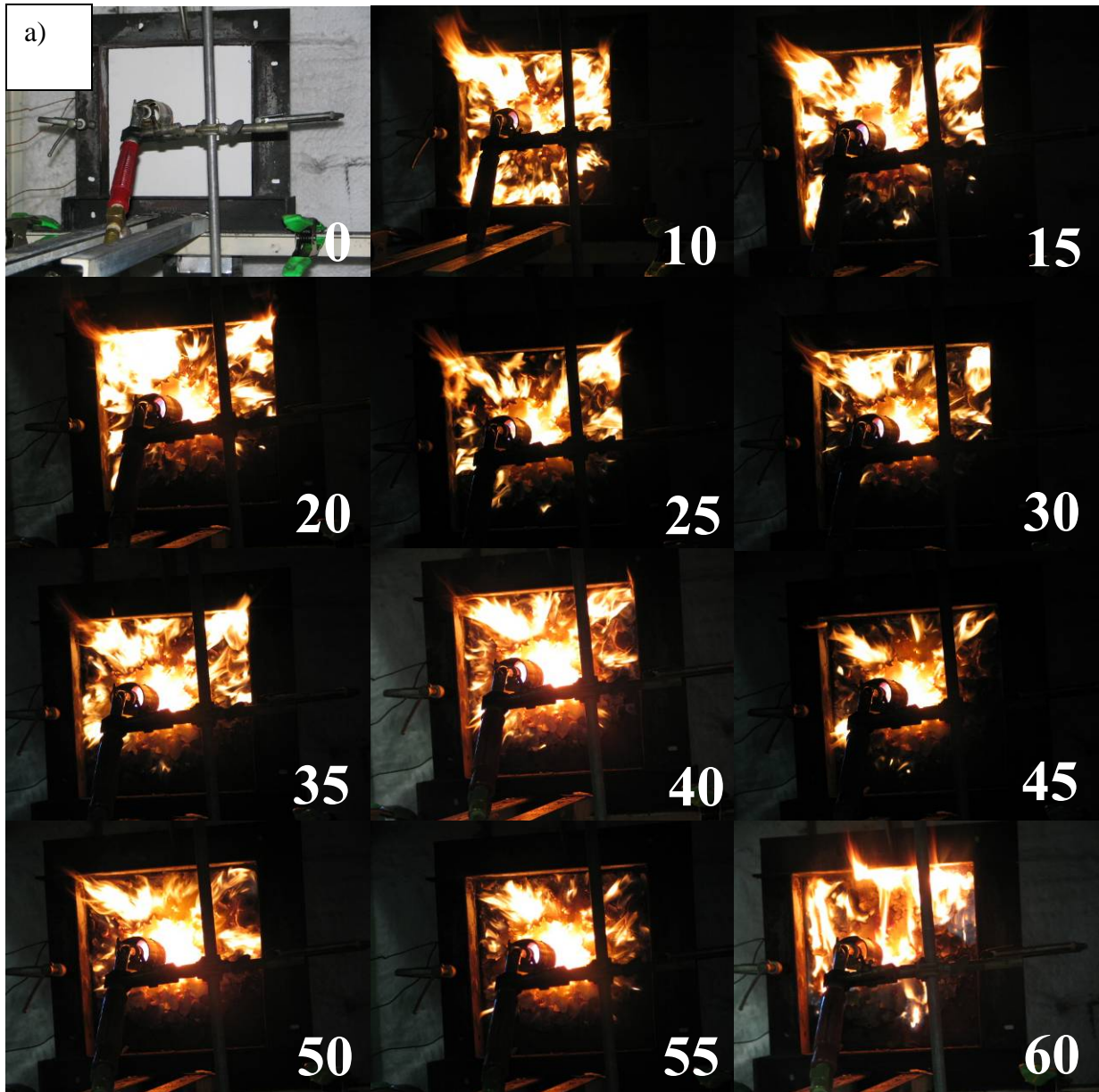


**Figure 5. Structure of Panel 3A**

#### *Observations:*

On completion of 60 minutes of burn-through testing, the temperature on the back face of the panel was found to be at  $220 \pm 2^\circ \text{C}$ . The temperature progression with time measured from the thermocouples attached to the back face of the panel is shown in Figure 7. The aluminum witness plate located 101.6mm from the back face registered temperature of  $46.5^\circ \text{C}$ . The plate experienced localized blistering in the fire side as the fire developed. **The backside of the plate showed no signs of damage, except for discoloration. In contrast Panel Type 1 had exhibited delamination for similar conditions.** There was a mass loss percentage of 17.63% on completion of the test.





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Figure 6. a) Panel 3-A burn through progression (5 minute interval). b) Panel 3-A back face and fire side after burn through testing

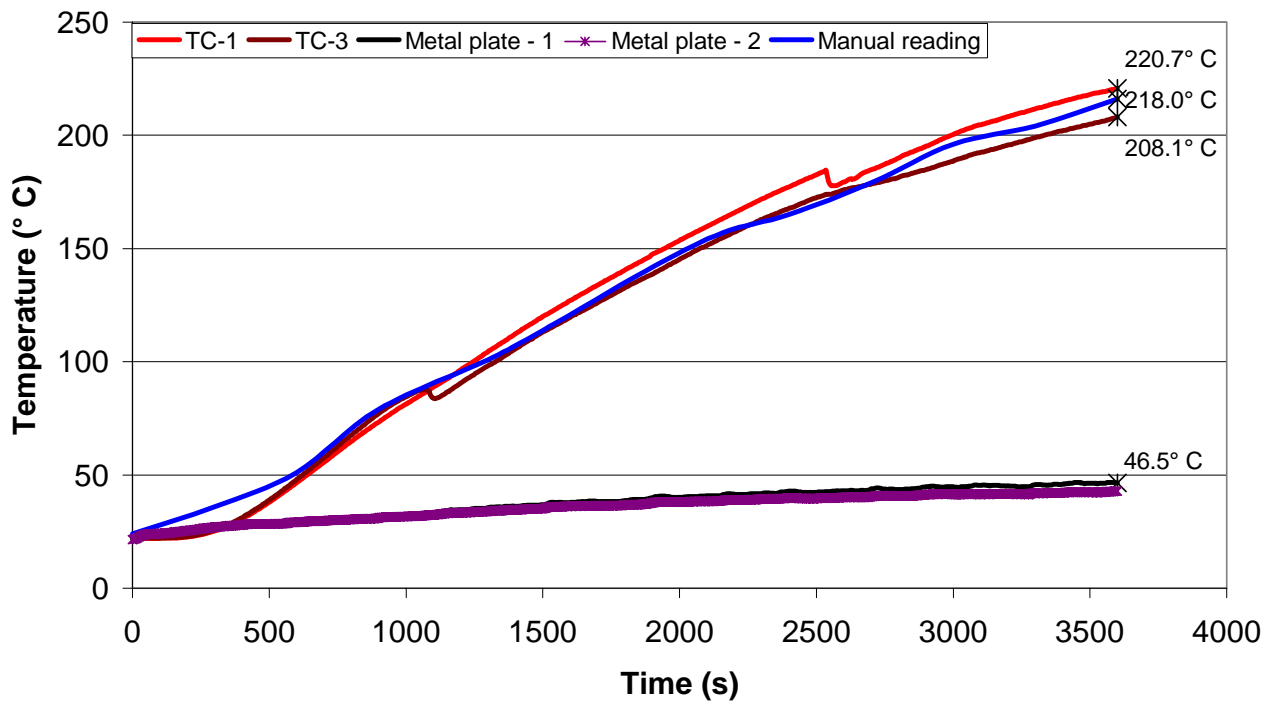
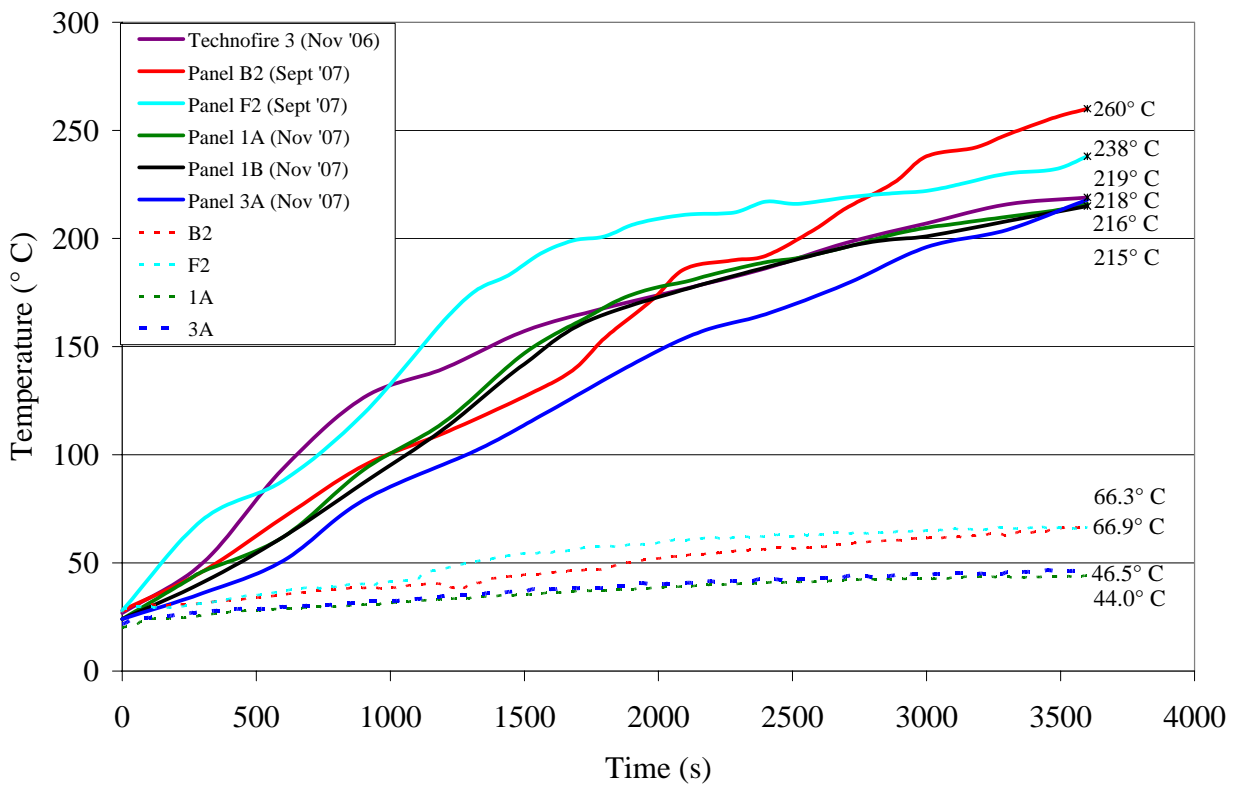


Figure 7. Temperature versus time for the burn-through testing of Panel 3-A.

**Comparison of back face temperature progression versus time during a burn-through testing, for ALL the hardwire panels tested betn. November 2006 through November 2007.**



**Summary:**

- The panels have a performance rating in the following order, based on their peak back-face temperature during burn-through testing for all panels tested Nov 06 to Nov 07 period.

$$\mathbf{B2 < F2 < Technofire\ 3 < 3A \leq 1A \approx 1B}$$

- Maximum damage to the back face was observed on Panel B2.
- Least damage to the back face was noted on Panel 3A.
- Panel 1A and 1B showed similar burn behavior.
- Panel 3A had better overall performance amongst all the panels, when both back face peak temperature and back face damage are taken into consideration.