

CLIENT: **TF CONCRETE FORMING SYSTEMS**
3030 Holmgren
Green Bay, WI 54304
Attn. Rich Mortlock and Don Rudolph

Test Report No:	TJ1412-FT	Date:	August 8, 2013
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SUBJECT: Flammability Testing to NFPA 286, Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth – 2011 Edition.

PRODUCT EVALUATED: Client refers to samples received as “**The TF SYSTEM®**”. This project was entered into our receiving system on June 25, 2013.

TEST REQUESTED: Flammability Testing to NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth – 2011 Edition* and 2006 IBC Section 803.2.1 / 2009 IBC Section 803.1.2 / NFPA 101, and *Life Safety Code*, 2009 Edition, Section 10.2.3.7.2, and 2009 IRC 316.6. The referenced procedure was used to generate this report and data obtained from the test.

SAMPLING DETAIL: Sampling of the test components was conducted by a representative from QAI Laboratories on July 9, 2013 at TF Concrete Forming System’s facility in Ozark, Missouri. . The components of the test module were shipped to QAI Laboratories, Inc in Tulsa OK and received on July 10, 2013.

TEST DATE: Testing was conducted on July 11, 2013

CONCLUSION: Currently, there are no acceptance criteria listed in NFPA 286. Based on the test results herein, the TF SYSTEM room constructed with the interior walls covered with ½” drywall **COMPLIES** with NFPA 101; Life Safety Code, 2009 Edition, Section 10.2.3.7.2., 2009 IBC Section 803.1.2, and 2009 IRC 316.6.

**SIGNED FOR AND ON BEHALF OF
QAI LABORATORIES, INC.**



David Bauchmoyer
Test Technician



J. Brian McDonald
Operations Manager



Test Sample Description:

QAI Laboratories, Inc. conducted testing for TF Concrete Forming Systems on The TF SYSTEM® Thermo-Form ICFs (Insulated Concrete Forms). This consists of expanded polystyrene (EPS) foam plastic panels which are connected using recycled, high density polyvinyl chloride (PVC) cross-tie assemblies. This assembly was built and tested to evaluate heat release and flame spread properties when subjected to specific ignition conditions. Testing was conducted in accordance with NFPA 286, 2011 Edition, on July 11, 2013.

The components that made up the test module were randomly sampled by a QAI Laboratories representative at TF Concrete Forming Systems location in Ozark, MO on July 9, 2013. Items sampled consisted of 200 pieces of EPS flat panels, 50 cross ties, 2 corner EPS Panels, 10 C-Channels, and a 14' Corner Tie. The details of this sampling can be referenced by report number TJ1412-ENG.

The test room was built by TF Concrete Forming Systems personnel prior to the conduction of the test. The test module consists of an ICF wall system constructed of EPS panels and vertical plastic rails held in steel c-channel. The room was constructed using the manufacturer's detailed instructions. No concrete was used to fill the cavities of the wall. The interior of the test module was covered with ½" thick gypsum board. The final interior dimensions with sample in place were 8 feet high, 8 feet wide and 12 feet deep.

This room was placed into a conditioning room with conditions that meet the requirement of this standard for at least 48 hours prior to testing.

The temperature of the test chamber prior to test was 76°F (24°C) and the relative humidity was 47%.

Ignition Source:

The ignition source for the test is a gas burner with a nominal 12 by 12 inch orifice, filled with a minimum 4 inch layer of Ottawa sand. The top surface of the burner through which the gas is applied is positioned 12 inches above the floor. The burner enclosure was placed 1 inch away from each wall in the test corner, opposite the door.

Burner Gas Flow:

CP Grade Propane was used for burner supply gas. A calibrated mass flow meter (Asset A300110, due for calibration 3/28/14) was used to meter flow to the burner. The 40 kW 5 minute exposure flowed 27 l/min Propane and the 160 kW exposure flowed 108 l/min Propane. These numbers were based upon the following constant: 1.485 kW min/l.

Compartment Geometry:

The interior dimensions of the floor of the fire test room, when the specimens are in place, measures 8 by 12 feet. The finished ceiling is 8 feet +/- 0.5 inches above the floor. The four walls are right angles defining the compartment. The compartment contains a 30 +/- 0.25 by 80 +/- 0.25 inch doorway in the center of one of the 8 by 8 foot walls. No other openings were present to provide ventilation.

Heat Release Rate Information:

All Heat Release Rate information obtained during this test utilized oxygen consumption calorimetry. The equation used for calculation is as follows:

$$\dot{q} = E * 1.10 * C \sqrt{\left[\frac{\Delta p}{T_e} \right]} * \left[\frac{(X_{O_2}^{A^*} - X_{O_2}^A)}{1 + \phi + (\alpha - 1)} \right]$$

Thermocouple Placement:

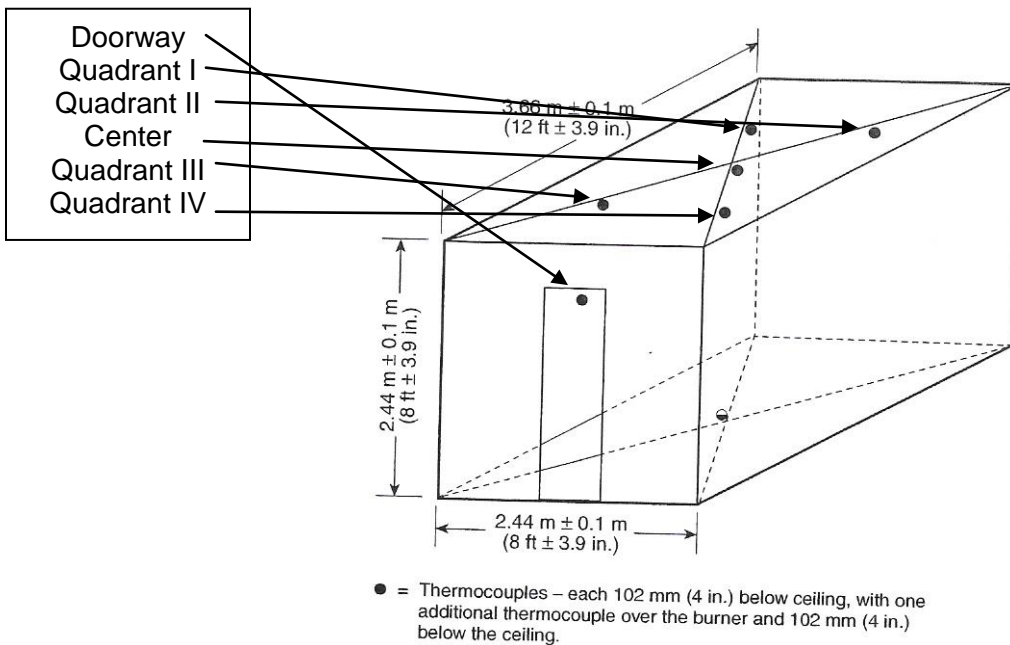


FIGURE 1. Thermocouple Locations



VISUAL OBSERVATIONS and DISCUSSIONS OF PERFORMANCE:

- 0:00:00 – Sand diffusion burner lit to 40 kW flame
- 0:01:00 – Very light clear smoke present, some charring on wall directly behind burner
- 0:02:00 – Smoke leveling out, very good visibility
- 0:03:00 – Light, very clear smoke layer starting to form at ceiling level, flame level steady
- 0:04:00 – Flame level steady, no contribution from test assembly noted
- 0:05:00 – Sand diffusion burner increased to 160 kW flame
- 0:06:00 – No increase in smoke density, excellent visibility, only charring on dry wall noted
- 0:08:00 – Some increase in smoke level seen from the ceiling level
- 0:09:00 – Flames from burner only flaming present, none from test module
- 0:10:00 – Excellent visibility, very light smoke layer
- 0:13:00 – Little change in conditions above
- 0:14:00 – Little change in conditions above
- 0:15:00 – NFPA 286 test complete, some slight flaming still present after gas shut off

Flame Spread and Discussion: *(video record on file)*

Flame spread of the sample did not occur. Flames did not reach the extremities of the test module and flashover, as defined in the specified test designation, did not occur.

Smoke Density:

A peak duct smoke obscuration value of 81% (19 % blocked) and a Peak Smoke Release Rate was 0.15 m²/s 9 minutes and 40 seconds after ignition.

The smoke obscuration reading was taken in the center of a 16 inch diameter duct.

Heat Flux Information:

The heat flux gauge at the floor registered a peak Heat Flux of 1.1 kW/m² measured 15 minutes and 00 seconds into test.

CHARRING MEASUREMENT:

All charring as a result of testing this assembly was limited to the corner of the burner placement up the side walls and to the ceiling. Approximately two feet in both directions of the corner of burner placement showed charring up the walls and began to taper out at about 7 feet from the ceiling. The entire assembly showed charring and discoloration of the coating at about 3 feet from the ceiling down.



FLASHOVER POTENTIAL:

In Section 1.3.1 of NFPA 286, the definition of flashover is an event where any two of the following conditions have been attained:

- Heat Release Rate exceeds 1 MW
- Heat Flux at the floor exceeds 20 kW/m²
- Average upper layer temperature exceeds 600°C (1112°F)
- Flames exit doorway
- Autoignition of a paper target on the floor occurs

For purposes these test results, the following compares the standard's definition of flashover with actual test results for comparison purposes:

- Peak Heat Release Rate of 217 kW
- Heat Flux at floor – Peak of 1.1 kW/m²
- Average upper average temperature – 400°F (204°C)
- Flames did not exit doorway
- Both paper targets undamaged during test

LIFE SAFETY CODE:

From NFPA 101, Section 10.2.3.7.2, and 2009 IBC 803.1.2.1, the following conditions shall be met when using the test protocol of NFPA 286, Standard Methods of Fire Tests for Evaluating Contribution Wall and Ceiling Interior Finish to Room Fire Growth:

- Flames shall not spread to the ceiling during the 40 kW exposure.
- During the 160 kW exposure, the following criteria shall be met:
 - Flames shall not spread to the outer extremities of the sample of the 8 ft x 12 ft wall
 - Flashover shall not occur
- The peak heat release rate throughout the test shall not exceed 800 kW.
- For new installations, the total smoke released shall not exceed 1000 m²



RESULTS:

Temperature vs. Time Chart:

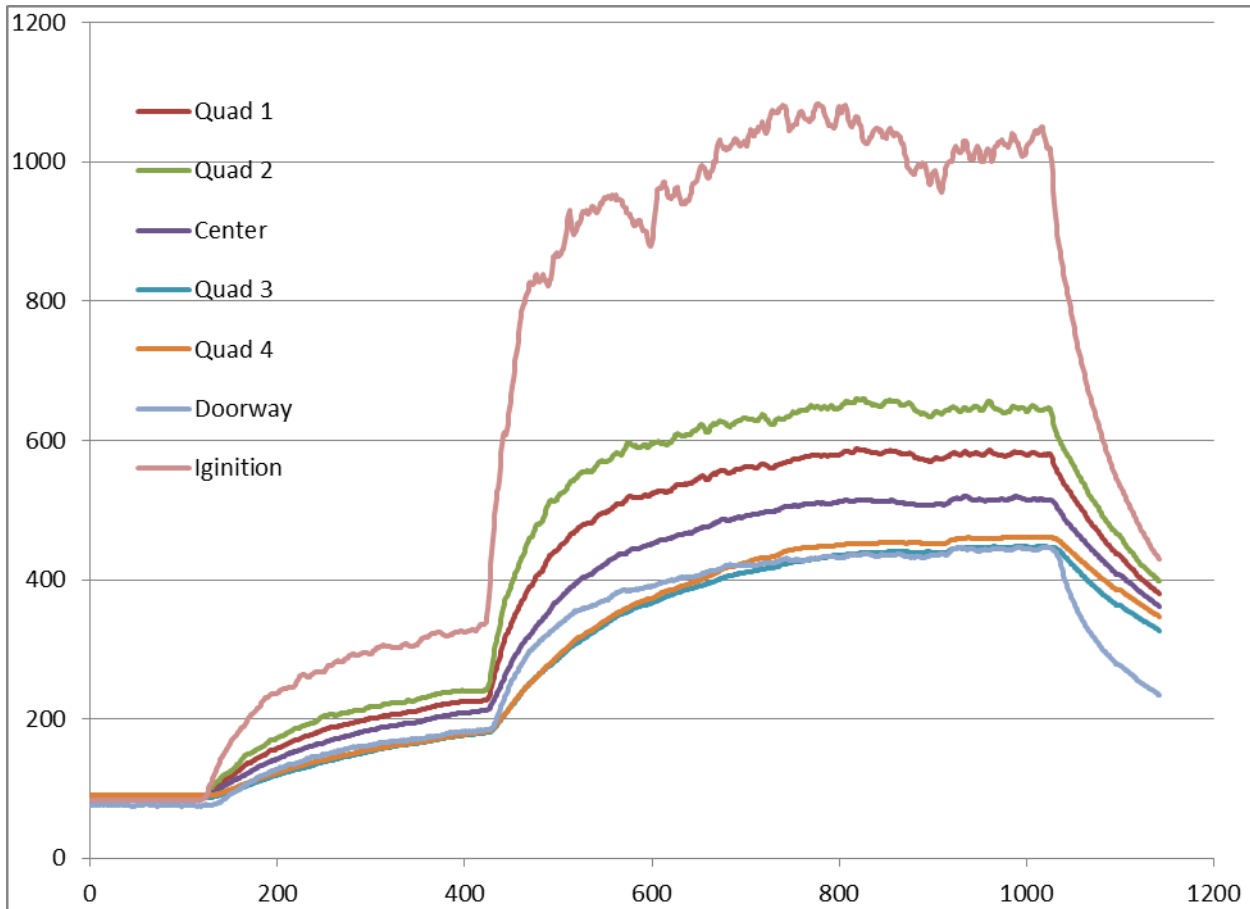


FIGURE 2. Temperature vs. Time

Maximum Peak Temperatures:

Doorway	447°F (231°C)
Center	520°F (271°C)
Quadrant I	588°F (309°C)
Quadrant II	661°F (349°C)
Ignition	1084°F (584°C)
Quadrant III	448°F (231°C)
Quadrant IV	461°F (238°C)

AVERAGE UPPER LAYER TEMP – 400°F (204°C)



Heat Release Rate vs. Time Chart:

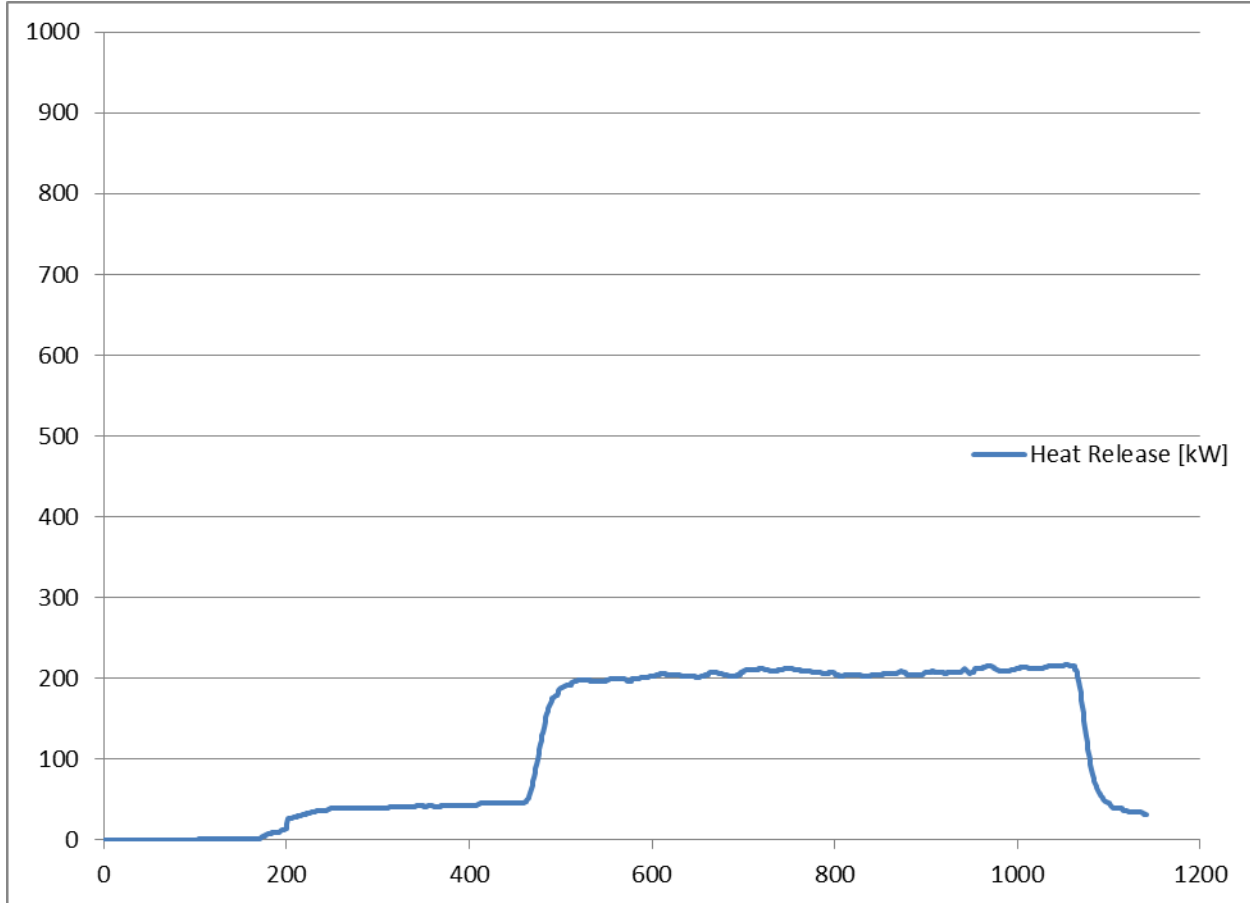


FIGURE 3. Heat Release Rate vs. Time

Numerical Values:

0-5 min average (kW)	41
5-15 min average (kW)	204
Peak Heat Release Rate	217 kW @ 15:00
Total Heat Released During 15 min Test	137.2



Smoke Obscuration and Smoke Release Rate:

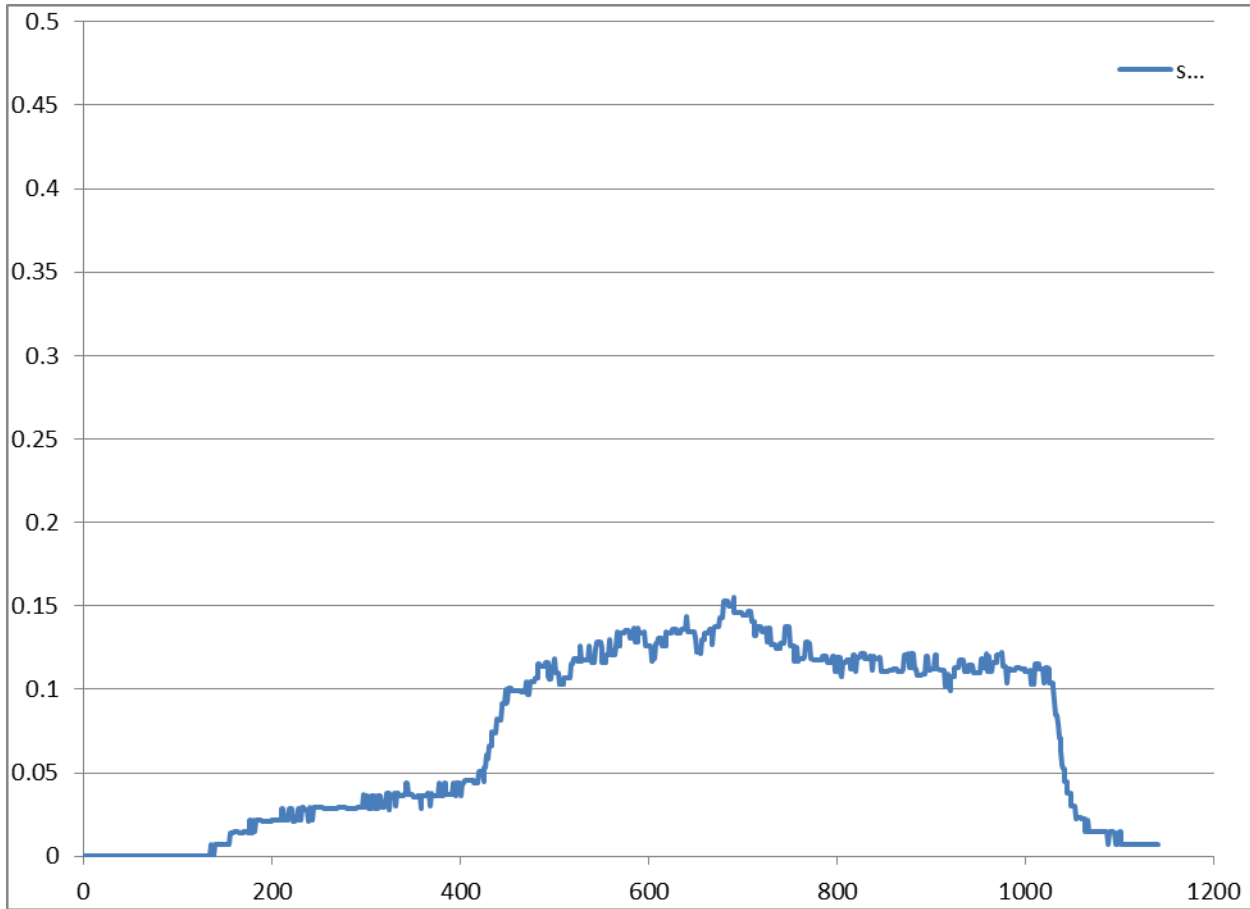
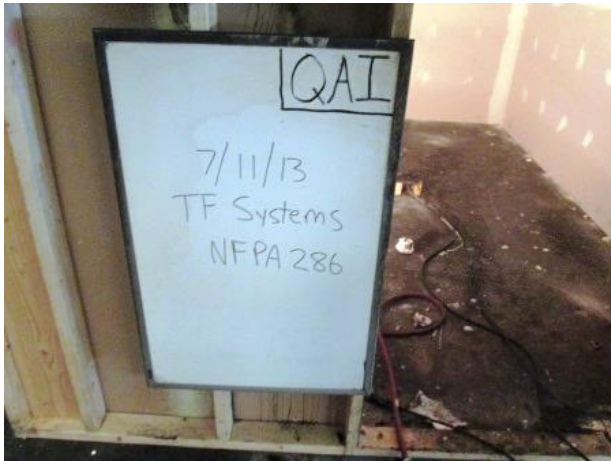


FIGURE 4. Smoke Release Rate vs. Time

Numerical Values:

0-5 min average (m ² /s)	0.02
5-15 min average (m ² /s)	0.11
Peak Smoke Release Rate	0.15 m ² /s @ 9:40
Total Smoke Released	81.7
Peak Obscuration	19% Blocked

PHOTO: BEFORE TEST



Sign



Overall



Opposite and Ignition Corner

PHOTO: BEFORE TEST



Outside Test Set Up

PHOTOS: DURING TEST



Test Start



2 Minutes In



3 Minutes In



5 Minutes In

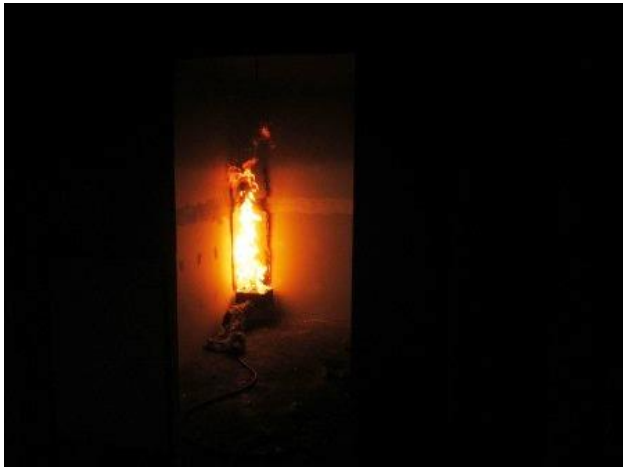
PHOTO: DURING TEST (Cont.)



6 Minutes In



9 Minutes In



13 Minutes In



15 Minutes In

PHOTO: AFTER TEST



Photo Immediately After Test

END OF REPORT