The Effect of Sprinkler Spray on Combustion Products Leaving a Compartment

A Major Qualifying Project Report

submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

By:

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Valerie Adams

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Steven Southard

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Chang Su

AUGUST 2010
Project number: NAD-RI10

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Professor Nicholas A. Dembsey, Advisor

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Dr. Patricia Beaulieu, Co-Advisor
Tyco Fire Suppression & Building Products

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1.0 Organization of this MQP

This MQP is built around a 15-page conference paper that will be submitted to a Fire Protection Engineering conference in the future. The conference paper is Chapter 2 of this MQP. Included within the conference paper are the abstract and acknowledgements section of this report. This MQP contains 11 appendices, one of which is a Capstone Design related exercise performed by Valerie Adams and Steven Southard.

2.0 The Effect of Sprinkler Spray on Combustion Products Leaving a Compartment

2.1 Abstract

Performance based design is becoming increasingly popular in order to design structures that would not be possible using prescriptive-based codes. To effectively use performance based design methodologies, engineers and architects need to have access to engineering tools that can predict how a structure would be affected in a fire scenario. Currently, there are few engineering tools that can be used to easily predict the effect of sprinkler spray on fire scenarios. Crocker has proposed a simplified engineering tool based on Rockett's 2-layer outflow equation. This model predicted that sprinkler spray would decrease the mass flow out of a compartment.

Building on Crocker's work, twenty-seven full scale fire tests and eight non-fire tests were run at Tyco Fire Suppression and Building Products in Cranston, RI in attempt to determine a method to account for the effect of a single sprinkler on fire induced doorway flows. Several of these tests showed that mass flows out of the compartment increased after the sprinkler was manually activated. This is contradictory to the prediction by Crocker that a sprinklers cooling effect would lead to a reduction in mass flow.

Since existing simplified engineering tools may not be valid across a wide variety of potential fire situations, developing a new tool would be significantly useful to the fire protection community. A new simplified engineering tool was developed based on integrating the superposition of mass flux profiles in the doorway for both fire-only and sprinkler-only conditions. The results of this study are a beginning step to being able to predict the effect of a sprinkler on fire induced doorway flows from a compartment.

2.2 Introduction

The use of performance based designs in new construction has been increasing steadily over the last decade and performance based design methodologies often offer numerous advantages over prescriptive design strategies [1]. Performance based design relies heavily on scientifically based engineering tools to predict how structural integrity and life safety would be impacted in the event of a fire scenario. Fire is a very complex phenomenon and there is still an extensive amount of research needed in order to be able to predict many important practical fire scenarios.

One area of interest to the fire community is the effect of a sprinkler on the transport of toxic species out of a compartment through a vent or doorway. As mentioned in Robert Acosta's research, studies of Gann and Proulx have shown that there is great need for a tool that is able to predict the amount of toxic gases that will leave the room of origin during a fire [2]. This issue is paramount because the majority of fire related deaths are due to smoke inhalation and the majority of these deaths occur outside the room of origin [3]. A simple engineering tool that could predict a sprinkler's effect on the transport of toxic gases would be extremely useful to the fire protection community.

In recent research, Crocker developed a simple engineering tool that modified Rockett's two zone mass flow equation in order to apply it to a sprinklered fire scenario [4]. Crocker's data led him to believe that a "Cooling Coefficient" should be incorporated into Rockett's equation, which would result in a decreased mass flow out the doorway. His result has been challenged by the scientific community because of the limited number of fire sizes and sprinkler types tested. There have been other studies done related to the impact of sprinkler spray on the transport of gas flow, but these studies rely on specific sprinkler characteristics such as droplet diameter and sprinkler spray distribution; this information is not readily available according to Crocker's literature review [4].

The goal of this study was to further investigate the effect of sprinkler spray on mass flows out of a compartment. This paper will cover the experimental setup for the different tests run during this study. Direct and indirect measurements are discussed as well as their corresponding uncertainties. Observations and results are discussed and ultimately a simple engineering tool that can predict the mass flow out of a compartment with sprinkler spray is proposed. Finally, suggestions are made for future study of the effect of sprinkler spray on fire induced doorway flows.

2.3 Experimental Study

2.3.1 Room and Instrumentation

A total of 27 fire tests and 8 non-fire tests were conducted at Tyco Fire Suppression and Building Products residential test facility in Cranston, RI. Figure 1 shows a plan view of the test room used for all tests. The room geometry is based on a standard UL 1626 room [5]. The dimensions of the room are 9.75 meters long by 4.88 meters wide, with a smooth flat ceiling 2.44 meters from the floor. The room contained a doorway which was located in the corner opposite the fire and measured 1.04 meters wide by 2.24 meters. The room was constructed of gypsum board ceilings, a concrete floor, and black fire-resistant coated plywood walls. All openings other than the doorway were sealed using aluminum tape or ceramic insulation in order to ensure that the mass flow measured in the doorway was as accurate as possible.

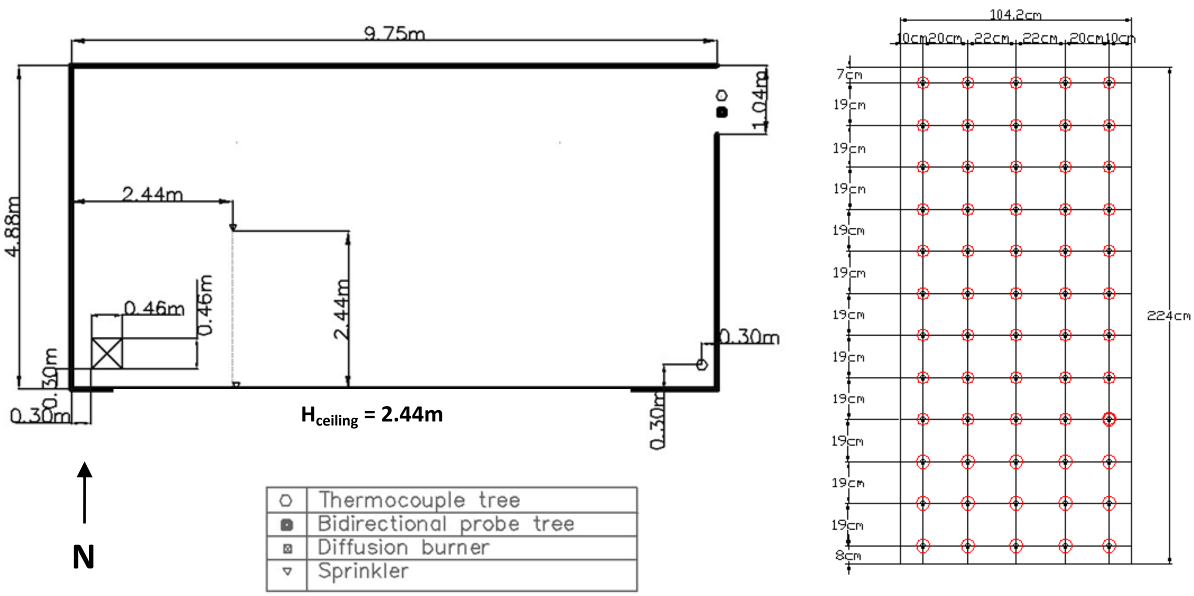

Figure 1(Left) Plan view of experimental test room layout, including the locations of the burner and instrumentation. (Right) Elevation view of doorway showing measurement mass flux measurement locations. The first measurement location within the doorway is the position furthest to the right.

A propane diffusion burner was used for testing [6]. A diffusion flame was preferred because diffusion flames are more representative of real fire scenarios than are pre-mixed flames. A new type of diffusion burner was designed for this study in order to limit the effect of sprinkler spray on the diffusion flame. The burner allowed for water to drain out the bottom while using steel ball bearings to diffuse the propane vapors. During testing there were no visible changes in flame shape, flame height, or flame location between tests that had a sprinkler (dry) and tests that involved sprinkler spray(wet). It is assumed that the heat release rate remained constant throughout the test, due to the fact that the propane flow didn't change more than five percent. The burner was placed in the Southwest corner of the test room. Propane flow was measured using a mass flow meter.

In the experiment, temperature was measured directly using 23 Type-K 24 Gauge thermocouples [7]. A thermocouple tree consisting of 8 thermocouples spaced approximately

0.30 meters vertically was located in the Southeast corner of the room. This thermocouple tree is used to represent the temperature profile in the room. A movable assembly consisting of 12 thermocouples was located in the doorway. These thermocouples were spaced approximately 0.19 meters vertically. Additionally, three thermocouples were placed outside of the enclosure: one outside the North wall, one outside the South wall, and one above the test room.

The movable assembly in the doorway also contained 12 bidirectional probes attached to differential pressure transducers [8]. These 12 pressure transducers were used to directly measure the pressure differential in the doorway.

2.3.2 Experiments

This study consisted of three different types of experiments: Dry, Wet, and Sprinkler Induced Flow (SIF). Each of these different types of experiments has a similar procedure. In a Dry experiment, a steady heat release rate (HRR) propane fire is ignited in the Southwest corner of the room. Tests were run at a HRR of 75 $\pm$ 6 kW or 150 $\pm$ 6 kW. These fire sizes were selected because they represent an expected fire size that a sprinkler would activate. The room reached a quasi-steady state before any measurements were taken. Quasi-steady state was defined as a temperature change of no greater than $\pm$ 5 K in the room corner over a 5 minute period. Once the test room reached steady state, data was recorded for two minutes at the first probe location in the doorway as shown in Figure 1. Next, the array was moved to each of the remaining four locations. Once measurements stabilized, data was recorded for two minutes at each location. After measurements were taken at all five locations, the Dry experiment was complete. It was important to wait for the room to reach a quasi-steady before recording data so that the flow characteristics in the doorway would remain relatively constant for each measurement position.

Since Dry experimental data will be compared to Wet experimental data, all Wet experiments were run immediately after the conclusion of a Dry experiment. This kept conditions as consistent as possible, which leads to a more valid comparison. The procedure for a Wet experiment is identical to that of a dry experiment with the exception of one thing; a sprinkler is manually activated. The flow-rate of the sprinkler is set to its minimum flow. Measurements were taken once the room reaches quasi-steady state with the sprinkler activated. Like the dry test measurements were taken for 2 minutes at each of the five doorway probe locations.

SIF tests were conducted using a similar procedure to a wet test, except there is no fire. The room starts at ambient conditions and the sprinkler is activated at its minimum flow rate. Once the room reaches quasi-steady state, measurements are taken for two minutes at each of the doorway measurement locations. The purpose of this test is to characterize the compartment doorway flow caused by the sprinkler in a non-fire situation. Each of the sprinklers in Table 1 were tested in Dry, Wet, and SIF experiments.

SIN	**Orientation**	**K-Factor** $Lpm * kPa^{-0.5}$ $(gpm * psi^{-0.5})$	**Flow,** Lpm, (Gpm)
TY-1234	Pendent	4.32 (3.0)	29.9 (7.9)
TY-2234	Pendent	7.05 (4.9)	49.2 (13.0)
TY-3251	Pendent	8.06 (5.6)	56.0 (14.8)
TY-4211	Pendent	11.51 (8.0)	80.3 (21.2)
TY-5521	Pendent	16.12 (11.2)	112.0 (29.6)
TY-1334	Sidewall	6.05 (4.2)	42.0 (11.1)
TY-3334	Sidewall	8.06 (5.6)	56.0 (14.8)
AM-29*	Pendent	0.85 (5.9)	23.5 (6.2)

Table 1: Table of sprinklers tested; AM29 is a water mist nozzle

2.3.4 Direct and Indirect Measurements

2.3.4.1 Direct Measurements

Temperature is measured directly by using the Type-K 24 Gauge thermocouples which have an associated uncertainty of $\pm$ 2.2 K as stated by the manufacturer [7]. Differential pressure at the door is measured directly using Omega PX-655 differential pressure transducers which have an associated uncertainty of $\pm$ 0.006Pa [8]. Propane flow was measured using a Teledyne Hastings mass flow meter.]. The mass flow meter is extremely accurate, but the propane flow fluctuates slightly throughout the tests, so the error in the heat release rates was calculated based on the maximum fluctuation in propane flow during any given test, which was determined to be $\pm$ 4%.

2.3.4.2 Indirect Measurements

Mass flux measurements were made indirectly in the doorway. Mass flux can be calculated using direct measurements of Temperature, Pressure, and an experimentally measured bidirectional probe coefficient. The probe calibration factor had an uncertainty of $\pm$ 7% as reported by McCafrey and Heskestad [9]. The upper and lower gas layers in the compartment can be represented as an ideal gas. For simplicity, it is assumed that the molecular weight of the upper gas layer was constant. By making this assumption and assuming a relatively constant pressure, density can be represented as a function of temperature [10]. In order to calculate mass flux, the velocity (measured by the bidirectional probes) was multiplied by the density of the air (calculated based on temperature measurements). Using Taylors' law of propagation of uncertainties for one standard deviation, mass flux measurements were determined to be accurate within $\pm$ 10% of the measured values [11]. In order to obtain the mass flow into and out of the compartment integration of the mass flux profiles was performed using Equation 1a and 1b, where $\dot{m}_{out}$ is the mass flow out of the compartment, $\dot{m}_{in}$ is the mass flow into the compartment, Z_n is the neutral plane, H is the height of the doorway, FLUX is the experimentally measured mass flux profile.

$$\dot{m}_{out} = \int_{Z_n}^{H} [FLUX]\, dA \qquad (1a)$$

$$\dot{m}_{out} = \int_{0}^{Z_n} [FLUX]\, dA \qquad (1b)$$

The integration was performed using a slightly modified version of a custom Matlab program written by Crocker to interpolate mass fluxes between each point. The code for this Matlab can be found in Crocker's thesis [4]. One hundred interpolations are done horizontally and vertically between each probe location. These interpolated mass fluxes multiplied by a differential area result in total mass flow into or out of the doorway, which is also accurate within $\pm$ 10%.

The neutral plane is calculated using the Matlab interpolation mentioned above. The elevation of any interpolated point that has a flux of 0 is averaged together to determine the neutral plane across the width of the doorway. The average neutral plane was determined to be 1.37 $\pm$ 0.12 meters for all experiments.

Upper gas layer temperature was calculated indirectly using the thermocouple tree located in the Southeast corner of the room. All temperature readings for thermocouples above the largest ΔT between thermocouples were averaged together in order to determine the upper gas layer temperature. The uncertainty of this indirect measurement is $\pm$ 0.49 K based on using Taylor's law of propagation of uncertainty with a $\pm$ 1 standard deviation for directly measured temperatures in the upper gas layer [11].

Outflow temperature was indirectly measured by using the thermocouples on the movable probe assembly located within the doorway. Temperature readings above the neutral plane (as determined by the differential pressure transducers) were averaged together to determine the outflow gas temperature. The uncertainty of this indirect measurement is $\pm$ 0.49 K based on using Taylor's law of propagation of uncertainty with a $\pm$ 1 standard deviation for directly measured temperatures in the upper gas layer [11].

Heat Release Rate (HRR) was calculated based on the propane flow rate measured by the mass flow meter. Combustion of propane using a diffusion burner is assumed to be 95% efficient as calculated by taking the ratio of $\chi = \frac{\Delta H_{ch}}{\Delta H_T}$, where χ is the efficiency ratio, ΔH_{ch} is the chemical heat of combustion, and ΔH_T is the theoretical heat of combustion [12]. The resulting uncertainty of HRR is $\pm$ 6kW, which is 4% of the largest tested fire size.

2.4 Validity of Experimental Setup

Results from Dry tests are comparable to previous work accepted by the scientific community, such as those done by Rockett. Figure 2 shows that all experimentally measured values are accurate within the established margin of error when plotted versus Rockett's outflow equation (Equation 2) where $\dot{m}_{out}$ is the mass flux out the doorway, C_D is the discharge coefficient, W is the width of the vent, ρ is the ambient density, T is the ambient temperature, T_G is the upper gas layer temperature, g is the gravitational constant, H is the height of the vent, and Z_N is the height of the neutral plane. [13]

$$\dot{m}_{out} = \frac{2}{3} C_D W \rho \sqrt{2\left(\frac{T}{T_G}\right)\left(1 - \frac{T}{T_G}\right) g}\, (H - Z_N)^{3/2} \qquad (2)$$

The theoretical curve was generated using the average values from all test data for Neutral Plane and Ambient Temperature. The theoretical curve assumes a discharge coefficient of 0.7, which is the value discharge value typically associated with a standard doorway such as the doorway in the UL1626 room[13]. The experimental setup appears to be valid because all of the experimentally measured data points are within the determined error range.

Error analysis on our experimental measurements using the theory of propagation of error showed that the mass fluxes measured by the bidirectional probes are accurate within 10%. Since the room is at a quasi-steady state is expected that the flow out of the compartment will be equal to the flow into the compartment due to conservation of mass. Data obtained during tests confirmed that the experimentally measured mass flows out of, and into the compartment were equal within the calculated margin of error.

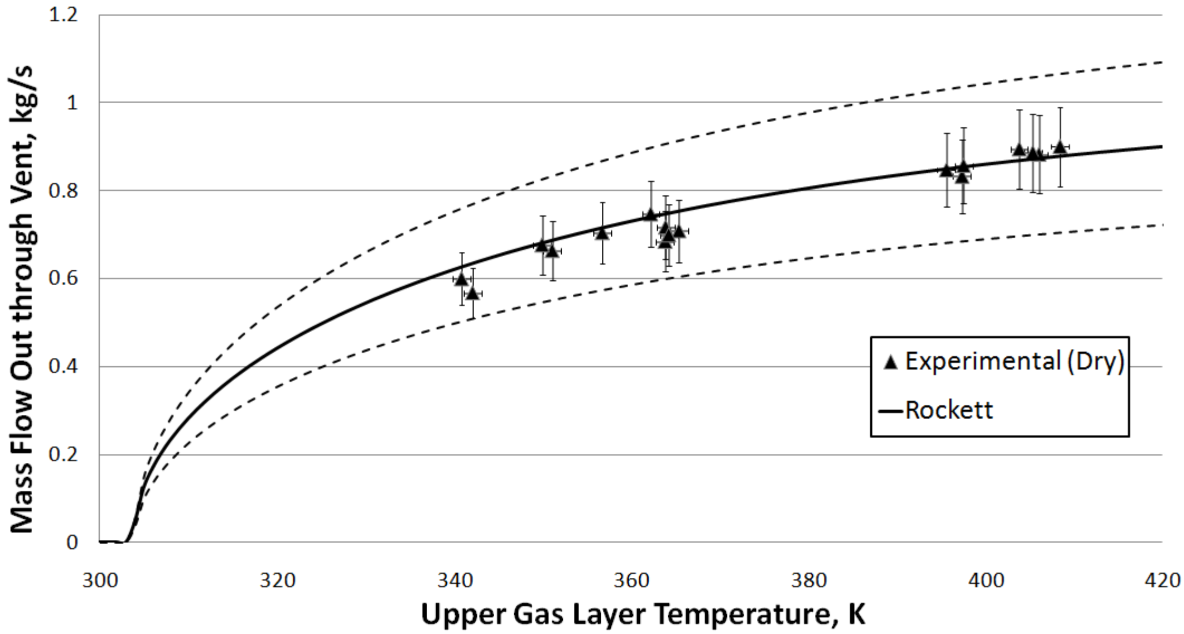

Figure 2: Dry test data compared to Rockett's theoretical equation[13] using a discharge coefficient of 0.7, the average Z_n = 1.37 ± 0.12 meters, and the average Upper Gas Layer Temperature of 304 K. Dashed lines account for the uncertainty in Z_n.

2.5 Results and Discussion

2.5.1 Effect of Sprinkler Spray on Exit Gas Flow

In the early stage of testing there was no obvious drop in mass flow out of the compartment and in most cases there was even an increase in mass flow once the sprinkler was activated. Data shows an average upper gas layer temperature drop of 26 K, which should result in a lower mass flow out of the compartment based on Rockett's outflow equation (Equation 2). This phenomenon shows that a sprinkler activated in a fire situation has additional effects other than only cooling.

In order to investigate additional effects, room temperature profiles taken from the Southeast room corner thermocouple tree were examined. In non-sprinklered (dry) conditions, there were always two stratified layers as shown in both the left and right side of Figure 3. However, once the sprinkler was activated two distinct stratified layers were not always present. The left side of Figure 3 below shows a small K-factor sprinkler that does not greatly mix the two stratified layers. The right side of Figure 3 below shows a larger K-factor sprinkler greatly mixes the gases within compartment. When pressure is constant, a larger K-factor sprinkler sprays more water than a smaller K-factor sprinkler, which is a likely reason why mixing is more apparent in larger K-factor sprinklers as shown in Table 2. In a compartment where a sprinkler has activated, it may not be prudent to use Rockett's equation to predict mass flow out of the compartment.

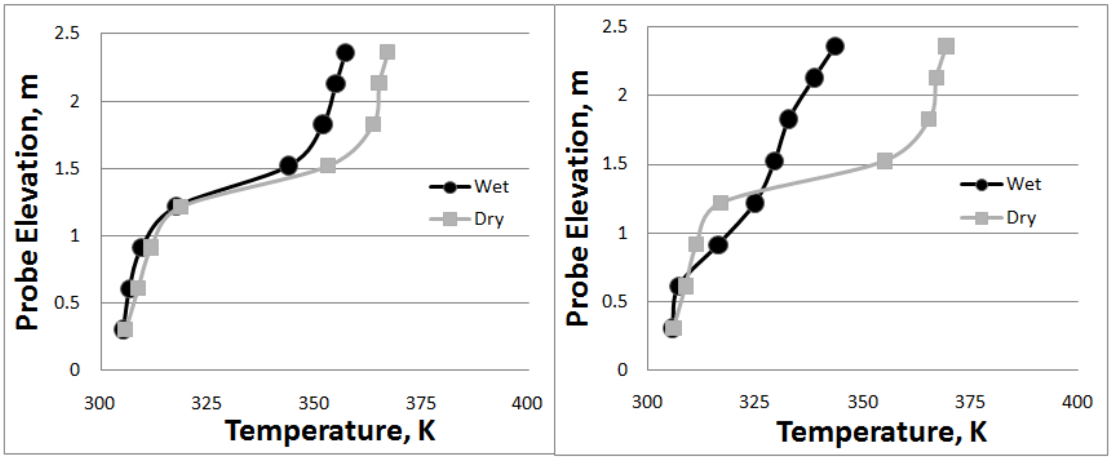

Figure 3: (Left) Room corner temperature profile for test 0806-A, showing 2 stratified layers in both wet and dry tests; test used a 3.0 K-factor residential sprinkler. (Right) Room corner temperature profile for test 0803-B showing, showing 2 stratified layers in dry test and a mixed compartment in wet test; test used an 8.0 K-factor standard spray sprinkler. Temperature uncertainty of +/- 2 K is not shown in profiles for clarity.

While the amount of mixing does not appear to directly correlate to the amount of mass flow leaving the compartment there appears to be a general trend that larger K-factor sprinklers result in an increase in mass flow out of the doorway once activated, while smaller K-factor sprinklers result in a decrease in mass flow leaving the doorway once activated. Table 2 below shows this general trend.

K-Factor, $Lpm * kPa^{-0.5}$ $(gpm * psi^{-0.5})$	**Fire Size,** kW	$\Delta\dot{m}_{out}$, kg/s	**K-Factor,** $Lpm * kPa^{-0.5}$ $(gpm * psi^{-0.5})$	**Fire Size,** kW	$\Delta\dot{m}_{out}$, kg/s
4.32 (3.0)	75	-0.0183	16.12 (11.2)	75	-0.1305
4.32 (3.0)	150	-0.0236	16.12 (11.2)	150	0.0033
7.05 (4.9)	75	-0.0196	6.05 (4.2)	75	0.0239
7.05 (4.9)	150	-0.074	8.06 (5.6)	75	0.0921
8.06 (5.6)	75	0.0412	8.06 (5.6)	150	-0.01
8.06 (5.6)	150	0.0093	0.85 (0.59)	75	0.0243
11.51 (8.0)	75	0.0086	0.85 (0.59)	150	0.0213
11.51 (8.0)	150	-0.0157			

Table 2: Summary of tests showing the general trend that larger K-factor sprinklers cause an increase in mass flow out of the compartment and smaller K-factor sprinklers cause a decrease in mass flow out of the compartment. $\Delta\dot{m}_{out}$ **is equal** $\Delta\dot{m}_{out}$**(Wet) -** $\Delta\dot{m}_{out}$ **(Dry)**

2.5.2 Sprinkler Induced Flow

A sprinkler was activated in a non-fire condition inside the test room, and its mass flux profile was recorded using the same method as the fire tests. A total of six sprinklers were tested in the non-fire condition and each produced a significant mass flow. Total mass flow produced ranged from twenty to fifty percent of the mass flow produced by typical fires. The mass flux profile from the sprinkler induced flow (SIF) has a neutral plane, an inflow region, and an outflow region. These characteristics are similar to wet or dry profiles, however, where there is inflow in a SIF profile there is outflow in a dry or wet profile and where there is outflow in a SIF profile there is inflow in a dry or wet profile. An example of typical Wet, Dry, and SIF profiles is shown below in Figure 4.

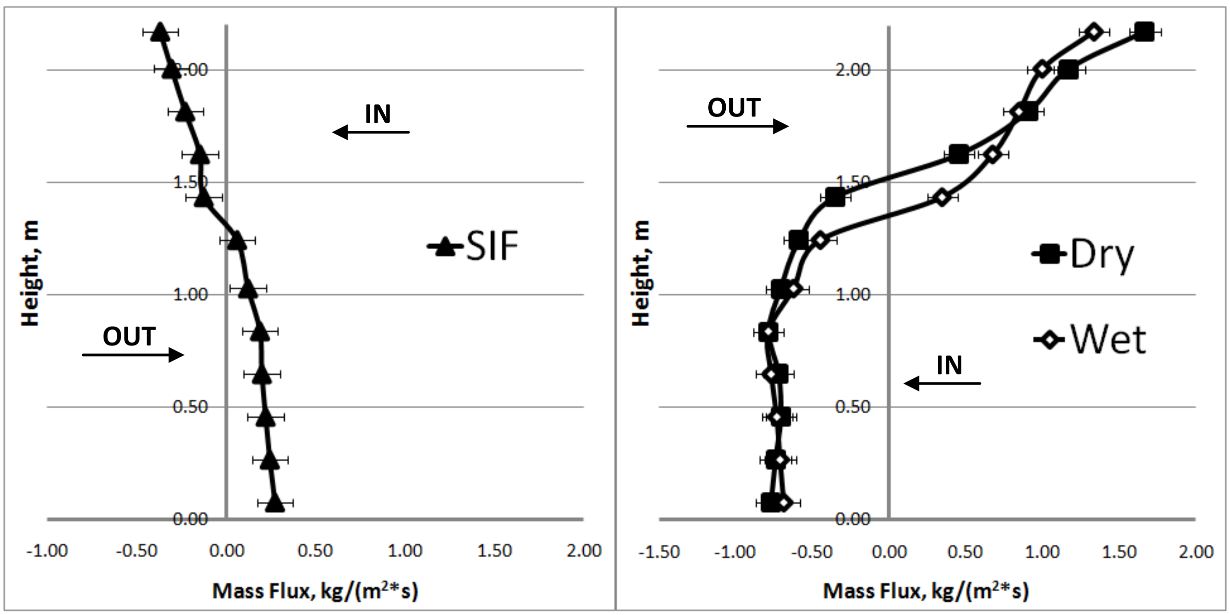

Figure 4: (Left) SIF mass flux profile for 8.0 K pendent sprinkler. (Right) Wet/Dry mass flux profiles from test 0803-B. Measurements were taken in the center of the doorway. Positive mass flux is outflow.

2.5.3 Direct Superposition

Since the fire and the sprinkler each produce a significant and opposing flow, a direct superposition was attempted in order to predict the mass flow out of the compartment in a sprinklered situation. The experimentally measured non-sprinklered (dry) mass flux profile was added to the SIF profile to obtain a superimposed profile as shown in Figure 5. By examining the figure, it is apparent that superposition yields a reasonable wet mass flux profile. This superimposed profile was then integrated using a custom Matlab program created by Crocker [4]to obtain a calculated mass flow out of the compartment.

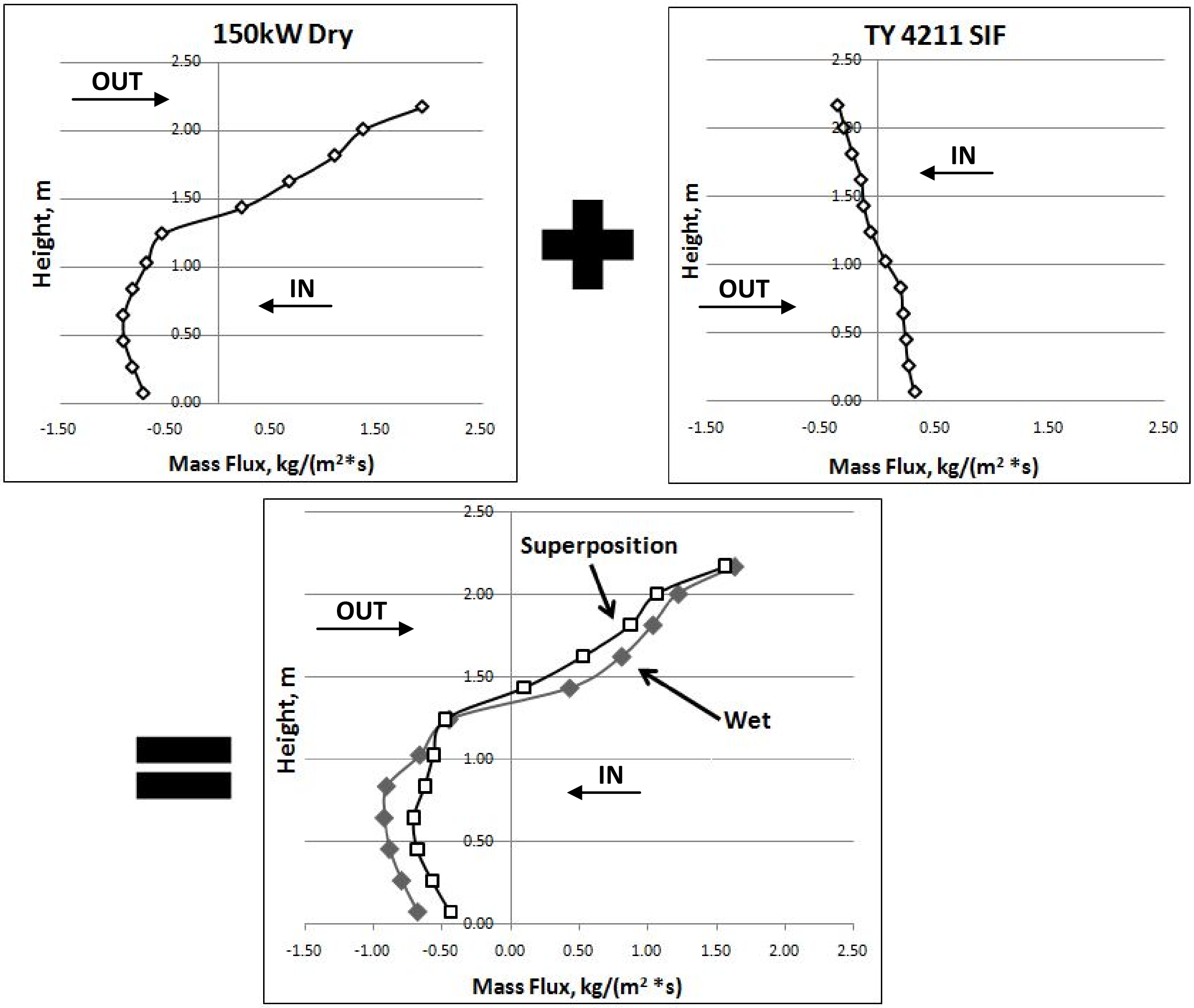

Figure 5: Process of superposition: (Dry mass flux profile) + (SIF mass flux profile) = (Super Position mass flux profile). The Super Position mass flux profile is similar to the Wet mass flux profile. Positive mass flux is outflow. Mass flux uncertainty of +/- 10% is not shown in profiles for clarity.

When these superimposed mass flows were calculated for each applicable test and graphed they uniformly underestimate the experimental. On average, the flow predicted by direct superposition is 22% lower than the experimental flow. If the mass flow out calculated using superposition is increased by a correction factor (1.22 based on our data), then they give a reasonable estimate of the actual mass flow out of the compartment once the sprinkler has activated as seen in Figure 6.

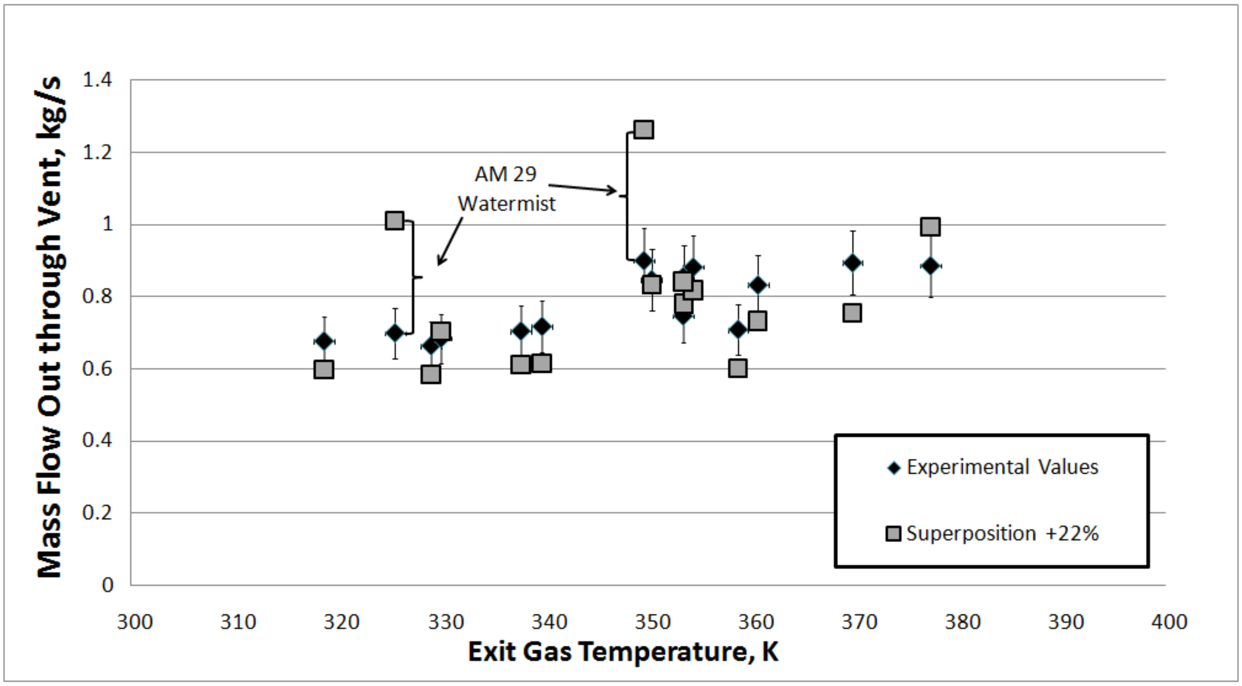

Figure 6: Calibrated Superposition: Using a direct superposition of SIF and Dry mass flux profiles to determine a superimposed mass flow out is able to predict, within a reasonable margin of error, the actual mass flow out of the compartment in a Wet test. On average this direct superposition is 20% lower than the actual mass flow out of the compartment. This graph shows both the actual experimental measurements and the Superposition values, which are multiplied by 1.22 to account for the fact that direct superposition is approximately 20% lower than experimental values.

The AM 29 nozzle operates at a significantly higher pressure, has increased droplet velocity, and produces droplets that are an order of magnitude smaller than any of the other sprinklers tested. Tests ran with the AM 29 water mist nozzle do not follow the general superposition trend that the pendent and sidewall sprinklers do. This could be due to the fact that the SIF mass flux profiles in the doorway are very turbulent and do not follow the typical trends of other sprinkler's SIF mass flux profiles as shown in Figure 7.

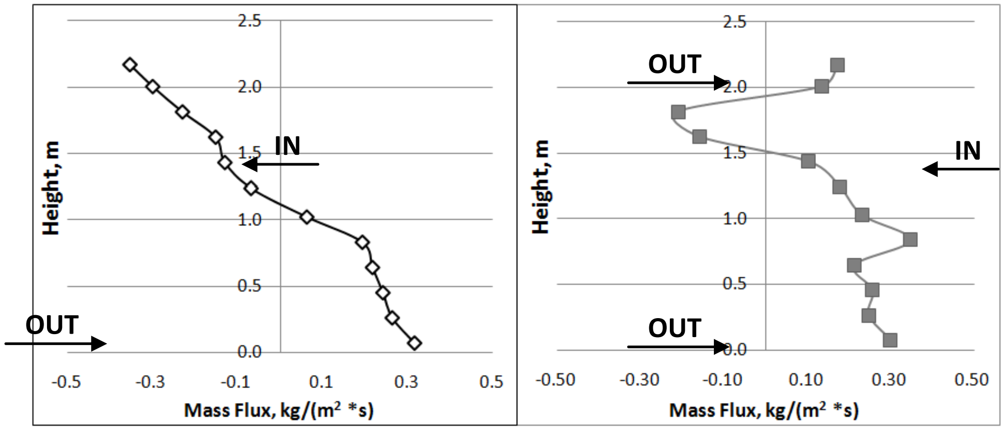

Figure 7: Comparison of a SIF profiles for a typical sprinkler and the AM 29 water mist nozzle. The sprinkler has a very linear profile, while the water mist nozzle has a non-linear profile, likely due to increased turbulence in the room with the water mist nozzle. Mass flux uncertainty of +/- 10% is not shown in profiles for clarity.

In a non-fire situation, the compartment is well stratified and mass flow out can be easily determined within a reasonable margin of error. Once a sprinkler is activated it becomes much more difficult to predict how the gases within the compartment will behave. The sprinkler introduces numerous confounded effects into the compartment including mixing, evaporation, and induced airflow. These effects cannot easily be isolated, so with the data collected deriving a simple engineering tool that is able to characterize all physical phenomenon introduced when a sprinkler is activated is not possible at this time. However, using a simple superposition of mass flux profiles resulting from Dry tests(DRY) and Sprinkler Induced Flow (SIF) can be integrated to obtain first approximation of expected mass flow leaving a compartment in a sprinklered fire scenario, as shown in equation 3 where $\dot{m}_{out}$ is the mass flow out of compartment, C_D is the discharge coefficient, W is the width of vent (doorway), ρ_∞ is the ambient air density, T_∞ is the ambient air temperature, T_G is the upper gas layer temperature, g is the gravitational constant, Z_n is the neutral plane height, and H is the height of the vent (doorway).

$$\dot{m}_{out} = C_c \int_{Z_n}^{H} ([DRY] + [SIF])\, dA \qquad (3)$$

2.6 Conclusion

There appears to be three confounded phenomena present within the compartment when the sprinkler is activated. The first is the mass flow induced by the sprinkler spray, the second is the cooling effect of the sprinkler, and the third is the mixing effect of a sprinkler. In a given fire situation sprinkler spray has the potential to either increase or decrease the mass flow exiting the vent of a compartment. If the cooling effect is more dominant than the sprinkler induced mass flow, the mass flow out the vent will decrease. If the sprinkler induced flow is more dominant than the cooling effect, the mass flow out of the compartment will increase. Simply using Rockett's equation modified with a cooling coefficient cannot be accurately used to predict mass flow out of a compartment in most sprinklered fire situations.

Although highly simplified, Equation 3 is able to predict mass flow out of a sprinklered fire scenario in the test compartment within 20% uncertainty for all standard spray and residential sprinklers tested. The AM29 water mist nozzle which was tested did not follow the trend of the rest of the data. It appears that water mist nozzles cannot be characterized using the methods proposed in this paper.

If this equation were to be used in industry, a database of mass flux profiles for both SIF and Dry conditions would need to be created in order to use this engineering tool. The creation of such databases would likely take be cost prohibitive, so a more simplified tool using only Rockett's equation would be ideal.

2.7 Future Work

Although a single coefficient equation is given above in (3) appears to be able to accurately predict the mass flow out of a doorway in a sprinklered fire scenario, the equation has a very limited use, but ideally a method should be determined that relies less on experimental results. Ideally, a final equation would better characterize the physics that take place in the enclosure, taking a form similar to equation 4, where $\dot{m}_{out}$ is equal to the mass flow expected out in a sprinklered fire scenario, $ROCKET$ is Rockett's theoretical two layer equation in an unsprinklered (dry) scenario (1), C_s is a sprinkler cooling coefficient, and f is a function of sprinkler characteristics such as Q_s (sprinkler flow rate), Θ (spray angle), V_s (spray velocity).

$$\dot{m}_{out} = C_s * [ROCKETT] + f(Q_s, \theta, V_s, \dots) \qquad (4)$$

In this equation, Cs would represent the cooling effect of a sprinkler, while the function f represents the induced mass flow as well as the mixing effect of a sprinkler. In order to use this equation a substantial amount of additional research needs to be If an equation such as this could be determined, it would be much more useful for fire protection engineers because it would not require a database of SIF and DRY mass flux profiles for use.

2.8 Acknowledgments

We would like to thank our Advisor Professor Nicholas Dembsey for his helpful guidance throughout the duration of this project. We would also like to thank Patricia Beaulieu, the leader of New Technology at Tyco Fire Suppression and Building Products, for all her time and suggestions as well as for making this project possible. Finally, we would like to thank members of the Tyco Fire Suppression and Building Products for allowing the use of their facilities as well as the many New Technology engineers and technicians who helped us throughout the project especially James Morgan, Zachary Magnone, and Jeremiah Crocker.

2.9 References

1 Puchovsky, M. T., & Hurley, M. J. "Performance-Based Codes and Standards for Fire Safety". In Fire Protection Handbook, pp. 3-167. National Fire Protection Association, Quincy, MA (2008).

2 Accosta Jr., R. F. "The Effect of Sprinkler Sprays on the Transport of Toxic Products" In Independent Study Report. Worcester Polytechnic Institute, Worcester, MA (2009).

3 Gann, R., Babrauskas, V., Peacock, R., & Hall Jr, J.. "Fire Conditions for Smoke Toxicity Measurements" In Fire and Materials , pp.193-199 (1994).

4 Crocker, J. P. "The Effect of Sprinkler Sprays of Fire Induced Mass Flow Rates" In Masters Thesis, Worcester Polytechnic Institute: Worcester, MA. (2008).

5 Cote, A. E. Operation of Fire Protection Systems. National Fire Protection Association: Quincy, MA (2003).

6 Adams, V., Su, C., Han, Z., & Southard, S. "The Effect of Sprinkler Spray on Combustion Products Leaving a Compartment" In MQP, Worcester Polytechnic Institute: Worcester, MA. (2010).

7 Omega Data Sheet "Thermocouple Wire Duplex Insulated K" (2010). Retrieved August 2010, from Omega.com: http://www.omega.com/temperature/z/pdf/z204-206.pdf

8 Omega Data Sheet "Omega PX-655 Pressure Transducer Instruction Sheet" (2010). Retrieved August 2010, from Omega.com: http://www.omega.com/Pressure/pdf/PX655.pdf

9 McCaffrey, B. J., & Heskestad, G. "A Robust Bidirectional Low-Velocity Probe for Flame and Fire Application" In Combustion and Flame, pp. 125-127. (1976).

10 Drysdale, D. An Introduction to Fire Dynamics. Wiley: New York, NY (1985).

11 Beckwith, T. G., Marangoni, R. D., & Leinhard, J. Mechanical Measurements. Prentice Hall: NJ (2007).

12 Tewardson, A. "Generation of Heat and Gaseous, Liquid, and Solid Products in Fires" In The SFPE Handbook of Fire Protection Engineering, Fourth Edition, Section 3-4. National Fire Protection Association: Quincy, MA (2008).

13 Emmons, H., & Tanaka, T. "Vent Flows" In The SFPE Handbook of Fire Protection Engineering, Fourth Edition, Section 2-3. National Fire Protection Association: Quincy, MA (2008).

Appendix A: Pre Qualifying Project (PQP)

Interoffice Memorandum

To: Dr. Patricia A. Beaulieu; Professor Nicholas A Dembsey

cc: Mr. James Morgan

Date: May 4, 2010

From: Valerie Adams, WPI
Su Chang, SJTU
Steven Southard, WPI
Han Zhiyi, SJTU

Subject: Research proposal for an empirical study in support of the Sprinkler Cooling Coefficient concept.

Overview

There are currently few existing engineering tools that account for effect of sprinkler discharge on fire induced flow. The development of an easy to use method to account for the effect of sprinkler discharge on doorway flow would be beneficial, especially for use in performance based design. Being able to predict sprinkler impact on fire induced flow is critical because the majority of fire deaths are from smoke inhalation. By performing the proposed fire tests, a better understanding of the effects of sprinkler discharge on fire induced flow will be developed. Crocker's thesis was the first step in this process, but since his results have been questioned by the scientific community, it must be validated by using more sprinklers and larger fire sizes. The cost of running the proposed tests will be minimized due to the fact that the majority of the work will be performed by students from Worcester Polytechnic Institute and Shanghai Jiao Tong University.

Background

There are currently few existing engineering tools that account for effect of sprinkler discharge on fire induced flow. The development of an easy to use method to account for the effect of sprinkler discharge on fire induced flow would be beneficial, especially for use in performance based design. Being able to predict sprinkler impact on fire induced flow is critical because the majority of fire deaths are from smoke inhalation In May 2008, Jeremiah Crocker presented his Master's Thesis to the faculty of Worcester Polytechnic Institute (WPI). Crocker studied how a discharging sprinkler affected the fire induced flow through a doorway. He proposed modifying Rocket's equation to include a sprinkler cooling coefficient. In order to test this modification to Rocket's equation, Crocker used four different fire sizes and a Tyco LFII Residential sprinkler. Twenty-four full scale fire tests were conducted at Tyco Fire

Suppression & Building Products Global Technology Center. The tests were conducted with the discharging sprinkler sufficiently far from the door to maintain stratified gas layers.

Problem Statement

Jeremiah Crocker's thesis has been challenged by the scientific community because of the fact that only one sprinkler type was used and there is not enough variance of fire sizes and room configurations. In order to validate Crocker's thesis, more extensive testing needs to be completed.

Objective

The objective is to determine whether the sprinkler cooling coefficient can be applied to a more broad range of widely used sprinklers. We propose increasing the number of sprinklers, modifying the fire sizes, and changing room configurations. Larger fire sizes should be tested to ensure that the sprinkler cooling coefficient is valid over a broader range of fire sizes.

Results, Deliverables and Benefit

The data from this research study will be recorded and organized into spreadsheets. Temperature, pressure, and vent dimensions will be directly measured. The velocity of the fire induced flow and the neutral plane height will be calculated from the pressure gradient across the doorway. Also, the density of the upper gas layer and the interface height will be determined from temperature data. Video recordings of all experiments will be made. We will use a modified version of Rocket's outflow equation to calculate a sprinkler cooling coefficient for each sprinkler being tested. A complete a conference paper, with supporting appendices to obtain a full whitepaper will be delivered upon completion of the study. This paper will potentially be published in a peer-reviewed journal soon after the completion of the research study. The deliverable will include a summary of all data obtained as well as a scientific analysis of the data. This study will be beneficial to Tyco Fire Suppression and Building Products, because it will provide insight into how several of their most commonly used products affect the flow of toxic fire gases through doorways. This study could potentially lead to future work which could determine what factors have the largest effect on toxic gas flow, which could be incorporated into future sprinkler designs.

Technical Approach

Fire Sizes

A total of 9 sprinklers will be tested on 3 different fire sizes. The selection process used by Crocker to choose fire sizes appears to be scientifically valid. Since there has been criticism regarding the selected fire sizes, it may be prudent to select different sizes. Due to the fact that Crocker's fires are relatively small, so we would like to use at least one larger fire. Based on compartment limitations, we propose the use of the following 3 fire sizes: 75kW, 150kW, 300kW. Only three fire sizes were selected because it will allow more sprinklers to be tested. Before performing the proposed experiment we will replicate a selection of tests from Crocker's work in order to verify proper experimental setup. We expect to obtain data consistent with Crocker's thesis. We will indirectly determine mass flow into and out of the compartment using Rocket's equations. These equations are listed on the final page of this proposal. The calculated flow into and out of the compartment should be equal once steady state conditions are reached. Doorway flow information will allow us to indirectly determine the neutral plane height. The fire sizes will be calibrated using a mass flow meter to determine the mass flow rate. Once the mass flow rate is determined, it can be multiplied by the chemical heat of combustion to obtain the fire heat release rate. Once the sprinklers activate, it is expected that the fire HRR will decrease slightly. We do not believe this to be a serious concern, since Tyco has already done some research that shows that the HRR of premixed flames decreases only slightly when a sprinkler discharges. The fire could be placed in the open, against a wall, and in the corner for each test.

UL 1626 Room

The same standard UL1626 fire test room used in Crocker's thesis will be used for this research study. The dimensions are 9.75 m long by 4.88 m wide by 2.44 m high, as shown in Figure 1. The room contains a single doorway 1.04 meters wide and 2.24 meters high. The room is constructed of a gypsum board ceiling, plywood walls with black fire resistant coating, and a concrete floor. All openings besides the doorway, including cracks and seams, are sealed to prevent unwanted mass losses. Thermocouples and bi-directional probes will be placed in the doorway. Since it will be expensive and unnecessary to have the entire doorway full of probes, movable arrays of thermocouples and bi-directional probes will be used. A stationary thermocouple tree will be placed away from the door, the fire and sprinkler discharge. Referring to Figure 1, the thermocouple tree will be placed in right third of the room, but not in the plane of the door. Data obtained from this thermocouple tree will need to be processed in order to be used for average upper layer temperature, average lower layer temperature, and interface height in Rocket's equations.

Sprinklers

Since it is preferred to test a broader range of sprinklers, we have selected 9 Tyco sprinklers shown in Table 1. These sprinklers were selected to represent a wide variety of standard, commonly used sprinkler types. The parameters of K-factor, orientation, and response time are varied. Each of these 9 sprinklers could potentially be used in the test room setup. The test room requires 3 standard coverage or 2 extended coverage sprinklers (per NFPA 13). K-factors of 3.0 to 14.0 were selected because they represent a wide range of orifice sizes and are likely to produce droplets of varying sizes. We will be able to observe the effect of droplet size on vent flow out of the compartment. In order to see if sprinkler orientation has an impact on flow through the vent, we chose two sprinklers that are identical in all ways except orientation (TY3221 and TY3311). Although these sprinklers have a different RTI, this does not impact the experiment because the elements are not in the sprinkler, so the sprinklers can be activated at an appropriate time as determined by the research team. Table 1 displays the selected sprinklers.

Table 1: Proposed sprinklers to be tested

Sprinkler Name	SIN	K-factor	Response	Orientation
LFII Residential	TY1234	3.0	Quick	Pendent
LFII Residential	TY1334	4.2	Quick	Sidewall
LFII Residential	TY2234	4.9	Quick	Pendent
Series TY-FRL	TY3221	5.6	Quick	Pendent
Series TY-L	TY3311	5.6	Standard	Sidewall
Series TY-L	TY4211	8.0	Standard	Pendent
Series EC-11	TY5237	14.0	Standard	Pendent
Series SW-20	TY5332	11.2	Standard	Sidewall

Bidirectional Probes

There is no need to change the pressure probe that Jeremiah Crocker used, because the pressures expected will still be on the same order of magnitude as in Crocker's experiment. Since the validity of the thesis is not questioned due to inaccuracy of recorded data, it does not appear to be necessary to change the pressure transducer. The differential pressure will be measured by either Omega PX655 or Omega PX274 high accuracy, low pressure bidirectional pressure transmitters. There will be 12 used for the arrays in the doorway. The trees will be moved to obtain readings at different points in the doorway. The pressure range of both devices is 0 to 25in Water (0 to 0.9psi). The bidirectional probe will be calibrated using a plunge tunnel.

Thermocouples

The thermocouples used by Crocker are sufficient for measuring the temperatures expected in the compartment. Therefore, we see no need to change the type of thermocouples used, especially considering that Tyco may already have these thermocouples on hand. The thermocouples used during experimentation were Type-K 24 gauge, duplex insulated. The number of the thermocouples used will be as follows: 12 for doorway trees, 13 for corner tree, and 5 spread throughout the room. The thermocouples will be calibrated using the known temperatures of ice and boiling water. We will record one sample per second for approximately 60 seconds in each probe position. Then, we would move the probe and once the readings stabilize, we will re-record for 60 seconds, until measurements were taken in all doorway positions.

Safety Precautions

Since fire testing is extremely dangerous when not performed correctly, safety procedures must be strictly followed. All Tyco safety protocols must be strictly followed throughout the duration of this research study. We need to be certain that there are no combustibles adjacent to the fire source and we must ensure that the fire be kept under control at all times. Fire sizes are not to exceed safe limits for the UL1626 room. It must also be verified that the temperatures of both the inside and the outside are not excessively hot. Since fires are intrinsically hot, we must keep a safe distance from the fire at all times. Probes may become extremely hot during testing, so proper use of heat resistant gloves will be necessary. We must also check for leakage in the propane delivery system. We could perform this check by applying a water-soap solution on the delivery systems and flowing a non combustible gas through the delivery system. If bubbles form, this implies there is a leak in the discharge lines. Trained fire test technicians must be on hand for all of the fire tests.

Potential Modifications and Future Work

While there are seemingly an infinite amount of possible modifications that could lead to a more definitive experimental result, we will not be able to try every configuration due to time constraints. Because of these time constraints, we would like to focus on the following areas in order of importance:

1. Test a wide variety of sprinklers with different characteristics.
    - In Jeremiah Crocker's thesis there is only one sprinkler tested. More sprinklers will be tested in order to help confirm Crocker's concept of a sprinkler cooling coefficient.
2. Have multiple sprinklers activated
    - It would be interesting to see how a second sprinkler, likely in the middle of the room, would impact the room. If the cooling coefficient could be extended to two sprinklers, perhaps it can be applied to a more broad range of fire scenarios.
3. Move the fire closer to the door (possible future work)
    - It would be helpful to find a limit, possibly using non-dimensional variables, to determine how close to the door the sprinkler can be moved before the cooling coefficient is no longer valid.
4. Using dynamic fires instead of static HRR (possible future work)
    - In a real fire situation, once the sprinkler activates, the sprinklers heat release rate will likely go down. If it were possible to have the fire's HRR decrease like a real fire, it would make any results that we find more valid.

Schedule, Resources and Cost Estimate

The research study proposed would be conducted over a time period of six weeks, commencing Tuesday, July 6, 2010 and completing Friday, August 20, 2010. The research team will mainly consist of four engineering students: 2 from WPI in Worcester, MA, USA and 2 from Shanghai Jaio Tong University in Shanghai, China. Students will be working approximately 40 hours per week. No new equipment needs to be purchased since existing equipment is available from Jeremiah Crocker's previous work.

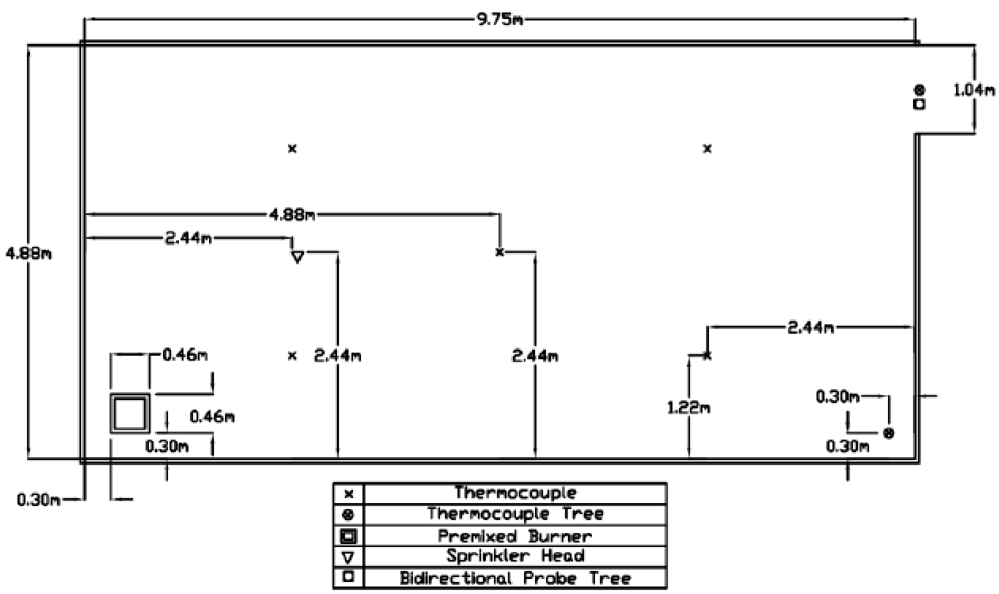

Figure 1: Crocker's Room Layout (UL 1626 Room). Exact locations of instrumentation has not yet been determined. Reproduced from Jeremiah Crocker's Master's Thesis with permission.

Equation 1: Rocket's Inflow Equation

$$\dot{m}_{in} = \frac{2}{3} C_D W \rho_\infty \sqrt{2 \frac{T_\infty}{T_G}\left(1 - \frac{T_\infty}{T_G}\right) g}\ (Z_N - Z_D)^{1/2} \left(Z_N - \frac{1}{2} Z_D\right)$$

Equation 2: Rocket's Outflow Equation

$$\dot{m}_{out} = \frac{2}{3} C_D W \rho_\infty \sqrt{2 \frac{T_\infty}{T_G}\left(1 - \frac{T_\infty}{T_G}\right) g}\ (H - Z_N)^{2/3}$$

Equation 3: Crocker's Proposed Modified

$$\dot{m}_{out} = \frac{2}{3} C_D C_S\, W\, \rho_\infty \sqrt{2 \frac{T_\infty}{T_G}\left(1 - \frac{T_\infty}{T_G}\right) g}\ (H - Z_N)^{2/3}$$

Nomenclature:

$\dot{m}_{in}$	Mass flow rate entering the vent [kg/s]
$\dot{m}_{out}$	Mass flow rate leaving the compartment [kg/s]
C_D	Vent discharge coefficient
W	Width of doorway vent [m]
ρ_∞	Ambient density [kg/m^3]
T_∞	Ambient temperature [K]
T_G	Upper gas layer temperature [K]
g	Gravitational constant [m/s^2]
H	Doorway height [m]
Z_N	Neutral plane height [m]
C_S	Sprinkler cooling coefficient

Appendix B: Unexpected Problems Encountered

Problems that Arose During Testing

Mass Flow Imbalance

During the first week of testing, it was noticed that the mass flow in and out of the enclosure did not equal. The mass flow out of the enclosure was about 20% greater than the mass flow in. Since the laws of physics states the mass flow out of the compartment must equal the mass flow into the compartment, it was determined there was something wrong with our measurements. There were many possibilities as to why our mass flow readings were not correct. The first possibility that was checked was possible gaps that would let unmeasured mass flow in. During this check, it was discovered that there was approximately a one inch gap along the wall that included the doorway. In order to prevent any further unmeasured mass flow in to the compartment, this gap was stuff with some ceramic blankets. The next test that was run still showed that there was a mass flow imbalance showing that the gap along the floor was not the result of our incorrect measurements.

The next possibility that was checked was the spans on the bidirectional probe transducers. Since the probes were zeroed during the set up of instrumentation, it was possible that the span was changed since it is located directly next to the zero screw. To do this, a new transducer that had never been used before was set up and took a reading at each probe location. These measurements were then compared to the measurements taken by the original transducer of the probe location. The data showed that the span had not been touch during the zeroing of the probes.

The location within the doorway was also checked to see if that was causing the incorrect mass flow readings. The original probe location was about ½ inch outside the doorway and the new location that was tested was within the middle of the doorway. The data showed that there was a difference in the readings from the two locations. The probe located within the middle of the doorway had a greater inflow reading then the original probe location. Since the reading for the new location was greater, it was decided that the best option to correct the mass flow imbalance was to frame out the doorway with two by six inch boards, placing the array of bidirectional probes within the middle of the doorway. A test was run to see if changing the probe location corrected the mass flow imbalance, and the data showed that the mass flows were within the percentage error.

Burner Drastically Affected by Sprinkler Spray

The original burner used was a ceramic blanket burner. This burner was affected when the sprinkler was turned on. As the watch sprayed would hit the burner, it would sit on top of the ceramic blanket preventing the fire from spreading over the whole burner. As the K-factors would increase, more and more water would end up sitting on the burner. This caused a problem with testing the larger K-factor sprinklers since the ceramic blanket could only handle sprinklers with a maximum K-factor of 5.6. In order to test the sprinklers with a K-factor of 8 and 11.2, engineers from the New Technology team of Tyco Fire Suppression and Building Products designed a burner using steal ball bearings to diffuse the propane instead of the ceramic blanket. The steal ball bearings will allow the water to flow to the bottom of the burner so that it does not affect the flame. The burner was then tested to make sure that the burner was in fact not affected by water. When the sprinkler was activated during the test, the flame shape did not differ from the shape the flame took during the dry test. The steal ball bearing burner was used to do most of the testing due to the flame shape not changing from the dry test to the wet test.

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Appendix C: Mass Flow based on Single Zone Model

Use of Single Zone Model

Since there was a noticeable level of mixing within the compartment, it was decided to see if the data matched better with a single zone model. Babrauskas and Williamson's single zone equation was used for the theoretical line to compare the experimental data for the exit gas flow too. This equation assumes the enclosure gases are uniformly mixed. Although the gases in the experimental compartment were not uniformly mixed, this equation could still be useful in predicting flow. Babrauskas and Williamson's equation is shown below [XX]:

$$\dot{m}_{out} = \frac{2}{3} C_d B \left(h_f\right)^{\frac{2}{3}} \rho_f \left(2\frac{\rho_o - \rho_f}{\rho_o}\right)^{\frac{1}{2}}$$

A plot of this single zone equation as well as experimentally measured mass flows is shown in Figure C1. From the figure, it is apparent that the single zone equation is a less accurate representation of the data than the two zone model of Rocket. Since the two zone model is closer to the experimentally measured values it appears that the compartment is closer to fully stratified than fully mixed. It was concluded to look at other options that will fit better with the experimental values.

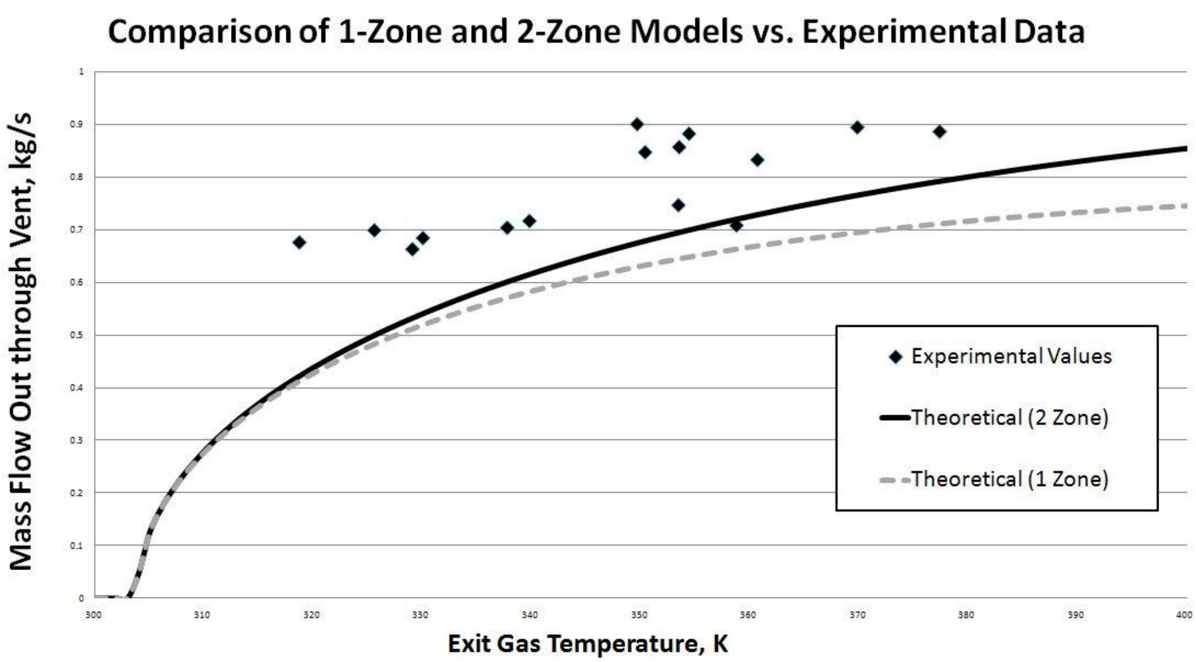


Figure C1: This graph of experimentally measured Wet data as well as 1-Zone and 2-Zone theoretical curves shows that the data is more closely approximated by a 2-Zone model than a 1-Zone model.

Appendix D: Data summary tables

TEST ID:	0726-A	HRR:	250 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.22	2.25	2.24	2.22	2.17	0.00
11	**2.01**	0.00	2.03	1.74	1.67	1.62	1.69	0.00
10	**1.82**	0.00	1.58	1.42	1.33	1.35	1.39	0.00
9	**1.63**	0.00	0.91	1.04	1.07	1.12	1.17	0.00
8	**1.44**	0.00	0.74	0.47	0.37	0.28	-0.08	0.00
7	**1.24**	0.00	0.21	-0.61	-0.69	-0.71	-0.78	0.00
6	**1.03**	0.00	-0.46	-0.88	-0.90	-0.93	-1.01	0.00
5	**0.84**	0.00	-1.02	-1.16	-1.13	-1.09	-1.08	0.00
4	**0.65**	0.00	-1.12	-1.17	-1.08	-1.08	-0.83	0.00
3	**0.46**	0.00	-1.23	-1.14	-1.08	-1.03	-0.51	0.00
2	**0.27**	0.00	-1.11	-1.05	-1.01	-0.83	-0.32	0.00
1	**0.08**	0.00	-1.03	-0.95	-0.91	-0.49	0.33	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.77	2.86	2.83	2.80	2.70	0.00
11	**2.01**	0.00	2.54	2.22	2.10	2.02	2.11	0.00
10	**1.82**	0.00	1.82	1.79	1.64	1.64	1.69	0.00
9	**1.63**	0.00	0.98	1.24	1.22	1.29	1.38	0.00
8	**1.44**	0.00	0.73	0.45	0.35	0.27	-0.08	0.00
7	**1.24**	0.00	0.19	-0.55	-0.61	-0.63	-0.69	0.00
6	**1.03**	0.00	-0.42	-0.77	-0.79	-0.81	-0.88	0.00
5	**0.84**	0.00	-0.91	-1.02	-0.99	-0.95	-0.94	0.00
4	**0.65**	0.00	-0.98	-1.02	-0.94	-0.94	-0.73	0.00
3	**0.46**	0.00	-1.07	-0.99	-0.94	-0.90	-0.44	0.00
2	**0.27**	0.00	-0.96	-0.91	-0.88	-0.72	-0.28	0.00
1	**0.08**	0.00	-0.89	-0.82	-0.79	-0.43	0.29	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		434	443	440	435	435	
11	**2.01**		437	444	439	435	435	
10	**1.82**		402	441	431	425	425	
9	**1.63**		372	415	397	410	410	
8	**1.44**		344	336	331	327	327	
7	**1.24**		324	313	310	308	308	
6	**1.03**		314	306	305	304	304	
5	**0.84**		309	305	305	304	304	
4	**0.65**		306	305	306	306	306	
3	**0.46**		303	304	304	305	305	
2	**0.27**		303	303	303	305	305	
1	**0.08**		301	302	302	305	305	
Bottom	**0.00**							

TEST ID:	0726-A	HRR:	250 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Density, kg/m3

Probe No.	**Width** / **Height**	wall **0.00**	pos. 3 **0.10**	pos. 2a **0.30**	pos 2 **0.52**	pos. 1a **0.74**	pos. 1 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		0.80	0.79	0.79	0.80	0.80	
11	**2.01**		0.80	0.78	0.79	0.79	0.80	
10	**1.82**		0.87	0.79	0.81	0.83	0.82	
9	**1.63**		0.94	0.84	0.88	0.87	0.85	
8	**1.44**		1.01	1.04	1.05	1.05	1.07	
7	**1.24**		1.08	1.11	1.13	1.13	1.13	
6	**1.03**		1.11	1.14	1.14	1.14	1.15	
5	**0.84**		1.13	1.14	1.14	1.14	1.15	
4	**0.65**		1.14	1.14	1.14	1.14	1.14	
3	**0.46**		1.15	1.15	1.15	1.15	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.14	
1	**0.08**		1.16	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	1.082	kg/s
Experimental M-in:	-1.054	kg/s
Balance	0.028	kg/s
Neutral Plane:	1.275	m
Tg:	432	K
Ambient T:	304	K
Predicted Ideal M-out:	1.527	kg/s
Associated C:	0.708	
Avg. Propane Flow:	0	Lpm

TEST ID:	0726-A	HRR:	250 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.09	2.09	2.10	2.09	2.06	0.00
11	**2.01**	0.00	1.82	1.57	1.48	1.49	1.55	0.00
10	**1.82**	0.00	1.47	1.33	1.27	1.26	1.29	0.00
9	**1.63**	0.00	1.21	0.99	0.91	0.87	0.81	0.00
8	**1.44**	0.00	0.66	0.34	0.33	0.26	0.09	0.00
7	**1.24**	0.00	-0.20	-0.69	-0.67	-0.65	-0.70	0.00
6	**1.03**	0.00	-0.57	-0.89	-0.89	-0.87	-0.91	0.00
5	**0.84**	0.00	-1.11	-1.23	-1.21	-1.22	-1.10	0.00
4	**0.65**	0.00	-1.08	-1.06	-1.01	-1.02	-0.53	0.00
3	**0.46**	0.00	-1.08	-0.96	-0.90	-0.83	0.40	0.00
2	**0.27**	0.00	-1.02	-0.95	-0.91	-0.64	0.29	0.00
1	**0.08**	0.00	-0.94	-0.82	-0.84	-0.03	0.40	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.52	2.55017	2.57	2.5739	2.56882	0.00
11	**2.01**	0.00	2.19	1.8902	1.79	1.7851	1.80776	0.00
10	**1.82**	0.00	1.63	1.55797	1.49	1.4857	1.48846	0.00
9	**1.63**	0.00	1.32	1.06421	0.96	0.9552	0.89116	0.00
8	**1.44**	0.00	0.62	0.31448	0.30	0.3029	0.24323	0.00
7	**1.24**	0.00	-0.18	-0.6111	-0.59	-0.59	-0.5809	0.00
6	**1.03**	0.00	-0.51	-0.7775	-0.78	-0.777	-0.76641	0.00
5	**0.84**	0.00	-0.98	-1.0796	-1.06	-1.063	-1.06785	0.00
4	**0.65**	0.00	-0.94	-0.9258	-0.88	-0.885	-0.89323	0.00
3	**0.46**	0.00	-0.94	-0.8418	-0.79	-0.786	-0.72267	0.00
2	**0.27**	0.00	-0.89	-0.8268	-0.79	-0.79	-0.5608	0.00
1	**0.08**	0.00	-0.81	-0.7086	-0.72	-0.725	-0.02618	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		420	424.962	427	428.98	428	
11	**2.01**		419	418.2	419	422.05	423	
10	**1.82**		386	407.173	408	411.32	412	
9	**1.63**		381	374.179	364	358.33	354	
8	**1.44**		330	322.711	322	322.73	321	
7	**1.24**		315	308.122	308	309.46	310	
6	**1.03**		309	305.379	305	305.53	306	
5	**0.84**		307	304.778	305	305.22	306	
4	**0.65**		304	305.173	306	306.32	308	
3	**0.46**		303	304.15	305	305.1	307	
2	**0.27**		303	303.487	304	304.24	307	
1	**0.08**		302	302.209	302	304.19	307	
Bottom	**0.00**							

TEST ID:	0726-A	HRR:	250 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Density, kg/m3

Probe No.	**Width** / **Height**	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		0.83	0.82	0.82	0.81	0.81	
11	**2.01**		0.83	0.83	0.83	0.83	0.82	
10	**1.82**		0.90	0.86	0.85	0.85	0.85	
9	**1.63**		0.92	0.93	0.96	0.97	0.98	
8	**1.44**		1.06	1.08	1.08	1.08	1.09	
7	**1.24**		1.11	1.13	1.13	1.13	1.13	
6	**1.03**		1.13	1.14	1.14	1.14	1.14	
5	**0.84**		1.14	1.14	1.14	1.14	1.14	
4	**0.65**		1.14	1.14	1.14	1.14	1.13	
3	**0.46**		1.15	1.15	1.14	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.13	
1	**0.08**		1.16	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	1.002	kg/s
Experimental M-in:	-0.953	kg/s
Balance	0.049	kg/s
Neutral Plane:	1.336	m
Tg:	409.1	K
Ambient T:	304.9	K
Predicted Ideal M-out:	1.313	kg/s
Associated C:	0.763	
Average Propane Flow:	0	Lpm
Cooling Coefficient:	0.926	

TEST ID:	0726-B	HRR:	150 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.99	2.04	1.97	1.94	1.94	0.00
11	**2.01**	0.00	1.79	1.54	1.45	1.42	1.46	0.00
10	**1.82**	0.00	1.44	1.24	1.14	1.19	1.20	0.00
9	**1.63**	0.00	0.92	0.87	0.89	0.94	0.99	0.00
8	**1.44**	0.00	0.20	0.06	-0.22	-0.17	0.24	0.00
7	**1.24**	0.00	-0.52	-0.63	-0.66	-0.72	-0.55	0.00
6	**1.03**	0.00	-0.65	-0.73	-0.76	-0.80	-0.46	0.00
5	**0.84**	0.00	-0.90	-0.86	-0.91	-0.93	0.09	0.00
4	**0.65**	0.00	-0.96	-0.87	-0.94	-0.94	0.35	0.00
3	**0.46**	0.00	-1.01	-0.90	-0.92	-0.87	0.34	0.00
2	**0.27**	0.00	-0.96	-0.94	-0.95	-0.72	0.29	0.00
1	**0.08**	0.00	-0.87	-0.79	-0.93	-0.56	0.25	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.31	2.40	2.30	2.26	2.25	0.00
11	**2.01**	0.00	2.09	1.81	1.69	1.65	1.69	0.00
10	**1.82**	0.00	1.57	1.45	1.31	1.34	1.37	0.00
9	**1.63**	0.00	0.96	0.94	0.96	1.02	1.08	0.00
8	**1.44**	0.00	0.19	0.06	-0.20	-0.16	0.23	0.00
7	**1.24**	0.00	-0.46	-0.56	-0.58	-0.63	-0.49	0.00
6	**1.03**	0.00	-0.57	-0.64	-0.67	-0.70	-0.41	0.00
5	**0.84**	0.00	-0.79	-0.75	-0.80	-0.82	0.08	0.00
4	**0.65**	0.00	-0.84	-0.77	-0.82	-0.83	0.31	0.00
3	**0.46**	0.00	-0.88	-0.79	-0.81	-0.76	0.30	0.00
2	**0.27**	0.00	-0.84	-0.82	-0.83	-0.63	0.26	0.00
1	**0.08**	0.00	-0.75	-0.69	-0.81	-0.48	0.22	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		405	408	405	403	403	
11	**2.01**		407	410	408	403	403	
10	**1.82**		380	408	401	397	397	
9	**1.63**		362	377	373	382	382	
8	**1.44**		320	320	319	332	332	
7	**1.24**		311	308	308	313	313	
6	**1.03**		307	305	306	310	310	
5	**0.84**		306	305	305	311	311	
4	**0.65**		305	306	306	309	309	
3	**0.46**		304	304	305	308	308	
2	**0.27**		304	304	304	308	308	
1	**0.08**		302	303	302	305	305	
Bottom	**0.00**							

TEST ID:	0726-B	HRR:	150 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.86	0.85	0.86	0.86	0.86	
11	**2.01**		0.86	0.85	0.85	0.86	0.87	
10	**1.82**		0.92	0.85	0.87	0.88	0.88	
9	**1.63**		0.96	0.92	0.93	0.92	0.91	
8	**1.44**		1.09	1.09	1.09	1.08	1.05	
7	**1.24**		1.12	1.13	1.13	1.13	1.11	
6	**1.03**		1.13	1.14	1.14	1.14	1.12	
5	**0.84**		1.14	1.14	1.14	1.14	1.12	
4	**0.65**		1.14	1.14	1.14	1.14	1.13	
3	**0.46**		1.15	1.15	1.14	1.14	1.13	
2	**0.27**		1.15	1.15	1.15	1.15	1.13	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.920	kg/s
Experimental M-in:	-0.852	kg/s
Balance	0.068	kg/s
Neutral Plane:	1.380	m
Tg:	401	K
Ambient T:	305	K
Predicted Ideal M-out:	1.192	kg/s
Associated C:	0.772	
Avg. Propane Flow:	0	Lpm

TEST ID:	0726-B	HRR:	150 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.79	1.79	1.76	1.77	1.80	0.00
11	**2.01**	0.00	1.57	1.30	1.25	1.28	1.36	0.00
10	**1.82**	0.00	1.28	1.11	1.06	1.05	1.09	0.00
9	**1.63**	0.00	0.81	0.67	0.60	0.63	0.66	0.00
8	**1.44**	0.00	-0.20	-0.22	-0.28	-0.11	-0.20	0.00
7	**1.24**	0.00	-0.42	-0.54	-0.57	-0.60	-0.60	0.00
6	**1.03**	0.00	-0.58	-0.63	-0.65	-0.72	-0.73	0.00
5	**0.84**	0.00	-0.84	-0.82	-0.80	-0.88	-0.84	0.00
4	**0.65**	0.00	-0.84	-0.81	-0.78	-0.83	-0.37	0.00
3	**0.46**	0.00	-0.81	-0.79	-0.74	-0.76	-0.76	0.00
2	**0.27**	0.00	-0.82	-0.78	-0.78	-0.66	0.22	0.00
1	**0.08**	0.00	-0.80	-0.64	-0.73	-0.49	0.25	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.99	2.00439	1.98	1.9788	1.98928	0.00
11	**2.01**	0.00	1.76	1.44485	1.38	1.3803	1.41806	0.00
10	**1.82**	0.00	1.37	1.18332	1.14	1.1364	1.13923	0.00
9	**1.63**	0.00	0.79	0.64825	0.58	0.5751	0.60872	0.00
8	**1.44**	0.00	-0.18	-0.1989	-0.25	-0.25	-0.0996	0.00
7	**1.24**	0.00	-0.37	-0.4749	-0.50	-0.502	-0.53087	0.00
6	**1.03**	0.00	-0.51	-0.5535	-0.57	-0.569	-0.62879	0.00
5	**0.84**	0.00	-0.74	-0.7191	-0.71	-0.705	-0.76974	0.00
4	**0.65**	0.00	-0.74	-0.711	-0.68	-0.683	-0.7328	0.00
3	**0.46**	0.00	-0.71	-0.6878	-0.65	-0.651	-0.66703	0.00
2	**0.27**	0.00	-0.71	-0.6823	-0.68	-0.683	-0.57585	0.00
1	**0.08**	0.00	-0.69	-0.5599	-0.63	-0.634	-0.42896	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		388	389.678	391	391.01	387	
11	**2.01**		389	386.288	386	387.39	385	
10	**1.82**		372	371.178	375	376.91	378	
9	**1.63**		341	339.633	336	338.49	340	
8	**1.44**		311	311.842	313	316.48	315	
7	**1.24**		308	306.327	307	308.17	308	
6	**1.03**		306	304.849	305	306.07	306	
5	**0.84**		305	304.627	305	305.12	305	
4	**0.65**		304	305.083	306	306.05	306	
3	**0.46**		304	303.98	305	305.17	306	
2	**0.27**		303	303.816	304	304.15	306	
1	**0.08**		302	302.843	302	302.57	305	
Bottom	**0.00**							

TEST ID:	0726-B	HRR:	150 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Density, kg/m3

Probe No.	**Width / Height**	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		0.90	0.89	0.89	0.89	0.90	
11	**2.01**		0.90	0.90	0.90	0.90	0.91	
10	**1.82**		0.94	0.94	0.93	0.92	0.92	
9	**1.63**		1.02	1.03	1.04	1.03	1.03	
8	**1.44**		1.12	1.12	1.11	1.10	1.11	
7	**1.24**		1.13	1.14	1.14	1.13	1.13	
6	**1.03**		1.14	1.14	1.14	1.14	1.14	
5	**0.84**		1.14	1.14	1.14	1.14	1.14	
4	**0.65**		1.14	1.14	1.14	1.14	1.14	
3	**0.46**		1.15	1.15	1.14	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.767	kg/s
Experimental M-in:	-0.839	kg/s
Balance	-0.072	kg/s
Neutral Plane:	1.454	m
Tg:	377.5	K
Ambient T:	305.2	K
Predicted Ideal M-out:	0.962	kg/s
Associated C:	0.797	
Average Propane Flow:	0	Lpm
Cooling Coefficient:	0.833	

TEST ID:	0726-C	HRR:	75 kW	SIN:	TY-2234	Flow: 13 gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.77	1.77	1.73	1.69	1.70	0.00
11	**2.01**	0.00	1.54	1.33	1.26	1.23	1.27	0.00
10	**1.82**	0.00	1.18	1.08	0.99	1.03	1.04	0.00
9	**1.63**	0.00	0.16	0.56	0.69	0.78	0.83	0.00
8	**1.44**	0.00	-0.41	-0.44	-0.35	-0.16	0.29	0.00
7	**1.24**	0.00	-0.61	-0.62	-0.65	-0.58	-0.11	0.00
6	**1.03**	0.00	-0.72	-0.71	-0.75	-0.72	0.14	0.00
5	**0.84**	0.00	-0.86	-0.83	-0.85	-0.80	0.14	0.00
4	**0.65**	0.00	-0.88	-0.82	-0.83	-0.73	0.26	0.00
3	**0.46**	0.00	-0.89	-0.81	-0.85	-0.53	0.20	0.00
2	**0.27**	0.00	-0.86	-0.79	-0.88	-0.36	0.25	0.00
1	**0.08**	0.00	7.24	7.24	7.24	7.23	7.23	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.88	1.88	1.83	1.79	1.79	0.00
11	**2.01**	0.00	1.64	1.42	1.34	1.30	1.34	0.00
10	**1.82**	0.00	1.18	1.15	1.03	1.07	1.08	0.00
9	**1.63**	0.00	0.14	0.54	0.68	0.78	0.85	0.00
8	**1.44**	0.00	-0.36	-0.39	-0.31	-0.15	0.27	0.00
7	**1.24**	0.00	-0.53	-0.55	-0.57	-0.51	-0.10	0.00
6	**1.03**	0.00	-0.63	-0.62	-0.66	-0.63	0.12	0.00
5	**0.84**	0.00	-0.76	-0.72	-0.75	-0.71	0.12	0.00
4	**0.65**	0.00	-0.77	-0.72	-0.73	-0.64	0.23	0.00
3	**0.46**	0.00	-0.78	-0.71	-0.74	-0.47	0.17	0.00
2	**0.27**	0.00	-0.75	-0.69	-0.76	-0.31	0.22	0.00
1	**0.08**	0.00	6.28	6.28	6.28	6.29	6.29	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		370	369	368	367	367	
11	**2.01**		370	372	370	367	367	
10	**1.82**		348	370	362	363	363	
9	**1.63**		318	339	342	353	353	
8	**1.44**		307	308	313	324	324	
7	**1.24**		306	305	307	315	315	
6	**1.03**		305	305	306	311	311	
5	**0.84**		305	305	305	310	310	
4	**0.65**		305	305	306	308	308	
3	**0.46**		304	305	305	306	306	
2	**0.27**		304	304	303	305	305	
1	**0.08**		302	302	302	303	303	
Bottom	**0.00**							

TEST ID:	0726-C	HRR:	75 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.94	0.94	0.95	0.95	0.95	
11	**2.01**		0.94	0.94	0.94	0.95	0.95	
10	**1.82**		1.00	0.94	0.96	0.96	0.96	
9	**1.63**		1.09	1.03	1.02	1.00	0.99	
8	**1.44**		1.14	1.13	1.11	1.09	1.08	
7	**1.24**		1.14	1.14	1.14	1.13	1.11	
6	**1.03**		1.14	1.14	1.14	1.14	1.12	
5	**0.84**		1.14	1.14	1.14	1.14	1.12	
4	**0.65**		1.14	1.14	1.14	1.14	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	1.611	kg/s
Experimental M-in:	-0.648	kg/s
Balance	0.963	kg/s
Neutral Plane:	1.320	m
Tg:	370	K
Ambient T:	305	K
Predicted Ideal M-out:	1.179	kg/s
Associated C:	1.366	
Avg. Propane Flow:	#DIV/0!	Lpm

TEST ID:	0726-C	HRR:	75 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.49	1.44	1.42	1.43	1.42	0.00
11	**2.01**	0.00	1.33	1.08	1.06	1.05	1.09	0.00
10	**1.82**	0.00	1.03	0.88	0.85	0.84	0.85	0.00
9	**1.63**	0.00	0.33	0.41	0.56	0.57	0.56	0.00
8	**1.44**	0.00	-0.35	-0.40	-0.24	0.15	0.21	0.00
7	**1.24**	0.00	-0.52	-0.55	-0.55	-0.41	-0.35	0.00
6	**1.03**	0.00	-0.61	-0.60	-0.62	-0.48	-0.35	0.00
5	**0.84**	0.00	-0.76	-0.72	-0.74	-0.60	-0.36	0.00
4	**0.65**	0.00	-0.72	-0.70	-0.71	-0.49	0.06	0.00
3	**0.46**	0.00	-0.70	-0.67	-0.66	-0.21	0.30	0.00
2	**0.27**	0.00	-0.69	-0.69	-0.69	-0.24	0.18	0.00
1	**0.08**	0.00	7.24	7.24	7.24	7.23	7.22	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.49	1.45756	1.44	1.4396	1.45225	0.00
11	**2.01**	0.00	1.32	1.08253	1.06	1.0622	1.06283	0.00
10	**1.82**	0.00	0.99	0.85305	0.84	0.8364	0.82989	0.00
9	**1.63**	0.00	0.30	0.37813	0.53	0.5274	0.53308	0.00
8	**1.44**	0.00	-0.31	-0.3562	-0.21	-0.214	0.1305	0.00
7	**1.24**	0.00	-0.46	-0.4804	-0.48	-0.479	-0.36249	0.00
6	**1.03**	0.00	-0.53	-0.5233	-0.54	-0.545	-0.42612	0.00
5	**0.84**	0.00	-0.66	-0.6341	-0.65	-0.651	-0.52943	0.00
4	**0.65**	0.00	-0.63	-0.6138	-0.62	-0.619	-0.43171	0.00
3	**0.46**	0.00	-0.61	-0.5852	-0.58	-0.576	-0.18718	0.00
2	**0.27**	0.00	-0.61	-0.6059	-0.60	-0.604	-0.2079	0.00
1	**0.08**	0.00	6.28	6.28499	6.28	6.2808	6.29045	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		349	351.637	352	353.66	350	
11	**2.01**		346	349.923	351	352.31	352	
10	**1.82**		334	337.778	341	343.31	345	
9	**1.63**		315	319.856	325	327.89	328	
8	**1.44**		306	306.481	310	312.21	314	
7	**1.24**		305	305.317	306	307.66	309	
6	**1.03**		305	305.11	305	306.32	307	
5	**0.84**		305	304.95	305	305.84	307	
4	**0.65**		305	305.093	305	305.96	306	
3	**0.46**		304	304.597	305	305.56	305	
2	**0.27**		304	303.836	304	304.6	305	
1	**0.08**		302	302.655	302	303.18	304	
Bottom	**0.00**							

TEST ID:	0726-C	HRR:	75 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.00	0.99	0.99	0.99	0.99	
11	**2.01**		1.01	1.00	0.99	0.99	0.99	
10	**1.82**		1.04	1.03	1.02	1.01	1.01	
9	**1.63**		1.11	1.09	1.07	1.06	1.06	
8	**1.44**		1.14	1.14	1.13	1.12	1.11	
7	**1.24**		1.14	1.14	1.14	1.13	1.13	
6	**1.03**		1.14	1.14	1.14	1.14	1.13	
5	**0.84**		1.14	1.14	1.14	1.14	1.14	
4	**0.65**		1.14	1.14	1.14	1.14	1.14	
3	**0.46**		1.15	1.14	1.14	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.14	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	1.494	kg/s
Experimental M-in:	-0.544	kg/s
Balance	0.950	kg/s
Neutral Plane:	1.433	m
Tg:	346.9	K
Ambient T:	305.1	K
Predicted Ideal M-out:	0.828	kg/s
Associated C:	1.805	
Average Propane Flow:	#DIV/0!	Lpm
Cooling Coefficient:	0.927	

TEST ID:	0727-B	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.70	1.71	1.68	1.61	1.64	0.00
11	**2.01**	0.00	1.49	1.29	1.23	1.22	1.25	0.00
10	**1.82**	0.00	1.12	1.06	0.95	0.99	1.02	0.00
9	**1.63**	0.00	0.66	0.63	0.70	0.74	0.84	0.00
8	**1.44**	0.00	-0.18	-0.44	-0.37	-0.30	0.23	0.00
7	**1.24**	0.00	-0.53	-0.71	-0.69	-0.68	-0.33	0.00
6	**1.03**	0.00	-0.74	-0.79	-0.75	-0.73	-0.25	0.00
5	**0.84**	0.00	-0.89	-0.87	-0.82	-0.78	-0.18	0.00
4	**0.65**	0.00	-0.83	-0.80	-0.80	-0.62	0.29	0.00
3	**0.46**	0.00	-0.87	-0.76	-0.82	-0.34	0.30	0.00
2	**0.27**	0.00	-0.86	-0.78	-0.87	-0.16	0.26	0.00
1	**0.08**	0.00	-0.83	-0.78	-0.85	-0.11	0.23	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.78	1.80	1.75	1.68	1.71	0.00
11	**2.01**	0.00	1.55	1.36	1.30	1.27	1.31	0.00
10	**1.82**	0.00	1.10	1.11	0.98	1.02	1.06	0.00
9	**1.63**	0.00	0.63	0.62	0.69	0.74	0.85	0.00
8	**1.44**	0.00	-0.17	-0.39	-0.33	-0.27	0.21	0.00
7	**1.24**	0.00	-0.47	-0.62	-0.61	-0.60	-0.30	0.00
6	**1.03**	0.00	-0.64	-0.69	-0.65	-0.64	-0.23	0.00
5	**0.84**	0.00	-0.78	-0.76	-0.72	-0.68	-0.15	0.00
4	**0.65**	0.00	-0.72	-0.70	-0.70	-0.54	0.26	0.00
3	**0.46**	0.00	-0.76	-0.66	-0.72	-0.30	0.26	0.00
2	**0.27**	0.00	-0.75	-0.68	-0.76	-0.14	0.22	0.00
1	**0.08**	0.00	-0.72	-0.68	-0.73	-0.10	0.20	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		364	365	364	363	363	
11	**2.01**		363	367	366	364	364	
10	**1.82**		344	366	360	361	361	
9	**1.63**		334	342	343	353	353	
8	**1.44**		313	307	311	322	322	
7	**1.24**		308	304	305	312	312	
6	**1.03**		305	304	305	309	309	
5	**0.84**		304	304	304	308	308	
4	**0.65**		304	304	305	306	306	
3	**0.46**		304	304	304	305	305	
2	**0.27**		303	303	302	304	304	
1	**0.08**		301	301	301	303	303	
Bottom	**0.00**							

TEST ID:	0727-B	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9 gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.96	0.95	0.96	0.96	0.96	
11	**2.01**		0.96	0.95	0.95	0.96	0.96	
10	**1.82**		1.01	0.95	0.97	0.97	0.97	
9	**1.63**		1.04	1.02	1.02	1.00	0.99	
8	**1.44**		1.11	1.13	1.12	1.10	1.08	
7	**1.24**		1.13	1.15	1.14	1.14	1.12	
6	**1.03**		1.14	1.15	1.14	1.14	1.13	
5	**0.84**		1.14	1.15	1.14	1.14	1.13	
4	**0.65**		1.15	1.14	1.14	1.14	1.14	
3	**0.46**		1.15	1.15	1.15	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.14	
1	**0.08**		1.16	1.16	1.16	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.751	kg/s
Experimental M-in:	-0.764	kg/s
Balance	-0.013	kg/s
Neutral Plane:	1.410	m
Tg:	354	K
Ambient T:	303	K
Predicted Ideal M-out:	0.936	kg/s
Associated C:	0.802	
Avg. Propane Flow:	n/a	Lpm

TEST ID:	0727-B	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.53	1.54	1.53	1.55	1.54	0.00
11	**2.01**	0.00	1.37	1.14	1.08	1.09	1.15	0.00
10	**1.82**	0.00	1.11	0.94	0.91	0.89	0.92	0.00
9	**1.63**	0.00	0.79	0.71	0.72	0.74	0.75	0.00
8	**1.44**	0.00	-0.36	-0.24	0.22	0.27	0.31	0.00
7	**1.24**	0.00	-0.69	-0.74	-0.67	-0.59	-0.09	0.00
6	**1.03**	0.00	-0.81	-0.84	-0.82	-0.73	0.16	0.00
5	**0.84**	0.00	-0.94	-0.96	-0.94	-0.80	-0.28	0.00
4	**0.65**	0.00	-0.87	-0.84	-0.82	-0.56	0.31	0.00
3	**0.46**	0.00	-0.79	-0.76	-0.82	-0.19	0.36	0.00
2	**0.27**	0.00	-0.76	-0.80	-0.86	-0.21	0.27	0.00
1	**0.08**	0.00	-0.79	-0.83	-0.86	-0.14	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.54	1.54847	1.54	1.5429	1.55886	0.00
11	**2.01**	0.00	1.38	1.14489	1.08	1.0824	1.09311	0.00
10	**1.82**	0.00	1.11	0.92615	0.90	0.8993	0.8775	0.00
9	**1.63**	0.00	0.76	0.68084	0.70	0.6994	0.71578	0.00
8	**1.44**	0.00	-0.32	-0.2172	0.21	0.2052	0.2545	0.00
7	**1.24**	0.00	-0.60	-0.6441	-0.59	-0.59	-0.52918	0.00
6	**1.03**	0.00	-0.70	-0.7346	-0.72	-0.721	-0.6371	0.00
5	**0.84**	0.00	-0.82	-0.8414	-0.82	-0.817	-0.70438	0.00
4	**0.65**	0.00	-0.76	-0.737	-0.72	-0.717	-0.48958	0.00
3	**0.46**	0.00	-0.69	-0.6631	-0.71	-0.71	-0.16901	0.00
2	**0.27**	0.00	-0.66	-0.6956	-0.75	-0.748	-0.17871	0.00
1	**0.08**	0.00	-0.68	-0.7171	-0.75	-0.745	-0.11962	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		351	349.947	351	350	349	
11	**2.01**		352	348.767	348	348.88	349	
10	**1.82**		347	344.498	344	345.44	345	
9	**1.63**		335	334.36	337	338.95	340	
8	**1.44**		311	312.753	319	322.96	325	
7	**1.24**		306	304.525	307	309.88	316	
6	**1.03**		304	303.938	305	305.97	310	
5	**0.84**		303	303.921	304	305.31	308	
4	**0.65**		303	304.198	304	305.48	306	
3	**0.46**		303	303.875	304	304.8	305	
2	**0.27**		302	302.354	302	303.64	304	
1	**0.08**		301	301.387	301	301.96	302	
Bottom	**0.00**							

TEST ID:	0727-B	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.99	1.00	0.99	1.00	1.00	
11	**2.01**		0.99	1.00	1.00	1.00	1.00	
10	**1.82**		1.00	1.01	1.01	1.01	1.01	
9	**1.63**		1.04	1.04	1.03	1.03	1.03	
8	**1.44**		1.12	1.11	1.09	1.08	1.07	
7	**1.24**		1.14	1.14	1.14	1.12	1.10	
6	**1.03**		1.15	1.15	1.14	1.14	1.12	
5	**0.84**		1.15	1.15	1.15	1.14	1.13	
4	**0.65**		1.15	1.15	1.14	1.14	1.14	
3	**0.46**		1.15	1.15	1.15	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.14	
1	**0.08**		1.16	1.16	1.16	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.732	kg/s
Experimental M-in:	-0.735	kg/s
Balance	-0.002	kg/s
Neutral Plane:	1.262	m
Tg:	344.5	K
Ambient T:	303.7	K
Predicted Ideal M-out:	1.101	kg/s
Associated C:	0.665	
Average Propane Flow:	n/a	Lpm
Cooling Coefficient:	0.975	

TEST ID:	0727-C	HRR:	250 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.80	1.79	1.75	1.74	1.71	0.00
11	**2.01**	0.00	1.33	1.35	1.26	1.25	1.34	0.00
10	**1.82**	0.00	1.08	1.07	1.00	1.05	1.07	0.00
9	**1.63**	0.00	0.71	0.70	0.77	0.84	0.87	0.00
8	**1.44**	0.00	-0.41	-0.41	-0.34	-0.02	0.33	0.00
7	**1.24**	0.00	-0.68	-0.69	-0.70	-0.55	0.10	0.00
6	**1.03**	0.00	-0.74	-0.76	-0.77	-0.71	0.17	0.00
5	**0.84**	0.00	-0.81	-0.82	-0.83	-0.79	0.19	0.00
4	**0.65**	0.00	-0.85	-0.83	-0.85	-0.75	0.24	0.00
3	**0.46**	0.00	-0.87	-0.85	-0.85	-0.56	0.20	0.00
2	**0.27**	0.00	-0.84	-0.84	-0.86	-0.34	0.20	0.00
1	**0.08**	0.00	-0.80	-0.81	-0.86	-0.28	0.19	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.93	1.92	1.86	1.85	1.80	0.00
11	**2.01**	0.00	1.44	1.45	1.35	1.33	1.42	0.00
10	**1.82**	0.00	1.16	1.15	1.04	1.10	1.13	0.00
9	**1.63**	0.00	0.72	0.70	0.77	0.85	0.89	0.00
8	**1.44**	0.00	-0.37	-0.37	-0.31	-0.02	0.32	0.00
7	**1.24**	0.00	-0.59	-0.61	-0.62	-0.49	0.09	0.00
6	**1.03**	0.00	-0.65	-0.67	-0.68	-0.63	0.15	0.00
5	**0.84**	0.00	-0.71	-0.72	-0.73	-0.70	0.17	0.00
4	**0.65**	0.00	-0.75	-0.73	-0.75	-0.66	0.21	0.00
3	**0.46**	0.00	-0.76	-0.75	-0.74	-0.49	0.17	0.00
2	**0.27**	0.00	-0.74	-0.74	-0.75	-0.30	0.18	0.00
1	**0.08**	0.00	-0.70	-0.70	-0.75	-0.24	0.17	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		373	373	372	367	367	
11	**2.01**		376	376	372	370	370	
10	**1.82**		374	373	364	366	366	
9	**1.63**		352	346	350	358	358	
8	**1.44**		311	310	315	330	330	
7	**1.24**		307	306	307	318	318	
6	**1.03**		306	306	306	312	312	
5	**0.84**		306	306	306	309	309	
4	**0.65**		306	306	306	307	307	
3	**0.46**		305	305	306	306	306	
2	**0.27**		305	305	304	305	305	
1	**0.08**		302	302	302	303	303	
Bottom	**0.00**							

TEST ID:	0727-C	HRR:	250 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.93	0.93	0.94	0.94	0.95	
11	**2.01**		0.93	0.93	0.94	0.94	0.94	
10	**1.82**		0.93	0.93	0.96	0.95	0.95	
9	**1.63**		0.99	1.01	1.00	0.98	0.97	
8	**1.44**		1.12	1.12	1.11	1.08	1.06	
7	**1.24**		1.14	1.14	1.14	1.12	1.10	
6	**1.03**		1.14	1.14	1.14	1.13	1.12	
5	**0.84**		1.14	1.14	1.14	1.14	1.13	
4	**0.65**		1.14	1.14	1.14	1.14	1.14	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.14	1.14	1.15	1.14	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.789	kg/s
Experimental M-in:	-0.763	kg/s
Balance	0.026	kg/s
Neutral Plane:	1.361	m
Tg:	367	K
Ambient T:	305	K
Predicted Ideal M-out:	1.078	kg/s
Associated C:	0.732	
Avg. Propane Flow:	0	Lpm

TEST ID:	0727-C	HRR:	250 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.78	1.78	1.78	1.77	1.74	0.00
11	**2.01**	0.00	1.56	1.54	1.28	1.24	1.29	0.00
10	**1.82**	0.00	1.19	1.31	1.07	1.03	1.04	0.00
9	**1.63**	0.00	0.66	1.03	0.78	0.78	0.77	0.00
8	**1.44**	0.00	-0.35	0.34	-0.42	-0.27	0.18	0.00
7	**1.24**	0.00	-0.63	-0.64	-0.74	-0.72	-0.37	0.00
6	**1.03**	0.00	-0.79	-0.84	-0.78	-0.82	-0.32	0.00
5	**0.84**	0.00	-0.87	-0.97	-0.88	-0.91	-0.29	0.00
4	**0.65**	0.00	-0.91	-0.98	-0.88	-0.85	0.21	0.00
3	**0.46**	0.00	-0.91	-0.93	-0.88	-0.83	0.29	0.00
2	**0.27**	0.00	-0.84	-0.85	-0.85	-0.88	0.16	0.00
1	**0.08**	0.00	-0.83	-0.83	-0.81	-0.88	0.19	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.90	1.90219	1.90	1.9041	1.89877	0.00
11	**2.01**	0.00	1.68	1.64964	1.35	1.3548	1.32702	0.00
10	**1.82**	0.00	1.21	1.37272	1.11	1.1144	1.08582	0.00
9	**1.63**	0.00	0.65	1.06958	0.78	0.7756	0.78297	0.00
8	**1.44**	0.00	-0.31	0.32018	-0.38	-0.38	-0.24612	0.00
7	**1.24**	0.00	-0.56	-0.5703	-0.65	-0.652	-0.63208	0.00
6	**1.03**	0.00	-0.69	-0.7401	-0.69	-0.69	-0.72074	0.00
5	**0.84**	0.00	-0.76	-0.8507	-0.77	-0.774	-0.8013	0.00
4	**0.65**	0.00	-0.80	-0.859	-0.77	-0.773	-0.75422	0.00
3	**0.46**	0.00	-0.79	-0.8143	-0.77	-0.772	-0.7328	0.00
2	**0.27**	0.00	-0.73	-0.7413	-0.75	-0.745	-0.76879	0.00
1	**0.08**	0.00	-0.72	-0.7232	-0.70	-0.701	-0.7606	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		373	373.06	373	374.69	376	
11	**2.01**		374	374.124	370	371.85	374	
10	**1.82**		355	365.938	363	365.86	369	
9	**1.63**		339	362.233	348	348.74	349	
8	**1.44**		312	325.299	312	317.36	321	
7	**1.24**		308	310.089	307	307.96	315	
6	**1.03**		306	306.391	306	307.01	311	
5	**0.84**		306	305.716	306	306.82	310	
4	**0.65**		305	305.586	307	307.42	309	
3	**0.46**		305	305.504	306	306.6	308	
2	**0.27**		304	304.708	306	304.5	307	
1	**0.08**		302	302.464	303	302.26	305	
Bottom	**0.00**							

TEST ID:	0727-C	HRR:	250 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		0.93	0.93	0.94	0.93	0.93	
11	**2.01**		0.93	0.93	0.94	0.94	0.93	
10	**1.82**		0.98	0.95	0.96	0.95	0.94	
9	**1.63**		1.03	0.96	1.00	1.00	1.00	
8	**1.44**		1.12	1.07	1.12	1.10	1.08	
7	**1.24**		1.13	1.12	1.14	1.13	1.11	
6	**1.03**		1.14	1.14	1.14	1.13	1.12	
5	**0.84**		1.14	1.14	1.14	1.14	1.12	
4	**0.65**		1.14	1.14	1.14	1.13	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.13	
2	**0.27**		1.15	1.14	1.14	1.14	1.13	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.818	kg/s
Experimental M-in:	-0.880	kg/s
Balance	-0.062	kg/s
Neutral Plane:	1.409	m
Tg:	366.4	K
Ambient T:	306.5	K
Predicted Ideal M-out:	0.978	kg/s
Associated C:	0.836	
Average Propane Flow:	0	Lpm
Cooling Coefficient:	1.037	

TEST ID:	0728-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.03	2.04	2.01	1.98	2.00	0.00
11	**2.01**	0.00	1.77	1.53	1.46	1.44	1.53	0.00
10	**1.82**	0.00	1.36	1.24	1.17	1.22	1.26	0.00
9	**1.63**	0.00	0.85	0.87	0.91	0.90	0.97	0.00
8	**1.44**	0.00	0.28	0.26	0.21	0.12	-0.10	0.00
7	**1.24**	0.00	-0.43	-0.54	-0.57	-0.60	-0.68	0.00
6	**1.03**	0.00	-0.54	-0.66	-0.70	-0.75	-0.85	0.00
5	**0.84**	0.00	-0.82	-0.93	-0.92	-0.98	-1.02	0.00
4	**0.65**	0.00	-0.82	-0.89	-0.85	-0.93	-0.76	0.00
3	**0.46**	0.00	-0.90	-0.85	-0.86	-0.88	-0.45	0.00
2	**0.27**	0.00	-0.90	-0.86	-0.91	-0.79	-0.28	0.00
1	**0.08**	0.00	-0.88	-0.84	-0.87	-0.61	0.34	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.36	2.39	2.35	2.30	2.30	0.00
11	**2.01**	0.00	2.05	1.80	1.70	1.66	1.77	0.00
10	**1.82**	0.00	1.43	1.45	1.32	1.37	1.43	0.00
9	**1.63**	0.00	0.85	0.90	0.95	0.94	1.03	0.00
8	**1.44**	0.00	0.26	0.24	0.20	0.11	-0.10	0.00
7	**1.24**	0.00	-0.38	-0.48	-0.51	-0.53	-0.60	0.00
6	**1.03**	0.00	-0.48	-0.59	-0.62	-0.66	-0.74	0.00
5	**0.84**	0.00	-0.73	-0.82	-0.81	-0.86	-0.89	0.00
4	**0.65**	0.00	-0.72	-0.78	-0.75	-0.82	-0.67	0.00
3	**0.46**	0.00	-0.79	-0.74	-0.75	-0.77	-0.40	0.00
2	**0.27**	0.00	-0.79	-0.75	-0.79	-0.69	-0.24	0.00
1	**0.08**	0.00	-0.77	-0.73	-0.76	-0.53	0.30	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		404	408	406	402	402	
11	**2.01**		405	409	405	402	402	
10	**1.82**		367	406	393	396	396	
9	**1.63**		351	361	366	370	370	
8	**1.44**		319	321	321	319	319	
7	**1.24**		312	310	310	308	308	
6	**1.03**		309	308	307	305	305	
5	**0.84**		308	307	307	305	305	
4	**0.65**		307	307	307	306	306	
3	**0.46**		305	305	305	305	305	
2	**0.27**		304	304	304	305	305	
1	**0.08**		303	303	303	305	305	
Bottom	**0.00**							

TEST ID:	0728-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.86	0.85	0.86	0.87	0.87	
11	**2.01**		0.86	0.85	0.86	0.86	0.87	
10	**1.82**		0.95	0.86	0.89	0.89	0.88	
9	**1.63**		0.99	0.96	0.95	0.96	0.94	
8	**1.44**		1.09	1.09	1.09	1.09	1.09	
7	**1.24**		1.12	1.12	1.12	1.13	1.13	
6	**1.03**		1.13	1.13	1.13	1.14	1.14	
5	**0.84**		1.13	1.13	1.14	1.14	1.14	
4	**0.65**		1.14	1.14	1.14	1.14	1.14	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.15	1.14	1.15	1.15	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.927	kg/s
Experimental M-in:	-0.902	kg/s
Balance	0.025	kg/s
Neutral Plane:	1.367	m
Tg:	400	K
Ambient T:	305	K
Predicted Ideal M-out:	1.218	kg/s
Associated C:	0.761	
Avg. Propane Flow:	156	Lpm

TEST ID:	0728-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.94	1.95	1.96	1.93	1.90	0.00
11	**2.01**	0.00	1.72	1.42	1.37	1.36	1.42	0.00
10	**1.82**	0.00	1.45	1.22	1.17	1.14	1.18	0.00
9	**1.63**	0.00	0.99	0.95	0.91	0.90	0.90	0.00
8	**1.44**	0.00	-0.17	0.17	0.21	0.19	-0.11	0.00
7	**1.24**	0.00	-0.56	-0.65	-0.69	-0.73	-0.70	0.00
6	**1.03**	0.00	-0.65	-0.73	-0.79	-0.86	-0.84	0.00
5	**0.84**	0.00	-0.95	-0.97	-1.04	-1.11	-0.94	0.00
4	**0.65**	0.00	-0.87	-0.87	-0.93	-0.93	-0.55	0.00
3	**0.46**	0.00	-0.86	-0.85	-0.86	-0.62	0.26	0.00
2	**0.27**	0.00	-0.87	-0.90	-0.90	-0.32	0.17	0.00
1	**0.08**	0.00	-0.82	-0.84	-0.84	0.20	0.37	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.15	2.15743	2.17	2.1727	2.13608	0.00
11	**2.01**	0.00	1.91	1.55802	1.50	1.4976	1.48811	0.00
10	**1.82**	0.00	1.55	1.31439	1.26	1.2636	1.2321	0.00
9	**1.63**	0.00	1.01	0.98834	0.94	0.9373	0.92809	0.00
8	**1.44**	0.00	-0.15	0.15259	0.20	0.201	0.17496	0.00
7	**1.24**	0.00	-0.50	-0.5748	-0.61	-0.611	-0.64171	0.00
6	**1.03**	0.00	-0.58	-0.6471	-0.69	-0.692	-0.76002	0.00
5	**0.84**	0.00	-0.84	-0.8558	-0.91	-0.914	-0.97675	0.00
4	**0.65**	0.00	-0.76	-0.7679	-0.82	-0.816	-0.81961	0.00
3	**0.46**	0.00	-0.75	-0.7462	-0.75	-0.755	-0.54143	0.00
2	**0.27**	0.00	-0.76	-0.7853	-0.79	-0.785	-0.28214	0.00
1	**0.08**	0.00	-0.71	-0.7255	-0.73	-0.727	0.17859	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		387	385.879	387	385.98	387	
11	**2.01**		388	382.923	382	380.73	380	
10	**1.82**		374	376.566	376	376.61	377	
9	**1.63**		356	363.9	360	359.56	360	
8	**1.44**		317	322.003	327	324.34	319	
7	**1.24**		310	308.403	308	307.72	308	
6	**1.03**		308	307.397	307	306.35	306	
5	**0.84**		307	306.968	306	305.72	306	
4	**0.65**		306	306.61	306	306.19	307	
3	**0.46**		304	305.4	305	305.61	306	
2	**0.27**		304	304.389	304	305.24	306	
1	**0.08**		303	302.727	302	304.57	306	
Bottom	**0.00**							

TEST ID:	0728-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.90	0.90	0.90	0.90	0.90	
11	**2.01**		0.90	0.91	0.91	0.92	0.92	
10	**1.82**		0.93	0.93	0.93	0.93	0.92	
9	**1.63**		0.98	0.96	0.97	0.97	0.97	
8	**1.44**		1.10	1.08	1.07	1.07	1.09	
7	**1.24**		1.12	1.13	1.13	1.13	1.13	
6	**1.03**		1.13	1.13	1.14	1.14	1.14	
5	**0.84**		1.13	1.14	1.14	1.14	1.14	
4	**0.65**		1.14	1.14	1.14	1.14	1.14	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.15	1.14	1.15	1.14	1.14	
1	**0.08**		1.15	1.15	1.15	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.906	kg/s
Experimental M-in:	-0.874	kg/s
Balance	0.032	kg/s
Neutral Plane:	1.409	m
Tg:	377.0	K
Ambient T:	305.5	K
Predicted Ideal M-out:	1.040	kg/s
Associated C:	0.872	
Average Propane Flow:	150	Lpm
Cooling Coefficient:	0.978	

TEST ID:	0728-B	HRR:	150 kW	SIN:	TY-3221	Flow: 14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.98	2.01	1.96	1.93	1.91	0.00
11	**2.01**	0.00	1.73	1.49	1.41	1.38	1.45	0.00
10	**1.82**	0.00	1.33	1.21	1.13	1.13	1.17	0.00
9	**1.63**	0.00	0.84	0.82	0.90	0.90	0.95	0.00
8	**1.44**	0.00	0.22	-0.25	0.10	-0.31	-0.29	0.00
7	**1.24**	0.00	-0.49	-0.73	-0.67	-0.75	-0.65	0.00
6	**1.03**	0.00	-0.71	-0.88	-0.87	-0.82	-0.63	0.00
5	**0.84**	0.00	-0.95	-1.02	-0.97	-0.88	-0.27	0.00
4	**0.65**	0.00	-1.00	-1.02	-0.97	-0.74	0.22	0.00
3	**0.46**	0.00	-0.97	-0.95	-0.90	-0.45	0.22	0.00
2	**0.27**	0.00	-0.93	-0.92	-0.89	-0.34	0.26	0.00
1	**0.08**	0.00	-0.89	-0.90	-0.86	-0.27	0.33	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.31	2.36	2.29	2.25	2.22	0.00
11	**2.01**	0.00	2.04	1.76	1.65	1.61	1.68	0.00
10	**1.82**	0.00	1.43	1.43	1.30	1.29	1.34	0.00
9	**1.63**	0.00	0.87	0.88	0.97	0.97	1.04	0.00
8	**1.44**	0.00	0.20	-0.23	0.09	-0.29	-0.27	0.00
7	**1.24**	0.00	-0.44	-0.65	-0.60	-0.67	-0.58	0.00
6	**1.03**	0.00	-0.63	-0.78	-0.77	-0.73	-0.56	0.00
5	**0.84**	0.00	-0.84	-0.90	-0.86	-0.78	-0.24	0.00
4	**0.65**	0.00	-0.88	-0.91	-0.86	-0.66	0.19	0.00
3	**0.46**	0.00	-0.85	-0.84	-0.80	-0.40	0.20	0.00
2	**0.27**	0.00	-0.82	-0.81	-0.78	-0.30	0.23	0.00
1	**0.08**	0.00	-0.78	-0.78	-0.75	-0.24	0.30	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		408	410	408	404	404	
11	**2.01**		409	412	408	406	406	
10	**1.82**		376	409	399	399	399	
9	**1.63**		361	375	376	383	383	
8	**1.44**		322	320	325	324	324	
7	**1.24**		314	310	311	314	314	
6	**1.03**		310	308	308	311	311	
5	**0.84**		308	307	308	311	311	
4	**0.65**		307	308	309	311	311	
3	**0.46**		307	308	308	310	310	
2	**0.27**		306	306	305	310	310	
1	**0.08**		304	303	303	308	308	
Bottom	**0.00**							

TEST ID:	0728-B	HRR:	150 kW	SIN:	TY-3221	Flow: 14.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.85	0.85	0.85	0.86	0.86	
11	**2.01**		0.85	0.85	0.85	0.86	0.86	
10	**1.82**		0.93	0.85	0.87	0.88	0.87	
9	**1.63**		0.96	0.93	0.93	0.93	0.91	
8	**1.44**		1.08	1.09	1.07	1.08	1.08	
7	**1.24**		1.11	1.12	1.12	1.12	1.11	
6	**1.03**		1.13	1.13	1.13	1.13	1.12	
5	**0.84**		1.13	1.13	1.13	1.13	1.12	
4	**0.65**		1.13	1.13	1.13	1.12	1.12	
3	**0.46**		1.14	1.13	1.13	1.13	1.12	
2	**0.27**		1.14	1.14	1.14	1.13	1.13	
1	**0.08**		1.15	1.15	1.15	1.14	1.13	
Bottom	**0.00**							

Experimental M-out:	0.884	kg/s
Experimental M-in:	-0.869	kg/s
Balance	0.015	kg/s
Neutral Plane:	1.394	m
Tg:	402	K
Ambient T:	307	K
Predicted Ideal M-out:	1.152	kg/s
Associated C:	0.768	
Avg. Propane Flow:	109	Lpm

TEST ID:	0728-B	HRR:	150 kW	SIN:	TY-3221	Flow: 14.8	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.69	1.65	1.60	1.55	1.57	0.00
11	**2.01**	0.00	1.39	1.21	1.16	1.17	1.25	0.00
10	**1.82**	0.00	0.77	0.95	0.97	0.97	1.01	0.00
9	**1.63**	0.00	0.47	0.53	0.56	0.56	0.66	0.00
8	**1.44**	0.00	-0.10	0.12	0.13	0.16	0.25	0.00
7	**1.24**	0.00	-0.53	-0.52	-0.47	-0.53	-0.35	0.00
6	**1.03**	0.00	-0.63	-0.65	-0.63	-0.70	-0.42	0.00
5	**0.84**	0.00	-0.74	-0.77	-0.78	-0.80	-0.26	0.00
4	**0.65**	0.00	-0.76	-0.80	-0.80	-0.69	0.16	0.00
3	**0.46**	0.00	-0.75	-0.75	-0.70	-0.39	0.35	0.00
2	**0.27**	0.00	-0.76	-0.77	-0.70	-0.33	0.18	0.00
1	**0.08**	0.00	-0.72	-0.73	-0.68	-0.21	0.22	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.89	1.85639	1.81	1.8075	1.75514	0.00
11	**2.01**	0.00	1.52	1.35284	1.28	1.2847	1.30147	0.00
10	**1.82**	0.00	0.73	0.94029	0.98	0.9769	1.00541	0.00
9	**1.63**	0.00	0.44	0.49957	0.53	0.5308	0.52701	0.00
8	**1.44**	0.00	-0.09	0.11237	0.12	0.1222	0.14224	0.00
7	**1.24**	0.00	-0.47	-0.4633	-0.42	-0.416	-0.47558	0.00
6	**1.03**	0.00	-0.55	-0.5728	-0.56	-0.556	-0.61531	0.00
5	**0.84**	0.00	-0.65	-0.6835	-0.68	-0.685	-0.70232	0.00
4	**0.65**	0.00	-0.67	-0.704	-0.71	-0.706	-0.61029	0.00
3	**0.46**	0.00	-0.66	-0.6585	-0.61	-0.614	-0.34637	0.00
2	**0.27**	0.00	-0.67	-0.6792	-0.62	-0.618	-0.28978	0.00
1	**0.08**	0.00	-0.62	-0.6391	-0.60	-0.596	-0.18526	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		390	392.397	394	393.35	390	
11	**2.01**		383	390.396	385	386.13	382	
10	**1.82**		332	344.763	352	360.91	368	
9	**1.63**		324	326.143	330	330.47	343	
8	**1.44**		314	315.414	317	317.98	320	
7	**1.24**		310	309.751	310	310.86	315	
6	**1.03**		308	307.897	308	308.42	312	
5	**0.84**		307	307.454	308	307.78	312	
4	**0.65**		307	307.903	309	308.99	311	
3	**0.46**		307	307.153	308	308.54	310	
2	**0.27**		306	305.867	306	307.3	310	
1	**0.08**		304	303.716	304	305.5	308	
Bottom	**0.00**							

TEST ID:	0728-B	HRR:	150 kW	SIN:	TY-3221	Flow: 14.8	gpm	WET

Density, kg/m3

Probe No.	**Width** / **Height**	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		0.89	0.89	0.88	0.89	0.89	
11	**2.01**		0.91	0.89	0.91	0.90	0.91	
10	**1.82**		1.05	1.01	0.99	0.97	0.95	
9	**1.63**		1.08	1.07	1.06	1.05	1.02	
8	**1.44**		1.11	1.10	1.10	1.10	1.09	
7	**1.24**		1.12	1.12	1.12	1.12	1.11	
6	**1.03**		1.13	1.13	1.13	1.13	1.12	
5	**0.84**		1.13	1.13	1.13	1.13	1.12	
4	**0.65**		1.13	1.13	1.13	1.13	1.12	
3	**0.46**		1.14	1.13	1.13	1.13	1.12	
2	**0.27**		1.14	1.14	1.14	1.13	1.13	
1	**0.08**		1.15	1.15	1.15	1.14	1.13	
Bottom	**0.00**							

Experimental M-out:	0.712	kg/s
Experimental M-in:	-0.672	kg/s
Balance	0.040	kg/s
Neutral Plane:	1.390	m
Tg:	376.5	K
Ambient T:	307.3	K
Predicted Ideal M-out:	1.058	kg/s
Associated C:	0.673	
Average Propane Flow:	107	Lpm
Cooling Coefficient:	0.806	

TEST ID:	0729-A	HRR:	75 kW	SIN:	TY-3221	Flow: 14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.72	1.74	1.71	1.68	1.69	0.00
11	**2.01**	0.00	1.56	1.32	1.22	1.22	1.29	0.00
10	**1.82**	0.00	1.27	1.06	0.96	1.01	1.04	0.00
9	**1.63**	0.00	0.89	0.76	0.73	0.79	0.84	0.00
8	**1.44**	0.00	0.43	0.24	-0.21	-0.15	-0.22	0.00
7	**1.24**	0.00	0.06	-0.53	-0.62	-0.62	-0.62	0.00
6	**1.03**	0.00	0.07	-0.60	-0.68	-0.69	-0.73	0.00
5	**0.84**	0.00	-0.33	-0.73	-0.79	-0.79	-0.81	0.00
4	**0.65**	0.00	0.06	-0.74	-0.73	-0.77	-0.71	0.00
3	**0.46**	0.00	-0.26	-0.82	-0.73	-0.79	-0.51	0.00
2	**0.27**	0.00	-0.47	-0.82	-0.73	-0.79	-0.42	0.00
1	**0.08**	0.00	-0.60	-0.80	-0.70	-0.75	-0.43	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.77	1.80	1.78	1.74	1.74	0.00
11	**2.01**	0.00	1.62	1.38	1.26	1.27	1.33	0.00
10	**1.82**	0.00	1.27	1.10	0.99	1.03	1.07	0.00
9	**1.63**	0.00	0.87	0.76	0.73	0.78	0.84	0.00
8	**1.44**	0.00	0.40	0.22	-0.19	-0.14	-0.20	0.00
7	**1.24**	0.00	0.05	-0.46	-0.55	-0.54	-0.54	0.00
6	**1.03**	0.00	0.07	-0.52	-0.59	-0.60	-0.64	0.00
5	**0.84**	0.00	-0.29	-0.64	-0.68	-0.68	-0.70	0.00
4	**0.65**	0.00	0.06	-0.65	-0.64	-0.67	-0.62	0.00
3	**0.46**	0.00	-0.23	-0.71	-0.63	-0.68	-0.44	0.00
2	**0.27**	0.00	-0.41	-0.71	-0.64	-0.68	-0.37	0.00
1	**0.08**	0.00	-0.52	-0.69	-0.61	-0.65	-0.37	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		359	362	362	359	359	
11	**2.01**		362	364	361	360	360	
10	**1.82**		347	362	356	357	357	
9	**1.63**		342	350	345	349	349	
8	**1.44**		321	318	315	314	314	
7	**1.24**		310	307	305	304	304	
6	**1.03**		308	305	303	303	303	
5	**0.84**		308	304	303	302	302	
4	**0.65**		307	304	303	303	303	
3	**0.46**		306	302	302	302	302	
2	**0.27**		304	302	302	302	302	
1	**0.08**		303	302	302	301	301	
Bottom	**0.00**							

TEST ID:	0729-A	HRR:	75 kW	SIN:	TY-3221	Flow: 14.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.97	0.96	0.96	0.97	0.97	
11	**2.01**		0.96	0.96	0.96	0.96	0.97	
10	**1.82**		1.00	0.96	0.98	0.98	0.98	
9	**1.63**		1.02	1.00	1.01	1.01	1.00	
8	**1.44**		1.09	1.09	1.11	1.11	1.11	
7	**1.24**		1.12	1.13	1.14	1.15	1.15	
6	**1.03**		1.13	1.14	1.15	1.15	1.15	
5	**0.84**		1.13	1.15	1.15	1.15	1.15	
4	**0.65**		1.14	1.15	1.15	1.15	1.15	
3	**0.46**		1.14	1.15	1.15	1.15	1.15	
2	**0.27**		1.14	1.15	1.15	1.15	1.15	
1	**0.08**		1.15	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.786	kg/s
Experimental M-in:	-0.755	kg/s
Balance	0.031	kg/s
Neutral Plane:	1.265	m
Tg:	357	K
Ambient T:	302	K
Predicted Ideal M-out:	1.227	kg/s
Associated C:	0.640	
Avg. Propane Flow:	54	Lpm

TEST ID:	0729-A	HRR:	75 kW	SIN:	TY-3221	Flow: 14.8	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.41	1.42	1.41	1.36	1.36	0.00
11	**2.01**	0.00	1.31	1.10	1.05	1.03	1.08	0.00
10	**1.82**	0.00	1.13	0.90	0.89	0.86	0.89	0.00
9	**1.63**	0.00	0.88	0.67	0.69	0.67	0.70	0.00
8	**1.44**	0.00	0.60	0.42	0.36	0.32	0.45	0.00
7	**1.24**	0.00	0.22	-0.39	-0.48	-0.52	-0.40	0.00
6	**1.03**	0.00	-0.30	-0.64	-0.60	-0.63	-0.55	0.00
5	**0.84**	0.00	-0.46	-0.83	-0.76	-0.78	-0.74	0.00
4	**0.65**	0.00	0.16	-0.78	-0.66	-0.66	-0.66	0.00
3	**0.46**	0.00	0.17	-0.82	-0.66	-0.69	-0.70	0.00
2	**0.27**	0.00	-0.33	-0.83	-0.67	-0.70	-0.76	0.00
1	**0.08**	0.00	-0.47	-0.83	-0.69	-0.70	-0.74	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.36	1.3872	1.38	1.3815	1.33422	0.00
11	**2.01**	0.00	1.27	1.07305	1.03	1.0268	1.00372	0.00
10	**1.82**	0.00	1.06	0.87025	0.85	0.8531	0.81752	0.00
9	**1.63**	0.00	0.82	0.62892	0.64	0.6403	0.63364	0.00
8	**1.44**	0.00	0.54	0.3845	0.33	0.3271	0.28936	0.00
7	**1.24**	0.00	0.20	-0.3493	-0.42	-0.417	-0.45611	0.00
6	**1.03**	0.00	-0.26	-0.5638	-0.52	-0.522	-0.54955	0.00
5	**0.84**	0.00	-0.41	-0.7207	-0.66	-0.659	-0.67355	0.00
4	**0.65**	0.00	0.14	-0.683	-0.57	-0.57	-0.57771	0.00
3	**0.46**	0.00	0.15	-0.7079	-0.57	-0.572	-0.59915	0.00
2	**0.27**	0.00	-0.29	-0.7223	-0.58	-0.582	-0.60335	0.00
1	**0.08**	0.00	-0.41	-0.7222	-0.60	-0.6	-0.60223	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		336	341.011	341	341.15	340	
11	**2.01**		337	340.583	340	339.83	339	
10	**1.82**		328	336.666	333	332.68	334	
9	**1.63**		326	325.559	326	328.34	330	
8	**1.44**		319	318.083	317	317.9	322	
7	**1.24**		313	308.119	305	304.72	308	
6	**1.03**		308	304.903	303	302.78	303	
5	**0.84**		307	304.042	303	302.44	303	
4	**0.65**		306	303.163	303	302.76	302	
3	**0.46**		305	302.343	302	302.12	302	
2	**0.27**		304	301.905	302	301.91	302	
1	**0.08**		303	301.751	302	301.66	301	
Bottom	**0.00**							

TEST ID:	**0729-A**	**HRR:**	**75 kW**	**SIN:**	**TY-3221**	**Flow: 14.8**	**gpm**	**WET**

Density, kg/m3

Probe No.	**Width / Height**	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.04	1.02	1.02	1.02	1.02	
11	**2.01**		1.03	1.02	1.03	1.03	1.03	
10	**1.82**		1.06	1.03	1.05	1.05	1.04	
9	**1.63**		1.07	1.07	1.07	1.06	1.06	
8	**1.44**		1.09	1.10	1.10	1.10	1.08	
7	**1.24**		1.11	1.13	1.14	1.14	1.13	
6	**1.03**		1.13	1.14	1.15	1.15	1.15	
5	**0.84**		1.13	1.15	1.15	1.15	1.15	
4	**0.65**		1.14	1.15	1.15	1.15	1.15	
3	**0.46**		1.14	1.15	1.15	1.15	1.15	
2	**0.27**		1.15	1.15	1.15	1.15	1.16	
1	**0.08**		1.15	1.15	1.15	1.15	1.16	
Bottom	**0.00**							

Experimental M-out:	0.728	kg/s
Experimental M-in:	-0.694	kg/s
Balance	0.034	kg/s
Neutral Plane:	1.250	m
Tg:	335.9	K
Ambient T:	301.9	K
Predicted Ideal M-out:	1.054	kg/s
Associated C:	0.691	
Average Propane Flow:	51	Lpm
Cooling Coefficient:	0.926	

TEST ID:	0729-C	HRR:	75 kW	SIN:	TY-3251	Flow: 14.8 gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.71	1.71	1.69	1.66	1.67	0.00
11	**2.01**	0.00	1.51	1.29	1.21	1.17	1.26	0.00
10	**1.82**	0.00	1.20	1.05	0.95	0.97	1.00	0.00
9	**1.63**	0.00	0.72	0.68	0.73	0.73	0.80	0.00
8	**1.44**	0.00	0.19	-0.27	-0.23	-0.33	-0.18	0.00
7	**1.24**	0.00	-0.26	-0.66	-0.64	-0.67	-0.49	0.00
6	**1.03**	0.00	-0.48	-0.76	-0.81	-0.76	-0.50	0.00
5	**0.84**	0.00	-0.72	-0.84	-0.85	-0.82	-0.30	0.00
4	**0.65**	0.00	-0.78	-0.81	-0.76	-0.73	0.26	0.00
3	**0.46**	0.00	-0.83	-0.79	-0.75	-0.49	0.24	0.00
2	**0.27**	0.00	-0.78	-0.73	-0.79	-0.27	0.20	0.00
1	**0.08**	0.00	-0.70	-0.72	-0.78	-0.19	0.31	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.78	1.80	1.77	1.73	1.74	0.00
11	**2.01**	0.00	1.58	1.36	1.27	1.22	1.31	0.00
10	**1.82**	0.00	1.20	1.10	0.97	1.00	1.03	0.00
9	**1.63**	0.00	0.69	0.67	0.72	0.72	0.80	0.00
8	**1.44**	0.00	0.17	-0.24	-0.21	-0.29	-0.16	0.00
7	**1.24**	0.00	-0.23	-0.58	-0.56	-0.59	-0.43	0.00
6	**1.03**	0.00	-0.43	-0.66	-0.71	-0.67	-0.45	0.00
5	**0.84**	0.00	-0.63	-0.74	-0.74	-0.71	-0.27	0.00
4	**0.65**	0.00	-0.68	-0.71	-0.67	-0.64	0.23	0.00
3	**0.46**	0.00	-0.72	-0.69	-0.66	-0.43	0.21	0.00
2	**0.27**	0.00	-0.68	-0.64	-0.69	-0.24	0.18	0.00
1	**0.08**	0.00	-0.61	-0.62	-0.68	-0.16	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		364	365	365	362	362	
11	**2.01**		366	367	365	363	363	
10	**1.82**		349	366	358	359	359	
9	**1.63**		337	347	345	349	349	
8	**1.44**		315	313	313	317	317	
7	**1.24**		310	306	306	310	310	
6	**1.03**		307	305	305	307	307	
5	**0.84**		306	305	305	307	307	
4	**0.65**		305	305	306	306	306	
3	**0.46**		304	305	305	306	306	
2	**0.27**		304	304	303	306	306	
1	**0.08**		303	303	303	304	304	
Bottom	**0.00**							

TEST ID:	0729-C	HRR:	75 kW	SIN:	TY-3251	Flow: 14.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.96	0.95	0.95	0.96	0.96	
11	**2.01**		0.95	0.95	0.95	0.96	0.96	
10	**1.82**		1.00	0.95	0.97	0.97	0.97	
9	**1.63**		1.03	1.01	1.01	1.01	1.00	
8	**1.44**		1.11	1.11	1.11	1.11	1.10	
7	**1.24**		1.12	1.14	1.14	1.14	1.13	
6	**1.03**		1.13	1.14	1.14	1.14	1.13	
5	**0.84**		1.14	1.14	1.14	1.14	1.13	
4	**0.65**		1.14	1.14	1.14	1.14	1.14	
3	**0.46**		1.15	1.14	1.14	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.753	kg/s
Experimental M-in:	-0.746	kg/s
Balance	0.007	kg/s
Neutral Plane:	1.387	m
Tg:	359	K
Ambient T:	305	K
Predicted Ideal M-out:	0.992	kg/s
Associated C:	0.759	
Avg. Propane Flow:	54	Lpm

TEST ID:	0729-C	HRR:	75 kW	SIN:	TY-3251	Flow: 14.8	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.35	1.38	1.43	1.41	1.42	0.00
11	**2.01**	0.00	1.07	1.01	0.98	0.98	1.05	0.00
10	**1.82**	0.00	0.98	0.86	0.84	0.84	0.80	0.00
9	**1.63**	0.00	0.63	0.56	0.54	0.46	0.46	0.00
8	**1.44**	0.00	-0.08	-0.19	-0.14	-0.07	0.09	0.00
7	**1.24**	0.00	-0.41	-0.58	-0.53	-0.52	-0.43	0.00
6	**1.03**	0.00	-0.61	-0.65	-0.64	-0.63	-0.47	0.00
5	**0.84**	0.00	-0.71	-0.77	-0.79	-0.75	-0.44	0.00
4	**0.65**	0.00	-0.61	-0.68	-0.67	-0.53	0.21	0.00
3	**0.46**	0.00	-0.56	-0.60	-0.56	-0.22	0.31	0.00
2	**0.27**	0.00	-0.57	-0.62	-0.60	-0.16	0.18	0.00
1	**0.08**	0.00	-0.59	-0.63	-0.64	0.10	0.21	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.37	1.40093	1.46	1.4583	1.43622	0.00
11	**2.01**	0.00	1.06	0.99609	0.98	0.9825	0.98143	0.00
10	**1.82**	0.00	0.93	0.82458	0.81	0.8052	0.81291	0.00
9	**1.63**	0.00	0.58	0.52786	0.50	0.4982	0.42814	0.00
8	**1.44**	0.00	-0.07	-0.1687	-0.13	-0.129	-0.06683	0.00
7	**1.24**	0.00	-0.36	-0.5068	-0.47	-0.468	-0.45805	0.00
6	**1.03**	0.00	-0.54	-0.5683	-0.56	-0.561	-0.55509	0.00
5	**0.84**	0.00	-0.62	-0.6725	-0.69	-0.694	-0.65977	0.00
4	**0.65**	0.00	-0.53	-0.5989	-0.59	-0.588	-0.46424	0.00
3	**0.46**	0.00	-0.48	-0.5258	-0.49	-0.486	-0.19277	0.00
2	**0.27**	0.00	-0.50	-0.5418	-0.52	-0.525	-0.13987	0.00
1	**0.08**	0.00	-0.51	-0.5471	-0.55	-0.552	0.0835	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		352	352.535	354	355.23	354	
11	**2.01**		347	344.009	348	348.98	349	
10	**1.82**		333	335.547	335	336.26	335	
9	**1.63**		324	326.864	324	323.02	323	
8	**1.44**		310	310.098	311	311.98	314	
7	**1.24**		306	305.743	306	307.17	309	
6	**1.03**		305	304.971	305	305.96	307	
5	**0.84**		304	304.925	305	305.75	307	
4	**0.65**		304	305.285	306	306.08	307	
3	**0.46**		304	305.021	305	305.55	306	
2	**0.27**		303	303.866	304	304.95	306	
1	**0.08**		303	302.807	303	304.01	305	
Bottom	**0.00**							

TEST ID:	0729-C	HRR:	75 kW	SIN:	TY-3251	Flow: 14.8	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.99	0.99	0.98	0.98	0.98	
11	**2.01**		1.00	1.01	1.00	1.00	1.00	
10	**1.82**		1.05	1.04	1.04	1.04	1.04	
9	**1.63**		1.07	1.07	1.07	1.08	1.08	
8	**1.44**		1.12	1.12	1.12	1.12	1.11	
7	**1.24**		1.14	1.14	1.14	1.13	1.13	
6	**1.03**		1.14	1.14	1.14	1.14	1.13	
5	**0.84**		1.14	1.14	1.14	1.14	1.13	
4	**0.65**		1.15	1.14	1.14	1.14	1.14	
3	**0.46**		1.15	1.14	1.14	1.14	1.14	
2	**0.27**		1.15	1.15	1.15	1.14	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.613	kg/s
Experimental M-in:	-0.614	kg/s
Balance	-0.001	kg/s
Neutral Plane:	1.423	m
Tg:	341.5	K
Ambient T:	305.3	K
Predicted Ideal M-out:	0.797	kg/s
Associated C:	0.769	
Average Propane Flow:	54	Lpm
Cooling Coefficient:	0.814	

TEST ID:	0730-A	HRR:	150 kW	SIN:	TY-3251	Flow: 14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.06	2.08	2.06	2.04	2.06	0.00
11	**2.01**	0.00	1.84	1.57	1.48	1.48	1.56	0.00
10	**1.82**	0.00	1.54	1.27	1.16	1.24	1.29	0.00
9	**1.63**	0.00	1.01	0.75	0.88	0.94	1.03	0.00
8	**1.44**	0.00	0.35	-0.37	-0.37	-0.23	-0.21	0.00
7	**1.24**	0.00	-0.33	-0.69	-0.63	-0.59	-0.57	0.00
6	**1.03**	0.00	-0.39	-0.82	-0.73	-0.69	-0.70	0.00
5	**0.84**	0.00	-0.56	-1.05	-0.93	-0.86	-0.86	0.00
4	**0.65**	0.00	0.27	-0.95	-0.87	-0.80	-0.81	0.00
3	**0.46**	0.00	0.40	-0.96	-0.91	-0.81	-0.79	0.00
2	**0.27**	0.00	0.43	-1.06	-0.99	-0.89	-0.82	0.00
1	**0.08**	0.00	0.32	-1.01	-0.95	-0.84	-0.68	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.37	2.43	2.41	2.37	2.38	0.00
11	**2.01**	0.00	2.14	1.84	1.72	1.70	1.81	0.00
10	**1.82**	0.00	1.67	1.47	1.30	1.40	1.46	0.00
9	**1.63**	0.00	1.05	0.76	0.91	0.99	1.11	0.00
8	**1.44**	0.00	0.32	-0.33	-0.33	-0.21	-0.19	0.00
7	**1.24**	0.00	-0.30	-0.60	-0.55	-0.51	-0.50	0.00
6	**1.03**	0.00	-0.34	-0.71	-0.63	-0.60	-0.61	0.00
5	**0.84**	0.00	-0.50	-0.92	-0.81	-0.75	-0.75	0.00
4	**0.65**	0.00	0.24	-0.83	-0.75	-0.70	-0.70	0.00
3	**0.46**	0.00	0.35	-0.83	-0.79	-0.70	-0.68	0.00
2	**0.27**	0.00	0.38	-0.92	-0.85	-0.77	-0.70	0.00
1	**0.08**	0.00	0.28	-0.87	-0.82	-0.72	-0.59	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		402	407	406	403	403	
11	**2.01**		406	408	406	403	403	
10	**1.82**		378	405	392	396	396	
9	**1.63**		363	351	361	375	375	
8	**1.44**		318	309	310	316	316	
7	**1.24**		312	304	304	303	303	
6	**1.03**		309	303	303	301	301	
5	**0.84**		310	303	303	301	301	
4	**0.65**		310	304	303	301	301	
3	**0.46**		309	302	301	300	300	
2	**0.27**		308	301	300	300	300	
1	**0.08**		306	301	300	300	300	
Bottom	**0.00**							

TEST ID:	0730-A	HRR:	150 kW	SIN:	TY-3251	Flow: 14.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.87	0.86	0.86	0.87	0.86	
11	**2.01**		0.86	0.85	0.86	0.86	0.86	
10	**1.82**		0.92	0.86	0.89	0.89	0.88	
9	**1.63**		0.96	0.99	0.97	0.95	0.93	
8	**1.44**		1.09	1.13	1.12	1.11	1.10	
7	**1.24**		1.12	1.14	1.15	1.14	1.15	
6	**1.03**		1.13	1.15	1.15	1.15	1.16	
5	**0.84**		1.12	1.15	1.15	1.15	1.16	
4	**0.65**		1.12	1.15	1.15	1.15	1.16	
3	**0.46**		1.13	1.15	1.16	1.16	1.16	
2	**0.27**		1.13	1.16	1.16	1.16	1.16	
1	**0.08**		1.14	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.935	kg/s
Experimental M-in:	-0.884	kg/s
Balance	0.051	kg/s
Neutral Plane:	1.402	m
Tg:	398	K
Ambient T:	301	K
Predicted Ideal M-out:	1.172	kg/s
Associated C:	0.798	
Avg. Propane Flow:	114	Lpm

TEST ID:	0730-A	HRR:	150 kW	SIN:	TY-3251	Flow: 14.8	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.84	1.83	1.82	1.88	1.90	0.00
11	**2.01**	0.00	1.47	1.25	1.26	1.30	1.37	0.00
10	**1.82**	0.00	1.22	1.04	1.04	1.14	1.17	0.00
9	**1.63**	0.00	0.72	0.52	0.52	0.72	0.76	0.00
8	**1.44**	0.00	0.29	-0.28	-0.28	-0.03	0.27	0.00
7	**1.24**	0.00	-0.30	-0.60	-0.60	-0.53	-0.44	0.00
6	**1.03**	0.00	-0.31	-0.71	-0.73	-0.63	-0.58	0.00
5	**0.84**	0.00	-0.66	-1.05	-1.05	-0.96	-1.00	0.00
4	**0.65**	0.00	0.35	-0.82	-0.80	-0.69	-0.73	0.00
3	**0.46**	0.00	0.45	-0.87	-0.84	-0.72	-0.72	0.00
2	**0.27**	0.00	0.46	-0.91	-0.90	-0.82	-0.74	0.00
1	**0.08**	0.00	0.34	-0.85	-0.86	-0.78	-0.65	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.06	2.0594	2.05	2.0482	2.1202	0.00
11	**2.01**	0.00	1.64	1.37295	1.38	1.3821	1.43157	0.00
10	**1.82**	0.00	1.27	1.06886	1.08	1.076	1.2005	0.00
9	**1.63**	0.00	0.68	0.48645	0.48	0.4784	0.69231	0.00
8	**1.44**	0.00	0.26	-0.2439	-0.25	-0.251	-0.02727	0.00
7	**1.24**	0.00	-0.26	-0.5236	-0.52	-0.524	-0.45836	0.00
6	**1.03**	0.00	-0.27	-0.6148	-0.63	-0.633	-0.54511	0.00
5	**0.84**	0.00	-0.58	-0.9084	-0.92	-0.916	-0.83716	0.00
4	**0.65**	0.00	0.30	-0.7132	-0.69	-0.694	-0.604	0.00
3	**0.46**	0.00	0.40	-0.7533	-0.73	-0.728	-0.62605	0.00
2	**0.27**	0.00	0.40	-0.791	-0.78	-0.782	-0.70936	0.00
1	**0.08**	0.00	0.30	-0.7377	-0.74	-0.744	-0.67683	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		392	392.294	392	392.89	392	
11	**2.01**		389	382.52	382	384.02	384	
10	**1.82**		363	358.27	359	366.23	370	
9	**1.63**		329	324.314	323	334.01	339	
8	**1.44**		313	307.635	308	311.74	317	
7	**1.24**		309	303.587	304	303.81	307	
6	**1.03**		308	302.734	303	302.96	303	
5	**0.84**		308	302.47	303	302.68	303	
4	**0.65**		308	302.98	303	302.93	302	
3	**0.46**		307	301.769	302	301.42	301	
2	**0.27**		306	301.521	302	301.1	301	
1	**0.08**		305	301.728	302	301.09	301	
Bottom	**0.00**							

TEST ID: 0730-A	HRR: 150 kW	SIN: TY-3251	Flow: 14.8 gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.89	0.89	0.89	0.89	0.89	
11	**2.01**		0.90	0.91	0.91	0.91	0.91	
10	**1.82**		0.96	0.97	0.97	0.95	0.94	
9	**1.63**		1.06	1.07	1.08	1.04	1.03	
8	**1.44**		1.11	1.13	1.13	1.12	1.10	
7	**1.24**		1.13	1.15	1.15	1.15	1.14	
6	**1.03**		1.13	1.15	1.15	1.15	1.15	
5	**0.84**		1.13	1.15	1.15	1.15	1.15	
4	**0.65**		1.13	1.15	1.15	1.15	1.15	
3	**0.46**		1.14	1.15	1.15	1.16	1.16	
2	**0.27**		1.14	1.16	1.15	1.16	1.16	
1	**0.08**		1.14	1.15	1.15	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.800	kg/s
Experimental M-in:	-0.808	kg/s
Balance	-0.007	kg/s
Neutral Plane:	1.389	m
Tg:	372.9	K
Ambient T:	301.3	K
Predicted Ideal M-out:	1.098	kg/s
Associated C:	0.729	
Average Propane Flow:	107	Lpm
Cooling Coefficient:	0.856	

TEST ID:	0802-A	HRR:	75 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.75	1.75	1.73	1.66	1.70	0.00
11	**2.01**	0.00	1.53	1.29	1.22	1.21	1.26	0.00
10	**1.82**	0.00	1.15	1.01	0.95	1.01	1.00	0.00
9	**1.63**	0.00	0.51	0.39	0.50	0.54	0.57	0.00
8	**1.44**	0.00	-0.12	-0.39	-0.39	-0.30	-0.29	0.00
7	**1.24**	0.00	-0.40	-0.56	-0.55	-0.46	-0.45	0.00
6	**1.03**	0.00	-0.41	-0.66	-0.62	-0.53	-0.51	0.00
5	**0.84**	0.00	-0.45	-0.75	-0.73	-0.64	-0.63	0.00
4	**0.65**	0.00	-0.09	-0.67	-0.75	-0.63	-0.62	0.00
3	**0.46**	0.00	0.20	-0.62	-0.79	-0.67	-0.63	0.00
2	**0.27**	0.00	0.23	-0.62	-0.83	-0.71	-0.63	0.00
1	**0.08**	0.00	0.21	-0.66	-0.80	-0.65	-0.53	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.81	1.83	1.79	1.73	1.75	0.00
11	**2.01**	0.00	1.60	1.35	1.27	1.25	1.30	0.00
10	**1.82**	0.00	1.13	1.04	0.95	1.02	1.02	0.00
9	**1.63**	0.00	0.47	0.36	0.47	0.50	0.54	0.00
8	**1.44**	0.00	-0.11	-0.34	-0.34	-0.26	-0.25	0.00
7	**1.24**	0.00	-0.35	-0.49	-0.47	-0.40	-0.39	0.00
6	**1.03**	0.00	-0.35	-0.57	-0.54	-0.46	-0.44	0.00
5	**0.84**	0.00	-0.39	-0.65	-0.63	-0.55	-0.54	0.00
4	**0.65**	0.00	-0.08	-0.58	-0.64	-0.54	-0.53	0.00
3	**0.46**	0.00	0.17	-0.53	-0.68	-0.58	-0.54	0.00
2	**0.27**	0.00	0.20	-0.54	-0.72	-0.61	-0.54	0.00
1	**0.08**	0.00	0.18	-0.57	-0.69	-0.56	-0.45	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		361	363	362	359	359	
11	**2.01**		363	365	363	359	359	
10	**1.82**		343	359	350	355	355	
9	**1.63**		321	319	325	328	328	
8	**1.44**		305	303	303	303	303	
7	**1.24**		303	302	301	300	300	
6	**1.03**		303	301	300	299	299	
5	**0.84**		303	301	300	300	300	
4	**0.65**		303	302	300	300	300	
3	**0.46**		303	301	300	299	299	
2	**0.27**		303	300	299	299	299	
1	**0.08**		302	300	299	299	299	
Bottom	**0.00**							

TEST ID:	0802-A	HRR:	75 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.96	0.96	0.96	0.97	0.97	
11	**2.01**		0.96	0.95	0.96	0.96	0.97	
10	**1.82**		1.02	0.97	0.99	0.99	0.98	
9	**1.63**		1.08	1.09	1.07	1.08	1.06	
8	**1.44**		1.14	1.15	1.15	1.15	1.15	
7	**1.24**		1.15	1.16	1.16	1.16	1.16	
6	**1.03**		1.15	1.16	1.16	1.16	1.16	
5	**0.84**		1.15	1.16	1.16	1.16	1.16	
4	**0.65**		1.15	1.16	1.16	1.16	1.16	
3	**0.46**		1.15	1.16	1.16	1.16	1.17	
2	**0.27**		1.15	1.16	1.16	1.16	1.17	
1	**0.08**		1.15	1.16	1.16	1.17	1.17	
Bottom	**0.00**							

Experimental M-out:	0.704	kg/s
Experimental M-in:	-0.719	kg/s
Balance	-0.015	kg/s
Neutral Plane:	1.469	m
Tg:	357	K
Exit Tg:	350	K
Ambient T:	299	K
Predicted Ideal M-out:	0.896	kg/s
Associated C:	0.786	
Avg. Propane Flow:	57	Lpm

TEST ID: 0802-A	HRR: 75 kW	SIN: TY-2234	Flow: 13 gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.55	1.57	1.57	1.56	1.55	0.00
11	**2.01**	0.00	1.31	1.15	1.11	1.13	1.16	0.00
10	**1.82**	0.00	1.07	0.96	0.96	0.98	0.95	0.00
9	**1.63**	0.00	0.57	0.48	0.59	0.61	0.59	0.00
8	**1.44**	0.00	-0.30	-0.27	-0.06	-0.16	-0.12	0.00
7	**1.24**	0.00	-0.41	-0.48	-0.41	-0.45	-0.42	0.00
6	**1.03**	0.00	-0.42	-0.63	-0.50	-0.54	-0.50	0.00
5	**0.84**	0.00	-0.49	-0.79	-0.71	-0.73	-0.72	0.00
4	**0.65**	0.00	0.22	-0.67	-0.58	-0.56	-0.54	0.00
3	**0.46**	0.00	0.36	-0.62	-0.61	-0.61	-0.53	0.00
2	**0.27**	0.00	0.40	-0.66	-0.66	-0.63	-0.58	0.00
1	**0.08**	0.00	0.35	-0.67	-0.66	-0.63	-0.53	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.54	1.56479	1.57	1.5712	1.56288	0.00
11	**2.01**	0.00	1.31	1.13802	1.09	1.0928	1.11673	0.00
10	**1.82**	0.00	1.04	0.92239	0.94	0.9356	0.95178	0.00
9	**1.63**	0.00	0.53	0.43801	0.55	0.5491	0.5592	0.00
8	**1.44**	0.00	-0.26	-0.2379	-0.05	-0.052	-0.13804	0.00
7	**1.24**	0.00	-0.36	-0.4172	-0.35	-0.354	-0.39247	0.00
6	**1.03**	0.00	-0.36	-0.5419	-0.43	-0.432	-0.46724	0.00
5	**0.84**	0.00	-0.42	-0.6807	-0.61	-0.608	-0.62775	0.00
4	**0.65**	0.00	0.19	-0.5806	-0.50	-0.503	-0.48646	0.00
3	**0.46**	0.00	0.31	-0.533	-0.53	-0.528	-0.5256	0.00
2	**0.27**	0.00	0.35	-0.567	-0.57	-0.571	-0.54374	0.00
1	**0.08**	0.00	0.30	-0.5783	-0.57	-0.566	-0.54526	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		345	347.996	349	348.11	348	
11	**2.01**		346	344.346	344	344.71	345	
10	**1.82**		337	336.382	338	339.96	340	
9	**1.63**		321	316.27	322	321.34	320	
8	**1.44**		304	302.249	305	304.88	305	
7	**1.24**		302	300.574	301	300.86	301	
6	**1.03**		302	300.34	301	300.3	300	
5	**0.84**		302	300.42	300	300.27	300	
4	**0.65**		302	300.603	301	300.4	300	
3	**0.46**		302	300.061	300	299.78	300	
2	**0.27**		302	299.97	300	299.61	300	
1	**0.08**		301	299.909	300	299.48	299	
Bottom	**0.00**							

TEST ID:	0802-A	HRR:	75 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Density, kg/m3

Probe No.	**Width / Height**	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.01	1.00	1.00	1.00	1.00	
11	**2.01**		1.01	1.01	1.01	1.01	1.01	
10	**1.82**		1.03	1.04	1.03	1.02	1.02	
9	**1.63**		1.09	1.10	1.08	1.08	1.09	
8	**1.44**		1.15	1.15	1.14	1.14	1.14	
7	**1.24**		1.15	1.16	1.16	1.16	1.16	
6	**1.03**		1.15	1.16	1.16	1.16	1.16	
5	**0.84**		1.15	1.16	1.16	1.16	1.16	
4	**0.65**		1.15	1.16	1.16	1.16	1.16	
3	**0.46**		1.15	1.16	1.16	1.16	1.16	
2	**0.27**		1.15	1.16	1.16	1.16	1.16	
1	**0.08**		1.16	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.684	kg/s
Experimental M-in:	-0.643	kg/s
Balance	0.041	kg/s
Neutral Plane:	1.459	m
Tg:	341.0	K
Exit Tg:	337.7	K
Ambient T:	299.2	K
Predicted Ideal M-out:	0.810	kg/s
Associated C:	0.845	
Average Propane Flow:	56	Lpm
Cooling Coefficient:	0.972	

TEST ID:	0802-B	HRR:	150 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.95	2.01	1.98	1.93	1.94	0.00
11	**2.01**	0.00	1.75	1.49	1.40	1.40	1.45	0.00
10	**1.82**	0.00	1.38	1.17	1.14	1.18	1.18	0.00
9	**1.63**	0.00	0.81	0.62	0.61	0.61	0.57	0.00
8	**1.44**	0.00	0.37	-0.22	-0.22	-0.27	-0.33	0.00
7	**1.24**	0.00	-0.15	-0.54	-0.54	-0.49	-0.46	0.00
6	**1.03**	0.00	-0.19	-0.66	-0.60	-0.55	-0.51	0.00
5	**0.84**	0.00	-0.37	-0.83	-0.75	-0.69	-0.61	0.00
4	**0.65**	0.00	0.18	-0.86	-0.83	-0.80	-0.75	0.00
3	**0.46**	0.00	0.13	-0.94	-0.93	-0.91	-0.88	0.00
2	**0.27**	0.00	-0.39	-0.99	-0.94	-0.87	-0.72	0.00
1	**0.08**	0.00	-0.55	-0.93	-0.82	-0.61	-0.24	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.25	2.36	2.31	2.25	2.24	0.00
11	**2.01**	0.00	2.04	1.75	1.64	1.61	1.67	0.00
10	**1.82**	0.00	1.48	1.34	1.25	1.31	1.33	0.00
9	**1.63**	0.00	0.79	0.58	0.59	0.58	0.55	0.00
8	**1.44**	0.00	0.34	-0.20	-0.19	-0.24	-0.29	0.00
7	**1.24**	0.00	-0.13	-0.48	-0.47	-0.43	-0.40	0.00
6	**1.03**	0.00	-0.17	-0.57	-0.52	-0.48	-0.44	0.00
5	**0.84**	0.00	-0.33	-0.73	-0.65	-0.60	-0.53	0.00
4	**0.65**	0.00	0.16	-0.75	-0.72	-0.69	-0.65	0.00
3	**0.46**	0.00	0.12	-0.82	-0.80	-0.79	-0.76	0.00
2	**0.27**	0.00	-0.34	-0.86	-0.81	-0.75	-0.62	0.00
1	**0.08**	0.00	-0.48	-0.81	-0.71	-0.52	-0.21	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		402	409	407	404	404	
11	**2.01**		406	411	407	402	402	
10	**1.82**		374	399	384	392	392	
9	**1.63**		339	330	332	333	333	
8	**1.44**		317	312	312	307	307	
7	**1.24**		312	306	305	304	304	
6	**1.03**		309	304	304	303	303	
5	**0.84**		309	304	303	303	303	
4	**0.65**		309	304	303	303	303	
3	**0.46**		308	303	302	301	301	
2	**0.27**		306	302	301	300	300	
1	**0.08**		304	301	300	300	300	
Bottom	**0.00**							

TEST ID:	0802-B	HRR:	150 kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.87	0.85	0.86	0.87	0.86	
11	**2.01**		0.86	0.85	0.86	0.86	0.87	
10	**1.82**		0.93	0.87	0.91	0.90	0.89	
9	**1.63**		1.03	1.06	1.05	1.05	1.05	
8	**1.44**		1.10	1.12	1.12	1.13	1.14	
7	**1.24**		1.12	1.14	1.14	1.15	1.15	
6	**1.03**		1.13	1.15	1.15	1.15	1.15	
5	**0.84**		1.13	1.15	1.15	1.15	1.15	
4	**0.65**		1.13	1.15	1.15	1.15	1.15	
3	**0.46**		1.13	1.15	1.16	1.16	1.16	
2	**0.27**		1.14	1.15	1.16	1.16	1.16	
1	**0.08**		1.15	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.833	kg/s
Experimental M-in:	-0.800	kg/s
Balance	0.033	kg/s
Neutral Plane:	1.361	m
Tg:	397	K
Exit Tg:	380	K
Ambient T:	302	K
Predicted Ideal M-out:	1.249	kg/s
Associated C:	0.667	
Avg. Propane Flow:	108	Lpm

TEST ID:	0802-B	HRR:	150 kW	SIN:	TY-2234	Flow: 13	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.80	1.78	1.76	1.80	1.82	0.00
11	**2.01**	0.00	1.56	1.31	1.26	1.29	1.35	0.00
10	**1.82**	0.00	1.20	1.09	1.08	1.10	1.12	0.00
9	**1.63**	0.00	0.67	0.52	0.53	0.57	0.63	0.00
8	**1.44**	0.00	0.31	-0.21	-0.22	-0.18	-0.20	0.00
7	**1.24**	0.00	-0.13	-0.53	-0.50	-0.45	-0.46	0.00
6	**1.03**	0.00	0.15	-0.63	-0.58	-0.49	-0.50	0.00
5	**0.84**	0.00	-0.41	-0.81	-0.82	-0.77	-0.77	0.00
4	**0.65**	0.00	0.19	-0.77	-0.74	-0.73	-0.71	0.00
3	**0.46**	0.00	-0.11	-0.83	-0.80	-0.81	-0.77	0.00
2	**0.27**	0.00	-0.62	-0.91	-0.85	-0.82	-0.73	0.00
1	**0.08**	0.00	-0.74	-0.89	-0.79	-0.68	-0.47	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.98	1.98122	1.97	1.9712	2.00569	0.00
11	**2.01**	0.00	1.71	1.43419	1.38	1.3833	1.41626	0.00
10	**1.82**	0.00	1.24	1.13349	1.14	1.1365	1.16998	0.00
9	**1.63**	0.00	0.63	0.48143	0.49	0.4908	0.53213	0.00
8	**1.44**	0.00	0.28	-0.1846	-0.19	-0.195	-0.15965	0.00
7	**1.24**	0.00	-0.11	-0.4656	-0.44	-0.438	-0.39057	0.00
6	**1.03**	0.00	0.14	-0.5491	-0.51	-0.51	-0.4261	0.00
5	**0.84**	0.00	-0.37	-0.7119	-0.71	-0.713	-0.67053	0.00
4	**0.65**	0.00	0.17	-0.6687	-0.65	-0.649	-0.63759	0.00
3	**0.46**	0.00	-0.10	-0.7186	-0.70	-0.695	-0.70362	0.00
2	**0.27**	0.00	-0.54	-0.7937	-0.74	-0.739	-0.70628	0.00
1	**0.08**	0.00	-0.65	-0.7685	-0.69	-0.687	-0.59093	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		383	387.897	389	389.02	387	
11	**2.01**		383	382.499	383	383.56	384	
10	**1.82**		358	363.704	365	370.48	373	
9	**1.63**		326	323.782	324	326.75	329	
8	**1.44**		313	310.146	309	309.9	310	
7	**1.24**		310	306.204	305	305.05	305	
6	**1.03**		309	305.001	304	304.25	304	
5	**0.84**		308	304.614	304	303.94	304	
4	**0.65**		308	304.417	304	303.65	304	
3	**0.46**		307	302.99	302	302.28	302	
2	**0.27**		305	302.405	302	301.87	302	
1	**0.08**		303	301.825	301	301.4	301	
Bottom	**0.00**							

TEST ID: 0802-B	HRR: 150 kW	SIN: TY-2234	Flow: 13 gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.91	0.90	0.90	0.90	0.90	
11	**2.01**		0.91	0.91	0.91	0.91	0.91	
10	**1.82**		0.97	0.96	0.95	0.94	0.93	
9	**1.63**		1.07	1.08	1.07	1.07	1.06	
8	**1.44**		1.11	1.12	1.13	1.12	1.12	
7	**1.24**		1.12	1.14	1.14	1.14	1.14	
6	**1.03**		1.13	1.14	1.15	1.15	1.15	
5	**0.84**		1.13	1.14	1.15	1.15	1.15	
4	**0.65**		1.13	1.14	1.15	1.15	1.15	
3	**0.46**		1.14	1.15	1.15	1.15	1.15	
2	**0.27**		1.14	1.15	1.15	1.15	1.16	
1	**0.08**		1.15	1.15	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.759	kg/s
Experimental M-in:	-0.772	kg/s
Balance	-0.013	kg/s
Neutral Plane:	1.306	m
Tg:	374.6	K
Exit Tg:	360.6	K
Ambient T:	302.5	K
Predicted Ideal M-out:	1.258	kg/s
Associated C:	0.603	
Average Propane Flow:	106	Lpm
Cooling Coefficient:	0.911	

TEST ID:	0802-C	HRR:	75 kW	SIN:	TY-3251	Flow: 14.8 gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.62	1.64	1.60	1.56	1.57	0.00
11	**2.01**	0.00	1.42	1.21	1.15	1.13	1.16	0.00
10	**1.82**	0.00	1.03	0.94	0.90	0.94	0.92	0.00
9	**1.63**	0.00	0.55	0.40	0.45	0.51	0.52	0.00
8	**1.44**	0.00	-0.08	-0.40	-0.40	-0.28	-0.16	0.00
7	**1.24**	0.00	-0.33	-0.58	-0.57	-0.54	-0.39	0.00
6	**1.03**	0.00	-0.45	-0.65	-0.62	-0.64	-0.37	0.00
5	**0.84**	0.00	-0.65	-0.77	-0.71	-0.71	-0.26	0.00
4	**0.65**	0.00	-0.67	-0.73	-0.67	-0.60	0.17	0.00
3	**0.46**	0.00	-0.74	-0.70	-0.68	-0.49	0.21	0.00
2	**0.27**	0.00	-0.78	-0.67	-0.68	-0.34	0.25	0.00
1	**0.08**	0.00	-0.80	-0.68	-0.72	-0.27	0.22	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.64	1.67	1.63	1.58	1.59	0.00
11	**2.01**	0.00	1.45	1.24	1.18	1.15	1.17	0.00
10	**1.82**	0.00	0.99	0.95	0.89	0.94	0.92	0.00
9	**1.63**	0.00	0.50	0.37	0.42	0.47	0.49	0.00
8	**1.44**	0.00	-0.07	-0.35	-0.35	-0.24	-0.14	0.00
7	**1.24**	0.00	-0.29	-0.50	-0.50	-0.47	-0.34	0.00
6	**1.03**	0.00	-0.39	-0.56	-0.54	-0.56	-0.33	0.00
5	**0.84**	0.00	-0.57	-0.67	-0.62	-0.61	-0.23	0.00
4	**0.65**	0.00	-0.58	-0.63	-0.58	-0.52	0.15	0.00
3	**0.46**	0.00	-0.64	-0.61	-0.59	-0.43	0.18	0.00
2	**0.27**	0.00	-0.67	-0.58	-0.59	-0.30	0.22	0.00
1	**0.08**	0.00	-0.69	-0.59	-0.62	-0.24	0.19	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		354	356	355	354	354	
11	**2.01**		354	357	355	353	353	
10	**1.82**		335	352	345	349	349	
9	**1.63**		319	320	322	325	325	
8	**1.44**		307	304	304	308	308	
7	**1.24**		305	303	302	305	305	
6	**1.03**		303	302	302	304	304	
5	**0.84**		303	302	302	305	305	
4	**0.65**		302	302	302	304	304	
3	**0.46**		302	302	302	303	303	
2	**0.27**		301	301	301	303	303	
1	**0.08**		301	301	301	301	301	
Bottom	**0.00**							

TEST ID:	0802-C	HRR:	75 kW	SIN:	TY-3251	Flow: 14.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.99	0.98	0.98	0.99	0.98	
11	**2.01**		0.98	0.97	0.98	0.98	0.99	
10	**1.82**		1.04	0.99	1.01	1.01	1.00	
9	**1.63**		1.09	1.09	1.08	1.08	1.07	
8	**1.44**		1.13	1.14	1.15	1.14	1.13	
7	**1.24**		1.14	1.15	1.15	1.15	1.14	
6	**1.03**		1.15	1.15	1.15	1.15	1.14	
5	**0.84**		1.15	1.15	1.15	1.15	1.14	
4	**0.65**		1.15	1.15	1.15	1.15	1.15	
3	**0.46**		1.16	1.15	1.15	1.15	1.15	
2	**0.27**		1.16	1.16	1.16	1.16	1.15	
1	**0.08**		1.16	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.663	kg/s
Experimental M-in:	-0.684	kg/s
Balance	-0.021	kg/s
Neutral Plane:	1.465	m
Tg:	351	K
Exit Tg:	344	K
Ambient T:	302	K
Predicted Ideal M-out:	0.842	kg/s
Associated C:	0.787	
Avg. Propane Flow:	55	Lpm

TEST ID: 0802-C	HRR: 75 kW	SIN: TY-3251	Flow: 14.8 gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.40	1.45	1.43	1.40	1.39	0.00
11	**2.01**	0.00	1.29	1.11	1.06	1.06	1.08	0.00
10	**1.82**	0.00	1.07	0.93	0.90	0.89	0.90	0.00
9	**1.63**	0.00	0.86	0.64	0.68	0.70	0.71	0.00
8	**1.44**	0.00	0.45	-0.27	0.20	0.34	0.41	0.00
7	**1.24**	0.00	-0.30	-0.58	-0.55	-0.47	-0.25	0.00
6	**1.03**	0.00	-0.54	-0.71	-0.67	-0.65	-0.44	0.00
5	**0.84**	0.00	-0.72	-0.89	-0.84	-0.85	-0.57	0.00
4	**0.65**	0.00	-0.62	-0.86	-0.80	-0.77	-0.15	0.00
3	**0.46**	0.00	-0.65	-0.83	-0.79	-0.74	0.20	0.00
2	**0.27**	0.00	-0.77	-0.76	-0.77	-0.63	0.29	0.00
1	**0.08**	0.00	-0.81	-0.77	-0.81	-0.67	0.22	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.35	1.40475	1.39	1.3948	1.36706	0.00
11	**2.01**	0.00	1.24	1.07363	1.02	1.022	1.01722	0.00
10	**1.82**	0.00	1.01	0.88157	0.85	0.847	0.8451	0.00
9	**1.63**	0.00	0.80	0.58567	0.63	0.634	0.65672	0.00
8	**1.44**	0.00	0.40	-0.2338	0.18	0.181	0.30377	0.00
7	**1.24**	0.00	-0.26	-0.4992	-0.48	-0.48	-0.40805	0.00
6	**1.03**	0.00	-0.48	-0.6132	-0.58	-0.585	-0.56607	0.00
5	**0.84**	0.00	-0.63	-0.7742	-0.73	-0.73	-0.73383	0.00
4	**0.65**	0.00	-0.54	-0.7454	-0.69	-0.69	-0.66792	0.00
3	**0.46**	0.00	-0.56	-0.7196	-0.69	-0.688	-0.64293	0.00
2	**0.27**	0.00	-0.67	-0.6597	-0.67	-0.668	-0.54801	0.00
1	**0.08**	0.00	-0.70	-0.6633	-0.70	-0.703	-0.57735	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		336	338.573	339	339.04	339	
11	**2.01**		336	336.812	336	335.67	336	
10	**1.82**		330	330.716	329	330.07	332	
9	**1.63**		323	319.34	323	325.17	327	
8	**1.44**		314	305.821	310	312.88	318	
7	**1.24**		308	302.38	302	304.08	309	
6	**1.03**		304	301.785	302	302.65	305	
5	**0.84**		303	301.631	302	301.87	305	
4	**0.65**		303	301.653	302	302.21	305	
3	**0.46**		302	301.478	302	301.68	304	
2	**0.27**		301	301.004	301	300.82	303	
1	**0.08**		301	300.836	301	300.43	302	
Bottom	**0.00**							

TEST ID:	0802-C	HRR:	75 kW	SIN:	TY-3251	Flow: 14.8	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.04	1.03	1.03	1.03	1.03	
11	**2.01**		1.04	1.03	1.04	1.04	1.04	
10	**1.82**		1.06	1.05	1.06	1.06	1.05	
9	**1.63**		1.08	1.09	1.08	1.07	1.07	
8	**1.44**		1.11	1.14	1.12	1.11	1.10	
7	**1.24**		1.13	1.15	1.15	1.15	1.13	
6	**1.03**		1.14	1.15	1.15	1.15	1.14	
5	**0.84**		1.15	1.16	1.15	1.15	1.14	
4	**0.65**		1.15	1.16	1.15	1.15	1.14	
3	**0.46**		1.15	1.16	1.16	1.15	1.15	
2	**0.27**		1.16	1.16	1.16	1.16	1.15	
1	**0.08**		1.16	1.16	1.16	1.16	1.15	
Bottom	**0.00**							

Experimental M-out:	0.704	kg/s
Experimental M-in:	-0.742	kg/s
Balance	-0.037	kg/s
Neutral Plane:	1.328	m
Tg:	333.3	K
Exit Tg:	329.0	K
Ambient T:	301.8	K
Predicted Ideal M-out:	0.905	kg/s
Associated C:	0.779	
Average Propane Flow:	53	Lpm
Cooling Coefficient:	1.062	

TEST ID:	0803-A	HRR:	150 kW	SIN:	TY-3251	Flow: 14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.98	1.99	1.98	1.94	1.96	0.00
11	**2.01**	0.00	1.74	1.46	1.42	1.42	1.47	0.00
10	**1.82**	0.00	1.33	1.15	1.14	1.20	1.21	0.00
9	**1.63**	0.00	0.84	0.69	0.68	0.66	0.55	0.00
8	**1.44**	0.00	0.46	0.25	-0.25	-0.29	-0.38	0.00
7	**1.24**	0.00	0.12	-0.35	-0.69	-0.64	-0.58	0.00
6	**1.03**	0.00	-0.15	-0.58	-0.81	-0.74	-0.64	0.00
5	**0.84**	0.00	-0.49	-0.86	-0.94	-0.86	-0.81	0.00
4	**0.65**	0.00	-0.34	-0.91	-0.94	-0.83	-0.79	0.00
3	**0.46**	0.00	-0.48	-0.97	-0.97	-0.74	-0.51	0.00
2	**0.27**	0.00	-0.68	-1.00	-0.88	-0.73	0.10	0.00
1	**0.08**	0.00	-0.77	-0.97	-0.84	-0.74	0.19	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.29	2.33	2.31	2.27	2.27	0.00
11	**2.01**	0.00	2.03	1.72	1.65	1.64	1.70	0.00
10	**1.82**	0.00	1.40	1.32	1.26	1.34	1.36	0.00
9	**1.63**	0.00	0.82	0.67	0.66	0.63	0.53	0.00
8	**1.44**	0.00	0.42	0.22	-0.23	-0.26	-0.33	0.00
7	**1.24**	0.00	0.11	-0.31	-0.61	-0.56	-0.51	0.00
6	**1.03**	0.00	-0.13	-0.51	-0.70	-0.64	-0.55	0.00
5	**0.84**	0.00	-0.44	-0.75	-0.82	-0.75	-0.70	0.00
4	**0.65**	0.00	-0.30	-0.79	-0.81	-0.72	-0.68	0.00
3	**0.46**	0.00	-0.42	-0.84	-0.83	-0.64	-0.44	0.00
2	**0.27**	0.00	-0.60	-0.86	-0.76	-0.63	0.09	0.00
1	**0.08**	0.00	-0.67	-0.84	-0.73	-0.64	0.16	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		404	409	406	403	403	
11	**2.01**		406	410	406	402	402	
10	**1.82**		368	402	386	393	393	
9	**1.63**		342	339	338	334	334	
8	**1.44**		320	316	312	308	308	
7	**1.24**		314	310	305	303	303	
6	**1.03**		310	306	303	302	302	
5	**0.84**		309	305	303	301	301	
4	**0.65**		308	304	302	302	302	
3	**0.46**		306	302	301	302	302	
2	**0.27**		305	301	301	302	302	
1	**0.08**		303	301	301	301	301	
Bottom	**0.00**							

TEST ID:	0803-A	HRR:	150 kW	SIN:	TY-3251	Flow: 14.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.86	0.85	0.86	0.87	0.86	
11	**2.01**		0.86	0.85	0.86	0.86	0.87	
10	**1.82**		0.95	0.87	0.90	0.90	0.89	
9	**1.63**		1.02	1.03	1.03	1.04	1.04	
8	**1.44**		1.09	1.10	1.12	1.12	1.13	
7	**1.24**		1.11	1.12	1.14	1.15	1.15	
6	**1.03**		1.12	1.14	1.15	1.15	1.15	
5	**0.84**		1.13	1.14	1.15	1.16	1.16	
4	**0.65**		1.13	1.15	1.15	1.15	1.15	
3	**0.46**		1.14	1.15	1.16	1.16	1.15	
2	**0.27**		1.14	1.16	1.16	1.16	1.15	
1	**0.08**		1.15	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.857	kg/s
Experimental M-in:	-0.844	kg/s
Balance	0.013	kg/s
Neutral Plane:	1.263	m
Tg:	398	K
Exit Tg:	375	K
Ambient T:	301	K
Predicted Ideal M-out:	1.470	kg/s
Associated C:	0.583	
Avg. Propane Flow:	106	Lpm

TEST ID:	0803-A	HRR:	150 kW	SIN:	TY-3251	Flow: 14.8	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.84	1.88	1.83	1.85	1.88	0.00
11	**2.01**	0.00	1.61	1.42	1.32	1.35	1.40	0.00
10	**1.82**	0.00	1.26	1.16	1.13	1.15	1.18	0.00
9	**1.63**	0.00	0.94	0.79	0.76	0.76	0.73	0.00
8	**1.44**	0.00	0.50	0.02	0.09	0.15	0.15	0.00
7	**1.24**	0.00	0.27	-0.59	-0.66	-0.61	-0.50	0.00
6	**1.03**	0.00	0.11	-0.76	-0.77	-0.69	-0.61	0.00
5	**0.84**	0.00	-0.56	-0.99	-0.98	-0.95	-0.92	0.00
4	**0.65**	0.00	-0.32	-0.88	-0.86	-0.91	-0.79	0.00
3	**0.46**	0.00	-0.50	-0.86	-0.87	-0.90	-0.49	0.00
2	**0.27**	0.00	-0.74	-0.84	-0.87	-0.70	0.28	0.00
1	**0.08**	0.00	-0.85	-0.85	-0.80	-0.45	0.37	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.03	2.07936	2.03	2.0343	2.06181	0.00
11	**2.01**	0.00	1.77	1.56271	1.43	1.4305	1.46854	0.00
10	**1.82**	0.00	1.28	1.21182	1.18	1.1774	1.21258	0.00
9	**1.63**	0.00	0.91	0.7653	0.74	0.7353	0.74029	0.00
8	**1.44**	0.00	0.46	0.01821	0.08	0.0828	0.13291	0.00
7	**1.24**	0.00	0.24	-0.5151	-0.57	-0.575	-0.52978	0.00
6	**1.03**	0.00	0.10	-0.658	-0.67	-0.668	-0.59788	0.00
5	**0.84**	0.00	-0.50	-0.8579	-0.85	-0.853	-0.82518	0.00
4	**0.65**	0.00	-0.28	-0.7611	-0.74	-0.745	-0.78876	0.00
3	**0.46**	0.00	-0.44	-0.7439	-0.75	-0.752	-0.77869	0.00
2	**0.27**	0.00	-0.64	-0.7283	-0.75	-0.753	-0.60472	0.00
1	**0.08**	0.00	-0.74	-0.7339	-0.69	-0.691	-0.38864	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		384	385.458	387	387.47	388	
11	**2.01**		383	383.273	376	380.04	380	
10	**1.82**		356	363.444	362	366.43	371	
9	**1.63**		339	338.367	339	337.84	335	
8	**1.44**		321	312.743	313	314.71	313	
7	**1.24**		315	305.113	305	304.57	305	
6	**1.03**		311	303.448	303	303.28	303	
5	**0.84**		309	302.997	303	302.93	303	
4	**0.65**		307	302.713	303	302.93	304	
3	**0.46**		305	301.778	302	302.02	303	
2	**0.27**		303	301.508	302	301.54	303	
1	**0.08**		302	301.916	302	301.93	303	
Bottom	**0.00**							

TEST ID:	0803-A	HRR:	150 kW	SIN:	TY-3251	Flow: 14.8	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.91	0.90	0.90	0.90	0.90	
11	**2.01**		0.91	0.91	0.93	0.92	0.92	
10	**1.82**		0.98	0.96	0.96	0.95	0.94	
9	**1.63**		1.03	1.03	1.03	1.03	1.04	
8	**1.44**		1.09	1.11	1.11	1.11	1.11	
7	**1.24**		1.11	1.14	1.14	1.14	1.14	
6	**1.03**		1.12	1.15	1.15	1.15	1.15	
5	**0.84**		1.13	1.15	1.15	1.15	1.15	
4	**0.65**		1.14	1.15	1.15	1.15	1.15	
3	**0.46**		1.14	1.15	1.15	1.15	1.15	
2	**0.27**		1.15	1.16	1.16	1.16	1.15	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.866	kg/s
Experimental M-in:	-0.809	kg/s
Balance	0.057	kg/s
Neutral Plane:	1.324	m
Tg:	372.7	K
Exit Tg:	353.5	K
Ambient T:	302.2	K
Predicted Ideal M-out:	1.216	kg/s
Associated C:	0.712	
Average Propane Flow:	103	Lpm
Cooling Coefficient:	1.011	

TEST ID:	0803-B	HRR:	75 kW	SIN:	TY-4211	Flow: 21.3	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.70	1.73	1.67	1.61	1.62	0.00
11	**2.01**	0.00	1.48	1.25	1.18	1.15	1.20	0.00
10	**1.82**	0.00	1.10	0.98	0.91	0.96	0.94	0.00
9	**1.63**	0.00	0.66	0.52	0.46	0.53	0.55	0.00
8	**1.44**	0.00	0.18	-0.31	-0.35	-0.32	-0.28	0.00
7	**1.24**	0.00	-0.35	-0.55	-0.59	-0.62	-0.55	0.00
6	**1.03**	0.00	-0.61	-0.63	-0.71	-0.71	-0.54	0.00
5	**0.84**	0.00	-0.81	-0.75	-0.78	-0.73	-0.38	0.00
4	**0.65**	0.00	-0.79	-0.73	-0.72	-0.55	0.21	0.00
3	**0.46**	0.00	-0.78	-0.72	-0.71	-0.25	0.28	0.00
2	**0.27**	0.00	-0.73	-0.67	-0.74	-0.18	0.26	0.00
1	**0.08**	0.00	-0.74	-0.66	-0.77	0.10	0.24	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.80	1.85	1.78	1.72	1.71	0.00
11	**2.01**	0.00	1.58	1.34	1.25	1.22	1.26	0.00
10	**1.82**	0.00	1.09	1.03	0.94	0.99	0.98	0.00
9	**1.63**	0.00	0.63	0.49	0.43	0.51	0.53	0.00
8	**1.44**	0.00	0.16	-0.27	-0.31	-0.28	-0.25	0.00
7	**1.24**	0.00	-0.31	-0.48	-0.51	-0.54	-0.48	0.00
6	**1.03**	0.00	-0.53	-0.55	-0.62	-0.62	-0.47	0.00
5	**0.84**	0.00	-0.71	-0.65	-0.68	-0.64	-0.34	0.00
4	**0.65**	0.00	-0.69	-0.64	-0.63	-0.48	0.18	0.00
3	**0.46**	0.00	-0.67	-0.62	-0.61	-0.22	0.24	0.00
2	**0.27**	0.00	-0.63	-0.58	-0.64	-0.15	0.23	0.00
1	**0.08**	0.00	-0.63	-0.57	-0.67	0.09	0.20	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		370	372	371	367	367	
11	**2.01**		370	374	371	367	367	
10	**1.82**		346	368	359	362	362	
9	**1.63**		331	328	327	333	333	
8	**1.44**		312	309	308	310	310	
7	**1.24**		307	304	304	305	305	
6	**1.03**		303	303	303	304	304	
5	**0.84**		302	303	303	304	304	
4	**0.65**		302	303	304	304	304	
3	**0.46**		302	303	303	303	303	
2	**0.27**		302	302	301	303	303	
1	**0.08**		301	302	301	302	302	
Bottom	**0.00**							

TEST ID:	0803-B	HRR:	75 kW	SIN:	TY-4211	Flow: 21.3	gpm	DRY

Density, kg/m3

Probe No.	**Width / Height**	wall **0.00**	pos. 3 **0.10**	pos. 2a **0.30**	pos 2 **0.52**	pos. 1a **0.74**	pos. 1 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		0.94	0.94	0.94	0.95	0.95	
11	**2.01**		0.94	0.93	0.94	0.94	0.95	
10	**1.82**		1.01	0.95	0.97	0.97	0.96	
9	**1.63**		1.05	1.06	1.06	1.05	1.05	
8	**1.44**		1.12	1.13	1.13	1.13	1.12	
7	**1.24**		1.14	1.15	1.15	1.14	1.14	
6	**1.03**		1.15	1.15	1.15	1.15	1.15	
5	**0.84**		1.15	1.15	1.15	1.15	1.14	
4	**0.65**		1.15	1.15	1.15	1.15	1.15	
3	**0.46**		1.15	1.15	1.15	1.15	1.15	
2	**0.27**		1.16	1.15	1.16	1.15	1.15	
1	**0.08**		1.16	1.15	1.16	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.685	kg/s
Experimental M-in:	-0.752	kg/s
Balance	-0.067	kg/s
Neutral Plane:	1.412	m
Tg:	364	K
Exit Tg:	355	K
Ambient T:	302	K
Predicted Ideal M-out:	0.999	kg/s
Associated C:	0.685	
Avg. Propane Flow:	56	Lpm

TEST ID:	0803-B	HRR:	75 kW	SIN:	TY-4211	Flow: 21.3 gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.36	1.33	1.34	1.32	1.29	0.00
11	**2.01**	0.00	1.23	1.05	1.00	1.00	1.02	0.00
10	**1.82**	0.00	1.03	0.91	0.85	0.83	0.83	0.00
9	**1.63**	0.00	0.74	0.67	0.68	0.67	0.65	0.00
8	**1.44**	0.00	0.34	0.29	0.35	0.46	0.40	0.00
7	**1.24**	0.00	-0.38	-0.49	-0.45	-0.36	-0.37	0.00
6	**1.03**	0.00	-0.68	-0.69	-0.62	-0.65	-0.67	0.00
5	**0.84**	0.00	-0.86	-0.86	-0.78	-0.82	-0.80	0.00
4	**0.65**	0.00	-0.84	-0.82	-0.77	-0.75	-0.24	0.00
3	**0.46**	0.00	-0.84	-0.77	-0.73	-0.67	0.37	0.00
2	**0.27**	0.00	-0.79	-0.73	-0.71	-0.52	0.28	0.00
1	**0.08**	0.00	-0.78	-0.70	-0.68	-0.42	0.25	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.31	1.2988	1.31	1.3131	1.29333	0.00
11	**2.01**	0.00	1.18	1.01959	0.97	0.9696	0.96816	0.00
10	**1.82**	0.00	0.96	0.86637	0.81	0.8056	0.78861	0.00
9	**1.63**	0.00	0.69	0.62685	0.63	0.6332	0.62323	0.00
8	**1.44**	0.00	0.31	0.25912	0.32	0.3164	0.42436	0.00
7	**1.24**	0.00	-0.34	-0.4329	-0.39	-0.391	-0.31589	0.00
6	**1.03**	0.00	-0.59	-0.5988	-0.54	-0.54	-0.56373	0.00
5	**0.84**	0.00	-0.75	-0.7474	-0.68	-0.682	-0.71284	0.00
4	**0.65**	0.00	-0.73	-0.7168	-0.67	-0.667	-0.65278	0.00
3	**0.46**	0.00	-0.73	-0.6719	-0.63	-0.634	-0.57852	0.00
2	**0.27**	0.00	-0.68	-0.6319	-0.61	-0.614	-0.45309	0.00
1	**0.08**	0.00	-0.67	-0.6023	-0.59	-0.592	-0.36644	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		337	341.405	342	342.39	341	
11	**2.01**		332	338.376	337	337.59	338	
10	**1.82**		324	332.286	330	330.71	331	
9	**1.63**		322	324.516	325	326.35	328	
8	**1.44**		314	313.757	317	320.8	323	
7	**1.24**		307	304.863	306	309.41	310	
6	**1.03**		304	302.85	303	303.88	305	
5	**0.84**		303	302.633	303	303.02	304	
4	**0.65**		302	302.985	303	303.43	304	
3	**0.46**		302	302.751	303	303	304	
2	**0.27**		302	302.425	302	302.37	303	
1	**0.08**		301	301.591	302	301.89	303	
Bottom	**0.00**							

TEST ID:	0803-B	HRR:	75 kW	SIN:	TY-4211	Flow: 21.3	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.03	1.02	1.02	1.02	1.02	
11	**2.01**		1.05	1.03	1.03	1.03	1.03	
10	**1.82**		1.07	1.05	1.05	1.05	1.05	
9	**1.63**		1.08	1.07	1.07	1.07	1.06	
8	**1.44**		1.11	1.11	1.10	1.09	1.08	
7	**1.24**		1.13	1.14	1.14	1.13	1.12	
6	**1.03**		1.15	1.15	1.15	1.15	1.14	
5	**0.84**		1.15	1.15	1.15	1.15	1.15	
4	**0.65**		1.15	1.15	1.15	1.15	1.14	
3	**0.46**		1.15	1.15	1.15	1.15	1.15	
2	**0.27**		1.16	1.15	1.15	1.15	1.15	
1	**0.08**		1.16	1.16	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.693	kg/s
Experimental M-in:	-0.720	kg/s
Balance	-0.027	kg/s
Neutral Plane:	1.325	m
Tg:	334.9	K
Exit Tg:	330.0	K
Ambient T:	302.8	K
Predicted Ideal M-out:	0.000	kg/s
Associated C:	#DIV/0!	
Average Propane Flow:	56	Lpm
Cooling Coefficient:	1.013	

TEST ID:	0803-C	HRR:	150 kW	SIN:	TY4211	Flow: 21.3	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.92	1.95	1.93	1.86	1.88	0.00
11	**2.01**	0.00	1.67	1.42	1.37	1.36	1.40	0.00
10	**1.82**	0.00	1.31	1.11	1.10	1.12	1.12	0.00
9	**1.63**	0.00	0.84	0.69	0.67	0.66	0.64	0.00
8	**1.44**	0.00	0.38	0.18	0.22	0.02	-0.23	0.00
7	**1.24**	0.00	-0.27	-0.54	-0.54	-0.59	-0.65	0.00
6	**1.03**	0.00	-0.52	-0.68	-0.68	-0.79	-0.79	0.00
5	**0.84**	0.00	-0.86	-0.82	-0.81	-0.91	-0.77	0.00
4	**0.65**	0.00	-0.99	-0.87	-0.90	-0.88	-0.27	0.00
3	**0.46**	0.00	-0.99	-0.89	-0.90	-0.73	0.13	0.00
2	**0.27**	0.00	-0.90	-0.84	-0.82	-0.56	0.16	0.00
1	**0.08**	0.00	-0.82	-0.72	-0.71	-0.40	0.31	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.23	2.29	2.24	2.17	2.17	0.00
11	**2.01**	0.00	1.95	1.68	1.60	1.56	1.62	0.00
10	**1.82**	0.00	1.40	1.28	1.22	1.25	1.27	0.00
9	**1.63**	0.00	0.84	0.68	0.65	0.65	0.63	0.00
8	**1.44**	0.00	0.35	0.17	0.20	0.02	-0.21	0.00
7	**1.24**	0.00	-0.24	-0.48	-0.48	-0.53	-0.58	0.00
6	**1.03**	0.00	-0.46	-0.60	-0.60	-0.69	-0.70	0.00
5	**0.84**	0.00	-0.76	-0.72	-0.71	-0.80	-0.67	0.00
4	**0.65**	0.00	-0.86	-0.76	-0.79	-0.77	-0.24	0.00
3	**0.46**	0.00	-0.86	-0.78	-0.79	-0.64	0.12	0.00
2	**0.27**	0.00	-0.79	-0.73	-0.71	-0.49	0.14	0.00
1	**0.08**	0.00	-0.72	-0.63	-0.62	-0.35	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		405	408	406	404	404	
11	**2.01**		408	410	407	402	402	
10	**1.82**		372	402	385	393	393	
9	**1.63**		350	341	340	342	342	
8	**1.44**		321	319	319	318	318	
7	**1.24**		314	310	310	309	309	
6	**1.03**		309	307	307	306	306	
5	**0.84**		307	306	306	306	306	
4	**0.65**		305	306	306	307	307	
3	**0.46**		304	305	305	306	306	
2	**0.27**		304	304	304	306	306	
1	**0.08**		303	303	303	305	305	
Bottom	**0.00**							

TEST ID:	0803-C	HRR:	150 kW	SIN:	TY4211	Flow: 21.3	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.86	0.85	0.86	0.87	0.86	
11	**2.01**		0.85	0.85	0.86	0.86	0.87	
10	**1.82**		0.94	0.87	0.91	0.90	0.89	
9	**1.63**		0.99	1.02	1.02	1.02	1.02	
8	**1.44**		1.09	1.09	1.09	1.10	1.10	
7	**1.24**		1.11	1.12	1.12	1.13	1.13	
6	**1.03**		1.13	1.14	1.14	1.14	1.14	
5	**0.84**		1.14	1.14	1.14	1.14	1.14	
4	**0.65**		1.14	1.14	1.14	1.14	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.14	1.15	1.15	1.15	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.847	kg/s
Experimental M-in:	-0.818	kg/s
Balance	0.030	kg/s
Neutral Plane:	1.366	m
Tg:	396	K
Exit Tg:	375	K
Ambient T:	305	K
Predicted Ideal M-out:	1.202	kg/s
Associated C:	0.705	
Avg. Propane Flow:	101	Lpm

TEST ID: 0803-C	HRR: 150 kW	SIN: TY4211	Flow: 21.3 gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.68	1.66	1.63	1.60	1.62	0.00
11	**2.01**	0.00	1.42	1.27	1.22	1.20	1.24	0.00
10	**1.82**	0.00	1.13	1.08	1.03	1.00	1.03	0.00
9	**1.63**	0.00	0.90	0.81	0.80	0.79	0.80	0.00
8	**1.44**	0.00	0.53	0.45	0.42	0.44	0.49	0.00
7	**1.24**	0.00	-0.28	-0.52	-0.45	-0.55	-0.49	0.00
6	**1.03**	0.00	-0.67	-0.80	-0.67	-0.81	-0.74	0.00
5	**0.84**	0.00	-0.95	-1.01	-0.91	-0.98	-0.87	0.00
4	**0.65**	0.00	-1.00	-1.00	-0.92	-0.89	-0.51	0.00
3	**0.46**	0.00	-0.95	-0.92	-0.88	-0.61	0.21	0.00
2	**0.27**	0.00	-0.89	-0.86	-0.80	-0.50	0.17	0.00
1	**0.08**	0.00	-0.81	-0.83	-0.68	-0.35	0.28	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.79	1.7748	1.74	1.7427	1.71056	0.00
11	**2.01**	0.00	1.49	1.3423	1.27	1.2735	1.2575	0.00
10	**1.82**	0.00	1.10	1.09772	1.04	1.0389	1.00371	0.00
9	**1.63**	0.00	0.86	0.78325	0.79	0.7854	0.7725	0.00
8	**1.44**	0.00	0.49	0.41968	0.40	0.3956	0.40829	0.00
7	**1.24**	0.00	-0.25	-0.4644	-0.40	-0.402	-0.49095	0.00
6	**1.03**	0.00	-0.59	-0.6984	-0.59	-0.585	-0.70947	0.00
5	**0.84**	0.00	-0.83	-0.8838	-0.80	-0.796	-0.86188	0.00
4	**0.65**	0.00	-0.87	-0.8743	-0.81	-0.812	-0.77932	0.00
3	**0.46**	0.00	-0.83	-0.8054	-0.78	-0.775	-0.53853	0.00
2	**0.27**	0.00	-0.78	-0.7557	-0.70	-0.696	-0.43295	0.00
1	**0.08**	0.00	-0.71	-0.7245	-0.59	-0.593	-0.30329	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		370	371.906	374	372.85	372	
11	**2.01**		365	367.552	365	364.54	365	
10	**1.82**		339	354.489	351	351.22	351	
9	**1.63**		334	337.385	340	341.66	342	
8	**1.44**		322	323.18	324	326.95	332	
7	**1.24**		315	310.481	311	310.55	314	
6	**1.03**		308	305.614	307	306.37	308	
5	**0.84**		306	305.422	306	305.76	307	
4	**0.65**		305	305.767	306	306.45	307	
3	**0.46**		305	305.493	305	305.81	306	
2	**0.27**		304	304.484	305	304.74	306	
1	**0.08**		303	303.397	304	304.29	305	
Bottom	**0.00**							

TEST ID: 0803-C	HRR: 150 kW	SIN: TY4211	Flow: 21.3 gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.94	0.94	0.93	0.93	0.94	
11	**2.01**		0.95	0.95	0.96	0.96	0.95	
10	**1.82**		1.03	0.98	0.99	0.99	0.99	
9	**1.63**		1.04	1.03	1.02	1.02	1.02	
8	**1.44**		1.08	1.08	1.07	1.07	1.05	
7	**1.24**		1.10	1.12	1.12	1.12	1.11	
6	**1.03**		1.13	1.14	1.14	1.14	1.13	
5	**0.84**		1.14	1.14	1.14	1.14	1.13	
4	**0.65**		1.14	1.14	1.14	1.14	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.15	1.14	1.14	1.14	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.832	kg/s
Experimental M-in:	-0.824	kg/s
Balance	0.007	kg/s
Neutral Plane:	1.314	m
Tg:	359.4	K
Exit Tg:	350.3	K
Ambient T:	305.8	K
Predicted Ideal M-out:	1.111	kg/s
Associated C:	0.749	
Average Propane Flow:	98	Lpm
Cooling Coefficient:	0.981	

TEST ID:	0804-A	HRR:	75 kW	SIN:	TY-5521	Flow: 29.6 gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.59	1.61	1.59	1.53	1.56	0.00
11	**2.01**	0.00	1.40	1.18	1.14	1.12	1.17	0.00
10	**1.82**	0.00	1.03	0.92	0.87	0.90	0.92	0.00
9	**1.63**	0.00	0.71	0.52	0.53	0.53	0.49	0.00
8	**1.44**	0.00	0.37	-0.23	-0.26	-0.29	-0.36	0.00
7	**1.24**	0.00	0.14	-0.50	-0.52	-0.56	-0.55	0.00
6	**1.03**	0.00	-0.22	-0.64	-0.65	-0.68	-0.67	0.00
5	**0.84**	0.00	-0.53	-0.72	-0.74	-0.75	-0.54	0.00
4	**0.65**	0.00	-0.59	-0.72	-0.73	-0.73	-0.09	0.00
3	**0.46**	0.00	-0.71	-0.70	-0.70	-0.65	0.14	0.00
2	**0.27**	0.00	-0.68	-0.65	-0.67	-0.48	0.23	0.00
1	**0.08**	0.00	-0.69	-0.66	-0.66	-0.28	0.32	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.61	1.65	1.61	1.56	1.58	0.00
11	**2.01**	0.00	1.42	1.22	1.17	1.14	1.18	0.00
10	**1.82**	0.00	1.00	0.93	0.87	0.90	0.93	0.00
9	**1.63**	0.00	0.67	0.48	0.49	0.50	0.46	0.00
8	**1.44**	0.00	0.33	-0.21	-0.23	-0.25	-0.31	0.00
7	**1.24**	0.00	0.12	-0.44	-0.45	-0.48	-0.48	0.00
6	**1.03**	0.00	-0.19	-0.55	-0.56	-0.59	-0.58	0.00
5	**0.84**	0.00	-0.46	-0.62	-0.64	-0.65	-0.47	0.00
4	**0.65**	0.00	-0.51	-0.63	-0.63	-0.63	-0.08	0.00
3	**0.46**	0.00	-0.62	-0.61	-0.60	-0.56	0.12	0.00
2	**0.27**	0.00	-0.59	-0.56	-0.58	-0.42	0.20	0.00
1	**0.08**	0.00	-0.60	-0.57	-0.57	-0.24	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		354	355	354	353	353	
11	**2.01**		355	358	356	354	354	
10	**1.82**		337	353	347	350	350	
9	**1.63**		328	322	326	325	325	
8	**1.44**		312	307	307	305	305	
7	**1.24**		307	303	303	303	303	
6	**1.03**		305	302	302	302	302	
5	**0.84**		304	302	302	302	302	
4	**0.65**		303	302	302	303	303	
3	**0.46**		302	302	302	302	302	
2	**0.27**		302	301	301	302	302	
1	**0.08**		301	301	301	302	302	
Bottom	**0.00**							

TEST ID:	0804-A	HRR:	75 kW	SIN:	TY-5521	Flow: 29.6 gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.99	0.98	0.98	0.99	0.99	
11	**2.01**		0.98	0.97	0.98	0.98	0.99	
10	**1.82**		1.03	0.99	1.00	1.00	1.00	
9	**1.63**		1.06	1.08	1.07	1.07	1.07	
8	**1.44**		1.12	1.13	1.14	1.14	1.14	
7	**1.24**		1.13	1.15	1.15	1.15	1.15	
6	**1.03**		1.14	1.15	1.15	1.15	1.15	
5	**0.84**		1.15	1.15	1.15	1.15	1.15	
4	**0.65**		1.15	1.15	1.15	1.15	1.15	
3	**0.46**		1.15	1.15	1.15	1.15	1.15	
2	**0.27**		1.15	1.16	1.16	1.16	1.15	
1	**0.08**		1.16	1.16	1.16	1.16	1.15	
Bottom	**0.00**							

Experimental M-out:	0.676	kg/s
Experimental M-in:	-0.686	kg/s
Balance	-0.010	kg/s
Neutral Plane:	1.301	m
Tg:	350	K
Exit Tg:	342	K
Ambient T:	301	K
Predicted Ideal M-out:	1.116	kg/s
Associated C:	0.606	
Avg. Propane Flow:	-1	Lpm

TEST ID:	0804-A	HRR:	75 kW	SIN:	TY-5521	Flow: 29.6	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.21	1.22	1.20	1.19	1.20	0.00
11	**2.01**	0.00	0.97	0.88	0.82	0.84	0.88	0.00
10	**1.82**	0.00	0.68	0.65	0.60	0.62	0.63	0.00
9	**1.63**	0.00	0.48	0.48	0.39	0.45	0.44	0.00
8	**1.44**	0.00	0.42	0.20	0.14	0.23	0.30	0.00
7	**1.24**	0.00	0.31	-0.35	-0.34	-0.32	-0.21	0.00
6	**1.03**	0.00	0.23	-0.43	-0.43	-0.45	-0.41	0.00
5	**0.84**	0.00	-0.11	-0.62	-0.59	-0.61	-0.64	0.00
4	**0.65**	0.00	0.20	-0.60	-0.56	-0.55	-0.54	0.00
3	**0.46**	0.00	-0.30	-0.67	-0.61	-0.58	-0.32	0.00
2	**0.27**	0.00	-0.66	-0.69	-0.62	-0.56	0.12	0.00
1	**0.08**	0.00	-0.66	-0.67	-0.57	-0.53	0.21	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.16	1.16858	1.14	1.1448	1.13583	0.00
11	**2.01**	0.00	0.93	0.83639	0.77	0.7732	0.79098	0.00
10	**1.82**	0.00	0.61	0.59351	0.54	0.5397	0.56028	0.00
9	**1.63**	0.00	0.43	0.42966	0.35	0.3508	0.40447	0.00
8	**1.44**	0.00	0.37	0.17983	0.12	0.1238	0.20556	0.00
7	**1.24**	0.00	0.27	-0.306	-0.29	-0.294	-0.27791	0.00
6	**1.03**	0.00	0.20	-0.3782	-0.37	-0.373	-0.39015	0.00
5	**0.84**	0.00	-0.10	-0.5381	-0.51	-0.51	-0.52453	0.00
4	**0.65**	0.00	0.17	-0.5173	-0.48	-0.482	-0.47775	0.00
3	**0.46**	0.00	-0.27	-0.5835	-0.52	-0.524	-0.50122	0.00
2	**0.27**	0.00	-0.57	-0.598	-0.54	-0.536	-0.48695	0.00
1	**0.08**	0.00	-0.57	-0.577	-0.49	-0.491	-0.45787	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		333	332.898	333	333.35	333	
11	**2.01**		332	331.494	328	329.41	329	
10	**1.82**		316	316.702	315	317.29	316	
9	**1.63**		311	311.116	310	310.57	311	
8	**1.44**		309	307.85	307	307.1	309	
7	**1.24**		308	304.523	303	304.02	305	
6	**1.03**		307	303.353	302	302.32	303	
5	**0.84**		306	302.653	302	301.74	302	
4	**0.65**		305	302.344	302	301.78	302	
3	**0.46**		304	301.573	301	301.46	302	
2	**0.27**		302	301.378	301	301.14	302	
1	**0.08**		302	301.501	301	301.4	302	
Bottom	**0.00**							

TEST ID:	0804-A	HRR:	75 kW	SIN:	TY-5521	Flow: 29.6	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.05	1.05	1.05	1.05	1.05	
11	**2.01**		1.05	1.05	1.06	1.06	1.06	
10	**1.82**		1.10	1.10	1.11	1.10	1.10	
9	**1.63**		1.12	1.12	1.12	1.12	1.12	
8	**1.44**		1.13	1.13	1.13	1.13	1.13	
7	**1.24**		1.13	1.14	1.15	1.15	1.14	
6	**1.03**		1.14	1.15	1.15	1.15	1.15	
5	**0.84**		1.14	1.15	1.15	1.15	1.15	
4	**0.65**		1.14	1.15	1.15	1.15	1.15	
3	**0.46**		1.15	1.16	1.16	1.16	1.15	
2	**0.27**		1.15	1.16	1.16	1.16	1.15	
1	**0.08**		1.15	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.546	kg/s
Experimental M-in:	-0.520	kg/s
Balance	0.026	kg/s
Neutral Plane:	1.296	m
Tg:	329.4	K
Exit Tg:	318.7	K
Ambient T:	301.4	K
Predicted Ideal M-out:	0.908	kg/s
Associated C:	0.601	
Average Propane Flow:	12	Lpm
Cooling Coefficient:	0.807	

TEST ID:	0804-C	HRR:	150 kW	SIN:	TY5521	Flow: 29.6	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.94	1.96	1.95	1.90	1.92	0.00
11	**2.01**	0.00	1.71	1.46	1.39	1.38	1.43	0.00
10	**1.82**	0.00	1.29	1.15	1.12	1.17	1.17	0.00
9	**1.63**	0.00	0.81	0.76	0.75	0.72	0.67	0.00
8	**1.44**	0.00	0.40	0.36	0.29	0.32	-0.21	0.00
7	**1.24**	0.00	-0.34	-0.47	-0.52	-0.52	-0.67	0.00
6	**1.03**	0.00	-0.63	-0.72	-0.74	-0.77	-0.80	0.00
5	**0.84**	0.00	-0.93	-0.99	-0.94	-0.95	-0.93	0.00
4	**0.65**	0.00	-1.01	-1.04	-0.97	-0.96	-0.77	0.00
3	**0.46**	0.00	-0.98	-0.96	-0.90	-0.84	-0.36	0.00
2	**0.27**	0.00	-0.87	-0.81	-0.80	-0.53	0.14	0.00
1	**0.08**	0.00	-0.89	-0.77	-0.71	0.15	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.30	2.37	2.34	2.29	2.29	0.00
11	**2.01**	0.00	2.04	1.77	1.68	1.64	1.70	0.00
10	**1.82**	0.00	1.38	1.38	1.27	1.34	1.36	0.00
9	**1.63**	0.00	0.81	0.76	0.75	0.71	0.67	0.00
8	**1.44**	0.00	0.37	0.34	0.26	0.30	-0.19	0.00
7	**1.24**	0.00	-0.31	-0.42	-0.47	-0.47	-0.60	0.00
6	**1.03**	0.00	-0.56	-0.64	-0.65	-0.68	-0.71	0.00
5	**0.84**	0.00	-0.82	-0.87	-0.83	-0.84	-0.82	0.00
4	**0.65**	0.00	-0.89	-0.92	-0.86	-0.85	-0.68	0.00
3	**0.46**	0.00	-0.86	-0.84	-0.79	-0.74	-0.31	0.00
2	**0.27**	0.00	-0.76	-0.72	-0.70	-0.47	0.12	0.00
1	**0.08**	0.00	-0.78	-0.68	-0.62	0.13	0.24	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		413	420	418	415	415	
11	**2.01**		415	423	420	414	414	
10	**1.82**		372	417	397	403	403	
9	**1.63**		348	348	349	345	345	
8	**1.44**		325	325	324	319	319	
7	**1.24**		316	315	313	311	311	
6	**1.03**		310	309	309	308	308	
5	**0.84**		308	307	308	307	307	
4	**0.65**		307	307	308	308	308	
3	**0.46**		306	307	307	307	307	
2	**0.27**		306	306	306	307	307	
1	**0.08**		304	305	306	307	307	
Bottom	**0.00**							

TEST ID:	0804-C	HRR:	150 kW	SIN:	TY5521	Flow: 29.6 gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.84	0.83	0.83	0.84	0.84	
11	**2.01**		0.84	0.82	0.83	0.83	0.84	
10	**1.82**		0.94	0.84	0.88	0.87	0.86	
9	**1.63**		1.00	1.00	1.00	1.01	1.01	
8	**1.44**		1.07	1.07	1.08	1.07	1.09	
7	**1.24**		1.10	1.11	1.11	1.11	1.12	
6	**1.03**		1.12	1.13	1.13	1.13	1.13	
5	**0.84**		1.13	1.13	1.13	1.13	1.13	
4	**0.65**		1.14	1.13	1.13	1.13	1.13	
3	**0.46**		1.14	1.14	1.13	1.13	1.13	
2	**0.27**		1.14	1.14	1.14	1.14	1.13	
1	**0.08**		1.14	1.14	1.14	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.883	kg/s
Experimental M-in:	-0.869	kg/s
Balance	0.014	kg/s
Neutral Plane:	1.358	m
Tg:	406	K
Exit Tg:	383	K
Ambient T:	307	K
Predicted Ideal M-out:	1.238	kg/s
Associated C:	0.713	
Avg. Propane Flow:	108	Lpm

TEST ID:	0804-C	HRR:	150 kW	SIN:	TY5521	Flow: 29.6	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.71	1.73	1.70	1.68	1.70	0.00
11	**2.01**	0.00	1.45	1.28	1.22	1.24	1.28	0.00
10	**1.82**	0.00	1.27	1.09	1.01	1.02	1.08	0.00
9	**1.63**	0.00	1.02	0.91	0.82	0.84	0.86	0.00
8	**1.44**	0.00	0.65	0.64	0.59	0.60	0.58	0.00
7	**1.24**	0.00	-0.40	-0.39	-0.31	-0.37	-0.35	0.00
6	**1.03**	0.00	-0.63	-0.68	-0.70	-0.72	-0.72	0.00
5	**0.84**	0.00	-1.02	-0.95	-0.98	-0.99	-1.00	0.00
4	**0.65**	0.00	-1.10	-1.03	-1.02	-1.05	-0.83	0.00
3	**0.46**	0.00	-1.09	-1.03	-0.96	-0.90	-0.27	0.00
2	**0.27**	0.00	-0.96	-0.90	-0.89	-0.66	0.03	0.00
1	**0.08**	0.00	-0.86	-0.81	-0.82	-0.30	0.35	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.86	1.89663	1.87	1.8661	1.85287	0.00
11	**2.01**	0.00	1.57	1.37453	1.29	1.2937	1.32092	0.00
10	**1.82**	0.00	1.25	1.08635	1.00	1.0038	1.0087	0.00
9	**1.63**	0.00	0.98	0.89045	0.80	0.7952	0.81466	0.00
8	**1.44**	0.00	0.61	0.60672	0.57	0.5653	0.5741	0.00
7	**1.24**	0.00	-0.36	-0.3574	-0.29	-0.286	-0.33895	0.00
6	**1.03**	0.00	-0.55	-0.6044	-0.62	-0.617	-0.6414	0.00
5	**0.84**	0.00	-0.90	-0.8353	-0.86	-0.863	-0.87153	0.00
4	**0.65**	0.00	-0.96	-0.9066	-0.90	-0.901	-0.93078	0.00
3	**0.46**	0.00	-0.95	-0.9053	-0.84	-0.84	-0.79424	0.00
2	**0.27**	0.00	-0.84	-0.7888	-0.78	-0.78	-0.57774	0.00
1	**0.08**	0.00	-0.75	-0.71	-0.72	-0.715	-0.26117	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		380	381.894	384	383.32	383	
11	**2.01**		376	375.305	371	371.5	373	
10	**1.82**		343	346.271	346	344.53	348	
9	**1.63**		335	340.731	339	339.31	341	
8	**1.44**		327	330.683	332	333.4	334	
7	**1.24**		314	316.168	317	317.07	319	
6	**1.03**		309	308.729	309	308.9	310	
5	**0.84**		307	307.373	307	307.61	308	
4	**0.65**		306	306.716	308	307.81	309	
3	**0.46**		305	305.764	307	306.76	308	
2	**0.27**		306	305.585	306	306.1	308	
1	**0.08**		305	305.248	305	306.11	307	
Bottom	**0.00**							

TEST ID: 0804-C	HRR: 150 kW	SIN: TY5521	Flow: 29.6 gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.92	0.91	0.91	0.91	0.91	
11	**2.01**		0.93	0.93	0.94	0.94	0.93	
10	**1.82**		1.02	1.01	1.01	1.01	1.00	
9	**1.63**		1.04	1.02	1.03	1.03	1.02	
8	**1.44**		1.07	1.05	1.05	1.05	1.04	
7	**1.24**		1.11	1.10	1.10	1.10	1.09	
6	**1.03**		1.13	1.13	1.13	1.13	1.12	
5	**0.84**		1.13	1.13	1.13	1.13	1.13	
4	**0.65**		1.14	1.14	1.13	1.13	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.13	
2	**0.27**		1.14	1.14	1.14	1.14	1.13	
1	**0.08**		1.14	1.14	1.14	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.886	kg/s
Experimental M-in:	-0.881	kg/s
Balance	0.005	kg/s
Neutral Plane:	1.293	m
Tg:	359.7	K
Exit Tg:	354.4	K
Ambient T:	307.0	K
Predicted Ideal M-out:	1.136	kg/s
Associated C:	0.780	
Average Propane Flow:	107	Lpm
Cooling Coefficient:	1.004	

TEST ID:	0805-A	HRR:	150 kW	SIN:	TY-3334	Flow: 14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.98	2.03	1.98	1.95	1.95	0.00
11	**2.01**	0.00	1.75	1.49	1.42	1.42	1.45	0.00
10	**1.82**	0.00	1.37	1.16	1.14	1.20	1.19	0.00
9	**1.63**	0.00	0.94	0.78	0.74	0.69	0.70	0.00
8	**1.44**	0.00	0.52	0.29	0.24	0.20	-0.30	0.00
7	**1.24**	0.00	0.12	-0.48	-0.54	-0.56	-0.58	0.00
6	**1.03**	0.00	-0.24	-0.69	-0.70	-0.69	-0.71	0.00
5	**0.84**	0.00	-0.53	-0.80	-0.79	-0.79	-0.87	0.00
4	**0.65**	0.00	-0.61	-0.77	-0.77	-0.82	-0.81	0.00
3	**0.46**	0.00	-0.78	-0.79	-0.79	-0.84	-0.57	0.00
2	**0.27**	0.00	-0.95	-0.83	-0.82	-0.86	-0.34	0.00
1	**0.08**	0.00	-0.94	-0.81	-0.78	-0.77	0.10	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.36	2.44	2.36	2.32	2.31	0.00
11	**2.01**	0.00	2.10	1.81	1.70	1.68	1.71	0.00
10	**1.82**	0.00	1.48	1.37	1.28	1.36	1.36	0.00
9	**1.63**	0.00	0.96	0.78	0.74	0.67	0.69	0.00
8	**1.44**	0.00	0.48	0.27	0.22	0.18	-0.27	0.00
7	**1.24**	0.00	0.11	-0.43	-0.48	-0.50	-0.51	0.00
6	**1.03**	0.00	-0.22	-0.60	-0.61	-0.61	-0.62	0.00
5	**0.84**	0.00	-0.47	-0.70	-0.69	-0.69	-0.76	0.00
4	**0.65**	0.00	-0.54	-0.68	-0.68	-0.72	-0.71	0.00
3	**0.46**	0.00	-0.69	-0.69	-0.69	-0.74	-0.50	0.00
2	**0.27**	0.00	-0.83	-0.72	-0.72	-0.75	-0.30	0.00
1	**0.08**	0.00	-0.82	-0.71	-0.68	-0.67	0.08	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		415	419	416	411	411	
11	**2.01**		418	422	418	410	410	
10	**1.82**		375	410	393	401	401	
9	**1.63**		353	349	345	345	345	
8	**1.44**		324	320	320	314	314	
7	**1.24**		316	311	310	306	306	
6	**1.03**		311	307	306	304	304	
5	**0.84**		310	306	305	304	304	
4	**0.65**		309	306	305	305	305	
3	**0.46**		306	304	304	303	303	
2	**0.27**		305	304	303	304	304	
1	**0.08**		303	303	303	303	303	
Bottom	**0.00**							

TEST ID:	0805-A	HRR:	150 kW	SIN:	TY-3334	Flow:	14.8 gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.84	0.83	0.84	0.84	0.85	
11	**2.01**		0.83	0.83	0.83	0.84	0.85	
10	**1.82**		0.93	0.85	0.89	0.88	0.87	
9	**1.63**		0.99	1.00	1.01	1.03	1.01	
8	**1.44**		1.08	1.09	1.09	1.09	1.11	
7	**1.24**		1.10	1.12	1.12	1.13	1.14	
6	**1.03**		1.12	1.14	1.14	1.14	1.14	
5	**0.84**		1.13	1.14	1.14	1.14	1.15	
4	**0.65**		1.13	1.14	1.14	1.14	1.14	
3	**0.46**		1.14	1.15	1.15	1.15	1.15	
2	**0.27**		1.14	1.15	1.15	1.15	1.15	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.895	kg/s
Experimental M-in:	-0.820	kg/s
Balance	0.075	kg/s
Neutral Plane:	1.281	m
Tg:	404	K
Exit Tg:	378	
Ambient T:	304	K
Predicted Ideal M-out:	1.427	kg/s
Associated C:	0.627	
Avg. Propane Flow:	0	Lpm

TEST ID: 0805-A	HRR: 150 kW	SIN: TY-3334	Flow: 14.8 gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.78	1.73	1.78	1.87	1.72	0.00
11	**2.01**	0.00	1.61	1.45	1.43	1.48	1.54	0.00
10	**1.82**	0.00	1.40	1.26	1.25	1.28	1.29	0.00
9	**1.63**	0.00	1.08	0.83	0.81	0.78	0.85	0.00
8	**1.44**	0.00	0.56	0.14	-0.13	-0.13	-0.20	0.00
7	**1.24**	0.00	0.18	-0.60	-0.69	-0.70	-0.68	0.00
6	**1.03**	0.00	-0.17	-0.73	-0.75	-0.78	-0.76	0.00
5	**0.84**	0.00	-0.64	-0.93	-0.92	-0.96	-1.02	0.00
4	**0.65**	0.00	-0.61	-0.82	-0.83	-0.89	-0.92	0.00
3	**0.46**	0.00	-0.74	-0.80	-0.84	-0.87	-0.58	0.00
2	**0.27**	0.00	-0.94	-0.83	-0.86	-0.94	-0.33	0.00
1	**0.08**	0.00	-0.94	-0.82	-0.82	-0.84	0.07	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.97	1.93468	1.98	1.9811	2.08151	0.00
11	**2.01**	0.00	1.78	1.61941	1.58	1.5833	1.64712	0.00
10	**1.82**	0.00	1.52	1.36185	1.35	1.3492	1.38177	0.00
9	**1.63**	0.00	1.13	0.83896	0.82	0.823	0.78956	0.00
8	**1.44**	0.00	0.54	0.12797	-0.12	-0.123	-0.11563	0.00
7	**1.24**	0.00	0.16	-0.5288	-0.61	-0.606	-0.61653	0.00
6	**1.03**	0.00	-0.16	-0.6447	-0.65	-0.655	-0.68575	0.00
5	**0.84**	0.00	-0.56	-0.8119	-0.81	-0.81	-0.84423	0.00
4	**0.65**	0.00	-0.54	-0.721	-0.73	-0.731	-0.78372	0.00
3	**0.46**	0.00	-0.65	-0.6951	-0.73	-0.73	-0.76139	0.00
2	**0.27**	0.00	-0.82	-0.7259	-0.75	-0.75	-0.82056	0.00
1	**0.08**	0.00	-0.81	-0.7104	-0.71	-0.714	-0.73494	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		387	390.113	388	387.4	383	
11	**2.01**		385	388.482	387	387.05	387	
10	**1.82**		378	376.341	377	377.23	378	
9	**1.63**		365	353.863	355	353.63	353	
8	**1.44**		335	319.238	319	321.25	318	
7	**1.24**		315	308.322	308	307.57	307	
6	**1.03**		312	306.14	306	305.81	305	
5	**0.84**		309	305.695	306	305.42	305	
4	**0.65**		308	305.841	306	305.47	306	
3	**0.46**		306	304.253	305	304.22	304	
2	**0.27**		305	303.746	304	303.6	304	
1	**0.08**		304	303.543	304	303.44	304	
Bottom	**0.00**							

TEST ID: 0805-A	HRR: 150 kW	SIN: TY-3334	Flow: 14.8 gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.90	0.89	0.90	0.90	0.91	
11	**2.01**		0.90	0.90	0.90	0.90	0.90	
10	**1.82**		0.92	0.93	0.93	0.92	0.92	
9	**1.63**		0.95	0.98	0.98	0.99	0.99	
8	**1.44**		1.04	1.09	1.09	1.08	1.09	
7	**1.24**		1.11	1.13	1.13	1.13	1.14	
6	**1.03**		1.12	1.14	1.14	1.14	1.14	
5	**0.84**		1.13	1.14	1.14	1.14	1.14	
4	**0.65**		1.13	1.14	1.14	1.14	1.14	
3	**0.46**		1.14	1.15	1.14	1.15	1.14	
2	**0.27**		1.14	1.15	1.15	1.15	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.885	kg/s
Experimental M-in:	-0.903	kg/s
Balance	-0.018	kg/s
Neutral Plane:	1.286	m
Tg:	372.3	K
Exit Tg:	369.8	K
Ambient T:	304.7	K
Predicted Ideal M-out:	1.262	kg/s
Associated C:	0.701	
Average Propane Flow:	0	Lpm
Cooling Coefficient:	0.989	

TEST ID:	0805-B	HRR:	75 kW	SIN:	TY-3334	Flow: 14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall	pos. 3	pos. 2a	pos 2	pos. 1a	pos. 1	wall
		0.00	**0.10**	**0.30**	**0.52**	**0.74**	**0.94**	**1.04**
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.66	1.69	1.68	1.63	1.63	0.00
11	**2.01**	0.00	1.47	1.25	1.20	1.19	1.23	0.00
10	**1.82**	0.00	1.16	0.97	0.94	0.98	0.97	0.00
9	**1.63**	0.00	0.75	0.54	0.58	0.60	0.59	0.00
8	**1.44**	0.00	0.25	-0.34	-0.23	-0.14	-0.27	0.00
7	**1.24**	0.00	-0.45	-0.62	-0.58	-0.57	-0.55	0.00
6	**1.03**	0.00	-0.64	-0.71	-0.70	-0.71	-0.60	0.00
5	**0.84**	0.00	-0.82	-0.79	-0.79	-0.77	-0.44	0.00
4	**0.65**	0.00	-0.83	-0.77	-0.74	-0.55	-0.12	0.00
3	**0.46**	0.00	-0.79	-0.72	-0.71	-0.29	0.15	0.00
2	**0.27**	0.00	-0.76	-0.72	-0.68	-0.24	0.18	0.00
1	**0.08**	0.00	-0.76	-0.72	-0.69	0.03	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall	pos. 3	pos. 2a	pos 2	pos. 1a	pos. 1	wall
		0.00	**0.10**	**0.30**	**0.52**	**0.74**	**0.94**	**1.04**
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.75	1.80	1.79	1.73	1.72	0.00
11	**2.01**	0.00	1.57	1.34	1.28	1.26	1.30	0.00
10	**1.82**	0.00	1.18	1.02	0.97	1.01	1.01	0.00
9	**1.63**	0.00	0.72	0.51	0.55	0.57	0.57	0.00
8	**1.44**	0.00	0.22	-0.30	-0.21	-0.13	-0.24	0.00
7	**1.24**	0.00	-0.40	-0.54	-0.51	-0.50	-0.49	0.00
6	**1.03**	0.00	-0.56	-0.63	-0.62	-0.63	-0.53	0.00
5	**0.84**	0.00	-0.72	-0.70	-0.69	-0.68	-0.39	0.00
4	**0.65**	0.00	-0.73	-0.68	-0.65	-0.49	-0.10	0.00
3	**0.46**	0.00	-0.69	-0.63	-0.62	-0.26	0.13	0.00
2	**0.27**	0.00	-0.66	-0.63	-0.59	-0.21	0.16	0.00
1	**0.08**	0.00	-0.66	-0.63	-0.61	0.03	0.24	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall	pos. 3	pos. 2a	pos 2	pos. 1a	pos. 1	wall
		0.00	**0.10**	**0.30**	**0.52**	**0.74**	**0.94**	**1.04**
Top	**2.24**							
12	**2.17**		369	371	371	369	369	
11	**2.01**		372	374	372	369	369	
10	**1.82**		355	365	358	364	364	
9	**1.63**		337	328	332	335	335	
8	**1.44**		315	310	312	313	313	
7	**1.24**		309	307	307	308	308	
6	**1.03**		307	306	306	307	307	
5	**0.84**		306	306	306	307	307	
4	**0.65**		306	306	307	307	307	
3	**0.46**		305	306	306	306	306	
2	**0.27**		304	305	304	306	306	
1	**0.08**		304	304	304	306	306	
Bottom	**0.00**							

TEST ID:	0805-B	HRR:	75 kW	SIN:	TY-3334	Flow: 14.8 gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.94	0.94	0.94	0.94	0.94	
11	**2.01**		0.94	0.93	0.94	0.94	0.95	
10	**1.82**		0.98	0.95	0.97	0.97	0.96	
9	**1.63**		1.03	1.06	1.05	1.04	1.04	
8	**1.44**		1.11	1.12	1.12	1.11	1.11	
7	**1.24**		1.13	1.14	1.14	1.13	1.13	
6	**1.03**		1.14	1.14	1.14	1.14	1.13	
5	**0.84**		1.14	1.14	1.14	1.14	1.13	
4	**0.65**		1.14	1.14	1.14	1.13	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.14	1.14	1.15	1.14	1.14	
1	**0.08**		1.15	1.15	1.15	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.717	kg/s
Experimental M-in:	-0.718	kg/s
Balance	-0.001	kg/s
Neutral Plane:	1.423	m
Tg:	364	K
Exit Tg:	357	K
Ambient T:	306	K
Predicted Ideal M-out:	0.948	kg/s
Associated C:	0.756	
Avg. Propane Flow:	56	Lpm

TEST ID:	0805-B	HRR:	75 kW	SIN:	TY-3334	Flow: 14.8 gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.37	1.27	1.33	1.39	1.33	0.00
11	**2.01**	0.00	1.28	1.12	1.13	1.15	1.22	0.00
10	**1.82**	0.00	1.10	0.98	1.00	1.00	1.02	0.00
9	**1.63**	0.00	0.92	0.80	0.81	0.85	0.87	0.00
8	**1.44**	0.00	0.67	0.52	0.41	0.55	0.64	0.00
7	**1.24**	0.00	0.31	-0.43	-0.62	-0.52	0.15	0.00
6	**1.03**	0.00	-0.58	-0.86	-0.86	-0.88	-0.37	0.00
5	**0.84**	0.00	-0.97	-1.04	-1.02	-1.01	-0.34	0.00
4	**0.65**	0.00	-1.11	-1.05	-1.02	-0.98	0.17	0.00
3	**0.46**	0.00	-1.05	-0.99	-0.96	-0.89	0.28	0.00
2	**0.27**	0.00	-0.96	-0.94	-0.98	-0.63	0.27	0.00
1	**0.08**	0.00	-0.96	-0.89	-0.98	-0.51	0.30	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.35	1.26321	1.32	1.3189	1.37095	0.00
11	**2.01**	0.00	1.26	1.11398	1.12	1.1176	1.13881	0.00
10	**1.82**	0.00	1.08	0.95891	0.98	0.9774	0.97888	0.00
9	**1.63**	0.00	0.89	0.77185	0.78	0.7839	0.82802	0.00
8	**1.44**	0.00	0.65	0.49927	0.38	0.384	0.52634	0.00
7	**1.24**	0.00	0.30	-0.39	-0.55	-0.553	-0.47054	0.00
6	**1.03**	0.00	-0.53	-0.754	-0.76	-0.757	-0.77453	0.00
5	**0.84**	0.00	-0.86	-0.9132	-0.90	-0.901	-0.88939	0.00
4	**0.65**	0.00	-0.98	-0.9224	-0.90	-0.897	-0.86162	0.00
3	**0.46**	0.00	-0.92	-0.8667	-0.85	-0.846	-0.78403	0.00
2	**0.27**	0.00	-0.84	-0.8239	-0.86	-0.857	-0.55101	0.00
1	**0.08**	0.00	-0.84	-0.7724	-0.86	-0.858	-0.44138	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		345	345.9	346	344.59	344	
11	**2.01**		344	345.082	345	344.25	345	
10	**1.82**		341	341.618	342	341.62	342	
9	**1.63**		338	338.25	338	339.02	340	
8	**1.44**		336	333.466	329	333.46	336	
7	**1.24**		331	318.044	311	314.65	325	
6	**1.03**		313	306.64	307	307.6	317	
5	**0.84**		307	305.857	306	306.65	315	
4	**0.65**		305	306.273	307	306.8	311	
3	**0.46**		305	306.047	306	306.27	309	
2	**0.27**		304	305.303	304	305.07	307	
1	**0.08**		304	303.916	304	303.66	305	
Bottom	**0.00**							

TEST ID:	0805-B	HRR:	75 kW	SIN:	TY-3334	Flow: 14.8	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.01	1.01	1.01	1.01	1.01	
11	**2.01**		1.01	1.01	1.01	1.01	1.01	
10	**1.82**		1.02	1.02	1.02	1.02	1.02	
9	**1.63**		1.03	1.03	1.03	1.03	1.02	
8	**1.44**		1.04	1.04	1.06	1.04	1.04	
7	**1.24**		1.05	1.10	1.12	1.11	1.07	
6	**1.03**		1.11	1.14	1.14	1.13	1.10	
5	**0.84**		1.13	1.14	1.14	1.14	1.11	
4	**0.65**		1.14	1.14	1.14	1.14	1.12	
3	**0.46**		1.14	1.14	1.14	1.14	1.13	
2	**0.27**		1.15	1.14	1.15	1.14	1.13	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.809	kg/s
Experimental M-in:	-0.842	kg/s
Balance	-0.033	kg/s
Neutral Plane:	1.213	m
Tg:	336.3	K
Exit Tg:	339.7	K
Ambient T:	305.9	K
Predicted Ideal M-out:	1.044	kg/s
Associated C:	0.775	
Average Propane Flow:	55	Lpm
Cooling Coefficient:	1.128	

TEST ID:	0805-C	HRR:	75 kW	SIN:	TY-1334	Flow: 11.1	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.61	1.65	1.65	1.63	1.63	0.00
11	**2.01**	0.00	1.42	1.21	1.16	1.15	1.20	0.00
10	**1.82**	0.00	1.10	0.96	0.93	0.97	0.96	0.00
9	**1.63**	0.00	0.79	0.61	0.56	0.56	0.56	0.00
8	**1.44**	0.00	0.33	-0.14	-0.20	-0.17	-0.27	0.00
7	**1.24**	0.00	-0.22	-0.51	-0.48	-0.54	-0.50	0.00
6	**1.03**	0.00	-0.60	-0.71	-0.64	-0.70	-0.60	0.00
5	**0.84**	0.00	-0.78	-0.82	-0.76	-0.78	-0.56	0.00
4	**0.65**	0.00	-0.85	-0.85	-0.79	-0.67	-0.28	0.00
3	**0.46**	0.00	-0.82	-0.76	-0.76	-0.37	-0.04	0.00
2	**0.27**	0.00	-0.76	-0.72	-0.70	-0.30	0.09	0.00
1	**0.08**	0.00	-0.73	-0.72	-0.65	0.22	0.32	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.71	1.77	1.76	1.73	1.73	0.00
11	**2.01**	0.00	1.52	1.31	1.25	1.22	1.28	0.00
10	**1.82**	0.00	1.12	1.02	0.96	1.00	1.01	0.00
9	**1.63**	0.00	0.77	0.59	0.53	0.53	0.54	0.00
8	**1.44**	0.00	0.30	-0.13	-0.18	-0.16	-0.24	0.00
7	**1.24**	0.00	-0.19	-0.45	-0.43	-0.48	-0.44	0.00
6	**1.03**	0.00	-0.53	-0.62	-0.56	-0.62	-0.53	0.00
5	**0.84**	0.00	-0.69	-0.72	-0.67	-0.69	-0.49	0.00
4	**0.65**	0.00	-0.74	-0.75	-0.69	-0.59	-0.24	0.00
3	**0.46**	0.00	-0.72	-0.67	-0.67	-0.32	-0.03	0.00
2	**0.27**	0.00	-0.67	-0.63	-0.61	-0.27	0.08	0.00
1	**0.08**	0.00	-0.64	-0.63	-0.56	0.19	0.28	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		370	374	372	371	371	
11	**2.01**		372	376	373	371	371	
10	**1.82**		354	372	361	366	366	
9	**1.63**		340	335	333	336	336	
8	**1.44**		318	315	313	313	313	
7	**1.24**		311	309	308	309	309	
6	**1.03**		307	306	306	307	307	
5	**0.84**		306	306	306	307	307	
4	**0.65**		306	307	307	308	308	
3	**0.46**		305	306	306	307	307	
2	**0.27**		305	305	306	307	307	
1	**0.08**		304	304	304	306	306	
Bottom	**0.00**							

TEST ID:	0805-C	HRR:	75 kW	SIN:	TY-1334	Flow: 11.1	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.94	0.93	0.94	0.94	0.94	
11	**2.01**		0.94	0.93	0.93	0.94	0.94	
10	**1.82**		0.98	0.94	0.96	0.96	0.95	
9	**1.63**		1.03	1.04	1.05	1.04	1.04	
8	**1.44**		1.10	1.11	1.11	1.11	1.11	
7	**1.24**		1.12	1.13	1.13	1.13	1.13	
6	**1.03**		1.13	1.14	1.14	1.14	1.13	
5	**0.84**		1.14	1.14	1.14	1.14	1.13	
4	**0.65**		1.14	1.14	1.14	1.13	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.14	1.14	1.14	1.14	1.13	
1	**0.08**		1.15	1.15	1.15	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.708	kg/s
Experimental M-in:	-0.719	kg/s
Balance	-0.011	kg/s
Neutral Plane:	1.385	m
Tg:	365	K
Exit Tg:	359	K
Ambient T:	306	K
Predicted Ideal M-out:	1.018	kg/s
Associated C:	0.696	
Avg. Propane Flow:	54	Lpm

TEST ID:	0805-C	HRR:	75 kW	SIN:	TY-1334	Flow: 11.1	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.37	1.31	1.37	1.46	1.40	0.00
11	**2.01**	0.00	1.24	1.13	1.15	1.18	1.27	0.00
10	**1.82**	0.00	1.12	1.04	1.03	1.06	1.05	0.00
9	**1.63**	0.00	0.83	0.67	0.66	0.64	0.75	0.00
8	**1.44**	0.00	0.54	0.32	0.19	-0.09	0.11	0.00
7	**1.24**	0.00	-0.23	-0.59	-0.60	-0.67	-0.57	0.00
6	**1.03**	0.00	-0.48	-0.81	-0.81	-0.85	-0.73	0.00
5	**0.84**	0.00	-0.71	-0.88	-0.88	-0.86	-0.60	0.00
4	**0.65**	0.00	-0.89	-0.94	-0.90	-0.79	-0.22	0.00
3	**0.46**	0.00	-0.89	-0.85	-0.82	-0.50	0.19	0.00
2	**0.27**	0.00	-0.83	-0.79	-0.83	-0.31	0.15	0.00
1	**0.08**	0.00	-0.78	-0.73	-0.81	-0.17	0.30	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.40	1.33006	1.40	1.3959	1.48293	0.00
11	**2.01**	0.00	1.26	1.14318	1.16	1.1614	1.20191	0.00
10	**1.82**	0.00	1.12	1.0312	1.03	1.0308	1.05547	0.00
9	**1.63**	0.00	0.81	0.64828	0.63	0.633	0.61916	0.00
8	**1.44**	0.00	0.52	0.30506	0.17	0.172	-0.08342	0.00
7	**1.24**	0.00	-0.21	-0.5261	-0.53	-0.531	-0.5952	0.00
6	**1.03**	0.00	-0.43	-0.7081	-0.71	-0.709	-0.74717	0.00
5	**0.84**	0.00	-0.63	-0.7743	-0.77	-0.774	-0.75451	0.00
4	**0.65**	0.00	-0.78	-0.8225	-0.80	-0.796	-0.69977	0.00
3	**0.46**	0.00	-0.78	-0.7482	-0.72	-0.724	-0.44022	0.00
2	**0.27**	0.00	-0.72	-0.6969	-0.72	-0.723	-0.26889	0.00
1	**0.08**	0.00	-0.68	-0.6379	-0.71	-0.708	-0.14941	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		355	354.075	355	354.09	352	
11	**2.01**		354	353.376	353	353.44	354	
10	**1.82**		348	345.703	347	347.54	349	
9	**1.63**		339	335.666	335	335.71	338	
8	**1.44**		333	327.915	321	320.14	321	
7	**1.24**		317	309.705	309	308.82	311	
6	**1.03**		309	305.892	306	307.17	308	
5	**0.84**		307	305.989	307	307.16	308	
4	**0.65**		306	306.162	307	307.43	308	
3	**0.46**		305	305.918	307	306.85	307	
2	**0.27**		305	305.624	305	306.18	307	
1	**0.08**		304	303.936	304	305.1	307	
Bottom	**0.00**							

TEST ID:	0805-C	HRR:	75 kW	SIN:	TY-1334	Flow: 11.1	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.98	0.98	0.98	0.98	0.99	
11	**2.01**		0.98	0.99	0.99	0.99	0.98	
10	**1.82**		1.00	1.01	1.00	1.00	1.00	
9	**1.63**		1.03	1.04	1.04	1.04	1.03	
8	**1.44**		1.05	1.06	1.09	1.09	1.09	
7	**1.24**		1.10	1.13	1.13	1.13	1.12	
6	**1.03**		1.13	1.14	1.14	1.13	1.13	
5	**0.84**		1.14	1.14	1.14	1.13	1.13	
4	**0.65**		1.14	1.14	1.13	1.13	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.13	
2	**0.27**		1.14	1.14	1.14	1.14	1.13	
1	**0.08**		1.15	1.15	1.15	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.732	kg/s
Experimental M-in:	-0.782	kg/s
Balance	-0.049	kg/s
Neutral Plane:	1.348	m
Tg:	341.9	K
Exit Tg:	340.9	
Ambient T:	306.5	K
Predicted Ideal M-out:	0.897	kg/s
Associated C:	0.817	
Average Propane Flow:	55	Lpm
Cooling Coefficient:	1.034	

TEST ID:	0806-A	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.68	1.72	1.70	1.66	1.66	0.00
11	**2.01**	0.00	1.46	1.26	1.21	1.19	1.25	0.00
10	**1.82**	0.00	1.09	1.00	0.95	0.99	1.01	0.00
9	**1.63**	0.00	0.75	0.63	0.62	0.64	0.58	0.00
8	**1.44**	0.00	0.42	-0.23	-0.28	-0.14	-0.35	0.00
7	**1.24**	0.00	0.16	-0.59	-0.61	-0.54	-0.55	0.00
6	**1.03**	0.00	-0.38	-0.74	-0.73	-0.69	-0.66	0.00
5	**0.84**	0.00	-0.69	-0.87	-0.84	-0.82	-0.67	0.00
4	**0.65**	0.00	-0.83	-0.84	-0.76	-0.76	-0.39	0.00
3	**0.46**	0.00	-0.85	-0.71	-0.68	-0.57	0.21	0.00
2	**0.27**	0.00	-0.76	-0.67	-0.56	-0.29	0.26	0.00
1	**0.08**	0.00	-0.79	-0.72	-0.50	0.37	0.43	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.77	1.83	1.79	1.75	1.75	0.00
11	**2.01**	0.00	1.55	1.35	1.28	1.25	1.31	0.00
10	**1.82**	0.00	1.08	1.06	0.97	1.02	1.04	0.00
9	**1.63**	0.00	0.72	0.60	0.59	0.62	0.56	0.00
8	**1.44**	0.00	0.39	-0.21	-0.25	-0.13	-0.31	0.00
7	**1.24**	0.00	0.14	-0.52	-0.53	-0.47	-0.48	0.00
6	**1.03**	0.00	-0.34	-0.65	-0.64	-0.60	-0.58	0.00
5	**0.84**	0.00	-0.61	-0.75	-0.74	-0.72	-0.58	0.00
4	**0.65**	0.00	-0.72	-0.73	-0.66	-0.67	-0.34	0.00
3	**0.46**	0.00	-0.74	-0.61	-0.59	-0.50	0.19	0.00
2	**0.27**	0.00	-0.66	-0.58	-0.48	-0.25	0.23	0.00
1	**0.08**	0.00	-0.68	-0.63	-0.44	0.32	0.38	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		367	370	368	366	366	
11	**2.01**		370	373	370	367	367	
10	**1.82**		347	368	357	362	362	
9	**1.63**		336	334	332	334	334	
8	**1.44**		317	312	310	309	309	
7	**1.24**		311	306	305	305	305	
6	**1.03**		306	304	303	304	304	
5	**0.84**		305	303	303	303	303	
4	**0.65**		304	303	304	304	304	
3	**0.46**		303	303	303	304	304	
2	**0.27**		302	302	303	304	304	
1	**0.08**		302	303	303	304	304	
Bottom	**0.00**							

TEST ID:	0806-A	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.95	0.94	0.95	0.95	0.95	
11	**2.01**		0.94	0.94	0.94	0.95	0.95	
10	**1.82**		1.00	0.95	0.98	0.97	0.96	
9	**1.63**		1.04	1.04	1.05	1.04	1.04	
8	**1.44**		1.10	1.12	1.13	1.12	1.13	
7	**1.24**		1.12	1.14	1.14	1.14	1.14	
6	**1.03**		1.14	1.15	1.15	1.15	1.15	
5	**0.84**		1.14	1.15	1.15	1.15	1.15	
4	**0.65**		1.15	1.15	1.15	1.15	1.15	
3	**0.46**		1.15	1.15	1.15	1.15	1.15	
2	**0.27**		1.15	1.15	1.15	1.15	1.15	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.747	kg/s
Experimental M-in:	-0.723	kg/s
Balance	0.024	kg/s
Neutral Plane:	1.333	m
Tg:	362	K
Exit Tg:	353	K
Ambient T:	302	K
Predicted Ideal M-out:	1.135	kg/s
Associated C:	0.658	
Avg. Propane Flow:	56	Lpm

TEST ID:	0806-A	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.55	1.56	1.57	1.56	1.57	0.00
11	**2.01**	0.00	1.42	1.16	1.12	1.14	1.19	0.00
10	**1.82**	0.00	1.12	0.94	0.93	0.94	0.94	0.00
9	**1.63**	0.00	0.77	0.63	0.65	0.64	0.62	0.00
8	**1.44**	0.00	0.25	-0.18	-0.28	0.05	-0.26	0.00
7	**1.24**	0.00	-0.37	-0.50	-0.62	-0.57	-0.61	0.00
6	**1.03**	0.00	-0.57	-0.63	-0.73	-0.72	-0.60	0.00
5	**0.84**	0.00	-0.79	-0.81	-0.85	-0.85	-0.50	0.00
4	**0.65**	0.00	-0.77	-0.76	-0.75	-0.68	0.20	0.00
3	**0.46**	0.00	-0.72	-0.70	-0.60	-0.36	0.36	0.00
2	**0.27**	0.00	-0.70	-0.66	-0.49	0.15	0.35	0.00
1	**0.08**	0.00	-0.73	-0.63	-0.49	0.39	0.39	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.58	1.60421	1.61	1.6085	1.60207	0.00
11	**2.01**	0.00	1.45	1.19764	1.15	1.1497	1.17192	0.00
10	**1.82**	0.00	1.12	0.94599	0.93	0.9289	0.94834	0.00
9	**1.63**	0.00	0.74	0.60316	0.62	0.6243	0.609	0.00
8	**1.44**	0.00	0.22	-0.1601	-0.25	-0.249	0.04692	0.00
7	**1.24**	0.00	-0.33	-0.4403	-0.54	-0.542	-0.50127	0.00
6	**1.03**	0.00	-0.50	-0.5489	-0.63	-0.633	-0.62339	0.00
5	**0.84**	0.00	-0.69	-0.7055	-0.74	-0.743	-0.74125	0.00
4	**0.65**	0.00	-0.67	-0.6628	-0.65	-0.651	-0.59081	0.00
3	**0.46**	0.00	-0.63	-0.611	-0.52	-0.519	-0.31086	0.00
2	**0.27**	0.00	-0.61	-0.5732	-0.42	-0.423	0.12623	0.00
1	**0.08**	0.00	-0.63	-0.5469	-0.43	-0.426	0.3433	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		355	359.252	358	357.9	358	
11	**2.01**		356	358.329	356	357.28	357	
10	**1.82**		347	350.109	349	351.09	352	
9	**1.63**		333	333.766	335	333.98	335	
8	**1.44**		312	310.418	309	313.32	313	
7	**1.24**		307	306.024	304	305.41	307	
6	**1.03**		304	304.333	303	303.67	305	
5	**0.84**		303	303.571	303	303.86	305	
4	**0.65**		303	303.364	304	304.31	305	
3	**0.46**		302	302.941	303	303.57	305	
2	**0.27**		302	302.541	302	303.2	305	
1	**0.08**		302	302.094	302	303.56	304	
Bottom	**0.00**							

TEST ID:	0806-A	HRR:	75 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.98	0.97	0.97	0.97	0.97	
11	**2.01**		0.98	0.97	0.98	0.98	0.98	
10	**1.82**		1.00	1.00	1.00	0.99	0.99	
9	**1.63**		1.04	1.04	1.04	1.04	1.04	
8	**1.44**		1.12	1.12	1.13	1.11	1.11	
7	**1.24**		1.14	1.14	1.15	1.14	1.14	
6	**1.03**		1.15	1.14	1.15	1.15	1.14	
5	**0.84**		1.15	1.15	1.15	1.15	1.14	
4	**0.65**		1.15	1.15	1.15	1.14	1.14	
3	**0.46**		1.15	1.15	1.15	1.15	1.14	
2	**0.27**		1.15	1.15	1.15	1.15	1.14	
1	**0.08**		1.16	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.729	kg/s
Experimental M-in:	-0.666	kg/s
Balance	0.063	kg/s
Neutral Plane:	1.406	m
Tg:	352.2	K
Exit Tg:	339.3	K
Ambient T:	303.0	K
Predicted Ideal M-out:	0.932	kg/s
Associated C:	0.782	
Average Propane Flow:	56	Lpm
Cooling Coefficient:	0.975	

TEST ID:	0806-B	HRR:	75 kW	SIN:	AM29	Flow: 6.2	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.64	1.67	1.65	1.62	1.62	0.00
11	**2.01**	0.00	1.42	1.21	1.16	1.18	1.23	0.00
10	**1.82**	0.00	1.05	0.94	0.92	1.00	0.98	0.00
9	**1.63**	0.00	0.70	0.55	0.56	0.55	0.38	0.00
8	**1.44**	0.00	0.36	-0.20	-0.31	-0.35	-0.39	0.00
7	**1.24**	0.00	0.28	-0.42	-0.58	-0.54	-0.47	0.00
6	**1.03**	0.00	0.25	-0.58	-0.64	-0.59	-0.55	0.00
5	**0.84**	0.00	0.06	-0.74	-0.74	-0.68	-0.65	0.00
4	**0.65**	0.00	-0.24	-0.81	-0.80	-0.69	-0.64	0.00
3	**0.46**	0.00	-0.82	-0.85	-0.82	-0.73	-0.72	0.00
2	**0.27**	0.00	-0.84	-0.81	-0.67	-0.66	-0.08	0.00
1	**0.08**	0.00	-0.88	-0.79	-0.52	-0.42	0.20	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.74	1.77	1.76	1.72	1.71	0.00
11	**2.01**	0.00	1.50	1.30	1.23	1.25	1.30	0.00
10	**1.82**	0.00	1.03	0.99	0.95	1.04	1.03	0.00
9	**1.63**	0.00	0.68	0.53	0.53	0.53	0.35	0.00
8	**1.44**	0.00	0.32	-0.18	-0.28	-0.31	-0.34	0.00
7	**1.24**	0.00	0.25	-0.38	-0.51	-0.47	-0.42	0.00
6	**1.03**	0.00	0.22	-0.51	-0.56	-0.52	-0.48	0.00
5	**0.84**	0.00	0.05	-0.65	-0.65	-0.59	-0.57	0.00
4	**0.65**	0.00	-0.21	-0.71	-0.70	-0.60	-0.56	0.00
3	**0.46**	0.00	-0.72	-0.74	-0.72	-0.64	-0.63	0.00
2	**0.27**	0.00	-0.74	-0.71	-0.58	-0.57	-0.07	0.00
1	**0.08**	0.00	-0.76	-0.69	-0.46	-0.36	0.17	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		369	371	370	368	368	
11	**2.01**		369	373	371	368	368	
10	**1.82**		345	368	359	364	364	
9	**1.63**		336	332	333	326	326	
8	**1.44**		317	313	312	309	309	
7	**1.24**		313	309	306	305	305	
6	**1.03**		310	306	305	304	304	
5	**0.84**		310	305	304	304	304	
4	**0.65**		308	304	304	305	305	
3	**0.46**		306	304	304	304	304	
2	**0.27**		304	304	304	304	304	
1	**0.08**		303	303	303	303	303	
Bottom	**0.00**							

TEST ID:	0806-B	HRR:	75 kW	SIN:	AM29	Flow: 6.2	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.94	0.94	0.94	0.94	0.95	
11	**2.01**		0.94	0.93	0.94	0.94	0.95	
10	**1.82**		1.01	0.95	0.97	0.97	0.96	
9	**1.63**		1.04	1.05	1.05	1.05	1.07	
8	**1.44**		1.10	1.11	1.12	1.12	1.13	
7	**1.24**		1.11	1.13	1.14	1.14	1.14	
6	**1.03**		1.12	1.14	1.14	1.14	1.15	
5	**0.84**		1.13	1.14	1.15	1.15	1.14	
4	**0.65**		1.13	1.14	1.15	1.14	1.14	
3	**0.46**		1.14	1.15	1.15	1.15	1.15	
2	**0.27**		1.15	1.15	1.15	1.15	1.15	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.699	kg/s
Experimental M-in:	-0.733	kg/s
Balance	-0.034	kg/s
Neutral Plane:	1.406	m
Tg:	364	K
Exit Tg:	354	K
Ambient T:	304	K
Predicted Ideal M-out:	0.996	kg/s
Associated C:	0.702	
Avg. Propane Flow:	54	Lpm

TEST ID:	0806-B	HRR:	75 kW	SIN:	AM29	Flow: 6.2	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.38	1.38	1.34	1.32	1.35	0.00
11	**2.01**	0.00	1.15	1.05	1.02	1.02	1.05	0.00
10	**1.82**	0.00	0.71	0.94	0.87	0.87	0.88	0.00
9	**1.63**	0.00	0.13	0.80	0.74	0.73	0.72	0.00
8	**1.44**	0.00	0.19	0.54	0.45	0.47	0.56	0.00
7	**1.24**	0.00	0.36	-0.25	-0.31	0.10	0.32	0.00
6	**1.03**	0.00	0.32	-0.57	-0.56	-0.44	-0.41	0.00
5	**0.84**	0.00	0.13	-0.80	-0.72	-0.69	-0.70	0.00
4	**0.65**	0.00	0.14	-0.87	-0.76	-0.74	-0.74	0.00
3	**0.46**	0.00	-0.87	-0.87	-0.80	-0.79	-0.39	0.00
2	**0.27**	0.00	-0.95	-0.91	-0.83	-0.71	-0.20	0.00
1	**0.08**	0.00	-0.97	-0.75	-0.72	-0.47	0.04	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.34	1.35226	1.31	1.3116	1.28584	0.00
11	**2.01**	0.00	1.11	1.01907	0.97	0.9683	0.97286	0.00
10	**1.82**	0.00	0.65	0.88597	0.82	0.8156	0.81399	0.00
9	**1.63**	0.00	0.12	0.74363	0.69	0.6915	0.67918	0.00
8	**1.44**	0.00	0.17	0.49671	0.40	0.4035	0.4274	0.00
7	**1.24**	0.00	0.32	-0.2194	-0.28	-0.275	0.08706	0.00
6	**1.03**	0.00	0.29	-0.5044	-0.49	-0.491	-0.38826	0.00
5	**0.84**	0.00	0.11	-0.7019	-0.63	-0.627	-0.59901	0.00
4	**0.65**	0.00	0.13	-0.7599	-0.66	-0.665	-0.64743	0.00
3	**0.46**	0.00	-0.76	-0.7535	-0.70	-0.699	-0.69224	0.00
2	**0.27**	0.00	-0.83	-0.7893	-0.73	-0.727	-0.61705	0.00
1	**0.08**	0.00	-0.84	-0.6552	-0.63	-0.628	-0.41261	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		340	340.573	341	339.9	340	
11	**2.01**		335	339.171	332	332.36	333	
10	**1.82**		319	328.41	327	326.35	324	
9	**1.63**		316	324.394	324	323.21	322	
8	**1.44**		314	318.335	316	315.9	319	
7	**1.24**		313	311.455	308	309.89	316	
6	**1.03**		312	305.711	305	305.07	307	
5	**0.84**		309	304.329	304	304.34	305	
4	**0.65**		309	303.711	304	304.5	305	
3	**0.46**		306	303.313	304	304.14	304	
2	**0.27**		304	303.401	304	303.7	304	
1	**0.08**		303	302.661	303	302.81	303	
Bottom	**0.00**							

TEST ID:	0806-B	HRR:	75 kW	SIN:	AM29	Flow: 6.2	gpm	WET

Density, kg/m3

Probe No.	**Width / Height**	wall **0.00**	pos. 4 **0.10**	pos. 4a **0.30**	pos. 5 **0.52**	pos. 5a **0.74**	pos. 6 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.03	1.02	1.02	1.03	1.02	
11	**2.01**		1.04	1.03	1.05	1.05	1.05	
10	**1.82**		1.09	1.06	1.07	1.07	1.07	
9	**1.63**		1.10	1.07	1.08	1.08	1.08	
8	**1.44**		1.11	1.09	1.10	1.10	1.09	
7	**1.24**		1.11	1.12	1.13	1.12	1.10	
6	**1.03**		1.12	1.14	1.14	1.14	1.14	
5	**0.84**		1.13	1.14	1.15	1.14	1.14	
4	**0.65**		1.13	1.15	1.15	1.14	1.14	
3	**0.46**		1.14	1.15	1.15	1.15	1.15	
2	**0.27**		1.15	1.15	1.15	1.15	1.15	
1	**0.08**		1.15	1.15	1.15	1.15	1.15	
Bottom	**0.00**							

Experimental M-out:	0.724	kg/s
Experimental M-in:	-0.645	kg/s
Balance	0.079	kg/s
Neutral Plane:	1.195	m
Tg:	336.9	K
Exit Tg:	325.5	K
Ambient T:	304.3	K
Predicted Ideal M-out:	1.111	kg/s
Associated C:	0.651	
Average Propane Flow:	55	Lpm
Cooling Coefficient:	1.035	

TEST ID:	0806-C	HRR:	150 kW	SIN:	AM29	Flow: 6.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.97	1.99	1.99	1.94	1.96	0.00
11	**2.01**	0.00	1.72	1.49	1.41	1.43	1.49	0.00
10	**1.82**	0.00	1.31	1.15	1.14	1.20	1.21	0.00
9	**1.63**	0.00	0.80	0.75	0.76	0.76	0.75	0.00
8	**1.44**	0.00	0.42	0.27	0.25	0.25	0.17	0.00
7	**1.24**	0.00	-0.33	-0.50	-0.56	-0.59	-0.61	0.00
6	**1.03**	0.00	-0.59	-0.69	-0.72	-0.78	-0.82	0.00
5	**0.84**	0.00	-0.91	-0.92	-0.92	-0.97	-0.98	0.00
4	**0.65**	0.00	-0.95	-0.94	-0.95	-0.91	-0.61	0.00
3	**0.46**	0.00	-0.96	-0.95	-0.88	-0.77	-0.20	0.00
2	**0.27**	0.00	-0.92	-0.83	-0.74	-0.61	0.23	0.00
1	**0.08**	0.00	-0.80	-0.74	-0.65	-0.24	0.35	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.36	2.42	2.40	2.34	2.34	0.00
11	**2.01**	0.00	2.08	1.82	1.71	1.71	1.78	0.00
10	**1.82**	0.00	1.42	1.37	1.30	1.39	1.42	0.00
9	**1.63**	0.00	0.80	0.75	0.77	0.77	0.75	0.00
8	**1.44**	0.00	0.40	0.25	0.23	0.23	0.16	0.00
7	**1.24**	0.00	-0.30	-0.45	-0.50	-0.53	-0.55	0.00
6	**1.03**	0.00	-0.52	-0.61	-0.64	-0.69	-0.73	0.00
5	**0.84**	0.00	-0.81	-0.81	-0.81	-0.85	-0.86	0.00
4	**0.65**	0.00	-0.84	-0.83	-0.84	-0.80	-0.54	0.00
3	**0.46**	0.00	-0.85	-0.83	-0.78	-0.68	-0.18	0.00
2	**0.27**	0.00	-0.80	-0.73	-0.65	-0.53	0.20	0.00
1	**0.08**	0.00	-0.70	-0.65	-0.57	-0.21	0.31	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		418	424	421	417	417	
11	**2.01**		421	426	423	416	416	
10	**1.82**		379	413	398	407	407	
9	**1.63**		349	348	350	348	348	
8	**1.44**		326	324	322	323	323	
7	**1.24**		317	314	313	312	312	
6	**1.03**		311	310	309	308	308	
5	**0.84**		309	309	308	307	307	
4	**0.65**		308	308	308	309	309	
3	**0.46**		307	306	307	307	307	
2	**0.27**		306	306	306	308	308	
1	**0.08**		305	306	306	307	307	
Bottom	**0.00**							

TEST ID:	0806-C	HRR:	150 kW	SIN:	AM29	Flow: 6.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.83	0.82	0.83	0.84	0.84	
11	**2.01**		0.83	0.82	0.82	0.83	0.84	
10	**1.82**		0.92	0.84	0.88	0.87	0.86	
9	**1.63**		1.00	1.00	0.99	0.99	1.00	
8	**1.44**		1.07	1.08	1.08	1.07	1.08	
7	**1.24**		1.10	1.11	1.11	1.12	1.12	
6	**1.03**		1.12	1.12	1.13	1.13	1.13	
5	**0.84**		1.13	1.13	1.13	1.13	1.13	
4	**0.65**		1.13	1.13	1.13	1.13	1.13	
3	**0.46**		1.14	1.14	1.13	1.13	1.13	
2	**0.27**		1.14	1.14	1.14	1.14	1.13	
1	**0.08**		1.14	1.14	1.14	1.14	1.13	
Bottom	**0.00**							

Experimental M-out:	0.901	kg/s
Experimental M-in:	-0.847	kg/s
Balance	0.054	kg/s
Neutral Plane:	1.337	m
Tg:	383	K
Exit Tg:	383	K
Ambient T:	308	K
Predicted Ideal M-out:	1.185	kg/s
Associated C:	0.760	
Avg. Propane Flow:	111	Lpm

TEST ID: 0806-C	HRR: 150 kW	SIN: AM29	Flow: 6.8 gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.81	1.80	1.79	1.75	1.72	0.00
11	**2.01**	0.00	1.56	1.36	1.34	1.34	1.39	0.00
10	**1.82**	0.00	1.15	1.20	1.16	1.12	1.15	0.00
9	**1.63**	0.00	0.52	1.02	0.99	0.96	0.92	0.00
8	**1.44**	0.00	0.25	0.56	0.63	0.66	0.67	0.00
7	**1.24**	0.00	-0.40	-0.46	-0.33	-0.26	-0.32	0.00
6	**1.03**	0.00	-0.61	-0.69	-0.63	-0.66	-0.76	0.00
5	**0.84**	0.00	-0.94	-0.97	-0.85	-0.95	-1.07	0.00
4	**0.65**	0.00	-0.99	-1.02	-0.87	-0.97	-1.05	0.00
3	**0.46**	0.00	-0.98	-0.97	-0.89	-0.92	-0.44	0.00
2	**0.27**	0.00	-0.92	-0.86	-0.94	-0.76	-0.16	0.00
1	**0.08**	0.00	-0.88	-0.71	-0.79	-0.48	0.39	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.95	1.94469	1.94	1.9353	1.88452	0.00
11	**2.01**	0.00	1.65	1.44826	1.39	1.3945	1.40771	0.00
10	**1.82**	0.00	1.11	1.19614	1.15	1.1509	1.11524	0.00
9	**1.63**	0.00	0.48	1.00322	0.96	0.9626	0.93227	0.00
8	**1.44**	0.00	0.22	0.5193	0.59	0.5899	0.62074	0.00
7	**1.24**	0.00	-0.36	-0.4102	-0.30	-0.303	-0.23986	0.00
6	**1.03**	0.00	-0.54	-0.6066	-0.56	-0.562	-0.5887	0.00
5	**0.84**	0.00	-0.83	-0.8574	-0.75	-0.749	-0.83509	0.00
4	**0.65**	0.00	-0.87	-0.897	-0.77	-0.773	-0.86068	0.00
3	**0.46**	0.00	-0.86	-0.8557	-0.78	-0.78	-0.811	0.00
2	**0.27**	0.00	-0.81	-0.7545	-0.82	-0.823	-0.67088	0.00
1	**0.08**	0.00	-0.77	-0.621	-0.69	-0.692	-0.42523	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		375	376.163	376	375.48	374	
11	**2.01**		369	370.801	362	364.77	364	
10	**1.82**		336	346.819	346	346.09	345	
9	**1.63**		325	341.564	340	339.13	337	
8	**1.44**		318	324.315	327	328.51	331	
7	**1.24**		313	312.291	315	316.82	316	
6	**1.03**		309	308.434	310	309.18	308	
5	**0.84**		308	307.5	309	307.81	307	
4	**0.65**		307	307.184	308	307.6	308	
3	**0.46**		306	306.322	307	306.51	307	
2	**0.27**		305	306.356	306	305.82	307	
1	**0.08**		304	305.32	305	305.48	307	
Bottom	**0.00**							

TEST ID:	0806-C	HRR:	150 kW	SIN:	AM29	Flow: 6.8	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.93	0.93	0.93	0.93	0.93	
11	**2.01**		0.94	0.94	0.96	0.96	0.96	
10	**1.82**		1.04	1.00	1.01	1.01	1.01	
9	**1.63**		1.07	1.02	1.02	1.03	1.03	
8	**1.44**		1.09	1.07	1.07	1.06	1.05	
7	**1.24**		1.11	1.12	1.10	1.10	1.10	
6	**1.03**		1.13	1.13	1.13	1.13	1.13	
5	**0.84**		1.13	1.13	1.13	1.13	1.13	
4	**0.65**		1.14	1.13	1.13	1.13	1.13	
3	**0.46**		1.14	1.14	1.14	1.14	1.13	
2	**0.27**		1.14	1.14	1.14	1.14	1.14	
1	**0.08**		1.14	1.14	1.14	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.922	kg/s
Experimental M-in:	-0.870	kg/s
Balance	0.052	kg/s
Neutral Plane:	1.310	m
Tg:	349.6	K
Exit Tg:	349.6	K
Ambient T:	307.9	K
Predicted Ideal M-out:	1.011	kg/s
Associated C:	0.912	
Average Propane Flow:	111	Lpm
Cooling Coefficient:	1.024	

TEST ID:	0812-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.97	2.00	1.98	1.94	1.93	0.00
11	**2.01**	0.00	1.72	1.47	1.41	1.43	1.45	0.00
10	**1.82**	0.00	1.38	1.15	1.14	1.19	1.16	0.00
9	**1.63**	0.00	0.98	0.76	0.73	0.70	0.60	0.00
8	**1.44**	0.00	0.53	0.26	0.12	0.11	-0.36	0.00
7	**1.24**	0.00	0.24	-0.39	-0.53	-0.53	-0.67	0.00
6	**1.03**	0.00	-0.19	-0.62	-0.67	-0.66	-0.82	0.00
5	**0.84**	0.00	-0.52	-0.83	-0.78	-0.85	-0.96	0.00
4	**0.65**	0.00	-0.60	-0.81	-0.83	-0.94	-0.74	0.00
3	**0.46**	0.00	-0.82	-0.81	-0.88	-0.88	-0.36	0.00
2	**0.27**	0.00	-0.93	-0.86	-0.79	-0.71	-0.03	0.00
1	**0.08**	0.00	-0.89	-0.86	-0.82	-0.50	0.35	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.32	2.39	2.33	2.29	2.27	0.00
11	**2.01**	0.00	2.06	1.77	1.68	1.68	1.70	0.00
10	**1.82**	0.00	1.49	1.35	1.28	1.36	1.34	0.00
9	**1.63**	0.00	0.99	0.76	0.72	0.68	0.58	0.00
8	**1.44**	0.00	0.49	0.24	0.11	0.10	-0.32	0.00
7	**1.24**	0.00	0.22	-0.35	-0.48	-0.47	-0.59	0.00
6	**1.03**	0.00	-0.17	-0.55	-0.59	-0.58	-0.71	0.00
5	**0.84**	0.00	-0.47	-0.73	-0.68	-0.75	-0.84	0.00
4	**0.65**	0.00	-0.54	-0.72	-0.73	-0.82	-0.65	0.00
3	**0.46**	0.00	-0.72	-0.71	-0.77	-0.77	-0.32	0.00
2	**0.27**	0.00	-0.82	-0.75	-0.69	-0.62	-0.03	0.00
1	**0.08**	0.00	-0.78	-0.75	-0.71	-0.44	0.31	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		411	415	411	410	410	
11	**2.01**		417	419	415	410	410	
10	**1.82**		376	411	393	401	401	
9	**1.63**		354	347	344	338	338	
8	**1.44**		324	321	319	313	313	
7	**1.24**		317	313	310	307	307	
6	**1.03**		313	309	307	305	305	
5	**0.84**		312	308	307	305	305	
4	**0.65**		310	307	307	306	306	
3	**0.46**		306	305	305	305	305	
2	**0.27**		305	304	304	305	305	
1	**0.08**		304	304	304	305	305	
Bottom	**0.00**							

TEST ID:	0812-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.85	0.84	0.85	0.85	0.85	
11	**2.01**		0.84	0.83	0.84	0.85	0.85	
10	**1.82**		0.93	0.85	0.89	0.88	0.87	
9	**1.63**		0.98	1.00	1.01	1.02	1.03	
8	**1.44**		1.08	1.09	1.09	1.09	1.11	
7	**1.24**		1.10	1.11	1.12	1.13	1.13	
6	**1.03**		1.11	1.13	1.13	1.14	1.14	
5	**0.84**		1.12	1.13	1.14	1.14	1.14	
4	**0.65**		1.13	1.13	1.14	1.14	1.14	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.14	1.14	1.15	1.15	1.14	
1	**0.08**		1.15	1.15	1.15	1.15	1.14	
Bottom	**0.00**							

Experimental M-out:	0.887	kg/s
Experimental M-in:	-0.807	kg/s
Balance	0.079	kg/s
Neutral Plane:	1.248	m
Tg:	405	K
Exit Tg:	377	K
Ambient T:	304	K
Predicted Ideal M-out:	1.501	kg/s
Associated C:	0.591	
Avg. Propane Flow:	108	Lpm

TEST ID:	0812-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	1.90	1.89	1.87	1.91	1.92	0.00
11	**2.01**	0.00	1.63	1.41	1.34	1.36	1.45	0.00
10	**1.82**	0.00	1.30	1.16	1.14	1.18	1.21	0.00
9	**1.63**	0.00	0.89	0.77	0.73	0.77	0.78	0.00
8	**1.44**	0.00	0.45	0.28	0.08	0.10	-0.21	0.00
7	**1.24**	0.00	-0.11	-0.44	-0.52	-0.51	-0.61	0.00
6	**1.03**	0.00	-0.38	-0.59	-0.61	-0.62	-0.77	0.00
5	**0.84**	0.00	-0.71	-0.83	-0.86	-0.89	-1.06	0.00
4	**0.65**	0.00	-0.64	-0.70	-0.75	-0.85	-0.85	0.00
3	**0.46**	0.00	-0.70	-0.70	-0.75	-0.86	-0.52	0.00
2	**0.27**	0.00	-0.82	-0.81	-0.84	-0.85	-0.40	0.00
1	**0.08**	0.00	-0.83	-0.86	-0.80	-0.66	0.22	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	2.17	2.16041	2.14	2.1445	2.1831	0.00
11	**2.01**	0.00	1.85	1.59771	1.51	1.5115	1.54633	0.00
10	**1.82**	0.00	1.35	1.28104	1.23	1.2328	1.28508	0.00
9	**1.63**	0.00	0.87	0.75109	0.73	0.7258	0.77412	0.00
8	**1.44**	0.00	0.41	0.25399	0.07	0.0697	0.08973	0.00
7	**1.24**	0.00	-0.10	-0.3927	-0.46	-0.459	-0.45664	0.00
6	**1.03**	0.00	-0.34	-0.5182	-0.54	-0.543	-0.55094	0.00
5	**0.84**	0.00	-0.63	-0.7302	-0.76	-0.762	-0.78126	0.00
4	**0.65**	0.00	-0.56	-0.6148	-0.66	-0.664	-0.7502	0.00
3	**0.46**	0.00	-0.62	-0.6116	-0.65	-0.655	-0.75201	0.00
2	**0.27**	0.00	-0.72	-0.7076	-0.73	-0.734	-0.73914	0.00
1	**0.08**	0.00	-0.72	-0.7479	-0.70	-0.697	-0.5767	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		397	399.033	399	399.22	399	
11	**2.01**		397	393.991	393	395.06	397	
10	**1.82**		361	383.755	378	380.7	386	
9	**1.63**		343	341.967	344	348.1	347	
8	**1.44**		319	317.791	316	316.33	314	
7	**1.24**		314	310.863	309	309.15	308	
6	**1.03**		311	308.42	308	307.37	306	
5	**0.84**		309	307.781	307	306.83	306	
4	**0.65**		308	307.343	307	306.6	307	
3	**0.46**		306	305.506	305	305.02	306	
2	**0.27**		305	304.772	305	304.23	305	
1	**0.08**		304	304.514	304	304.32	305	
Bottom	**0.00**							

TEST ID:	0812-A	HRR:	150 kW	SIN:	TY-1234	Flow: 7.9	gpm	WET

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 4 0.10	pos. 4a 0.30	pos. 5 0.52	pos. 5a 0.74	pos. 6 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		0.88	0.87	0.87	0.87	0.87	
11	**2.01**		0.88	0.88	0.89	0.88	0.88	
10	**1.82**		0.97	0.91	0.92	0.92	0.90	
9	**1.63**		1.02	1.02	1.01	1.00	1.00	
8	**1.44**		1.09	1.10	1.10	1.10	1.11	
7	**1.24**		1.11	1.12	1.13	1.13	1.13	
6	**1.03**		1.12	1.13	1.13	1.13	1.14	
5	**0.84**		1.13	1.13	1.13	1.14	1.14	
4	**0.65**		1.13	1.13	1.13	1.14	1.14	
3	**0.46**		1.14	1.14	1.14	1.14	1.14	
2	**0.27**		1.14	1.14	1.14	1.15	1.14	
1	**0.08**		1.15	1.14	1.14	1.14	1.14	
Bottom	**0.00**							

Experimental M-out:	0.863	kg/s
Experimental M-in:	-0.821	kg/s
Balance	0.042	kg/s
Neutral Plane:	1.342	m
Tg:	386.8	K
Exit Tg:	362.6	
Ambient T:	305.4	K
Predicted Ideal M-out:	1.215	kg/s
Associated C:	0.710	
Average Propane Flow:	106	Lpm
Cooling Coefficient:	0.973	

TEST ID:	0806-D	HRR:	n/a	kW	SIN:	TY-3251	Flow:	14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.41	-0.41	-0.42	-0.44	-0.44	0.00
11	**2.01**	0.00	-0.38	-0.40	-0.37	-0.39	-0.37	0.00
10	**1.82**	0.00	-0.30	-0.31	-0.28	-0.31	-0.28	0.00
9	**1.63**	0.00	-0.25	-0.26	-0.23	-0.25	-0.23	0.00
8	**1.44**	0.00	-0.19	-0.20	-0.18	-0.17	-0.18	0.00
7	**1.24**	0.00	0.14	0.17	0.11	0.16	0.14	0.00
6	**1.03**	0.00	0.17	0.23	0.17	0.18	0.17	0.00
5	**0.84**	0.00	0.29	0.33	0.28	0.26	0.24	0.00
4	**0.65**	0.00	0.22	0.33	0.26	0.27	0.26	0.00
3	**0.46**	0.00	0.19	0.33	0.27	0.27	0.25	0.00
2	**0.27**	0.00	0.17	0.37	0.31	0.28	0.27	0.00
1	**0.08**	0.00	0.21	0.37	0.32	0.30	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.36	-0.36	-0.37	-0.38	-0.39	0.00
11	**2.01**	0.00	-0.33	-0.35	-0.32	-0.34	-0.33	0.00
10	**1.82**	0.00	-0.26	-0.27	-0.25	-0.27	-0.24	0.00
9	**1.63**	0.00	-0.21	-0.23	-0.20	-0.22	-0.20	0.00
8	**1.44**	0.00	-0.16	-0.17	-0.16	-0.15	-0.16	0.00
7	**1.24**	0.00	0.12	0.15	0.10	0.14	0.12	0.00
6	**1.03**	0.00	0.15	0.20	0.15	0.16	0.15	0.00
5	**0.84**	0.00	0.25	0.29	0.24	0.23	0.21	0.00
4	**0.65**	0.00	0.19	0.29	0.23	0.23	0.22	0.00
3	**0.46**	0.00	0.16	0.29	0.24	0.23	0.22	0.00
2	**0.27**	0.00	0.15	0.32	0.27	0.24	0.23	0.00
1	**0.08**	0.00	0.19	0.32	0.28	0.25	0.24	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		305	306	306	306	306	
11	**2.01**		304	304	304	305	305	
10	**1.82**		304	304	304	305	305	
9	**1.63**		304	304	304	304	304	
8	**1.44**		303	303	303	304	304	
7	**1.24**		303	302	303	303	303	
6	**1.03**		302	301	302	303	303	
5	**0.84**		302	301	301	302	302	
4	**0.65**		302	301	301	302	302	
3	**0.46**		301	301	301	301	301	
2	**0.27**		301	301	301	302	302	
1	**0.08**		301	301	301	301	301	
Bottom	**0.00**							

TEST ID:	0806-D	HRR: n/a kW	SIN:	TY-3251	Flow: 14.8 gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.14	1.14	1.14	1.14	1.14	
11	**2.01**		1.15	1.15	1.14	1.14	1.14	
10	**1.82**		1.15	1.15	1.15	1.14	1.14	
9	**1.63**		1.15	1.15	1.15	1.14	1.14	
8	**1.44**		1.15	1.15	1.15	1.15	1.15	
7	**1.24**		1.15	1.15	1.15	1.15	1.15	
6	**1.03**		1.15	1.16	1.15	1.15	1.15	
5	**0.84**		1.15	1.16	1.16	1.16	1.15	
4	**0.65**		1.16	1.16	1.16	1.16	1.16	
3	**0.46**		1.16	1.16	1.16	1.16	1.16	
2	**0.27**		1.16	1.16	1.16	1.16	1.16	
1	**0.08**		1.16	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.134	kg/s
Experimental M-in:	-0.148	kg/s
Balance	-0.015	kg/s
Neutral Plane:	1.750	m
Tg:	n/a	K
Ambient T:	304	K
Predicted Ideal M-out:	n/a	kg/s
Associated C:	n/a	
Avg. Propane Flow:	0	Lpm

TEST ID:	0806-E	HRR: n/a	kW	SIN:	TY-2234	Flow: 13	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.48	-0.49	-0.48	-0.47	-0.43	0.00
11	**2.01**	0.00	-0.49	-0.44	-0.42	-0.41	-0.35	0.00
10	**1.82**	0.00	-0.43	-0.36	-0.34	-0.33	-0.28	0.00
9	**1.63**	0.00	-0.35	-0.29	-0.28	-0.28	-0.23	0.00
8	**1.44**	0.00	-0.26	-0.25	-0.24	-0.22	-0.18	0.00
7	**1.24**	0.00	0.16	-0.03	-0.06	-0.09	0.05	0.00
6	**1.03**	0.00	0.28	0.17	0.17	0.13	0.14	0.00
5	**0.84**	0.00	0.38	0.26	0.24	0.21	0.18	0.00
4	**0.65**	0.00	0.43	0.32	0.28	0.26	0.21	0.00
3	**0.46**	0.00	0.45	0.35	0.33	0.32	0.24	0.00
2	**0.27**	0.00	0.46	0.41	0.40	0.34	0.28	0.00
1	**0.08**	0.00	0.44	0.46	0.42	0.38	0.27	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.42	-0.43	-0.42	-0.41	-0.38	0.00
11	**2.01**	0.00	-0.43	-0.39	-0.36	-0.36	-0.31	0.00
10	**1.82**	0.00	-0.38	-0.31	-0.30	-0.29	-0.25	0.00
9	**1.63**	0.00	-0.30	-0.25	-0.24	-0.25	-0.20	0.00
8	**1.44**	0.00	-0.22	-0.22	-0.21	-0.19	-0.15	0.00
7	**1.24**	0.00	0.14	-0.02	-0.05	-0.08	0.04	0.00
6	**1.03**	0.00	0.24	0.14	0.14	0.11	0.12	0.00
5	**0.84**	0.00	0.33	0.22	0.21	0.19	0.16	0.00
4	**0.65**	0.00	0.37	0.27	0.25	0.23	0.18	0.00
3	**0.46**	0.00	0.39	0.31	0.29	0.28	0.20	0.00
2	**0.27**	0.00	0.40	0.35	0.34	0.30	0.24	0.00
1	**0.08**	0.00	0.38	0.40	0.36	0.33	0.24	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		307	307	307	307	307	
11	**2.01**		305	305	305	306	306	
10	**1.82**		305	305	305	305	305	
9	**1.63**		305	305	305	305	305	
8	**1.44**		304	304	304	304	304	
7	**1.24**		302	303	303	304	304	
6	**1.03**		302	302	302	303	303	
5	**0.84**		302	302	302	303	303	
4	**0.65**		301	301	302	302	302	
3	**0.46**		301	301	301	302	302	
2	**0.27**		301	301	301	302	302	
1	**0.08**		301	301	301	301	301	
Bottom	**0.00**							

TEST ID:	0806-E	HRR:	n/a	kW	SIN:	TY-2234	Flow:	13	gpm	DRY

Density, kg/m3

Probe No.	**Width / Height**	wall **0.00**	pos. 3 **0.10**	pos. 2a **0.30**	pos 2 **0.52**	pos. 1a **0.74**	pos. 1 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.14	1.14	1.14	1.14	1.13	
11	**2.01**		1.14	1.14	1.14	1.13	1.14	
10	**1.82**		1.14	1.14	1.14	1.14	1.14	
9	**1.63**		1.14	1.14	1.14	1.14	1.14	
8	**1.44**		1.15	1.15	1.15	1.14	1.14	
7	**1.24**		1.15	1.15	1.15	1.15	1.15	
6	**1.03**		1.15	1.15	1.15	1.15	1.15	
5	**0.84**		1.16	1.15	1.15	1.15	1.15	
4	**0.65**		1.16	1.16	1.16	1.15	1.15	
3	**0.46**		1.16	1.16	1.16	1.15	1.15	
2	**0.27**		1.16	1.16	1.16	1.15	1.15	
1	**0.08**		1.16	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.310	kg/s
Experimental M-in:	-0.291	kg/s
Balance	0.019	kg/s
Neutral Plane:	1.247	m
Tg:	n/a	K
Ambient T:	305	K
Predicted Ideal M-out:	n/a	kg/s
Associated C:	n/a	
Avg. Propane Flow:	0	Lpm

TEST ID:	0806-F	HRR: n/a	kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	0.03	-0.08	-0.24	-0.26	-0.27	0.00
11	**2.01**	0.00	0.03	-0.06	-0.19	-0.23	-0.19	0.00
10	**1.82**	0.00	0.02	-0.03	-0.14	-0.20	-0.13	0.00
9	**1.63**	0.00	0.02	0.05	-0.11	-0.16	-0.12	0.00
8	**1.44**	0.00	0.01	0.07	-0.10	-0.08	-0.09	0.00
7	**1.24**	0.00	0.01	-0.07	-0.06	0.10	0.04	0.00
6	**1.03**	0.00	0.01	0.01	0.06	0.09	0.06	0.00
5	**0.84**	0.00	-0.02	0.05	0.16	0.11	0.03	0.00
4	**0.65**	0.00	-0.01	0.06	0.12	0.13	0.11	0.00
3	**0.46**	0.00	-0.02	0.11	0.18	0.18	0.15	0.00
2	**0.27**	0.00	-0.02	0.13	0.23	0.19	0.18	0.00
1	**0.08**	0.00	-0.02	0.12	0.24	0.21	0.17	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	0.03	-0.07	-0.21	-0.23	-0.23	0.00
11	**2.01**	0.00	0.02	-0.05	-0.16	-0.20	-0.17	0.00
10	**1.82**	0.00	0.02	-0.02	-0.13	-0.17	-0.11	0.00
9	**1.63**	0.00	0.01	0.04	-0.10	-0.14	-0.11	0.00
8	**1.44**	0.00	0.01	0.06	-0.08	-0.07	-0.08	0.00
7	**1.24**	0.00	0.00	-0.06	-0.05	0.09	0.04	0.00
6	**1.03**	0.00	0.01	0.01	0.06	0.07	0.05	0.00
5	**0.84**	0.00	-0.01	0.04	0.13	0.10	0.02	0.00
4	**0.65**	0.00	-0.01	0.05	0.11	0.11	0.09	0.00
3	**0.46**	0.00	-0.02	0.09	0.16	0.15	0.13	0.00
2	**0.27**	0.00	-0.02	0.11	0.20	0.17	0.15	0.00
1	**0.08**	0.00	-0.02	0.10	0.21	0.18	0.15	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		306	307	306	306	306	
11	**2.01**		305	305	304	305	305	
10	**1.82**		305	305	304	305	305	
9	**1.63**		305	305	304	304	304	
8	**1.44**		304	304	303	304	304	
7	**1.24**		304	304	303	303	303	
6	**1.03**		303	303	302	303	303	
5	**0.84**		302	303	301	302	302	
4	**0.65**		302	302	301	302	302	
3	**0.46**		302	302	301	301	301	
2	**0.27**		302	302	301	302	302	
1	**0.08**		301	301	301	301	301	
Bottom	**0.00**							

TEST ID:	0806-F	HRR: n/a	kW	SIN:	TY-1234	Flow: 7.9	gpm	DRY

Density, kg/m3

Probe No.	**Width / Height**	wall **0.00**	pos. 3 **0.10**	pos. 2a **0.30**	pos 2 **0.52**	pos. 1a **0.74**	pos. 1 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.14	1.14	1.14	1.14	1.14	
11	**2.01**		1.14	1.14	1.14	1.14	1.14	
10	**1.82**		1.14	1.14	1.15	1.14	1.14	
9	**1.63**		1.14	1.14	1.15	1.14	1.14	
8	**1.44**		1.15	1.15	1.15	1.15	1.15	
7	**1.24**		1.15	1.15	1.15	1.15	1.15	
6	**1.03**		1.15	1.15	1.15	1.15	1.15	
5	**0.84**		1.15	1.15	1.16	1.16	1.15	
4	**0.65**		1.15	1.15	1.16	1.16	1.16	
3	**0.46**		1.16	1.15	1.16	1.16	1.16	
2	**0.27**		1.16	1.15	1.16	1.16	1.16	
1	**0.08**		1.16	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.156	kg/s
Experimental M-in:	-0.142	kg/s
Balance	0.015	kg/s
Neutral Plane:	1.254	m
Tg:	n/a	K
Ambient T:	305	K
Predicted Ideal M-out:	n/a	kg/s
Associated C:	n/a	
Avg. Propane Flow:	0	Lpm

TEST ID:	0806-G	HRR: n/a	kW	SIN:	TY-4211	Flow: 21.1	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.39	-0.35	-0.37	-0.34	-0.34	0.00
11	**2.01**	0.00	-0.34	-0.30	-0.30	-0.28	-0.30	0.00
10	**1.82**	0.00	-0.28	-0.23	-0.23	-0.21	-0.21	0.00
9	**1.63**	0.00	-0.22	-0.15	-0.15	-0.15	-0.11	0.00
8	**1.44**	0.00	-0.15	-0.13	-0.13	-0.14	-0.05	0.00
7	**1.24**	0.00	0.02	-0.07	0.06	-0.05	0.13	0.00
6	**1.03**	0.00	0.09	0.06	0.12	0.11	0.16	0.00
5	**0.84**	0.00	0.21	0.19	0.19	0.22	0.22	0.00
4	**0.65**	0.00	0.19	0.22	0.20	0.24	0.23	0.00
3	**0.46**	0.00	0.21	0.24	0.22	0.27	0.23	0.00
2	**0.27**	0.00	0.19	0.26	0.24	0.33	0.28	0.00
1	**0.08**	0.00	0.25	0.32	0.27	0.33	0.30	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.34	-0.31	-0.32	-0.30	-0.30	0.00
11	**2.01**	0.00	-0.30	-0.26	-0.27	-0.25	-0.26	0.00
10	**1.82**	0.00	-0.25	-0.20	-0.20	-0.18	-0.18	0.00
9	**1.63**	0.00	-0.19	-0.13	-0.13	-0.13	-0.10	0.00
8	**1.44**	0.00	-0.13	-0.11	-0.11	-0.12	-0.04	0.00
7	**1.24**	0.00	0.02	-0.06	0.05	-0.04	0.11	0.00
6	**1.03**	0.00	0.08	0.06	0.11	0.10	0.14	0.00
5	**0.84**	0.00	0.18	0.17	0.16	0.19	0.19	0.00
4	**0.65**	0.00	0.16	0.19	0.17	0.21	0.20	0.00
3	**0.46**	0.00	0.18	0.21	0.19	0.24	0.20	0.00
2	**0.27**	0.00	0.17	0.23	0.21	0.28	0.24	0.00
1	**0.08**	0.00	0.22	0.27	0.23	0.28	0.26	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		305	305	305	305	305	
11	**2.01**		304	304	304	304	304	
10	**1.82**		304	304	304	304	304	
9	**1.63**		303	304	303	304	304	
8	**1.44**		303	303	303	303	303	
7	**1.24**		303	303	303	303	303	
6	**1.03**		302	302	302	302	302	
5	**0.84**		302	302	302	302	302	
4	**0.65**		301	301	301	302	302	
3	**0.46**		301	301	301	301	301	
2	**0.27**		301	300	300	301	301	
1	**0.08**		300	300	300	301	301	
Bottom	**0.00**							

TEST ID:	0806-G	HRR:	n/a	kW	SIN:	TY-4211	Flow:	21.1	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall **0.00**	pos. 3 **0.10**	pos. 2a **0.30**	pos 2 **0.52**	pos. 1a **0.74**	pos. 1 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.14	1.14	1.14	1.15	1.14	
11	**2.01**		1.15	1.15	1.15	1.14	1.15	
10	**1.82**		1.15	1.15	1.15	1.15	1.15	
9	**1.63**		1.15	1.15	1.15	1.15	1.15	
8	**1.44**		1.15	1.15	1.15	1.15	1.15	
7	**1.24**		1.15	1.15	1.15	1.15	1.15	
6	**1.03**		1.15	1.15	1.15	1.15	1.15	
5	**0.84**		1.15	1.16	1.15	1.16	1.15	
4	**0.65**		1.16	1.16	1.16	1.16	1.16	
3	**0.46**		1.16	1.16	1.16	1.16	1.16	
2	**0.27**		1.16	1.16	1.16	1.16	1.16	
1	**0.08**		1.16	1.16	1.16	1.16	1.16	
Bottom	**0.00**							

Experimental M-out:	0.224	kg/s
Experimental M-in:	-0.190	kg/s
Balance	0.035	kg/s
Neutral Plane:	1.254	m
Tg:	n/a	K
Ambient T:	304	K
Predicted Ideal M-out:	n/a	kg/s
Associated C:	n/a	
Avg. Propane Flow:	0	Lpm

TEST ID: 0806-H	HRR: n/a kW	SIN: TY-5521	Flow: 29.6 gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.48	-0.47	-0.42	-0.41	-0.43	0.00
11	**2.01**	0.00	-0.46	-0.39	-0.35	-0.36	-0.39	0.00
10	**1.82**	0.00	-0.42	-0.34	-0.28	-0.31	-0.31	0.00
9	**1.63**	0.00	-0.36	-0.29	-0.22	-0.23	-0.17	0.00
8	**1.44**	0.00	-0.27	-0.26	-0.15	-0.09	0.23	0.00
7	**1.24**	0.00	-0.19	0.11	0.16	0.28	0.31	0.00
6	**1.03**	0.00	-0.13	0.16	0.24	0.36	0.37	0.00
5	**0.84**	0.00	0.17	0.24	0.28	0.40	0.43	0.00
4	**0.65**	0.00	-0.10	0.19	0.26	0.43	0.46	0.00
3	**0.46**	0.00	-0.10	0.15	0.25	0.39	0.49	0.00
2	**0.27**	0.00	-0.07	-0.06	0.25	0.37	0.52	0.00
1	**0.08**	0.00	-0.20	-0.13	0.22	0.32	0.50	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.42	-0.41	-0.37	-0.36	-0.38	0.00
11	**2.01**	0.00	-0.40	-0.34	-0.30	-0.31	-0.34	0.00
10	**1.82**	0.00	-0.37	-0.30	-0.25	-0.27	-0.27	0.00
9	**1.63**	0.00	-0.31	-0.25	-0.19	-0.20	-0.15	0.00
8	**1.44**	0.00	-0.23	-0.22	-0.13	-0.08	0.20	0.00
7	**1.24**	0.00	-0.16	0.10	0.14	0.24	0.27	0.00
6	**1.03**	0.00	-0.12	0.14	0.21	0.31	0.32	0.00
5	**0.84**	0.00	0.15	0.21	0.24	0.35	0.37	0.00
4	**0.65**	0.00	-0.08	0.17	0.23	0.37	0.40	0.00
3	**0.46**	0.00	-0.08	0.13	0.22	0.33	0.42	0.00
2	**0.27**	0.00	-0.06	-0.05	0.22	0.32	0.45	0.00
1	**0.08**	0.00	-0.17	-0.11	0.19	0.27	0.43	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		304	304	304	304	304	
11	**2.01**		303	303	303	303	303	
10	**1.82**		303	303	303	303	303	
9	**1.63**		302	303	303	303	303	
8	**1.44**		302	302	302	301	301	
7	**1.24**		301	300	300	300	300	
6	**1.03**		300	300	300	300	300	
5	**0.84**		299	299	299	299	299	
4	**0.65**		299	299	299	299	299	
3	**0.46**		299	298	299	299	299	
2	**0.27**		299	299	299	299	299	
1	**0.08**		299	298	299	299	299	
Bottom	**0.00**							

TEST ID:	0806-H	HRR: n/a	kW	SIN:	TY-5521	Flow: 29.6	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.15	1.15	1.15	1.15	1.15	
11	**2.01**		1.15	1.15	1.15	1.15	1.15	
10	**1.82**		1.15	1.15	1.15	1.15	1.15	
9	**1.63**		1.15	1.15	1.15	1.15	1.15	
8	**1.44**		1.16	1.15	1.15	1.16	1.16	
7	**1.24**		1.16	1.16	1.16	1.16	1.16	
6	**1.03**		1.16	1.16	1.16	1.16	1.16	
5	**0.84**		1.16	1.17	1.16	1.17	1.16	
4	**0.65**		1.17	1.17	1.17	1.17	1.17	
3	**0.46**		1.17	1.17	1.17	1.17	1.17	
2	**0.27**		1.17	1.17	1.17	1.17	1.17	
1	**0.08**		1.17	1.17	1.17	1.17	1.17	
Bottom	**0.00**							

Experimental M-out:	0.280	kg/s
Experimental M-in:	-0.267	kg/s
Balance	0.013	kg/s
Neutral Plane:	1.367	m
Tg:	n/a	K
Ambient T:	303	K
Predicted Ideal M-out:	n/a	kg/s
Associated C:	n/a	
Avg. Propane Flow:	0	Lpm

TEST ID:	0806-I	HRR: n/a	kW	SIN:	TY-1334	Flow: 11.1	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.46	-0.46	-0.42	-0.44	-0.50	0.00
11	**2.01**	0.00	-0.45	-0.37	-0.37	-0.40	-0.48	0.00
10	**1.82**	0.00	-0.43	-0.34	-0.32	-0.36	-0.44	0.00
9	**1.63**	0.00	-0.36	-0.28	-0.26	-0.30	-0.37	0.00
8	**1.44**	0.00	-0.29	-0.24	-0.21	-0.22	-0.19	0.00
7	**1.24**	0.00	-0.19	-0.07	0.12	0.09	-0.09	0.00
6	**1.03**	0.00	-0.13	0.16	0.21	0.24	0.16	0.00
5	**0.84**	0.00	0.15	0.26	0.30	0.32	0.26	0.00
4	**0.65**	0.00	-0.06	0.24	0.30	0.35	0.30	0.00
3	**0.46**	0.00	0.07	0.24	0.32	0.39	0.34	0.00
2	**0.27**	0.00	-0.03	0.14	0.32	0.43	0.38	0.00
1	**0.08**	0.00	-0.20	-0.20	0.22	0.35	0.38	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.40	-0.40	-0.37	-0.39	-0.43	0.00
11	**2.01**	0.00	-0.39	-0.33	-0.32	-0.35	-0.42	0.00
10	**1.82**	0.00	-0.37	-0.30	-0.28	-0.31	-0.38	0.00
9	**1.63**	0.00	-0.31	-0.25	-0.23	-0.26	-0.32	0.00
8	**1.44**	0.00	-0.25	-0.21	-0.18	-0.19	-0.16	0.00
7	**1.24**	0.00	-0.16	-0.06	0.10	0.08	-0.08	0.00
6	**1.03**	0.00	-0.11	0.13	0.18	0.21	0.14	0.00
5	**0.84**	0.00	0.13	0.23	0.26	0.28	0.22	0.00
4	**0.65**	0.00	-0.05	0.21	0.26	0.30	0.25	0.00
3	**0.46**	0.00	0.06	0.21	0.27	0.33	0.30	0.00
2	**0.27**	0.00	-0.03	0.12	0.27	0.37	0.33	0.00
1	**0.08**	0.00	-0.17	-0.17	0.19	0.30	0.33	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		304	304	304	304	304	
11	**2.01**		303	303	303	303	303	
10	**1.82**		303	303	303	303	303	
9	**1.63**		303	303	302	303	303	
8	**1.44**		302	302	302	302	302	
7	**1.24**		301	301	301	301	301	
6	**1.03**		300	300	300	300	300	
5	**0.84**		300	299	299	300	300	
4	**0.65**		299	299	299	299	299	
3	**0.46**		299	299	299	299	299	
2	**0.27**		299	299	299	299	299	
1	**0.08**		299	299	299	299	299	
Bottom	**0.00**							

TEST ID:	0806-I	HRR: n/a kW	SIN:	TY-1334	Flow: 11.1 gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.15	1.15	1.15	1.15	1.15	
11	**2.01**		1.15	1.15	1.15	1.15	1.15	
10	**1.82**		1.15	1.15	1.15	1.15	1.15	
9	**1.63**		1.15	1.15	1.15	1.15	1.15	
8	**1.44**		1.15	1.15	1.15	1.15	1.15	
7	**1.24**		1.16	1.16	1.16	1.16	1.16	
6	**1.03**		1.16	1.16	1.16	1.16	1.16	
5	**0.84**		1.16	1.16	1.16	1.16	1.16	
4	**0.65**		1.16	1.17	1.17	1.17	1.16	
3	**0.46**		1.17	1.17	1.17	1.17	1.17	
2	**0.27**		1.17	1.17	1.17	1.17	1.16	
1	**0.08**		1.17	1.17	1.17	1.17	1.17	
Bottom	**0.00**							

Experimental M-out:	0.239	kg/s
Experimental M-in:	-0.306	kg/s
Balance	-0.067	kg/s
Neutral Plane:	1.120	m
Tg:	n/a	K
Ambient T:	303	K
Predicted Ideal M-out:	n/a	kg/s
Associated C:	n/a	
Avg. Propane Flow:	-426	Lpm

TEST ID: 0813-a	HRR: N/A kW	SIN: AM 29	Flow: 6.2 gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	0.17	0.36	0.30	-0.05	-0.19	0.00
11	**2.01**	0.00	0.13	0.35	0.27	0.15	-0.07	0.00
10	**1.82**	0.00	-0.21	0.32	0.21	0.12	-0.03	0.00
9	**1.63**	0.00	-0.16	0.32	0.26	0.17	0.16	0.00
8	**1.44**	0.00	0.10	0.24	0.22	0.16	0.16	0.00
7	**1.24**	0.00	0.18	0.13	0.11	0.14	0.15	0.00
6	**1.03**	0.00	0.23	-0.11	-0.12	0.08	0.15	0.00
5	**0.84**	0.00	0.35	0.05	0.06	0.15	0.21	0.00
4	**0.65**	0.00	0.21	-0.29	-0.32	-0.18	0.07	0.00
3	**0.46**	0.00	0.26	-0.30	-0.37	-0.20	0.11	0.00
2	**0.27**	0.00	0.25	-0.37	-0.41	-0.18	0.13	0.00
1	**0.08**	0.00	0.30	-0.34	-0.40	-0.19	0.12	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	0.15	0.31	0.26	-0.05	-0.16	0.00
11	**2.01**	0.00	0.12	0.30	0.23	0.13	-0.06	0.00
10	**1.82**	0.00	-0.18	0.27	0.18	0.10	-0.03	0.00
9	**1.63**	0.00	-0.14	0.28	0.22	0.15	0.14	0.00
8	**1.44**	0.00	0.09	0.20	0.19	0.14	0.14	0.00
7	**1.24**	0.00	0.15	0.11	0.09	0.12	0.13	0.00
6	**1.03**	0.00	0.20	-0.09	-0.10	0.06	0.13	0.00
5	**0.84**	0.00	0.30	0.04	0.05	0.13	0.18	0.00
4	**0.65**	0.00	0.18	-0.25	-0.27	-0.16	0.06	0.00
3	**0.46**	0.00	0.22	-0.25	-0.32	-0.17	0.09	0.00
2	**0.27**	0.00	0.21	-0.32	-0.35	-0.16	0.11	0.00
1	**0.08**	0.00	0.26	-0.29	-0.34	-0.16	0.10	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		300	300	300	299	299	
11	**2.01**		299	300	300	299	299	
10	**1.82**		299	300	300	299	299	
9	**1.63**		299	300	300	299	299	
8	**1.44**		299	300	300	299	299	
7	**1.24**		299	299	299	299	299	
6	**1.03**		299	299	299	299	299	
5	**0.84**		299	298	298	299	299	
4	**0.65**		299	298	298	298	298	
3	**0.46**		299	298	298	298	298	
2	**0.27**		299	298	298	299	299	
1	**0.08**		299	298	298	299	299	
Bottom	**0.00**							

TEST ID:	0813-a	HRR:	N/A	kW	SIN:	AM 29	Flow:	6.2	gpm	DRY

Density, kg/m3

Probe No.	**Width** / **Height**	wall **0.00**	pos. 3 **0.10**	pos. 2a **0.30**	pos 2 **0.52**	pos. 1a **0.74**	pos. 1 **0.94**	wall **1.04**
Top	**2.24**							
12	**2.17**		1.16	1.16	1.16	1.16	1.16	
11	**2.01**		1.16	1.16	1.16	1.16	1.17	
10	**1.82**		1.17	1.16	1.16	1.16	1.16	
9	**1.63**		1.16	1.16	1.16	1.16	1.16	
8	**1.44**		1.16	1.16	1.16	1.16	1.17	
7	**1.24**		1.16	1.16	1.17	1.17	1.17	
6	**1.03**		1.16	1.17	1.17	1.17	1.17	
5	**0.84**		1.17	1.17	1.17	1.17	1.17	
4	**0.65**		1.17	1.17	1.17	1.17	1.17	
3	**0.46**		1.17	1.17	1.17	1.17	1.17	
2	**0.27**		1.17	1.17	1.17	1.17	1.17	
1	**0.08**		1.17	1.17	1.17	1.17	1.17	
Bottom	**0.00**							

Experimental M-out:	0.222	kg/s
Experimental M-in:	-0.128	kg/s
Balance	0.095	kg/s
Neutral Plane:	1.694	m
Tg:	#DIV/0!	K
Ambient T:	299	K
Predicted Ideal M-out:	#DIV/0!	kg/s
Associated C:	#DIV/0!	
Avg. Propane Flow:	0	Lpm

TEST ID:	0813-B	HRR:	N/A	kW	SIN:	TY-3334	Flow:	14.8	gpm	DRY

Mass flux, kg/s*m^2

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.42	-0.47	-0.50	-0.50	-0.42	0.00
11	**2.01**	0.00	-0.37	-0.42	-0.45	-0.45	-0.36	0.00
10	**1.82**	0.00	-0.36	-0.40	-0.42	-0.40	-0.33	0.00
9	**1.63**	0.00	-0.30	-0.33	-0.35	-0.34	-0.29	0.00
8	**1.44**	0.00	-0.21	-0.24	-0.21	-0.22	-0.25	0.00
7	**1.24**	0.00	0.12	0.14	0.19	0.14	-0.18	0.00
6	**1.03**	0.00	0.28	0.30	0.34	0.28	-0.02	0.00
5	**0.84**	0.00	0.40	0.41	0.48	0.41	0.22	0.00
4	**0.65**	0.00	0.43	0.44	0.53	0.49	0.31	0.00
3	**0.46**	0.00	0.45	0.53	0.57	0.51	0.37	0.00
2	**0.27**	0.00	0.40	0.46	0.49	0.40	0.35	0.00
1	**0.08**	0.00	0.31	0.29	0.24	0.24	0.30	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Velocity, m/s

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	**2.17**	0.00	-0.36	-0.41	-0.43	-0.43	-0.36	0.00
11	**2.01**	0.00	-0.32	-0.36	-0.39	-0.39	-0.31	0.00
10	**1.82**	0.00	-0.31	-0.34	-0.36	-0.34	-0.28	0.00
9	**1.63**	0.00	-0.25	-0.29	-0.30	-0.29	-0.25	0.00
8	**1.44**	0.00	-0.18	-0.21	-0.18	-0.19	-0.21	0.00
7	**1.24**	0.00	0.10	0.12	0.16	0.12	-0.16	0.00
6	**1.03**	0.00	0.24	0.26	0.29	0.24	-0.02	0.00
5	**0.84**	0.00	0.34	0.35	0.41	0.35	0.19	0.00
4	**0.65**	0.00	0.37	0.38	0.46	0.42	0.27	0.00
3	**0.46**	0.00	0.38	0.46	0.48	0.43	0.32	0.00
2	**0.27**	0.00	0.34	0.39	0.42	0.34	0.30	0.00
1	**0.08**	0.00	0.27	0.25	0.21	0.21	0.25	0.00
Bottom	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Temperature, K

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		299	298	298	299	299	
11	**2.01**		298	298	298	299	299	
10	**1.82**		298	298	298	298	298	
9	**1.63**		298	298	298	298	298	
8	**1.44**		298	298	298	298	298	
7	**1.24**		298	298	298	298	298	
6	**1.03**		298	298	298	298	298	
5	**0.84**		298	298	298	298	298	
4	**0.65**		298	298	298	298	298	
3	**0.46**		298	298	298	298	298	
2	**0.27**		298	298	298	298	298	
1	**0.08**		298	298	298	298	298	
Bottom	**0.00**							

TEST ID:	0813-B	HRR: N/A	kW	SIN:	TY-3334	Flow: 14.8	gpm	DRY

Density, kg/m3

Probe No.	Width / Height	wall 0.00	pos. 3 0.10	pos. 2a 0.30	pos 2 0.52	pos. 1a 0.74	pos. 1 0.94	wall 1.04
Top	**2.24**							
12	**2.17**		1.17	1.17	1.17	1.17	1.17	
11	**2.01**		1.17	1.17	1.17	1.17	1.17	
10	**1.82**		1.17	1.17	1.17	1.17	1.17	
9	**1.63**		1.17	1.17	1.17	1.17	1.17	
8	**1.44**		1.17	1.17	1.17	1.17	1.17	
7	**1.24**		1.17	1.17	1.17	1.17	1.17	
6	**1.03**		1.17	1.17	1.17	1.17	1.17	
5	**0.84**		1.17	1.17	1.17	1.17	1.17	
4	**0.65**		1.17	1.17	1.17	1.17	1.17	
3	**0.46**		1.17	1.17	1.17	1.17	1.17	
2	**0.27**		1.17	1.17	1.17	1.17	1.17	
1	**0.08**		1.17	1.17	1.17	1.17	1.17	
Bottom	**0.00**							

Experimental M-out:	0.411	kg/s
Experimental M-in:	-0.298	kg/s
Balance	0.114	kg/s
Neutral Plane:	1.215	m
Tg:	n/a	K
Ambient T:	298	K
Predicted Ideal M-out:	n/a	kg/s
Associated C:	n/a	
Avg. Propane Flow:	0	Lpm

Appendix E: Error Analysis

Error analysis of mass flux

The following explains how the uncertainty in the measured mass flux was determined. It is based on Taylor's law of propagation of uncertainty, which assumes that a function y has the variables of x_1, $x_2 \ldots x_n$, each of the variables has a known uncertainty of δx_1, $\delta x_2 \ldots \delta x_n$.

$$y=f(x_1, x_2 \ldots x_n)$$

The error associated with y is a function of its partial derivative and the known uncertainties of each variable. The equation is:

$$\delta y = \sqrt{\left(\frac{\partial y}{\partial x_1}\delta x_1\right)^2 + \left(\frac{\partial y}{\partial x_2}\delta x_2\right)^2 + \cdots + \left(\frac{\partial y}{\partial x_n}\delta x_n\right)^2}$$

Below is the equation used to determine the experimental mass flux

$$\dot{m}'' = \frac{K}{T} C_f \sqrt{\Delta P T}$$

There are three factors contribute to the total uncertainty of mass flux. The temperature measured by thermocouple(T), the differential pressure measured by transducers(ΔP) and the calibration coefficient of bidirectional probes(C_f).K is a constant equals 26.37.

The next 3 equations are partial derivatives of the mass flux equation:

$$\frac{\partial \dot{m}''}{\partial C_f} = K\sqrt{\Delta P T}$$

$$\frac{\partial \dot{m}''}{\partial \Delta P} = \frac{K}{2}\frac{C_f T}{\sqrt{\Delta P T}}$$

$$\frac{\partial \dot{m}''}{\partial T} = \frac{K}{2}\frac{C_f \Delta P}{\sqrt{\Delta P T}}$$

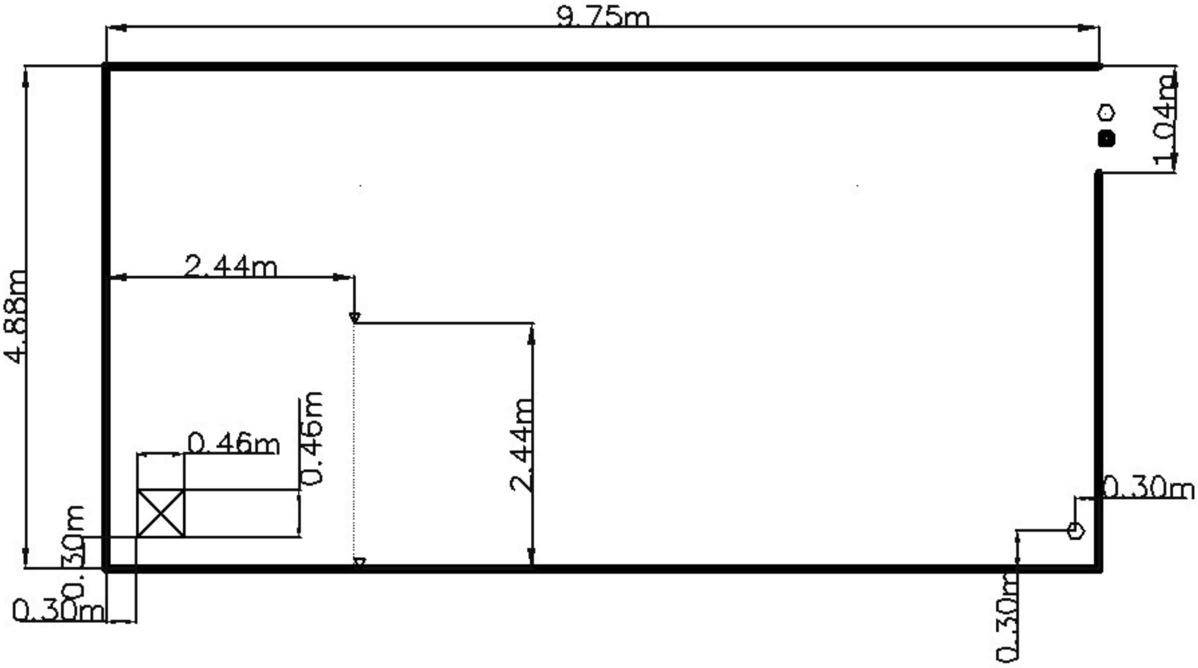
Applying Taylor's law of Propagation of uncertainty, we get the following equation:

$$\delta \dot{m}'' = \sqrt{\left(K\sqrt{\Delta PT}\,\delta C_f\right)^2 + \left(\frac{K}{2}\frac{C_f T}{\sqrt{\Delta PT}}\delta \Delta P\right)^2 + \left(\frac{K}{2}\frac{C_f \Delta P}{\sqrt{\Delta PT}}\delta T\right)^2}$$

The errors of T, ΔP, C_f are known from the instrumentation data sheets (Appendix J) and Reference 9 of Chapter 2 in this MQP. By using this equation we get the uncertainty of mass flux to be +/- 10%

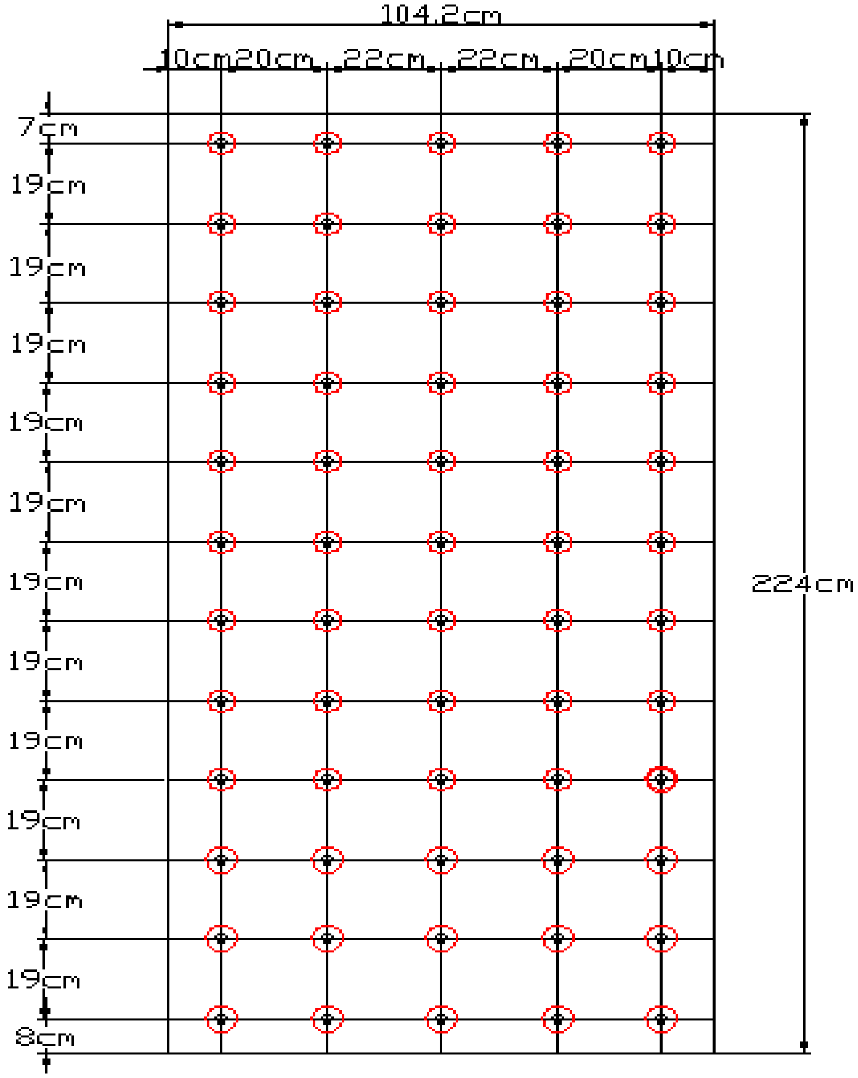
Appendix F: Test Room Layout

1 layout of the testing room (UL1626)



○	Thermocouple tree
■	Bidirectional probe tree
⊠	Diffusion burner
▽	Sprinkler

2 doorway


104.2cm
10cm 20cm 22cm 22cm 20cm 10cm
7cm
19cm
19cm
19cm
19cm
19cm
19cm
19cm
19cm
19cm
19cm
19cm
8cm
224cm

Appendix G: Scientific Presentation Slides

tyco
Fire Suppression
& Building Products

WPI

上海交通大學
Shanghai Jiao Tong

The Effect of Sprinkler Spray on Combustion Products Leaving a Compartment

Valerie Adams, Zhiyi Han (Henry), Steven Southard, Chang Su (Robin)

To be covered:

- Reason for research
- Experimental setup
- Validation of setup
- Effects of sprinkler spray
- Conclusions
- Future work

2 | confidential

Why research this topic?

- Performance-Based Design
- Transport of toxic species out of room of origin
  - Little research performed
- Crocker proposed a simplified tool based on Rockett's 2-layer equation

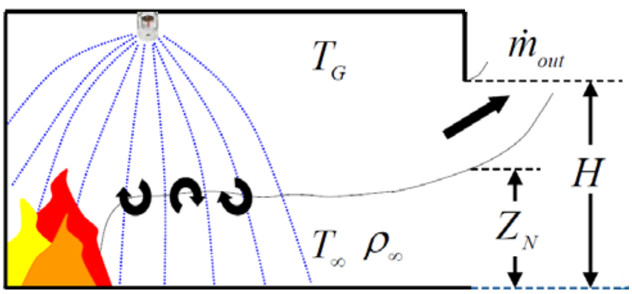
$$\dot{m}_{out} = \frac{2}{3} C_D W \rho_\infty \sqrt{2 \frac{T_\infty}{T_G}\left(1 - \frac{T_\infty}{T_G}\right) g}\ (H - Z_N)^{3/2}$$

$$\Downarrow$$

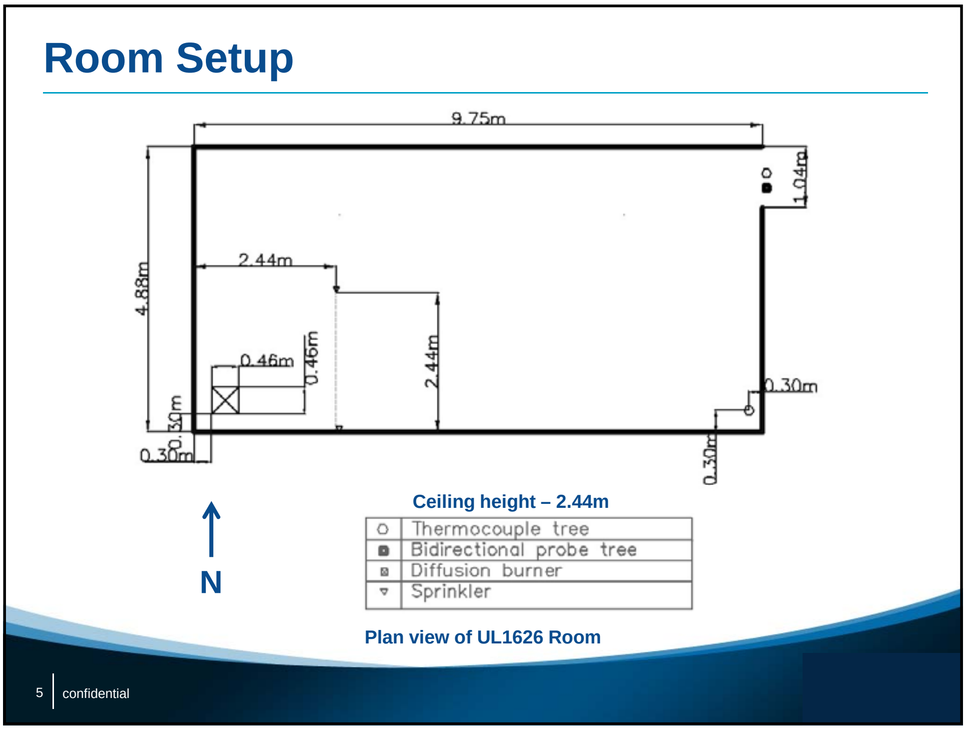
$$\dot{m}_{out} = \frac{2}{3} C_s C_D W \rho_\infty \sqrt{2 \frac{T_\infty}{T_G}\left(1 - \frac{T_\infty}{T_G}\right) g}\ (H - Z_N)^{3/2}$$

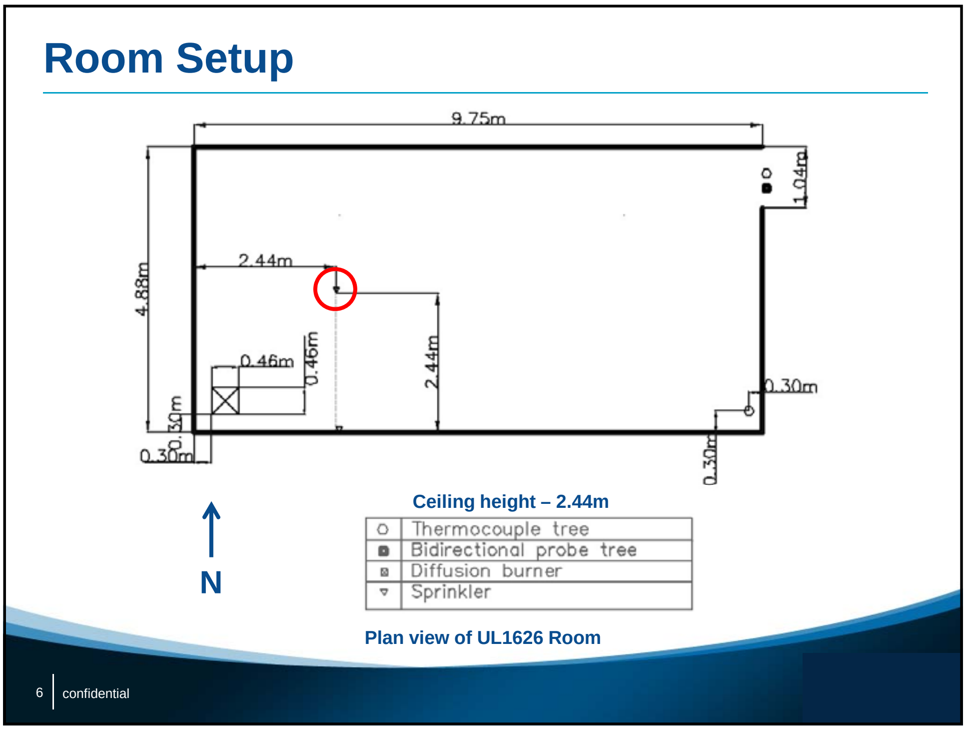
Why research this topic?

$$\dot{m}_{out} = \frac{2}{3} C_D W \rho_\infty \sqrt{2 \frac{T_\infty}{T_G}\left(1 - \frac{T_\infty}{T_G}\right) g}\ (H - Z_N)^{3/2}$$

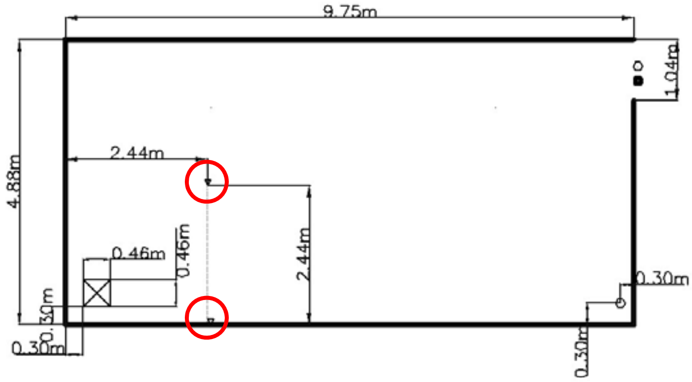


- Crocker's concept criticized: further research required


Room Setup
9.75m
1.04m
4.88m
2.44m
0.46m
0.46m
2.44m
0.30m
0.30m
0.30m
0.30m
N
Ceiling height – 2.44m
Thermocouple tree
Bidirectional probe tree
Diffusion burner
Sprinkler
Plan view of UL1626 Room
5
confidential


Room Setup
9.75m
1.04m
4.88m
2.44m
0.46m
0.46m
2.44m
0.30m
0.30m
0.30m
0.30m
N
Ceiling height – 2.44m
Thermocouple tree
Bidirectional probe tree
Diffusion burner
Sprinkler
Plan view of UL1626 Room
6
confidential

Room Setup

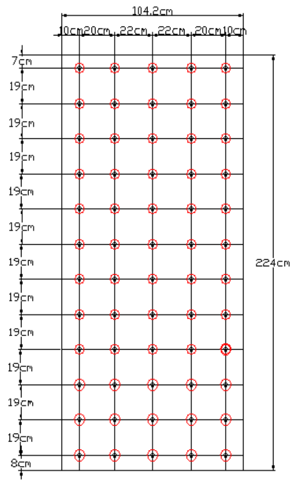


Ceiling height – 2.44m

○	Thermocouple tree
■	Bidirectional probe tree
⊠	Diffusion burner
▽	Sprinkler

Plan view of UL1626 Room

Room Setup



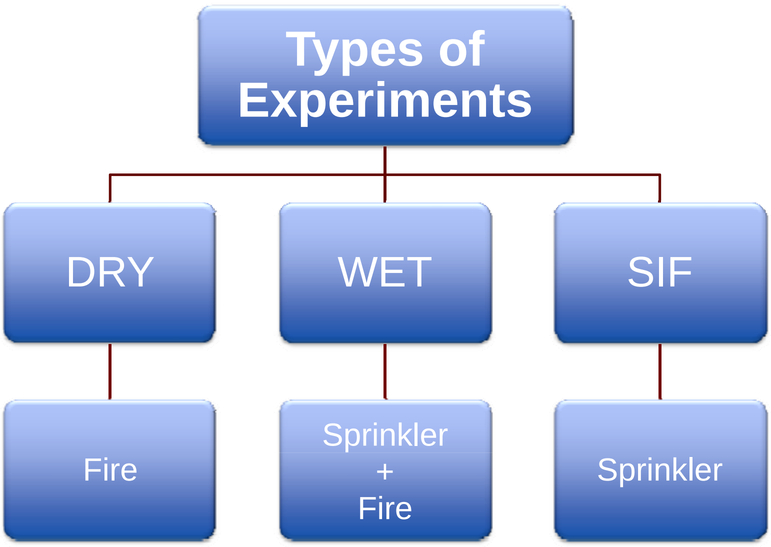
Doorway with movable array of bi-directional probes and thermocouples

Room Setup- Burner

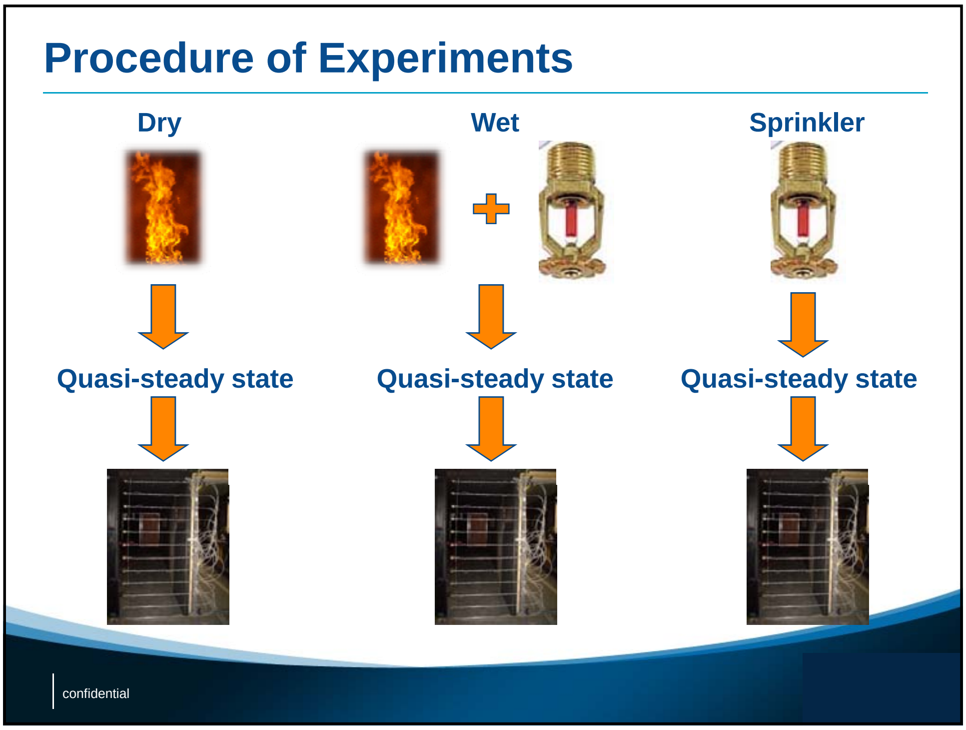
- Burner designed by TFSBP engineers
  - No visible change in flame shape from dry to wet
- Propane diffusion burner

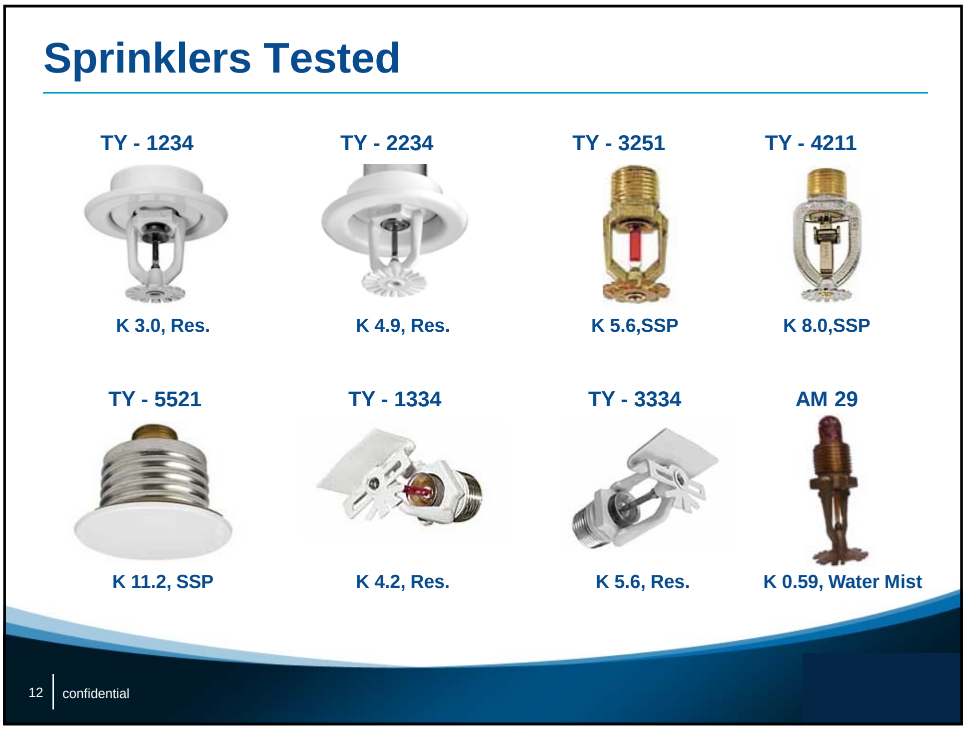
Steel Ball Bearing Burner

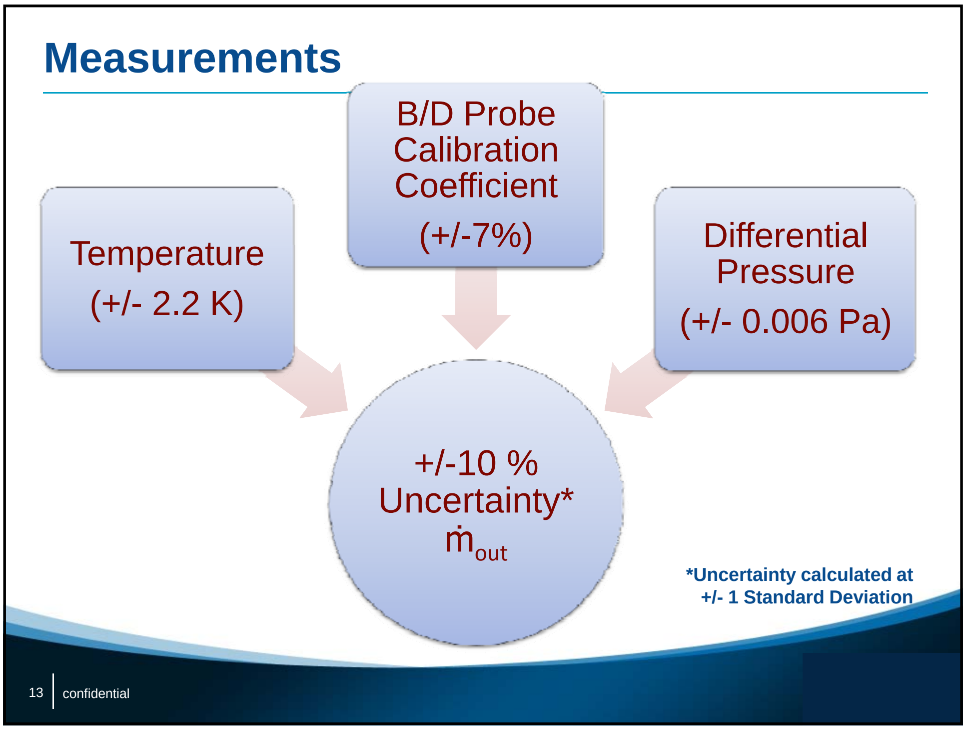
9 | confidential

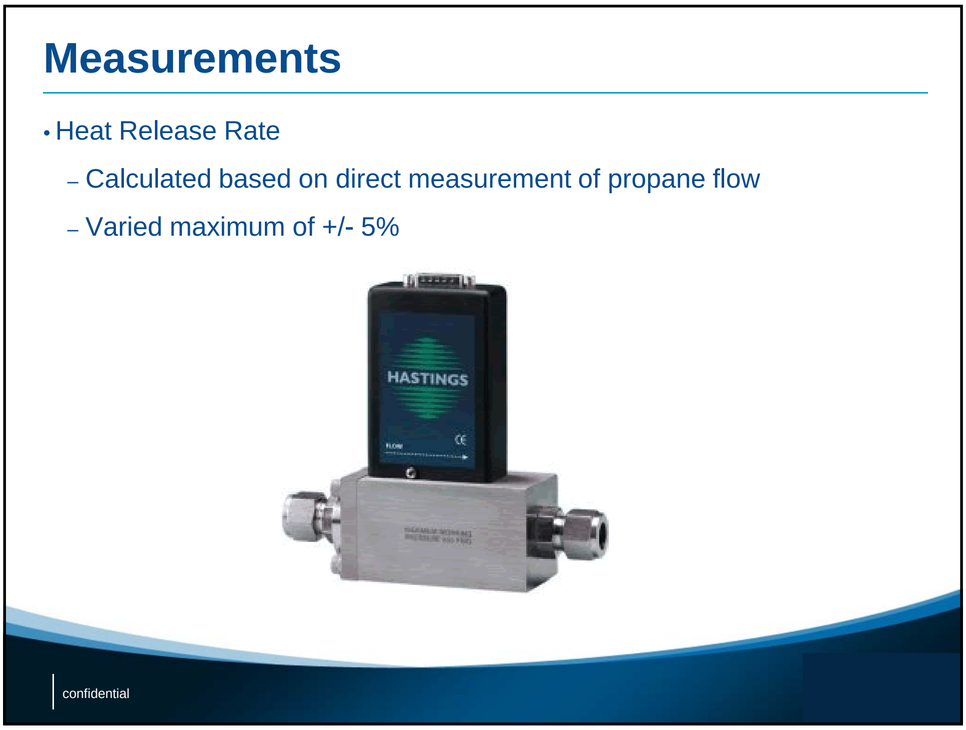


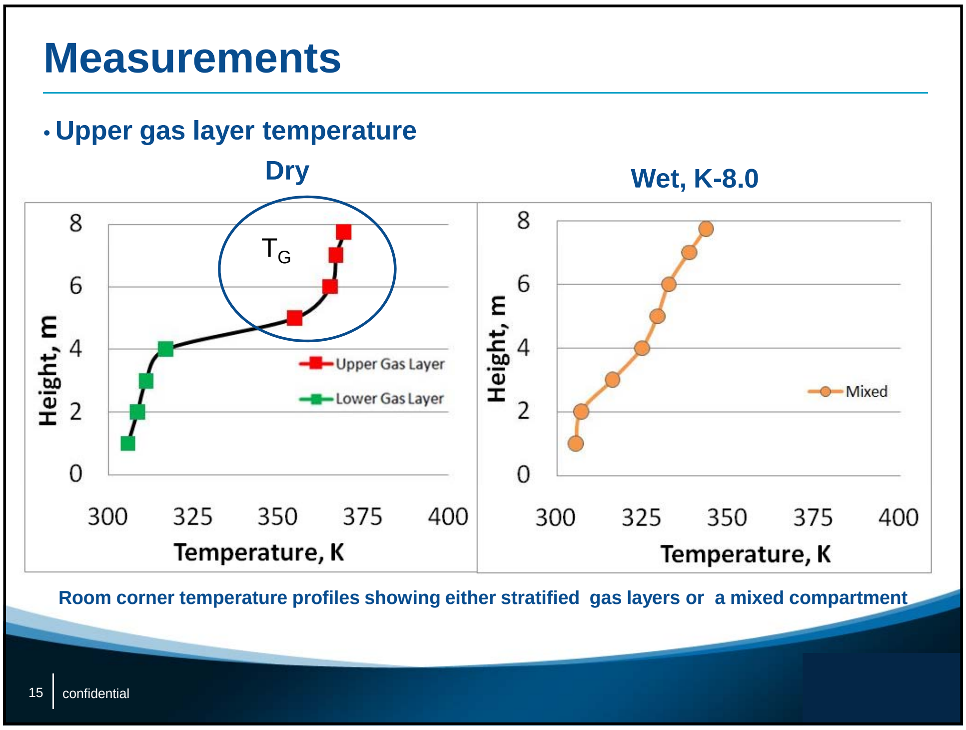
10 | confidential

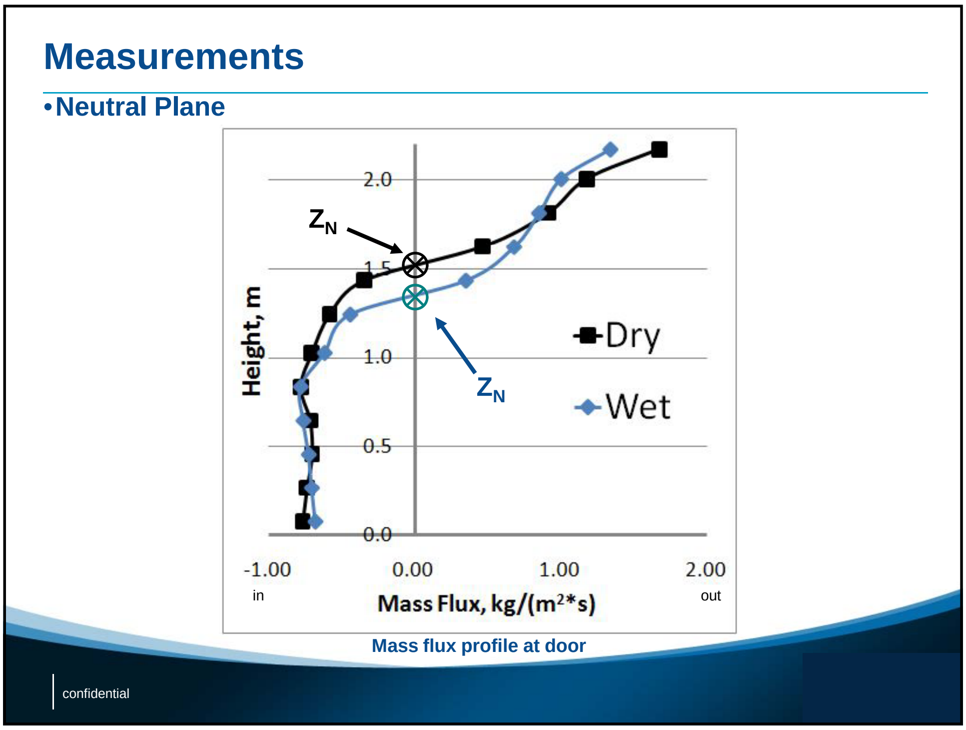

Procedure of Experiments
Dry
Wet
Sprinkler
Quasi-steady state
Quasi-steady state
Quasi-steady state
confidential

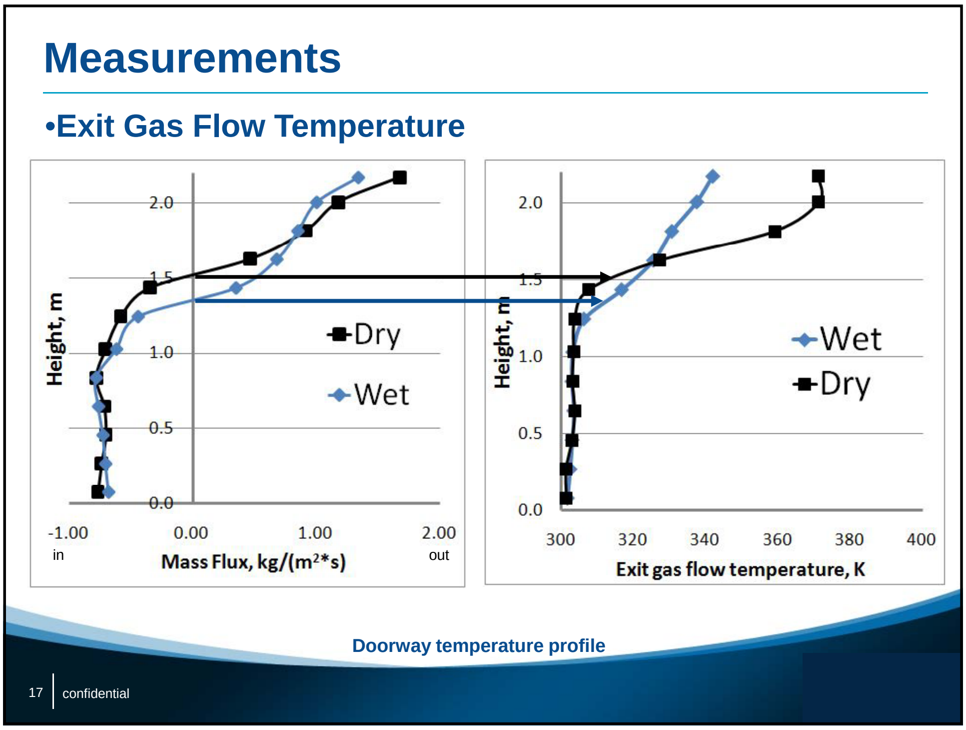

Sprinklers Tested
TY - 1234
K 3.0, Res.
TY - 2234
K 4.9, Res.
TY - 3251
K 5.6,SSP
TY - 4211
K 8.0,SSP
TY - 5521
K 11.2, SSP
TY - 1334
K 4.2, Res.
TY - 3334
K 5.6, Res.
AM 29
K 0.59, Water Mist
12
confidential

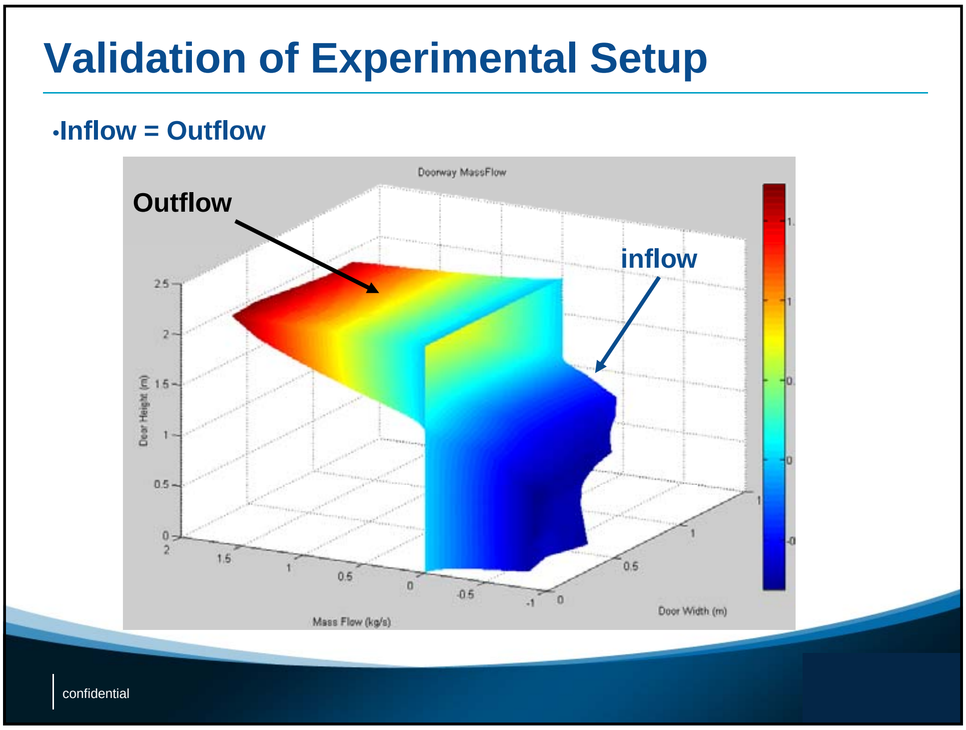

Measurements
B/D Probe Calibration Coefficient
(+/-7%)
Temperature
(+/- 2.2 K)
Differential Pressure
(+/- 0.006 Pa)
+/-10 % Uncertainty* ṁout
*Uncertainty calculated at +/- 1 Standard Deviation
13
confidential


Measurements
• Heat Release Rate
– Calculated based on direct measurement of propane flow
– Varied maximum of +/- 5%
HASTINGS
confidential


Measurements
• Upper gas layer temperature
Dry
Wet, K-8.0
T_G
Upper Gas Layer
Lower Gas Layer
Mixed
Height, m
Temperature, K
0
2
4
6
8
300
325
350
375
400
Room corner temperature profiles showing either stratified gas layers or a mixed compartment
15
confidential

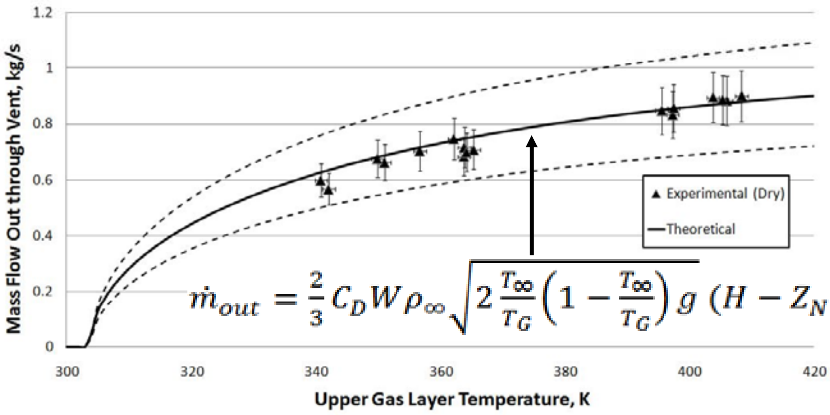

Measurements
•Neutral Plane
Z_N
Z_N
Dry
Wet
Height, m
0.0
0.5
1.0
1.5
2.0
-1.00
0.00
1.00
2.00
in
out
Mass Flux, kg/(m²*s)
Mass flux profile at door
confidential


Measurements
•Exit Gas Flow Temperature
Height, m
2.0
1.5
1.0
0.5
0.0
-1.00
in
0.00
1.00
2.00
out
Mass Flux, kg/(m²*s)
Dry
Wet
Height, m
2.0
1.5
1.0
0.5
0.0
300
320
340
360
380
400
Exit gas flow temperature, K
Wet
Dry
Doorway temperature profile
17
confidential


Validation of Experimental Setup
•Inflow = Outflow
Doorway MassFlow
Outflow
inflow
Door Height (m)
Mass Flow (kg/s)
Door Width (m)
confidential

Validation of Experimental Setup

• Follows Rockett's Equation



$$\dot{m}_{out} = \frac{2}{3} C_D W \rho_\infty \sqrt{2\frac{T_\infty}{T_G}\left(1-\frac{T_\infty}{T_G}\right) g}\,(H-Z_N)^{3/2}$$

Experimental data matches work done by Rockett within the experimental margin of error

19 | confidential

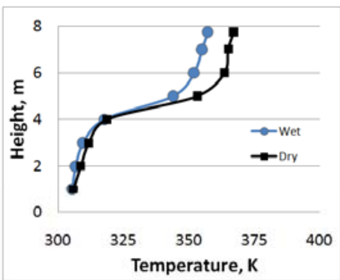
Effects of Sprinkler Spray

• Decrease temperature

• 2 stratified layers (dry & wet)

• Decrease in mass flow like Crocker

TY-1234, K-3.0



Room corner temperature profile

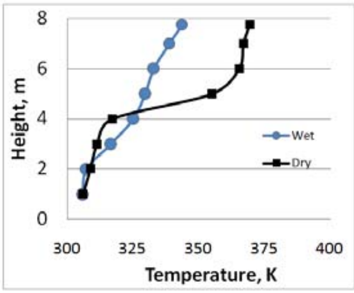
K-Factor	Fire Size	$\Delta\dot{m}_{out}$	K-Factor	Fire Size	$\Delta\dot{m}_{out}$
3.0	75	-0.0183	11.2	75	-0.1305
3.0	150	-0.0236	11.2	150	0.0033
4.9	75	-0.0196	4.2	75	0.0239
4.9	150	-0.074	5.6	75	0.0921
5.6	75	0.0412	5.6	150	-0.01
5.6	150	0.0093	0.59	75	0.0243
8.0	75	0.0086	0.59	150	0.0213
8.0	150	-0.0157			

20 | confidential

Effects of Sprinkler Spray

- Decrease temperature
- 2 stratified layers dry but **wet is mixed**
- Increase in mass flow unlike Crocker
- Using a cooling coefficient in Rockett's equation not strictly valid

TY-4211, K-8.0



Room corner temperature profile

K-Factor	Fire Size	$\Delta \dot{m}_{out}$	K-Factor	Fire Size	$\Delta \dot{m}_{out}$
3.0	75	-0.0183	11.2	75	-0.1305
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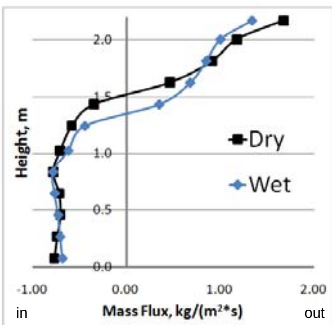
4.9	150	-0.074	5.6	75	0.0921
5.6	75	0.0412	5.6	150	-0.01
5.6	150	0.0093	0.59	75	0.0243
8.0	75	0.0086	0.59	150	0.0213
8.0	150	-0.0157			

21 confidential

Effects of Sprinkler Spray

- Mass flux profile changes after activation
- Outflow increases
- Sprinkler must be inducing some flow

75kW Dry, TY-4211, K-8.0

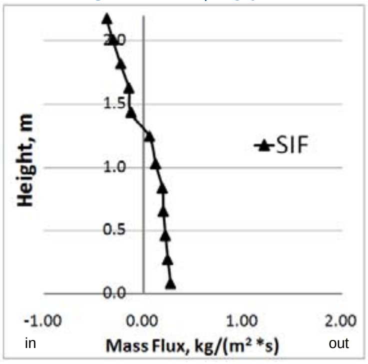


22 confidential

Effects of Sprinkler Spray

- Sprinklers induce a doorway flow
- Similar shape, opposite direction as sprinkler
- Will likely have an effect on the fire scenario

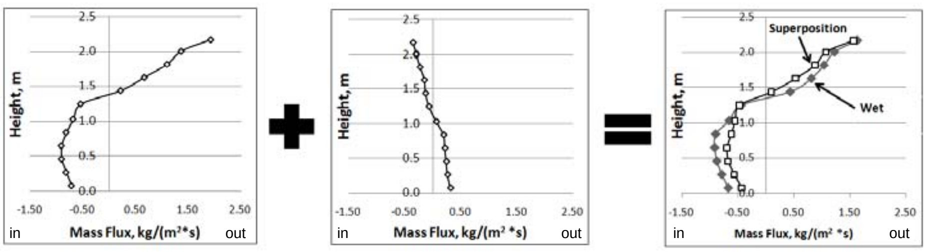
SIF: TY-4421, K-8.0



23 | confidential

Direct Superposition of DRY and SIF

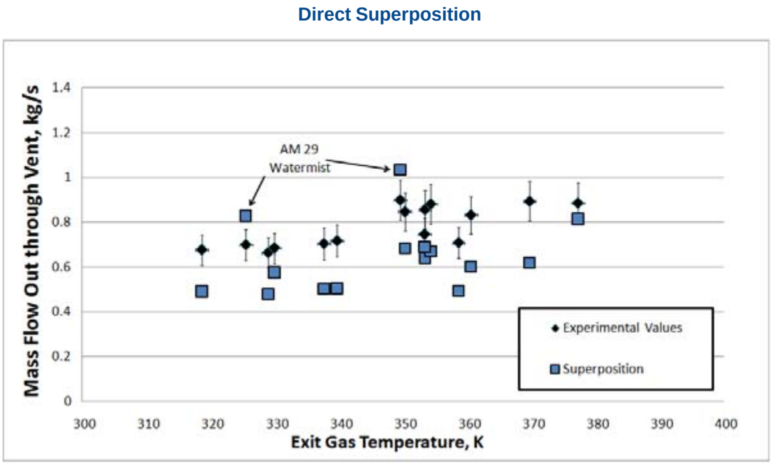
DRY: 150 kW **SIF: TY-4421, K-8.0** **Superposition / Wet**



Sample superposition of mass flux profiles compared to a Wet profile

24 | confidential

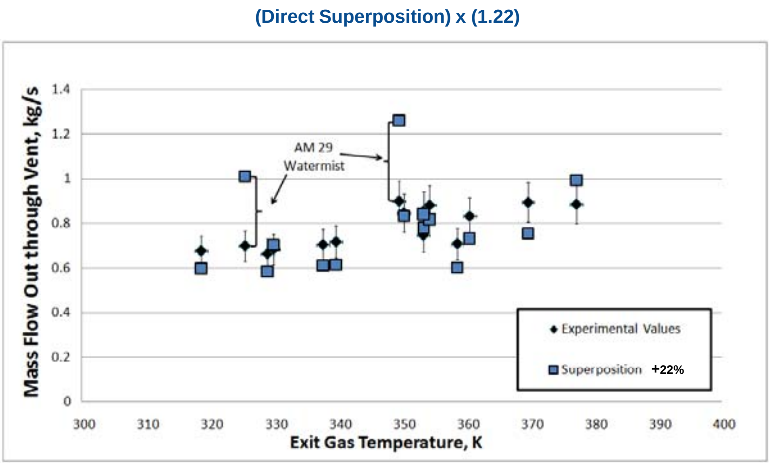
Direct Superposition vs. Wet Data



Experimental data compared to direct superposition data: superposition is consistently low

25 | confidential

Calibrated Superposition vs. Wet Data

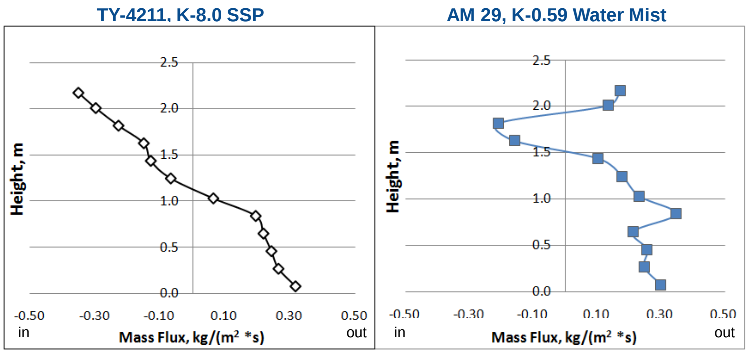


Experimental data compared to calibrated superposition data

26 | confidential

AM 29

- Comparison of mass flux profiles



Approximately linear — Turbulent

27 | confidential

Equation to Model Flow

- Calibrated Superposition
  - Requires a database of DRY and SIF mass flux profiles
  - not fully capture physics

$$\dot{m}_{out} = C_c \int_{Z_n}^{H} ([DRY] + [SIF])\, dA$$

C_c = 1.22 for our data set

28 | confidential

Conclusion

- Experimental setup is valid
- Mass flow increases → Crocker's method not strictly valid

- 3 Effects of sprinkler spray
  - Mixing
  - Cooling
  - Induced mass flow

- Superposition is a "next-step"
- More work needs to be done to fully understand this phenomena

Future Work

- Additional research to better understand the physics
- Tests should include
  - More fire sizes
  - More sprinklers
  - Different compartment geometry

Future Work

- Creation of a simple engineering tool
  - Theoretically based equation
  - Does not require any mass flux profiles
  - Requires specific information about the sprinkler
  - Much more research required
- Could be easily used in PBD

$$\dot{m}_{out} = C_c * [ROCKETT] + f(Q_s, \theta, V_s, \dots)$$

31 confidential

Thank You

- Prof. Nick Dembsey - WPI
- Tyco Team
  - James Morgan – Project Leader
  - Zachary Magnone
  - Jeremiah Crocker
  - Dr. Patricia Beaulieu

32 confidential


Thank You ☺ Questions ?

Appendix H: Presentation for TFSBP President George Oliver Slides

tyco
Fire Suppression
& Building Products

WPI
上海交通大学 Shanghai Jiao Tong

TSP Student Intern Project
Suppression Team

Valerie Adams

Zhiyi Han (Henry)

Steven Southard

Chang Su (Robin)

Introduction

- Lack of scientific understanding of the effect of sprinklers on fire scenarios
  - a current topic of research by the fire community
- Crocker previously suggested simple methods for incorporating sprinklers in fire environments is possible
  - sprinkler cooling coefficient
- Data is needed to provide evidence that the concept holds true for more than the limited conditions used by Crocker.

2

Project Objective

- Obtain a dataset of fire induced doorway flow for various fire sizes and sprinkler models

- Provide unique training in fire science research to the students
- Provide exposure to the particulars of fire testing
- The deliverable is a conference paper written by the students

- This information is very much needed
  - Incorporating sprinklers in performance based design
  - PBD allows unique solutions, as opposed to current code-driven prescriptive approach

3

Suppression Team - Students

From Left: Henry, Robin, Val, Steve

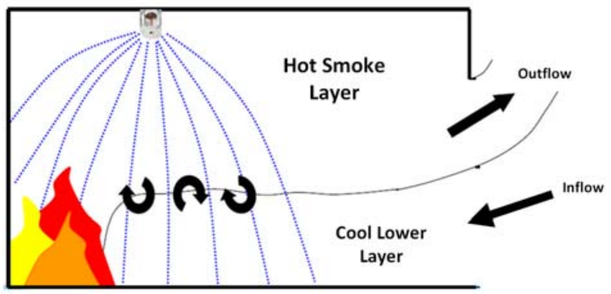
4

What We Will Cover

- The Project
- Developing a Plan of Action
- Handling Unexpected Problems
- Project Conclusions
- Managing Cultural Differences
- Team Collaboration
- Suggestions for Improvement

5

The Project



- Well understood unsprinklered
- Limited understanding sprinklered

6

Developing a Plan of Action

- **PQP preparation learning**
  - Enclosure fire dynamics and Basic experimental concepts
  - Research proposal/plan written
- **During MQP**
  - Developed more detailed plan and checklist
  - Finalized sprinklers and fire sizes to be tested
  - Created and modified testing schedule
  - Completed enclosure preperation
  - Implemented plan
    - Collected data - Analyzed data
  - Documented project including conference paper and presentation

7

Handling “Unexpected” Problems

Inflow ≠ Outflow

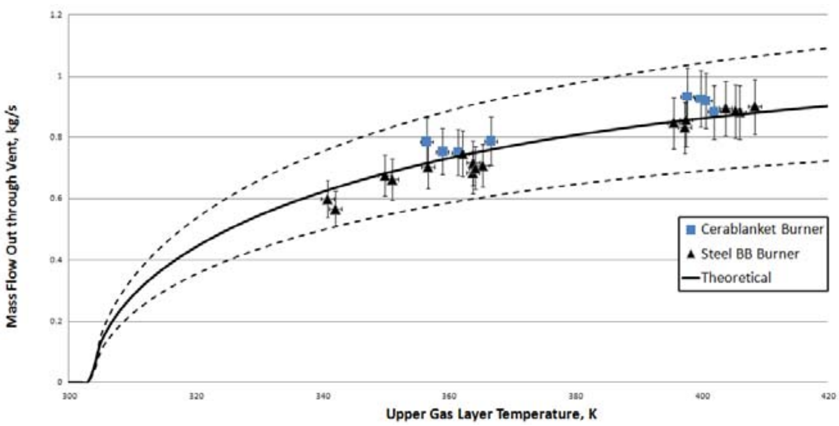
- Determination of cause
  - Seal of the compartment
  - Checked instrumentation
  - Measurement location in the doorway
- Changed measurement location

Other Problems

- Some fires were too large
  - Discontinued testing them
- Initial burner was affected by water
  - Designed a new burner that was not affected by water

8

Experimental Validation



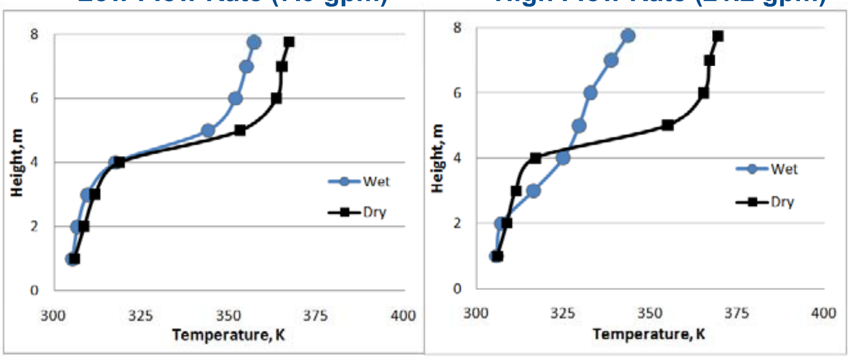
Experimental data matches work done by Rocket within the experimental margin of error

9

Mixing

Low Flow Rate (7.9 gpm)

High Flow Rate (21.2 gpm)

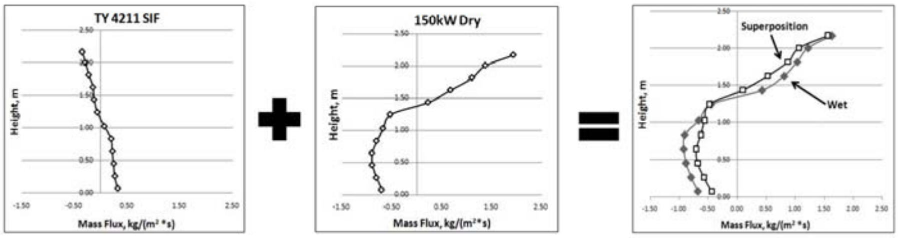


Non-mixed

Mixed

10

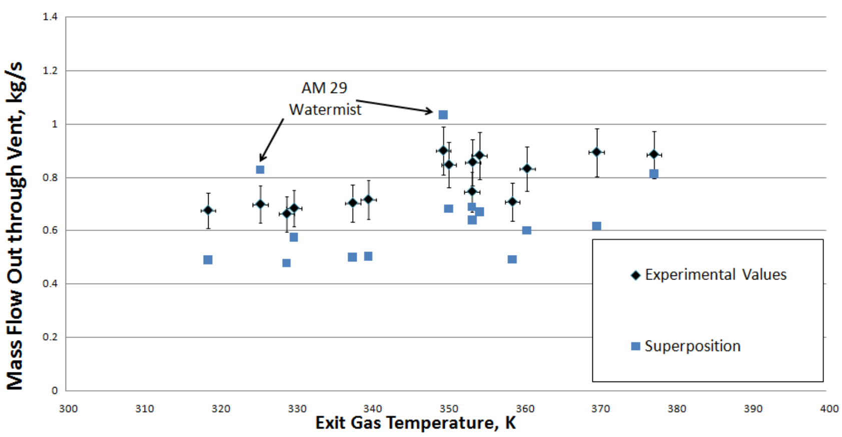
Superposition



Sample superposition of mass flux profiles compared to a Wet profile

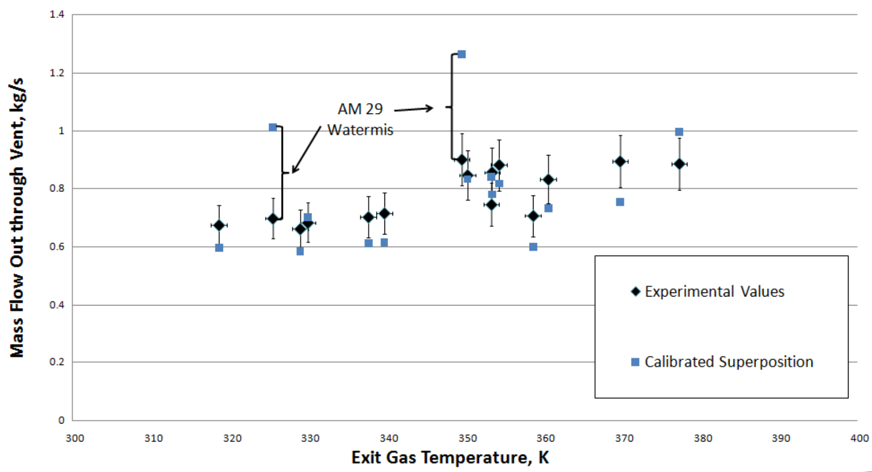
11

Conclusions



12

Conclusions

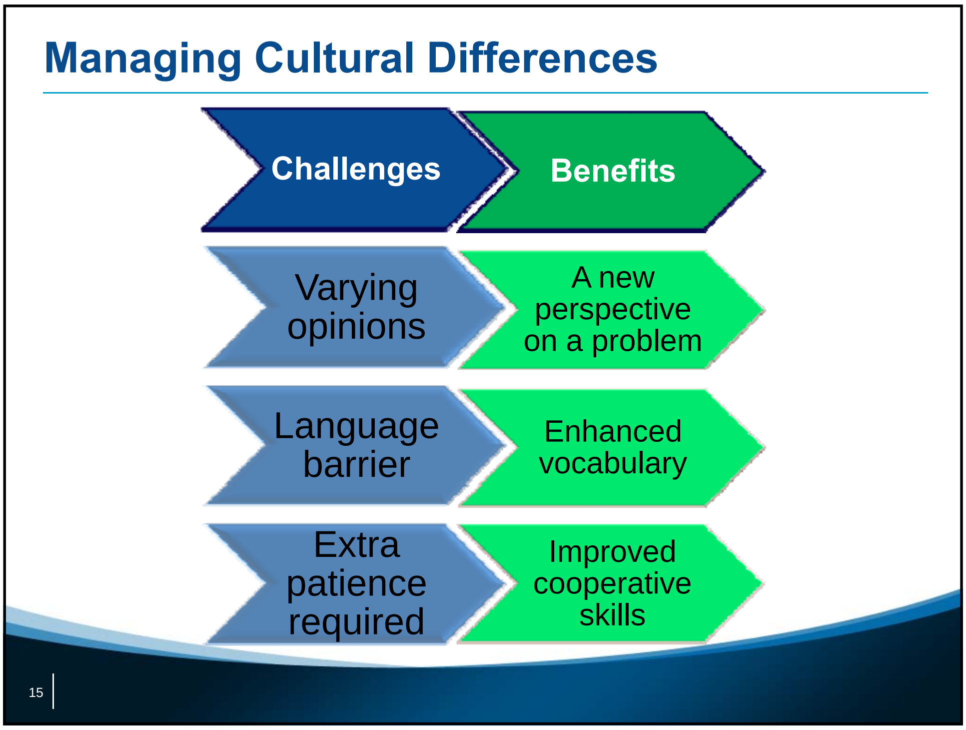


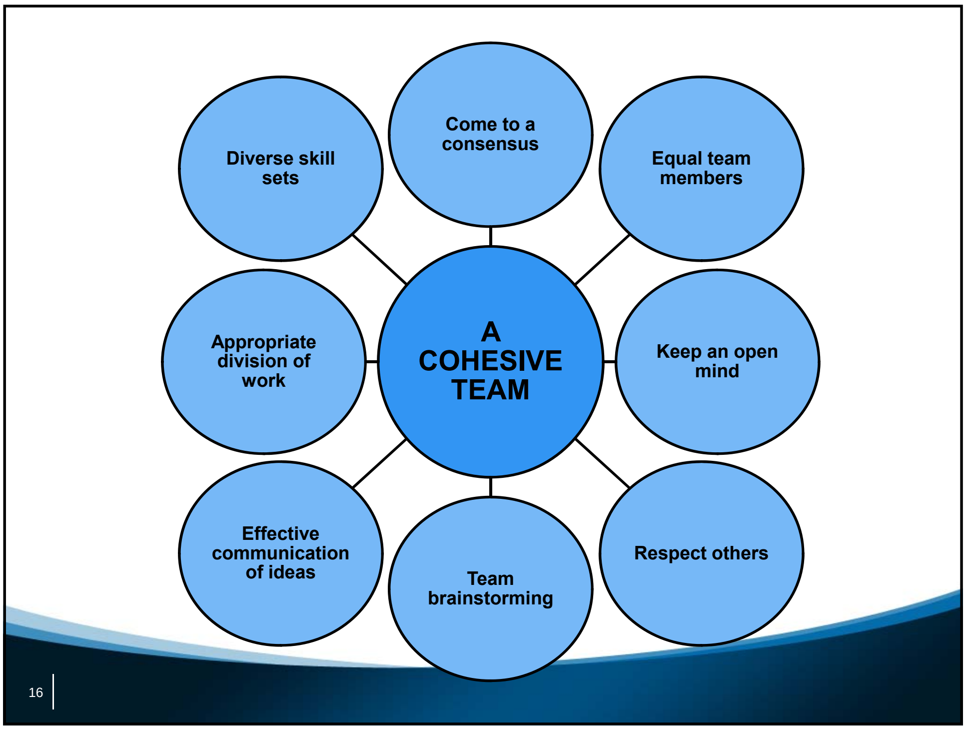
13

Conclusions

- Water flow mixes upper gas layer with lower gas layer making Rocket's equation with just a cooling coefficient (Crocker) not strictly valid
- Found 3 confounded phenomena present in a sprinklered fire scenario
  - Cooling effect of the sprinkler
  - Mass flow induced by the sprinkler flow
  - Mixing
- Original contribution to scientific literature
- Made a significant step forward from Crocker's research

14


Managing Cultural Differences
Challenges
Benefits
Varying opinions
A new perspective on a problem
Language barrier
Enhanced vocabulary
Extra patience required
Improved cooperative skills
15


A COHESIVE TEAM
Come to a consensus
Diverse skill sets
Equal team members
Appropriate division of work
Keep an open mind
Effective communication of ideas
Team brainstorming
Respect others
16

Suggestions for Improvement

- For Chinese Students:
  - Better understand American culture
  - Language skills related to engineering
  - Preparation – more fire science
- For American Students:
  - Better understanding of Chinese culture
  - Preparation – more fire science
- For Tyco
  - Team building activities before starting the project (schedule conflict this year)

17

Thank You

- Prof. Nick Dembsey - WPI
- Tyco Team
  - James Morgan – Project Leader
  - Zachary Magnone
  - Jeremiah Crocker
  - Dr. Patricia Beaulieu
  - Yuen Chan – cultural aspects

18

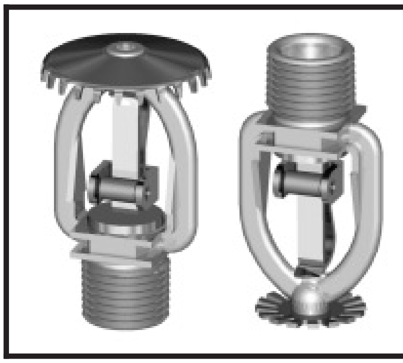

Thank You ☺ Questions ?

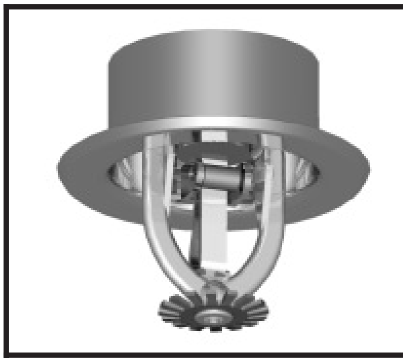
Appendix I: Sprinkler Data Sheets

tyco / Fire & Building Products

Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

Series TY-L — 5.6 and 8.0 K-factor Upright, Pendent, and Recessed Pendent Sprinklers Standard Response, Standard Coverage





General Description

The Series TY-L, 5.6 and 8.0 K-factor, Upright and Pendent Sprinklers described in this data sheet are standard response - standard coverage, solder type spray sprinklers designed for use in light, ordinary, and extra hazard, commercial occupancies such as banks, hotels, shopping malls, factories, refineries, chemical plants, etc.

The recessed version of the Series TY-L Pendent Sprinkler, where applicable, is intended for use in areas with a finished ceiling. It uses a two-piece Style 20 (1/2 inch NPT) or Style 30 (3/4 inch NPT) Recessed Escutcheon. The Recessed Escutcheon provides 1/4 inch (6,4 mm) of recessed adjustment or up to 1/2 inch (12,7 mm) of total adjustment from the flush pendent position. The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the fixed pipe drops to the sprinklers must be cut.

Corrosion resistant coatings, where applicable, are utilized to extend the life of copper alloy sprinklers beyond that which would otherwise be obtained when exposed to corrosive atmospheres. Although corrosion resistant coated sprinklers have passed the standard corrosion tests of the applicable approval agencies, the testing is not representative of all possible corrosive atmospheres. Consequently, it is recommended that the end user be consulted with respect to the suitability of these coatings for any given corrosive environment. The effects of ambient temperature, concentration of chemicals, and gas/chemical velocity, should be considered, as a minimum, along with the corrosive nature of the chemical to which the sprinklers will be exposed.

An intermediate level version of the Series TY-L Pendent Sprinkler can be obtained by utilizing the Series TY-L Pendent Sprinkler in combination with the Model S Shield.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

WARNINGS

The Series TY-L Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. ***Failure to do so may impair the performance of these devices.***

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Model/Sprinkler Identification Numbers

TY3111 - Upright 5.6K, 1/2"NPT
TY3211 - Pendent 5.6K, 1/2"NPT
TY4111 - Upright 8.0K, 3/4"NPT
TY4211 - Pendent 8.0K, 3/4"NPT
TY4811 - Upright 8.0K, 1/2"NPT
TY4911 - Pendent 8.0K, 1/2"NPT

TY3111 is a redesignation for S1800 and G3111.

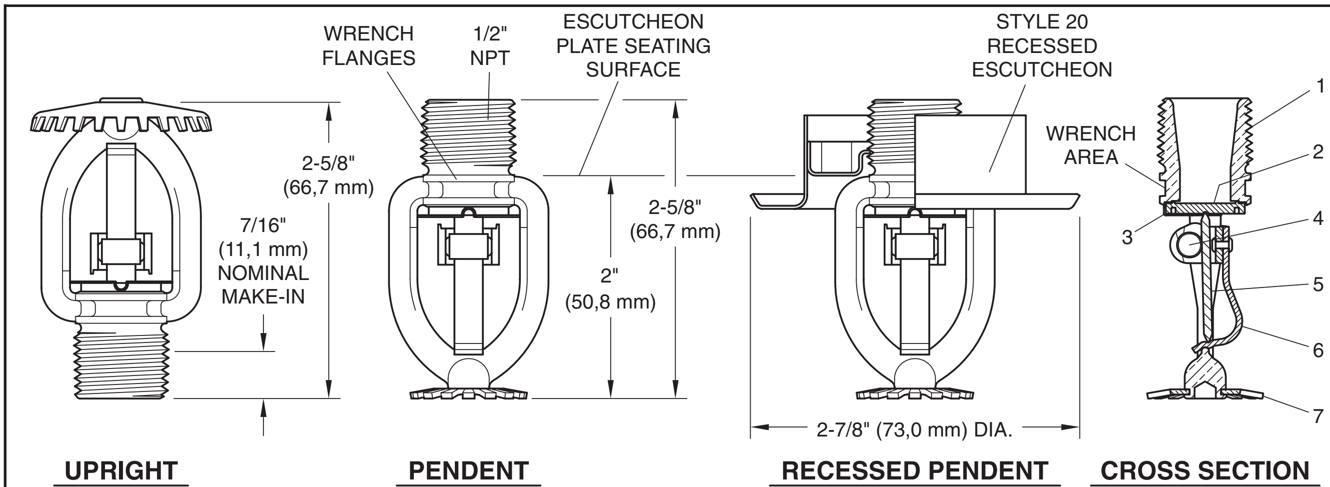
TY3211 is a redesignation for S1801 and G3112.

TY4111 is a redesignation for S1810 and G3101.

TY4211 is a redesignation for S1811 and G3102.

TY4811 is a redesignation for S1805.

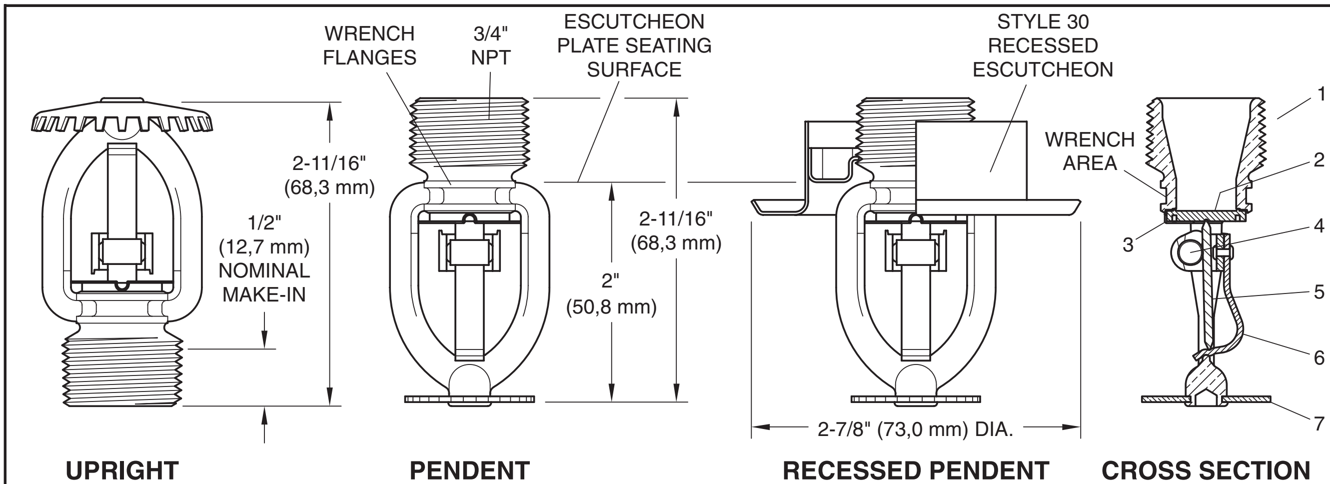
TY4911 is a redesignation for S1806



1 - Frame
2 - Sealing Button
3 - Ejection Spring
4 - Fusible Element
5 - Strut
6 - Hook
7 - Deflector

* Temperature rating is indicated on deflector.
**Pipe thread connections per ISO 7/1 can be provided on special request.

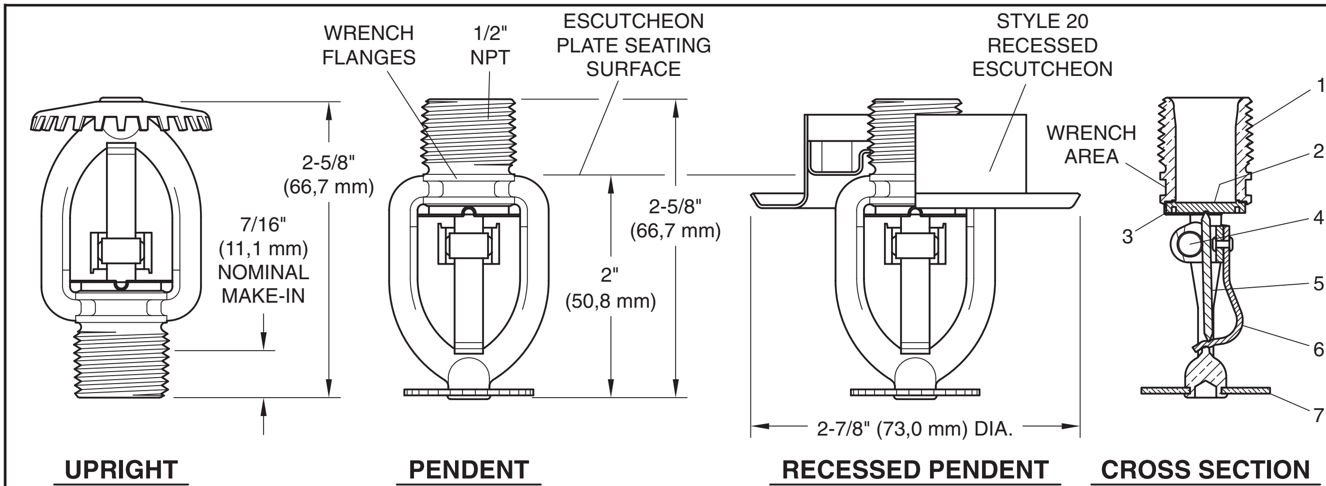
FIGURE 1
STANDARD RESPONSE SERIES TY-L UPRIGHT (TY3111) AND PENDENT (TY3211) SPRINKLERS
5.6 K-FACTOR, 1/2 INCH NPT



1 - Frame
2 - Sealing Button
3 - Ejection Spring
4 - Fusible Element
5 - Strut
6 - Hook
7 - Deflector

* Temperature rating is indicated on deflector.
**Pipe thread connections per ISO 7/1 can be provided on special request.

FIGURE 2
STANDARD RESPONSE SERIES TY-L UPRIGHT (TY4111) AND PENDENT (TY4211) SPRINKLERS
8.0 K-FACTOR, 3/4 INCH NPT



1 - Frame
2 - Sealing Button
3 - Ejection Spring
4 - Fusible Element
5 - Strut
6 - Hook
7 - Deflector

* Temperature rating is indicated on deflector.
** Pipe thread connections per ISO 7/1 can be provided on special request.

FIGURE 3
STANDARD RESPONSE SERIES TY-L UPRIGHT (TY4811) AND PENDENT (TY4911) SPRINKLERS
8.0 K-FACTOR, 1/2 INCH NPT

Technical Data

Approvals
UL and C-UL Listed.
FM, and LPCB Approved.
(Refer to Table A for complete approval information including corrosion resistant status.)

Maximum Working Pressure
175 psi (12,1 bar)

Discharge Coefficient
K = 5.6 GPM/psi$^{1/2}$ (80,6 LPM/bar$^{1/2}$)
K = 8.0 GPM/psi$^{1/2}$ (115,2 LPM/bar$^{1/2}$)

Temperature Ratings
Refer to Table A

Finishes
Sprinkler: Refer to Table A
Recessed Escutcheon: White Coated, Chrome Plated, or Brass Plated

Physical Characteristics
Frame . . . . Brass
Sealing Button . . Bronze w/Teflon†
Ejection Spring . . . . Stainless Steel
Fusible Element . . . Solder, Copper
. . . . Stainless Steel
Strut . . . . Monel
Hook . . . . Bronze/Monel
Deflector . . . . Bronze
† DuPont Registered Trademark

Operation

A copper tube sealed by two stainless steel balls holds a fusible alloy. When the rated temperature is reached, the alloy melts, the balls are forced toward each other releasing the tension mechanism, allowing the sprinkler to operate.

Design Criteria

The Series TY-L Pendent and Upright Sprinklers are intended for fire protection systems designed in accordance with the standard installation rules recognized by the applicable Listing or Approval agency (e.g., UL Listing is based on the requirements of NFPA 13, and FM Approval is based on the requirements of FM's Loss Prevention Data Sheets). Only the Style 20 or 30 Recessed Escutcheon, as applicable, is to be used for recessed pendent installations.

Installation

The Series TY-L Sprinklers must be installed in accordance with the following instructions:

NOTES

A leak tight 1/2 inch NPT sprinkler joint should be obtained with a torque of 7 to 14 ft.lbs. (9,5 to 19,0 Nm). A maximum of 21 ft. lbs. (28,5 Nm) of torque may be used to install sprinklers with 1/2 NPT connections. A leak tight 3/4 inch NPT sprinkler joint should be obtained with a torque of 10 to 20 ft.lbs. (13,4 to 26,8 Nm). A maximum of 30 ft.lbs. (40,7 Nm) of torque is to be used to install sprinklers with 3/4 NPT connections. Higher levels of torque may distort the sprinkler inlet and cause leakage or impairment of the sprinkler.

Do not attempt to make-up for insufficient adjustment in the escutcheon plate by under- or over-tightening the sprinkler. Readjust the position of the sprinkler fitting to suit.

The **Series TY-L Pendent and Upright Sprinklers** must be installed in accordance with the following instructions.

Step 1. Pendent sprinklers are to be installed in the pendent position, and upright sprinklers are to be installed in the upright position.

Step 2. With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

<table>
<tr><th colspan="4"></th><th colspan="5">SPRINKLER FINISH</th></tr>
<tr><th>K</th><th>TYPE</th><th>TEMP.
RATING</th><th>FRAME COLOR CODE</th><th>NATURAL BRASS</th><th>CHROME PLATED</th><th>LEAD COATED</th><th>WAX COATED</th><th>WAX OVER LEAD COATED</th></tr>
<tr><td rowspan="5">5.6
1/2"
NPT</td><td rowspan="3">PENDENT (TY3211)
and
UPRIGHT (TY3111)</td><td>165°F/74°C</td><td>Unpainted</td><td rowspan="3" colspan="2">1, 2, 3, 5</td><td rowspan="2" colspan="3">1, 2, 3</td></tr>
<tr><td>212°F/100°C</td><td>White</td></tr>
<tr><td>280°F/138°C</td><td>Blue</td><td>1, 2</td><td>4</td><td>N/A</td></tr>
<tr><td rowspan="2">RECESSED PENDENT
(TY3211 w/ Style 20)</td><td>165°F/74°C</td><td>Unpainted</td><td colspan="2">1, 2, 3, 5</td><td rowspan="2" colspan="3">N/A</td></tr>
<tr><td>212°F/100°C</td><td>White</td><td colspan="2">1, 2, 3, 5</td></tr>
</table>

<table>
<tr><th colspan="4"></th><th colspan="5">SPRINKLER FINISH</th></tr>
<tr><th>K</th><th>TYPE</th><th>TEMP.
RATING</th><th>FRAME COLOR CODE</th><th>NATURAL BRASS</th><th>CHROME PLATED</th><th>LEAD COATED</th><th>WAX COATED</th><th>WAX OVER LEAD COATED</th></tr>
<tr><td rowspan="5">8.0
3/4"
NPT</td><td rowspan="3">PENDENT (TY4211)
and
UPRIGHT (TY4111)</td><td>165°F/74°C</td><td>Unpainted</td><td rowspan="3" colspan="2">1, 2, 3, 5</td><td rowspan="2" colspan="3">1, 2, 3</td></tr>
<tr><td>212°F/100°C</td><td>White</td></tr>
<tr><td>280°F/138°C</td><td>Blue</td><td>1, 2</td><td>4</td><td>N/A</td></tr>
<tr><td rowspan="2">RECESSED PENDENT
(TY4211 w/ Style 30)</td><td>165°F/74°C</td><td>Unpainted</td><td rowspan="2" colspan="2">1, 2, 5</td><td rowspan="2" colspan="3">N/A</td></tr>
<tr><td>212°F/100°C</td><td>White</td></tr>
</table>

<table>
<tr><th colspan="4"></th><th colspan="5">SPRINKLER FINISH</th></tr>
<tr><th>K</th><th>TYPE</th><th>TEMP.
RATING</th><th>FRAME COLOR CODE</th><th>NATURAL BRASS</th><th>CHROME PLATED</th><th>LEAD COATED</th><th>WAX COATED</th><th>WAX OVER LEAD COATED</th></tr>
<tr><td rowspan="5">8.0
1/2"
NPT</td><td rowspan="3">PENDENT (TY4911)
and
UPRIGHT (TY4811)</td><td>165°F/74°C</td><td>Unpainted</td><td rowspan="3" colspan="2">1, 2, 3, 5</td><td rowspan="2" colspan="3">1, 2, 3</td></tr>
<tr><td>212°F/100°C</td><td>White</td></tr>
<tr><td>280°F/138°C</td><td>Blue</td><td>1, 2</td><td colspan="2">N/A</td></tr>
<tr><td rowspan="2">RECESSED PENDENT
(TY4911 w/ Style 20)</td><td>165°F/74°C</td><td>Unpainted</td><td rowspan="2" colspan="2">1, 2</td><td rowspan="2" colspan="3">N/A</td></tr>
<tr><td>212°F/100°C</td><td>White</td></tr>
</table>

NOTES:
1. Listed by Underwriters Laboratories, Inc. (UL).
2. Listed by Underwriters Laboratories, Inc. for use in Canada (C-UL).
3. Approved by Factory Mutual Research Corporation (FM).
4. Approved by Factory Mutual Research Corporation (FM) for maximum 150°F/68°C ambient temperatures.
5. Approved by the Loss Prevention Certification Board (LPCB Ref. No. 094a/03).

N/A: Not Available

TABLE A
LABORATORY LISTINGS AND APPROVALS

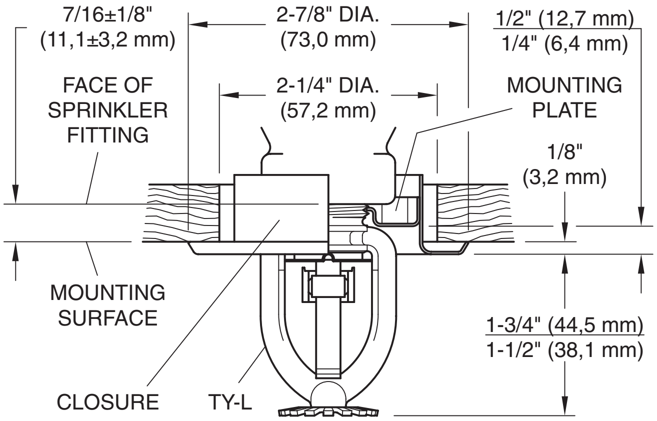


FIGURE 4
SERIES TY-L (TY3211) RECESSED PENDENT SPRINKLER ASSEMBLY WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT STYLE 20 RECESSED ESCUTCHEON 5.6 K-FACTOR, 1/2 INCH NPT

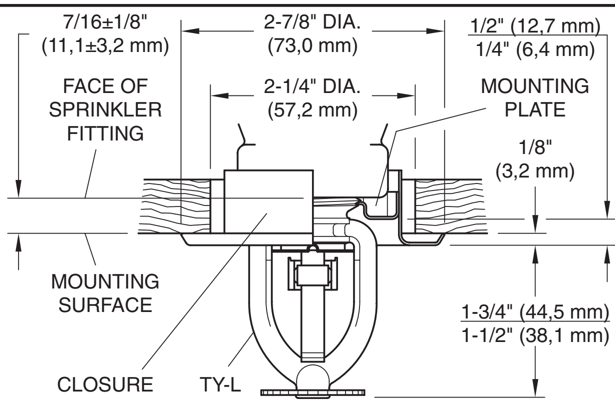


FIGURE 5
SERIES TY-L (TY4211) RECESSED PENDENT SPRINKLER ASSEMBLY WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT STYLE 30 RECESSED ESCUTCHEON 8.0 K-FACTOR, 3/4 INCH NPT

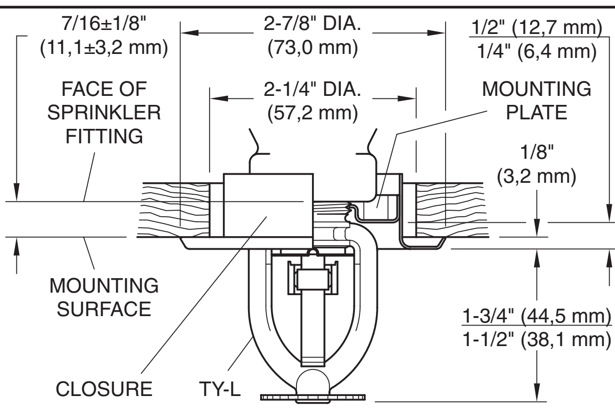


FIGURE 6
SERIES TY-L (TY4911) RECESSED PENDENT SPRINKLER ASSEMBLY WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT STYLE 20 RECESSED ESCUTCHEON 8.0 K-FACTOR, 1/2 INCH NPT

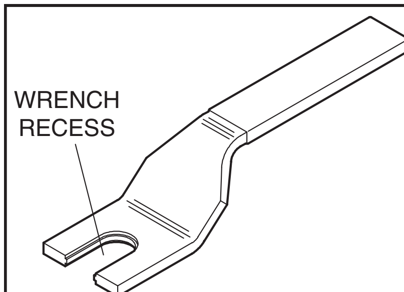


FIGURE 7
W-TYPE 9 SPRINKLER WRENCH

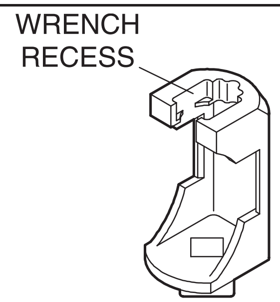


FIGURE 8
W-TYPE 10 RECESSED SPRINKLER WRENCH

Step 3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 9 Sprinkler Wrench (Ref. Figure 7), except that an 8 or 10 inch adjustable Crescent wrench is to be used for wax coated sprinklers. With reference to Figures 1, 2, and 3, the W-Type 9 Sprinkler Wrench is to be applied to the wrench area, or as applicable, the adjustable Crescent wrench is to be applied to the wrenching flanges.

When installing wax coated sprinklers with the adjustable Crescent wrench, additional care needs to be exercised to prevent damage to the wax coating on the sprinkler wrench flats or frame arms and, consequently, exposure of bare metal to the corrosive environment. The jaws of the wrench should be opened sufficiently wide to pass over the wrench flats without damaging the wax coating. Before wrench tightening the sprinkler, the jaws of the wrench are to be adjusted to just contact the sprinkler wrench flats. After wrench tightening the sprinkler, loosen the wrench jaws before removing the wrench.

After installation, the sprinkler wrench flats and frame arms must be inspected and the wax coating retouched (repaired) whenever the coating has been damaged and bare metal is exposed. The wax coating on the wrench flats can be retouched by gently applying a heated 1/8 inch diameter steel rod to the areas of wax that have been damaged, to smooth it back over areas where bare metal is exposed.

NOTES

Only retouching of the wax coating applied to the wrench flats and frame arms is permitted, and the retouching is to be performed only at the time of the initial sprinkler installation.

The steel rod should be heated only to the point at which it can begin to melt the wax, and appropriate precautions need to be taken, when handling the heated rod, in order to prevent the installer from being burned.

If attempts to retouch the wax coating with complete coverage are unsuccessful, additional wax can be ordered in the form of a wax stick (the end of which is color coded). Only the correct color coded wax is to be used, and retouching of wrench flats and frame arms is only permitted at the time of initial sprinkler installation. With the steel rod heated as previously described, touch the rod to the area requiring additional wax with the rod angled downward, and then touch the wax stick to the rod approximately one-half inch away from the area requiring retouching. The wax will melt and run down onto the sprinkler.

The **Series TY-L Recessed Pendent Sprinklers** must be installed in accordance with the following instructions.

Step A. After installing the Style 20 or 30 Mounting Plate, as applicable, over the sprinkler threads and with pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step B. Tighten the sprinkler into the sprinkler fitting using only the W-Type 10 Recessed Sprinkler Wrench (Ref. Figure 8). With reference to Figure 1, 2, or 3, the W-Type 10 Recessed Sprinkler Wrench is to be applied to the sprinkler wrenching flanges.

Step C. After the ceiling has been installed or the finish coat has been applied, slide on the Style 20 or 30 Closure over the Series TY-L Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the ceiling.

Care and Maintenance

The Series TY-L Sprinklers must be maintained and serviced in accordance with the following instructions:

NOTES

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Absence of an escutcheon, which is used to cover a clearance hole, may delay the time to sprinkler operation in a fire situation.

Sprinklers that are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated or otherwise altered after leaving the factory. Modified or over-heated sprinklers must be replaced.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced.

Frequent visual inspections are recommended to be initially performed for corrosion resistant coated sprinklers, after the installation has been completed, to verify the integrity of the corrosion resistant coating. Thereafter, annual inspections per NFPA 25 should suffice; however, instead of inspecting from the floor level, a random sampling of close-up visual inspections should be made, so as to better determine the exact sprinkler condition and the long term integrity of the corrosion resistant coating, as it may be affected by the corrosive conditions present.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

It is recommended that automatic sprinkler systems be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire Products are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by Tyco Fire Products. No warranty is given for products or components manufactured by companies not affiliated by ownership with Tyco Fire Products or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by Tyco Fire Products to be defective shall be either repaired or replaced, at Tyco Fire Products' sole option. Tyco Fire Products neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. Tyco Fire Products shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

IN NO EVENT SHALL TYCO FIRE PRODUCTS BE LIABLE, IN CONTRACT, TORT, STRICT LIABILITY OR UNDER ANY OTHER LEGAL THEORY, FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LABOR CHARGES, REGARDLESS OF WHETHER TYCO FIRE PRODUCTS WAS INFORMED ABOUT THE POSSIBILITY OF SUCH DAMAGES, AND IN NO EVENT SHALL TYCO FIRE PRODUCTS' LIABILITY EXCEED AN AMOUNT EQUAL TO THE SALES PRICE.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ANY AND ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

P/N 53 — XXX — X — XXX

		MODEL/SIN
111	5.6K UPRIGHT (1/2"NPT)	TY3111
112	5.6K PENDENT (1/2"NPT)	TY3211
101	8.0K UPRIGHT (3/4"NPT)	TY4111
102	8.0K PENDENT (3/4"NPT)	TY4211
106	8.0K UPRIGHT (1/2"NPT)	TY4811
107	8.0K PENDENT (1/2"NPT)	TY4911

	SPRINKLER
1	NATURAL BRASS
9	CHROME PLATED
7	LEAD COATED
6	WAX COATED 165°F to 280°F ONLY
8	WAX OVER LEAD 165°F and 212°F ONLY

	TEMPERATURE RATING
165	165°F/74°C
212	212°F/100°C
280	280°F/138°C

TABLE B
PART NUMBER SELECTION
SERIES TY-L PENDENT AND UPRIGHT SPRINKLERS

Ordering Procedure

When placing an order, indicate the full product name. Refer to the Price List for complete listing of Part Numbers.

Contact your local distributor for availability.

Sprinkler Assemblies with NPT Thread Connections:
Specify: (Specify Model/SIN), Standard Response, (specify K-factor), (specify temperature rating), Series TY-L (specify Pendent or Upright) Sprinkler with (specify type of finish or coating), P/N (specify from Table B).

Recessed Escutcheon:
Specify: Style (specify) Recessed Escutcheon with (specify finish), P/N (specify).

1/2" (15 mm)
Style 20
Chrome Plated . . . . P/N 56-705-9-010
1/2" (15 mm)
Style 20
White Color
Coated . . . . P/N 56-705-4-010
1/2" (15 mm)
Style 20
Brass Plated . . . . P/N 56-705-2-010
3/4" (20 mm)
Style 30
Chrome Plated . . . . P/N 56-705-9-011
3/4" (20 mm)
Style 30
White Color
Coated . . . . P/N 56-705-4-011
3/4" (20 mm)
Style 30
Brass Plated . . . . P/N 56-705-2-011

Sprinkler Wrench:
Specify: W-Type 9 Sprinkler Wrench, P/N 56-000-1-849.

Specify: W-Type 10 Sprinkler Wrench, P/N 56-000-1-948.

Wax Sticks:
(for retouching wrench damaged wax coating)
Specify: (Specify color) color coded Wax Stick for retouching (specify temperature rating) temperature rated Series TY-L Sprinklers, P/N (specify).

Red for 165°F . . . . P/N 56-065-1-155
Blue for 212°F and
280°F . . . . P/N 56-065-1-286

NOTES

Each wax stick is suitable for retouching up to twenty-five sprinklers.

The wax used for 280°F sprinklers is the same as for 212°F sprinklers, and, therefore, the 280°F sprinkler is limited to the same maximum ceiling temperature as the 212°F sprinkler (i.e., 150°F).

tyco / Fire & Building Products

Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

Series TY-B — 2.8, 5.6, and 8.0 K-factor Upright, Pendent, and Recessed Pendent Sprinklers Standard Response, Standard Coverage

General Description

The Series TY-B, 2.8, 5.6, and 8.0 K-factor, Upright and Pendent Sprinklers described in this data sheet are standard response - standard coverage, decorative 5 mm glass bulb type spray sprinklers designed for use in light, ordinary, or extra hazard, commercial occupancies such as banks, hotels, shopping malls, factories, refineries, chemical plants, etc.

The recessed version of the Series TY-B Pendent Sprinkler, where applicable, is intended for use in areas with a finished ceiling. It uses a two-piece Style 10 (1/2 inch NPT) or Style 40 (3/4 inch NPT) Recessed Escutcheon. The Recessed Escutcheon provides 1/2 inch (12,7 mm) of recessed adjustment or up to 3/4 inch (19,1 mm) of total adjustment from the flush pendent position. The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the fixed pipe drops to the sprinklers must be cut.

Corrosion resistant coatings, where applicable, are utilized to extend the life of copper alloy sprinklers beyond that which would otherwise be obtained when exposed to corrosive atmospheres. Although corrosion resistant coated sprinklers have passed the standard corrosion tests of the applicable approval agencies, the testing is not representative of all possible corrosive atmospheres. Consequently, it is recommended that the end user be consulted with respect to the suitability of these coatings for any given corrosive environment. The effects of ambient temperature, concentration of chemicals, and gas/chemical velocity, should be considered, as a minimum, along with the corrosive nature of the chemical to which the sprinklers will be exposed.

An intermediate level version of the Series TY-B Pendent Sprinkler can be obtained by utilizing the Series TY-B Pendent Sprinkler in combination with the Model S2 Shield.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

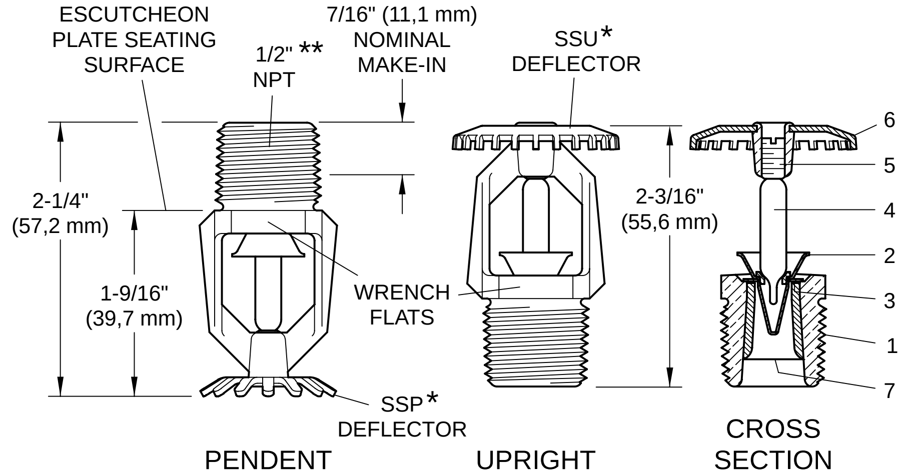
WARNINGS

The Series TY-B Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. ***Failure to do so may impair the performance of these devices.***

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Model/Sprinkler Identification Numbers

TY1151 - Upright 2.8K, 1/2"NPT
TY1251 - Pendent 2.8K, 1/2"NPT
TY3151 - Upright 5.6K, 1/2"NPT
TY3251 - Pendent 5.6K, 1/2"NPT
TY4151 - Upright 8.0K, 3/4"NPT
TY4251 - Pendent 8.0K, 3/4"NPT
TY4851 - Upright 8.0K, 1/2"NPT
TY4951 - Pendent 8.0K, 1/2"NPT

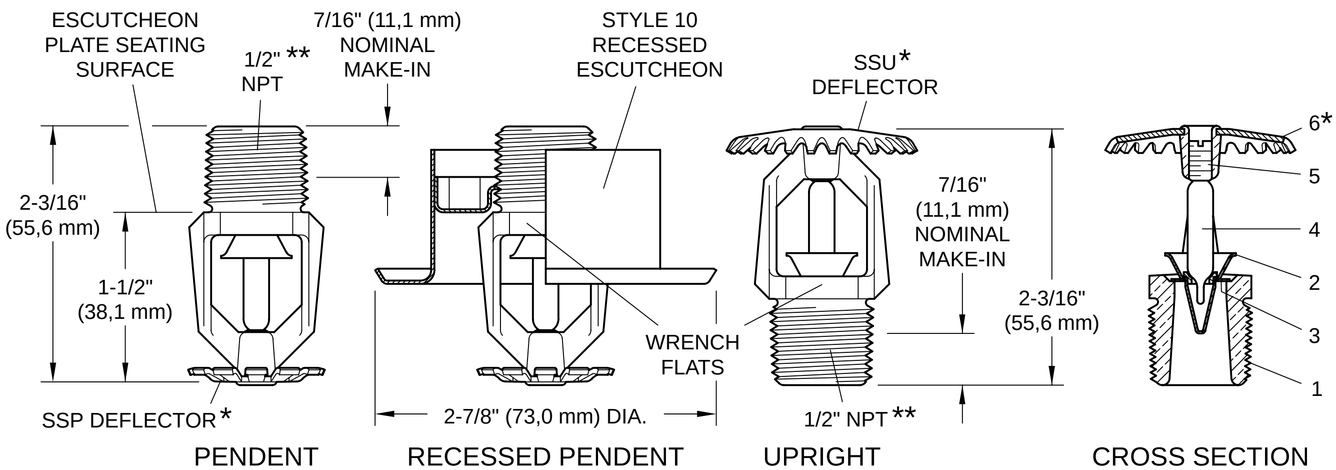


1 - Frame
2 - Button
3 - Sealing Assembly
4 - Bulb
5 - Compression Screw
6 - Deflector
7 - Bushing

* Temperature rating is indicated on deflector or adjacent to orifice seat on frame.

**Pipe thread connections per ISO 7/1 can be provided on special request.

FIGURE 1
STANDARD RESPONSE SERIES TY-B UPRIGHT (TY1151) AND PENDENT (TY1251) SPRINKLERS
2.8 K-FACTOR, 1/2 INCH NPT

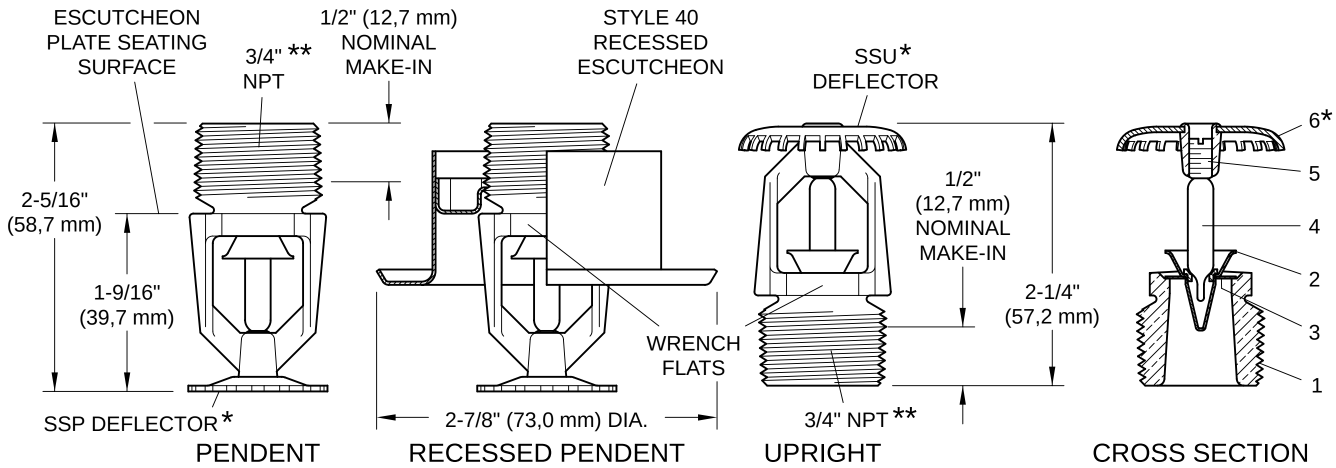


1 - Frame
2 - Button
3 - Sealing Assembly
4 - Bulb
5 - Compression Screw
6 - Deflector

* Temperature rating is indicated on deflector or adjacent to orifice seat on frame.

**Pipe thread connections per ISO 7/1 can be provided on special request.

FIGURE 2
STANDARD RESPONSE SERIES TY-B UPRIGHT (TY3151) AND PENDENT (TY3251) SPRINKLERS
5.6 K-FACTOR, 1/2 INCH NPT

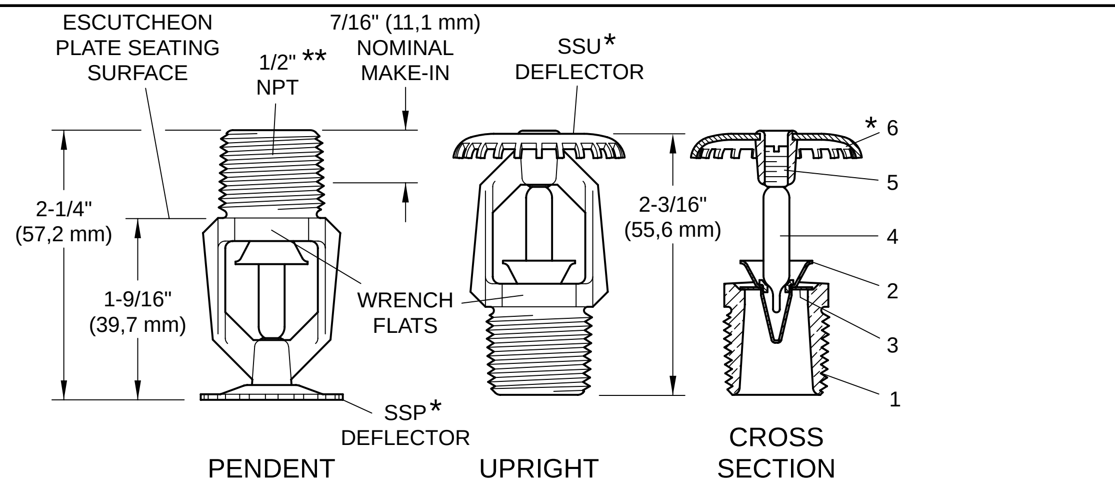


1 - Frame
2 - Button
3 - Sealing Assembly
4 - Bulb
5 - Compression Screw
6 - Deflector

* Temperature rating is indicated on deflector or adjacent to orifice seat on frame.

**Pipe thread connections per ISO 7/1 can be provided on special request.

FIGURE 3
STANDARD RESPONSE SERIES TY-B UPRIGHT (TY4151) AND PENDENT (TY4251) SPRINKLERS
8.0 K-FACTOR, 3/4 INCH NPT



1 - Frame
2 - Button
3 - Sealing Assembly
4 - Bulb
5 - Compression Screw
6 - Deflector

* Temperature rating is indicated on deflector or adjacent to orifice seat on frame.

**Pipe thread connections per ISO 7/1 can be provided on special request.

FIGURE 4
STANDARD RESPONSE SERIES TY-B UPRIGHT (TY4851) AND PENDENT (TY4951) SPRINKLERS
8.0 K-FACTOR, 1/2 INCH NPT

<table>
<tr><th></th><th></th><th></th><th></th><th colspan="6">SPRINKLER FINISH (See Note 8)</th></tr>
<tr><th>K</th><th>TYPE</th><th>TEMP.</th><th>BULB LIQUID</th><th>NATURAL BRASS</th><th>CHROME PLATED</th><th>WHITE*** POLYESTER</th><th>LEAD COATED</th><th>WAX COATED</th><th>WAX OVER LEAD COATED</th></tr>
<tr><td rowspan="6">2.8
1/2"
NPT</td><td rowspan="6">PENDENT (TY1251) and UPRIGHT (TY1151)</td><td>135°F/57°C</td><td>Orange</td><td colspan="3" rowspan="5">1, 2, 3</td><td colspan="3" rowspan="6">N/A</td></tr>
<tr><td>155°F/68°C</td><td>Red</td></tr>
<tr><td>175°F/79°C</td><td>Yellow</td></tr>
<tr><td>200°F/93°C</td><td>Green</td></tr>
<tr><td>286°F/141°C</td><td>Blue</td></tr>
<tr><td>360°F/182°C</td><td>Mauve</td><td colspan="3">1, 2</td></tr>
<tr><td rowspan="11">5.6
1/2"
NPT</td><td rowspan="6">PENDENT (TY3251) and UPRIGHT (TY3151)</td><td>135°F/57°C</td><td>Orange</td><td colspan="3" rowspan="6">1, 2, 3, 4, 5, 6, 7</td><td rowspan="6">1, 2, 3, 5</td><td rowspan="4">1, 2, 3, 5</td><td rowspan="4">1, 2, 3, 5</td></tr>
<tr><td>155°F/68°C</td><td>Red</td></tr>
<tr><td>175°F/79°C</td><td>Yellow</td></tr>
<tr><td>200°F/93°C</td><td>Green</td></tr>
<tr><td>286°F/141°C</td><td>Blue</td><td>1**,2**, 3**, 5**</td><td>1**, 2**, 3**, 5**</td></tr>
<tr><td>360°F/182°C</td><td>Mauve</td><td colspan="2">N/A</td></tr>
<tr><td rowspan="5">RECESSED PENDENT (TY3251)* Figure 4</td><td>135°F/57°C</td><td>Orange</td><td colspan="3" rowspan="4">1, 2, 3, 4, 5</td><td colspan="3" rowspan="5">N/A</td></tr>
<tr><td>155°F/68°C</td><td>Red</td></tr>
<tr><td>175°F/79°C</td><td>Yellow</td></tr>
<tr><td>200°F/93°C</td><td>Green</td></tr>
<tr><td>286°F/141°C</td><td>Blue</td><td colspan="3">1, 2</td></tr>
<tr><td rowspan="11">8.0
3/4"
NPT</td><td rowspan="6">PENDENT (TY4251) and UPRIGHT (TY4151)</td><td>135°F/57°C</td><td>Orange</td><td colspan="3" rowspan="6">1, 2, 3, 4, 5, 6, 7</td><td rowspan="6">1, 2, 5</td><td rowspan="4">1, 2, 3, 5</td><td rowspan="4">1, 2, 5</td></tr>
<tr><td>155°F/68°C</td><td>Red</td></tr>
<tr><td>175°F/79°C</td><td>Yellow</td></tr>
<tr><td>200°F/93°C</td><td>Green</td></tr>
<tr><td>286°F/141°C</td><td>Blue</td><td>1**,2**, 3**, 5**</td><td>1**, 2**, 5**</td></tr>
<tr><td>360°F/182°C</td><td>Mauve</td><td colspan="2">N/A</td></tr>
<tr><td rowspan="5">RECESSED PENDENT (TY4251)* Figure 5</td><td>135°F/57°C</td><td>Orange</td><td colspan="3" rowspan="4">1, 2, 3, 4, 5</td><td colspan="3" rowspan="5">N/A</td></tr>
<tr><td>155°F/68°C</td><td>Red</td></tr>
<tr><td>175°F/79°C</td><td>Yellow</td></tr>
<tr><td>200°F/93°C</td><td>Green</td></tr>
<tr><td>286°F/141°C</td><td>Blue</td><td colspan="3">1, 2</td></tr>
<tr><td rowspan="6">8.0
1/2"
NPT</td><td rowspan="6">PENDENT (TY4951) and UPRIGHT (TY4851)</td><td>135°F/57°C</td><td>Orange</td><td colspan="3" rowspan="6">1, 2, 3, 4, 5, 6</td><td colspan="3" rowspan="6">N/A</td></tr>
<tr><td>155°F/68°C</td><td>Red</td></tr>
<tr><td>175°F/79°C</td><td>Yellow</td></tr>
<tr><td>200°F/93°C</td><td>Green</td></tr>
<tr><td>286°F/141°C</td><td>Blue</td></tr>
<tr><td>360°F/182°C</td><td>Mauve</td></tr>
</table>

NOTES:
1. Listed by Underwriters Laboratories, Inc. (UL).
2. Listed by Underwriters Laboratories, Inc. for use in Canada (C-UL).
3. Approved by Factory Mutual Research Corporation (FM).
4. Approved by the Loss Prevention Certification Board (LPCB Ref. No. 007k/03).
5. Approved by the City of New York under MEA 354-01-E.
6. VdS Approved (For details contact Tyco Fire & Building Products, Enschede, Netherlands, Tel. 31-53-428-4444/Fax 31-53-428-3377).
7. Approved by the Loss Prevention Certification Board (LPCB Ref. No. 094a/05).
8. Where Polyester Coated, Lead Coated, Wax Coated, and Wax over Lead Coated Sprinklers are noted to be UL and C-UL Listed, the sprinklers are UL and C-UL Listed as Corrosion Resistant Sprinklers. Where Lead Coated, Wax Coated, and Wax over Lead Coated Sprinklers are noted to be FM Approved, the sprinklers are FM Approved as Corrosion Resistant Sprinklers.

* Installed with Style 10 (1/2" NPT) or Style 40 (3/4" NPT) 3/4" Total Adjustment Recessed Escutcheon, as applicable.
** 150°F/66°C Maximum Ceiling Temperature.
*** Frame and deflector only. Listings and approvals apply to color (Special Order).

TABLE A, LABORATORY LISTINGS AND APPROVALS

K	TYPE	SPRINKLER FINISH: NATURAL BRASS	CHROME PLATED	WHITE POLYESTER	LEAD COATED	WAX COATED	WAX OVER LEAD COATED
2.8 1/2" NPT	**PENDENT (TY1251) and UPRIGHT (TY1151)**	175 PSI (12,1 BAR)			N/A		
5.6 1/2" NPT	**PENDENT (TY3251) and UPRIGHT (TY3151)**	250 PSI (17,2 BAR) OR 175 PSI (12,1 BAR) (SEE NOTE 1)			175 PSI (12,1 BAR)		
	RECESSED PENDENT (TY3251)				N/A		
8.0 3/4" NPT	**PENDENT (TY4251) and UPRIGHT (TY4151)**	175 PSI (12,1 BAR)					
	RECESSED PENDENT (TY4251)	175 PSI (12,1 BAR)			N/A		
8.0 1/2" NPT	**PENDENT (TY4951) and UPRIGHT (TY4851)**	175 PSI (12,1 BAR)					

NOTE:
1. The maximum working pressure of 250 psi (17,2 bar) only applies to the Listing by Underwriters Laboratories, Inc. (UL); the Listing by Underwriters Laboratories, Inc. for use in Canada (C-UL); and, the Approval by the City of New York.

TABLE B, MAXIMUM WORKING PRESSURE

Technical Data

Approvals
UL and C-UL Listed.
FM, LPCB, VdS, and NYC Approved.
(Refer to Table A for complete approval information including corrosion resistant status.)

Maximum Working Pressure
Refer to Table B.

Discharge Coefficient
K = 2.8 GPM/psi$^{1/2}$ (40,3 LPM/bar$^{1/2}$)
K = 5.6 GPM/psi$^{1/2}$ (80,6 LPM/bar$^{1/2}$)
K = 8.0 GPM/psi$^{1/2}$ (115,2 LPM/bar$^{1/2}$)

Temperature Ratings
Refer to Table A.

Finishes
Sprinkler: Refer to Table A.
Recessed Escutcheon: White Coated, Chrome Plated, or Brass Plated.

Physical Characteristics
Frame . . . . Bronze
Button . . . . Brass/Copper
Sealing Assembly . . . . Beryllium Nickel w/Teflon†
Bulb . . . . Glass
Compression Screw . . . . . Bronze
Deflector . . . . Copper
Bushing (K=2.8) . . . . Bronze

Operation

The glass Bulb contains a fluid which expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass Bulb, allowing the sprinkler to activate and water to flow.

Design Criteria

The Series TY-B Pendent and Upright Sprinklers are intended for fire protection systems designed in accordance with the standard installation rules recognized by the applicable Listing or Approval agency (e.g., UL Listing is based on the requirements of NFPA 13, and FM Approval is based on the requirements of FM's Loss Prevention Data Sheets). Only the Style 10 or 40 Recessed Escutcheon, as applicable, is to be used for recessed pendent installations.

† DuPont Registered Trademark

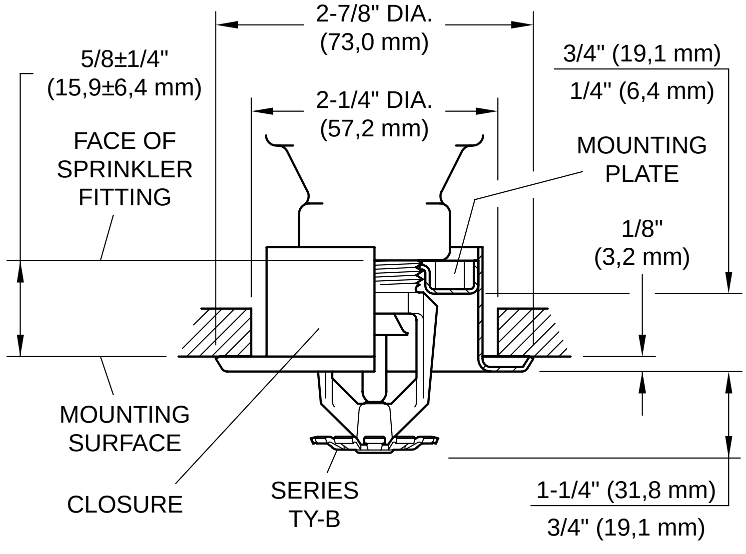


FIGURE 5
SERIES TY-B RECESSED PENDENT SPRINKLER ASSEMBLY WITH TWO-PIECE 3/4 INCH TOTAL ADJUSTMENT STYLE 10 RECESSED ESCUTCHEON 5.6 K-FACTOR, 1/2 INCH NPT

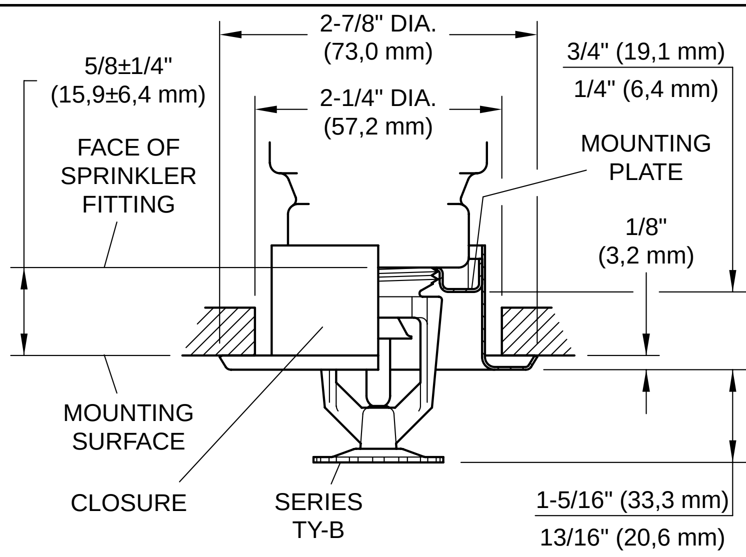


FIGURE 6
SERIES TY-B RECESSED PENDENT SPRINKLER ASSEMBLY WITH TWO-PIECE 3/4 INCH TOTAL ADJUSTMENT STYLE 40 RECESSED ESCUTCHEON 8.0 K-FACTOR, 3/4 INCH NPT

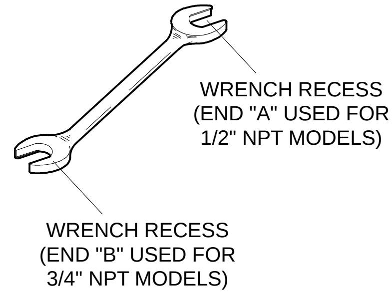


FIGURE 7
W-TYPE 6 SPRINKLER WRENCH

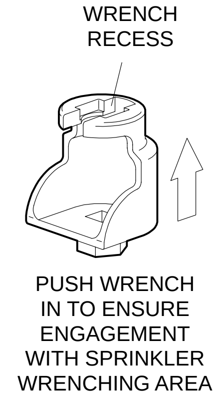


FIGURE 8
W-TYPE 7 RECESSED SPRINKLER WRENCH

Installation

The Series TY-B Sprinklers must be installed in accordance with the following instructions:

NOTES

Do not install any bulb type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm) for the 135°F/57°C to 3/32 inch (2,4 mm) for the 360°F/182°C temperature ratings.

A 1/2 inch NPT sprinkler joint should be obtained with a minimum to maximum torque of 7 to 14 ft.lbs. (9,5 to 19,0 Nm). A 3/4 inch NPT sprinkler joint should be obtained with a minimum to maximum torque of 10 to 20 ft.lbs. (13,4 to 26,8 Nm). Higher levels of torque may distort the sprinkler inlet and cause leakage or impairment of the sprinkler.

Do not attempt to make-up for insufficient adjustment in the escutcheon plate by under- or over-tightening the *sprinkler. Readjust the position of the sprinkler fitting to suit.*

The **Series TY-B Pendent and Upright Sprinklers** must be installed in accordance with the following instructions.

Step 1. Pendent sprinklers are to be installed in the pendent position, and upright sprinklers are to be installed in the upright position.

Step 2. With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step 3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 6 Sprinkler Wrench (Ref. Figure 7), except that an 8 or 10 inch adjustable Crescent wrench is to be used for wax coated sprinklers. With reference to Figures 1, 2, 3, and 4 the W-Type 7 Sprinkler Wrench or the adjustable Crescent wrench, as applicable is to be applied to the wrench flats.

When installing wax coated sprinklers with the adjustable Crescent wrench, additional care needs to be exercised to prevent damage to the wax coating on the sprinkler wrench flats or frame arms and, consequently, exposure of bare metal to the corrosive environment. The jaws of the wrench should be opened sufficiently wide to pass over the wrench flats without damaging the wax coating. Before wrench tightening the sprinkler, the jaws of the wrench are to be adjusted to just contact the sprinkler wrench flats. After wrench tightening the sprinkler, loosen the wrench jaws before removing the wrench.

After installation, the sprinkler wrench flats and frame arms must be inspected and the wax coating retouched (repaired) whenever the coating has been damaged and bare metal is exposed. The wax coating on the wrench flats can be retouched by gently applying a heated 1/8 inch diameter steel rod to the areas of wax that have been damaged, to smooth it back over areas where bare metal is exposed.

NOTES

Only retouching of the wax coating applied to the wrench flats and frame arms is permitted, and the retouching is to be performed only at the time of the initial sprinkler installation.

The steel rod should be heated only to the point at which it can begin to melt the wax, and appropriate precautions need to be taken, when handling the heated rod, in order to prevent the installer from being burned.

The **Series TY-B Recessed Pendent Sprinklers** must be installed in accordance with the following instructions.

Step A. After installing the Style 10 or 40 Mounting Plate, as applicable, over the sprinkler threads and with pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step B. Tighten the sprinkler into the sprinkler fitting using only the W-Type 7 Recessed Sprinkler Wrench (Ref. Figure 8). With reference to Figure 3 or 4, the W-Type 7 Recessed Sprinkler Wrench is to be applied to the sprinkler wrench flats.

Step C. After the ceiling has been installed or the finish coat has been applied, slide on the Style 10 or 40 Closure over the Series TY-B Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the ceiling.

Care and Maintenance

The Series TY-B Sprinklers must be maintained and serviced in accordance with the following instructions:

NOTES

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

The owner must assure that the sprinklers are not used for hanging of any objects; otherwise, non-operation in the event of a fire or inadvertent operation may result.

Absence of an escutcheon, which is used to cover a clearance hole, may delay the time to sprinkler operation in a fire situation.

Sprinklers that are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section).

Frequent visual inspections are recommended to be initially performed for corrosion resistant coated sprinklers, after the installation has been completed, to verify the integrity of the corrosion resistant coating. Thereafter, annual inspections per NFPA 25 should suffice; however, instead of inspecting from the floor level, a random sampling of close-up visual inspections should be made, so as to better determine the exact sprinkler condition and the long term integrity of the corrosion resistant coating, as it may be affected by the corrosive conditions present.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

Automatic sprinkler systems should be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

P/N 57 — XXX — X — XXX

		MODEL/SIN
530	2.8K UPRIGHT (1/2"NPT)	TY1151
531	2.8K PENDENT (1/2"NPT)	TY1251
570	5.6K UPRIGHT (1/2"NPT)	TY3151
571	5.6K PENDENT (1/2"NPT)	TY3251
590	8.0K UPRIGHT (3/4"NPT)	TY4151
591	8.0K PENDENT (3/4"NPT)	TY4251
560	8.0K UPRIGHT (1/2"NPT)	TY4851
561	8.0K PENDENT (1/2"NPT)	TY4951

	SPRINKLER
1	NATURAL BRASS
4	WHITE POLYESTER
3	WHITE (RAL9010) *
9	CHROME PLATED
7	LEAD COATED
6	WAX COATED 286°F/141°C MAX.
8	WAX OVER LEAD 286°F/141°C MAX.

	TEMPERATURE RATING
135	135°F/57°C
155	155°F/68°C
175	175°F/79°C
200	200°F/93°C
286	286°F/141°C
360	360°F/182°C

* Eastern Hemisphere sales only.

TABLE C
PART NUMBER SELECTION
SERIES TY-B PENDENT AND UPRIGHT SPRINKLERS

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

<u>The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.</u>

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

When placing an order, indicate the full product name. Refer to the Price List for complete listing of Part Numbers.

Contact your local distributor for availability.

Sprinkler Assemblies with NPT Thread Connections:
Specify: (Specify Model/SIN), Standard Response, (specify K-factor), (specify temperature rating), Series TY-B (specify Pendent or Upright) Sprinkler with (specify type of finish or coating), P/N (specify from Table C).

Recessed Escutcheon:
Specify: Style (specify 10 or 40) Recessed Escutcheon with (specify*) finish, P/N (specify*).

* Refer to Technical Data Sheet TFP770.

Sprinkler Wrench:
Specify: W-Type 6 Sprinkler Wrench, P/N 56-000-6-387.

Specify: W-Type 7 Sprinkler Wrench, P/N 56-850-4-001.

tyco / Fire & Building Products

Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

rapid response™
HOME FIRE SPRINKLER SYSTEM

Series LFII Residential Horizontal Sidewall Sprinklers 4.2 K-factor

General Description

The Series LFII (TY1334) Residential Horizontal Sidewall Sprinklers are decorative, fast response, frangible bulb sprinklers designed for use in residential occupancies such as homes, apartments, dormitories, and hotels. When aesthetics and optimized flow characteristics are the major consideration, the Series LFII (TY1334) should be the first choice.

The Series LFII are to be used in wet pipe residential sprinkler systems for one- and two-family dwellings and mobile homes per NFPA 13D; wet pipe residential sprinkler systems for residential occupancies up to and including four stories in height per NFPA 13R; or, wet pipe sprinkler systems for the residential portions of any occupancy per NFPA 13.

The Series LFII (TY1334) has a 4.2 (60,5) K-factor that provides the required residential flow rates at reduced pressures, enabling smaller pipe sizes and water supply requirements.

The recessed version of the Series LFII (TY1334) is intended for use in areas with finished walls. It employs a two-piece Style 20 Recessed Escutcheon. The Recessed Escutcheon provides 1/4 inch (6,4 mm) of recessed adjustment or up to 1/2 inch (12,7 mm) of total adjustment from the flush mounting surface position. The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the pipe nipples to the sprinklers must be cut.

The Series LFII (TY1334) has been designed with heat sensitivity and water distribution characteristics proven to help in the control of residential fires and to improve the chance for occupants to escape or be evacuated.

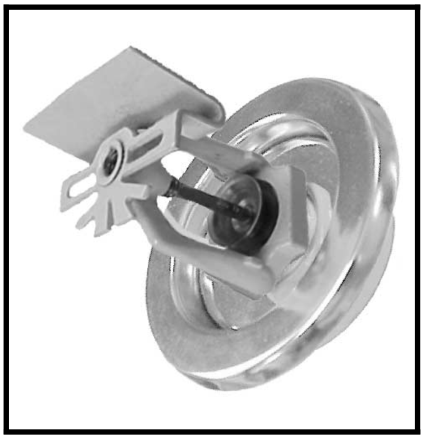
IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

WARNINGS

The Series LFII (TY1334) Residential Horizontal Sidewall Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. ***Failure to do so may impair the performance of these devices.***

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.



Sprinkler/Model Identification Number

SIN TY1334

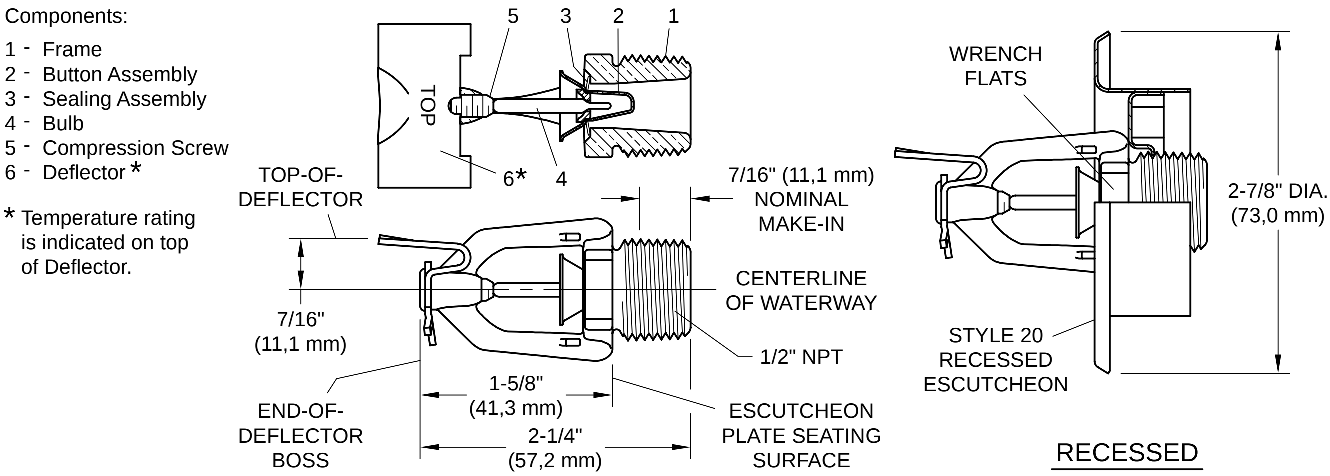


FIGURE 1
SERIES LFII (TY1334) RESIDENTIAL
HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS

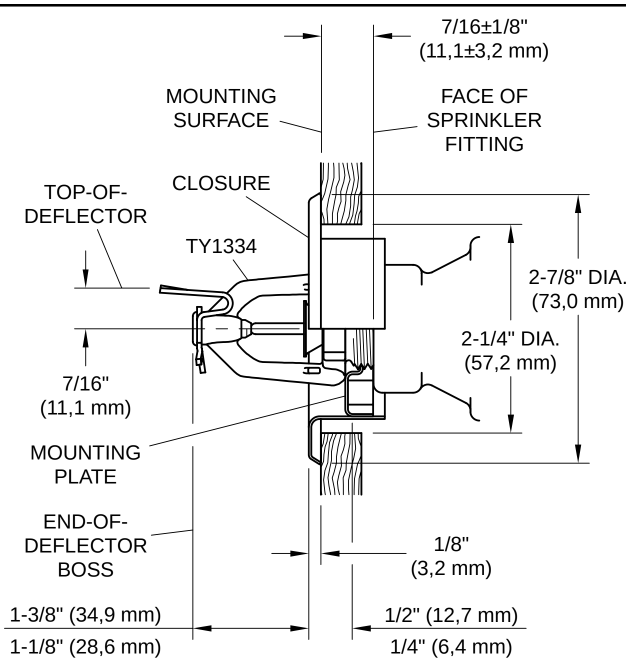


FIGURE 2
STYLE 20 RECESSED ESCUTCHEON
FOR USE WITH THE SERIES LFII (TY1334)
RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER

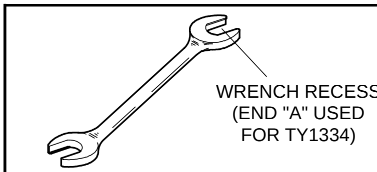


FIGURE 3
W-TYPE 6 SPRINKLER WRENCH

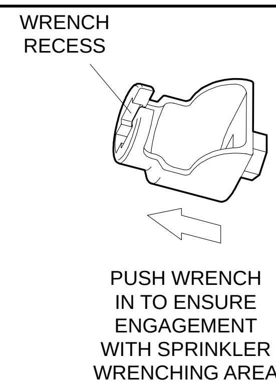


FIGURE 4
W-TYPE 7 RECESSED SPRINKLER WRENCH

Technical Data

Approvals:
UL and C-UL Listed. NYC Approved under MEA 44-03-E.

Maximum Working Pressure:
175 psi (12,1 bar)

Discharge Coefficient:
K = 4.2 GPM/psi$^{1/2}$ (60,5 LPM/bar$^{1/2}$)

Temperature Rating:
155°F/68°C or 175°F/79°C

Finishes:
White Polyester Coated,
Chrome Plated, or Natural Brass

Physical Characteristics:
Frame . . . . Brass
Button . . . . Bronze
Sealing Assembly . . . . Beryllium Nickel w/Teflon†
Bulb . . . . 3 mm dia. Glass
Compression Screw . . . . . Bronze
Deflector . . . . Copper

†Dupont Registered Trademark

Operation

The glass Bulb contains a fluid that expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass Bulb allowing the sprinkler to activate and flow water.

Design Criteria

The Series LFII (TY1334) Residential Horizontal Sidewall Sprinklers are UL and C-UL Listed for installation in accordance with the following criteria.

NOTE
When conditions exist that are outside the scope of the provided criteria, refer to the Residential Sprinkler Design Guide TFP490 for the manufacturer's recommendations that may be acceptable to the local Authority Having Jurisdiction.

System Type. Only wet pipe systems may be utilized.

Hydraulic Design. The minimum required sprinkler flow rate for systems designed to NFPA 13D or NFPA 13R are given in Table A, B, C, and D as a function of temperature rating and the maximum allowable coverage areas. The sprinkler flow rate is the minimum required discharge from each of the total number of "design sprinklers" as specified in NFPA 13D or NFPA 13R.

For systems designed to NFPA 13, the number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in Tables A, B, C, and D for NFPA 13D and 13R as a function of temperature rating and the maximum allowable coverage area.
- A minimum discharge of 0.1 gpm/sq. ft. over the "design area" comprised of the four most hydraulically demanding sprinklers for the actual coverage areas being protected by the four sprinklers.

Obstruction To Water Distribution. Locations of sprinklers are to be in accordance with the obstruction rules of NFPA 13 for residential sprinklers.

Operational Sensitivity. The sprinklers are to be installed with an end-of-deflector-boss to wall distance of 1-3/8 to 6 inches or in the recessed position using only the Style 20 Recessed Escutcheon as shown in Figure 2.

In addition the top-of-deflector-to-ceiling distance is to be within the range (Ref. Table A, B, C, or D) being hydraulically calculated.

Sprinkler Spacing. The minimum spacing between sprinklers is 8 feet (2,4 m). The maximum spacing between sprinklers cannot exceed the width of the coverage area (Ref. Table A) being hydraulically calculated (e.g., maximum 12 feet for a 12 ft. x 12 ft. coverage area, or 16 feet for a 16 ft. x 20 ft. coverage area).

Installation

The Series LFII (TY1334) must be installed in accordance with the following instructions:

NOTES
Do not install any bulb type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm).

A leak tight 1/2 inch NPT sprinkler joint should be obtained with a torque of 7 to 14 ft.lbs. (9,5 to 19,0 Nm). A maximum of 21 ft.lbs. (28,5 Nm) of torque is to be used to install sprinklers. Higher levels of torque may distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in an Escutcheon Plate by under- or over-tightening the Sprinkler. Readjust the position of the sprinkler fitting to suit.

The Series LFII Horizontal Sidewall Sprinklers must be installed in accordance with the following instructions.

Step 1. Horizontal sidewall sprinklers are to be installed in the horizontal position with their centerline of waterway perpendicular to the back wall and parallel to the ceiling. The word "TOP" on the Deflector is to face towards the ceiling with the front edge of the Deflector parallel to the ceiling.

Step 2. With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step 3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 6 Sprinkler Wrench (Ref. Figure 3). With reference to Figure 1, the W-Type 6 Sprinkler Wrench is to be applied to the wrench flats.

The **Series LFII Recessed Horizontal Sidewall Sprinklers** must be installed in accordance with the following instructions.

Step A. Recessed horizontal sidewall sprinklers are to be installed in the horizontal position with their centerline of waterway perpendicular to the back wall and parallel to the ceiling. The word "TOP" on the Deflector is to face towards the ceiling.

Step B. After installing the Style 20 Mounting Plate over the sprinkler threads and with pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step C. Tighten the sprinkler into the sprinkler fitting using only the W-Type 7 Recessed Sprinkler Wrench (Ref. Figure 4). With reference to Figure 1, the W-Type 7 Recessed Sprinkler Wrench is to be applied to the sprinkler wrench flats.

Step C. After the wall has been installed or the finish coat has been applied, slide on the Style 20 Closure over the Series LFII Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the wall.

(Continued on Page 8)

ELEVATION

Maximum Coverage Area [a] Width x Length [b] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	Minimum Flow [c] and Residual Pressure			
		Top-Of-Deflector- To- Ceiling: 4 to 6 Inches (100 to 150 mm)		Top-Of-Deflector- To- Ceiling: 6 to 12 Inches (150 to 300 mm)	
		155°F/68°C	175°F/79°C	155°F/68°C	175°F/79°C
12 x 12 (3,7 x 3,7)	12 (3,7)	12 GPM (45,4 LPM) 8.2 psi (0,57 bar)	12 GPM (45,4 LPM) 8.2 psi (0,57 bar)	13 GPM (49,2 LPM) 9.6 psi (0,66 bar)	13 GPM (49,2 LPM) 9.6 psi (0,66 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	14 GPM (53,0 LPM) 11.1 psi (0,77 bar)	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	17 GPM (64,3 LPM) 16.4 psi (1,13 bar)	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)
16 x 18 (4,9 x 5,5)	16 (4,9)	19 GPM (71,9 LPM) 20.5 psi (1,41 bar)	19 GPM (71,9 LPM) 20.5 psi (1,41 bar)	21 GPM (79,5 LPM) 25.0 psi (1,72 bar)	21 GPM (79,5 LPM) 25.0 psi (1,72 bar)
16 x 20 (4,9 x 6,1)	16 (4,9)	23 GPM (87,1 LPM) 30.0 psi (2,07 bar)	23 GPM (87,1 LPM) 30.0 psi (2,07 bar)	26 GPM (98,4 LPM) 38.3 psi (2,64 bar)	26 GPM (98,4 LPM) 38.3 psi (2,64 bar)

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

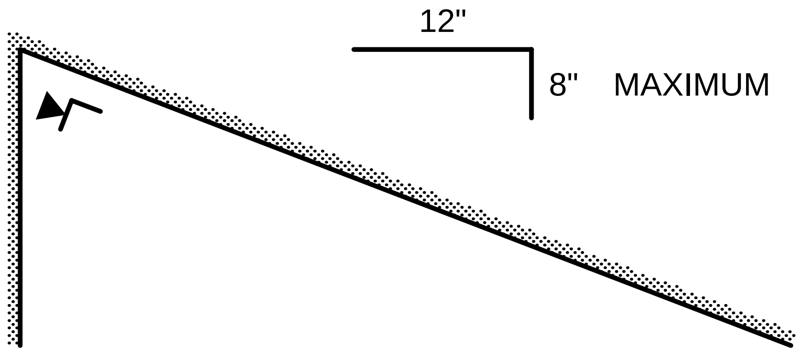
(b) Width (backwall where sprinkler is located) x Length (horizontal throw of sprinkler).

(c) Requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design Criteria Section for details.

(d) Sidewall sprinklers, where installed under a ceiling with a slope greater than 0 inch rise for a 12 inch run to a slope up to 2 inch rise for 12 inch run, must be located per one of the following:

- Locate the sprinklers at the high point of the slope and positioned to discharge down the slope.
- Locate the sprinklers along the slope and positioned to discharge across the slope.

TABLE A
NFPA 13D AND NFPA 13R WET PIPE HYDRAULIC DESIGN CRITERIA
FOR THE SERIES LFII (TY1334)
RESIDENTIAL HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS
FOR HORIZONTAL CEILING (Maximum 2 Inch Rise for 12 Inch Run)



ELEVATION

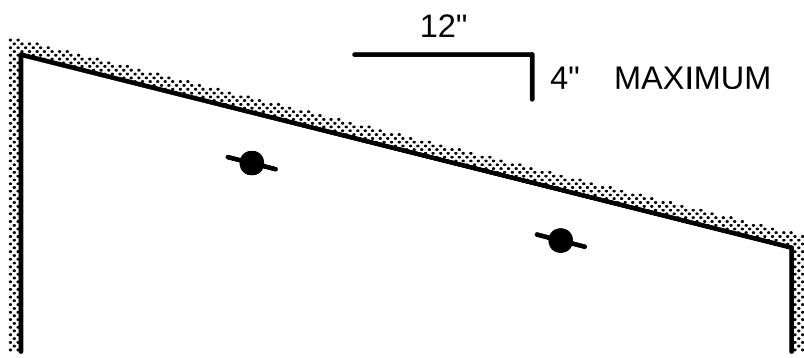
Maximum Coverage Area [a] Width x Length [b] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	Minimum Flow [c] and Residual Pressure (I) Two sprinkler design with the sprinklers at the high point of the slope and positioned to discharge down the slope.							
		Top-Of-Deflector- To- Ceiling: 4 to 6 Inches (100 to 150 mm)				Top-Of-Deflector- To- Ceiling: 6 to 12 Inches (150 to 300 mm)			
		155°F/68°C		175°F/79°C		155°F/68°C		175°F/79°C	
12 x 12 (3,7 x 3,7)	12 (3,7)	I	12 GPM (45,4 LPM) 8.2 psi (0,57 bar)	I	12 GPM (45,4 LPM) 8.2 psi (0,57 bar)	I	13 GPM (49,2 LPM) 9.6 psi (0,66 bar)	I	13 GPM (49,2 LPM) 9.6 psi (0,66 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	I	14 GPM (53,0 LPM) 11.1 psi (0,77 bar)	I	14 GPM (53,0 LPM) 11.1 psi (0,77 bar)	I	17 GPM (64.3 LPM) 16.4 psi (1,13 bar)	I	17 GPM (64.3 LPM) 16.4 psi (1,13 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	I	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	I	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	I	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)	I	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)
16 x 18 (4,9 x 5,5)	16 (4,9)	I	19 GPM (71,9 LPM) 20.5 psi (1,41 bar)	I	19 GPM (71,9 LPM) 20.5 psi (1,41 bar)	I	21 GPM (79,5 LPM) 25.0 psi (1,72 bar)	I	21 GPM (79,5 LPM) 25.0 psi (1,72 bar)
16 x 20 (4,9 x 6,1)	16 (4,9)	I	24 GPM (90,8 LPM) 32.7 psi (2,25 bar)	I	24 GPM (90,8 LPM) 32.7 psi (2,25 bar)	I	26 GPM (98,4 LPM) 38.3 psi (2,64 bar)	I	26 GPM (98,4 LPM) 38.3 psi (2,64 bar)

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) Width (backwall where sprinkler is located) x Length (horizontal throw of sprinkler).

(c) Requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design Criteria Section for details..

TABLE B
NFPA 13D AND NFPA 13R WET PIPE HYDRAULIC DESIGN CRITERIA
FOR THE SERIES LFII (TY1334)
RESIDENTIAL HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS
FOR SPRINKLERS AT THE HIGH POINT OF THE SLOPE AND DISCHARGING DOWN THE SLOPE
(Greater Than 2 Inch Rise for 12 Inch Run Up To 8 Inch Rise for 12 Inch Run)



ELEVATION

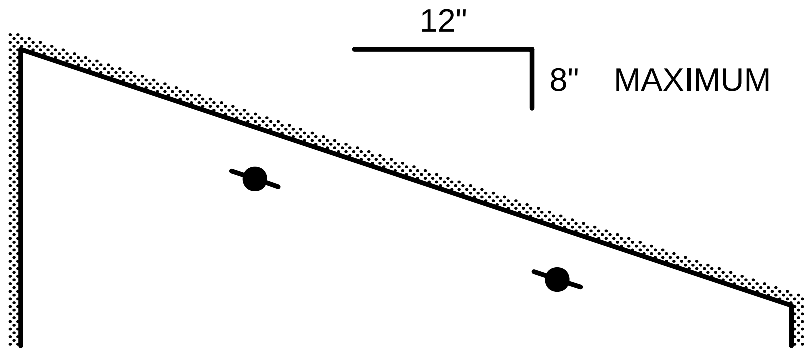
Maximum Coverage Area [a] Width x Length [b] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	Minimum Flow [c] and Residual Pressure (II) Two sprinkler design with the sprinklers located along the slope and positioned to discharge across the slope. (III) Three sprinkler design when there are more than two sprinklers in a compartment and with the sprinklers located along the slope and positioned to discharge across the slope.							
		Top-Of-Deflector- To- Ceiling: 4 to 6 Inches (100 to 150 mm)				Top-Of-Deflector- To- Ceiling: 6 to 12 Inches (150 to 300 mm)			
		155°F/68°C		175°F/79°C		155°F/68°C		175°F/79°C	
12 x 12 (3,7 x 3,7)	12 (3,7)	II	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	II	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	II	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)	II	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	II	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	II	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	II	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)	II	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	II	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	II	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	II	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)	II	18 GPM (68,1 LPM) 18.4 psi (1,27 bar)
16 x 18 (4,9 x 5,5)	16 (4,9)	II	22 GPM (83,3 LPM) 27.4 psi (1,89 bar)	II	22 GPM (83,3 LPM) 27.4 psi (1,89 bar)	II	22 GPM (83,3 LPM) 27.4 psi (1,89 bar)	II	22 GPM (83,3 LPM) 27.4 psi (1,89 bar)
16 x 20 (4,9 x 6,1)	16 (4,9)	III	23 GPM (87,1 LPM) 30.0 psi (2,07 bar)	III	23 GPM (87,1 LPM) 30.0 psi (2,07 bar)	III	26 GPM (98,4 LPM) 38.3 psi (2,64 bar)	III	26 GPM (98,4 LPM) 38.3 psi (2,64 bar)

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) Width (backwall where sprinkler is located) x Length (horizontal throw of sprinkler).

(c) Requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design Criteria Section for details..

TABLE C
NFPA 13D AND NFPA 13R WET PIPE HYDRAULIC DESIGN CRITERIA
FOR THE SERIES LFII (TY1334)
RESIDENTIAL HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS
FOR SPRINKLERS LOCATED ALONG A SLOPE AND DISCHARGING ACROSS THE SLOPE
(Greater Than 2 Inch Rise for 12 Inch Run Up To 4 Inch Rise for 12 Inch Run)



ELEVATION

Maximum Coverage Area [a] Width x Length [b] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	Minimum Flow [c] and Residual Pressure (III) Three sprinkler design when there are more than two sprinklers in a compartment and with the sprinklers located along the slope and positioned to discharge across the slope.			
		Top-Of-Deflector- To- Ceiling: 4 to 6 Inches (100 to 150 mm)			
		155°F/68°C		175°F/79°C	
12 x 12 (3,7 x 3,7)	12 (3,7)	III	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	III	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	III	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	III	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	III	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)	III	16 GPM (60,6 LPM) 14.5 psi (1,00 bar)
16 x 18 (4,9 x 5,5)	16 (4,9)	N/A		N/A	
16 x 20 (4,9 x 6,1)	16 (4,9)	N/A		N/A	

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) Width (backwall where sprinkler is located) x Length (horizontal throw of sprinkler).

(c) Requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design Criteria Section for details..

TABLE D
NFPA 13D AND NFPA 13R WET PIPE HYDRAULIC DESIGN CRITERIA
FOR THE SERIES LFII (TY1334)
RESIDENTIAL HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS
FOR SPRINKLERS LOCATED ALONG A SLOPE AND DISCHARGING ACROSS THE SLOPE
(Greater Than 4 Inch Rise for 12 Inch Run Up To 8 Inch Rise for 12 Inch Run)

Care and Maintenance

The Series LFII (TY1334) must be maintained and serviced in accordance with the following instructions:

NOTES

Absence of an Escutcheon Plate may delay the sprinkler operation in a fire situation.

Before closing a fire protection system main control valve for maintenance work on the fire protection system which it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section).

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

NOTE

The owner must assure that the sprinklers are not used for hanging of any objects and that the sprinklers are only cleaned by means of gently dusting with a feather duster; otherwise, non-operation in the event of a fire or inadvertent operation may result.

It is recommended that automatic sprinkler systems be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

<u>The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.</u>

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

When placing an order, indicate the full product name. Contact your local distributor for availability..

Sprinkler Assembly:

Series LFII (TY1334), K=4.2, Residential Horizontal Sidewall Sprinkler with (specify) temperature rating and (specify) finish, P/N (specify).

155°F/68°C or
Chrome Plated . . . . P/N 51-211-9-155
155°F/68°C
White Polyester . . . . P/N 51-211-4-155
155°F/68°C
White
(RAL9010)* . . . . P/N 51-211-3-155
155°F/68°C
Natural Brass. . . . . P/N 51-211-1-155
175°F/79°C or
Chrome Plated . . . . P/N 51-211-9-175
175°F/79°C
White Polyester . . . . P/N 51-211-4-175
175°F/79°C
White
(RAL9010)* . . . . P/N 51-211-3-175
175°F/79°C
Natural Brass. . . . . P/N 51-211-1-175

*Eastern Hemisphere sales only.

Recessed Escutcheon:

Specify: Style 20 Recessed Escutcheon with (specify*) finish, P/N (specify*).

*Refer to Technical Data Sheet TFP770.

Sprinkler Wrench:

Specify: W-Type 6 Sprinkler Wrench, P/N 56-000-6-387.

Specify: W-Type 7 Sprinkler Wrench, P/N 56-850-4-001.

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rapid response®
HOME FIRE SPRINKLER SYSTEM

Series LFII Dry-Type Residential Sprinklers, Recessed Pendent and Domed Concealed Pendent 4.9 Nominal K-Factor

General Description

The TYCO RAPID RESPONSE Series LFII Dry-Type Residential Sprinklers are decorative, fast response, frangible bulb sprinklers designed for use in residential occupancies such as homes, apartments, dormitories, and hotels. These sprinklers may be used in wet pipe, dry pipe, or preaction systems.

Residential sprinklers listed for dry pipe or preaction systems must undergo special testing at Underwriters Laboratories, Inc., including a 15-second delay while passing all UL1626 test criteria. The sprinklers described in this data sheet have undergone this special UL testing and are therefore listed for the types of residential designs cited below.

Dry-Type Sprinklers are typically used where:

- sprinklers are required on dry pipe systems that are exposed to freezing temperatures; for example, sprinkler drops from unheated portions of buildings.
- sprinklers and/or a portion of the connecting piping are exposed to freezing temperatures; for example, sprinkler drops from wet systems into unheated areas.
- sprinklers are used on systems that are seasonally drained to avoid freezing; for example, vacation areas.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

The Series LFII Dry-Type Residential Sprinklers are intended for use in residential sprinkler systems for one- and two-family dwellings and mobile homes per NFPA 13D; residential sprinkler systems for residential occupancies up to and including four stories in height per NFPA 13R; or, sprinkler systems for the residential portions of any occupancy per NFPA 13.

The Series LFII Dry-Type Residential Sprinklers are designed with heat sensitivity and water characteristics proven to help in controlling residential fires and improving the chance for occupants to escape or be evacuated.

The Series LFII Dry-Type Residential Sprinklers provide flexibility in adjusting sprinklers to the fixed pipe drops.

- The Recessed Escutcheon provides 1/4 inch (6,4 mm) of recessed adjustment or up to 1/2 inch (12,7 mm) of total adjustment from the flush mounting surface position.
- The Domed Concealed Cover Plate provides for 1/2 inch (12,7 mm) of vertical adjustment.

The Domed Concealed Cover-Retainer Assembly includes a Cover Plate and a retaining ring or Retainer. The assembly's separable, "push-on-and-thread-off", two-piece design allows sprinkler installation and pressure testing of the fire protection system before installing or finishing the ceiling. Additionally, the Domed Concealed Cover-Retainer Assembly ships with a disposable Protective Cap.

Temporarily removed during sprinkler installation then subsequently replaced, the Protective Cap protects the sprinkler during ceiling installation or finish. After ceiling installation is complete, the Protective Cap is removed and the Cover Plate is installed. The Protective Cap must be removed for proper sprinkler performance.

Maximum Coverage Area [a] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	WET PIPE Minimum Flow[b] and Residual Pressure for Horizontal Ceiling (Max. 2-inch Rise for 12-Inch Run)		DRY PIPE Minimum Flow[b] and Residual Pressure for Horizontal Ceiling (Max. 2-Inch Rise for 12-Inch Run)	
		Recessed Pendent (TY2235)	Dome Concealed Pendent (TY2535)	Recessed Pendent (TY2235)	Dome Concealed Pendent (TY2535)
		155°F (68°C)	155°F (68°C) with 139°F (59°C) Cover Plate	155°F (68°C)	155°F (68°C) with 139°F (59°C) Cover Plate
12 x 12 (3,7 x 3,7)	12 (3,7)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)	13 GPM (49,2 LPM) 7.0 psi (0,48 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	14 GPM (52,9 LPM) 8.2 psi (0,57 bar)	14 GPM (52,9 LPM) 8.2 psi (0,57 bar)	14 GPM (52,9 LPM) 8.2 psi (0,57 bar)	14 GPM (52,9 LPM) 8.2 psi (0,57 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	15 GPM (56,8 LPM) 9.4 psi (0,65 bar)	15 GPM (56,8 LPM) 9.4 psi (0,65 bar)	15 GPM (56,8 LPM) 9.4 psi (0,65 bar)	15 GPM (56,8 LPM) 9.4 psi (0,65 bar)
18 x 18 (5,5 x 5,5)	18 (5,5)	18 GPM (68,1 LPM) 13.5 psi (0,93 bar)	20 GPM (75,7 LPM) 16.7 psi (1,15 bar)	18 GPM (68,1 LPM) 13.5 psi (0,93 bar)	20 GPM (75,7 LPM) 16.7 psi (1,15 bar)
20 x 20 (6,1 x 6,1)	20 (6,1)	21 GPM (79,5 LPM) 18.4 psi (1,3 bar)	22 GPM (83,3 LPM) 20.2 psi (1,39 bar)	21 GPM (79,5 LPM) 18.3 psi (1,3 bar)	22 GPM (83,3 LPM) 20.2 psi (1,39 bar)

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) The requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design under the Design Criteria section.

TABLE A
UL LISTED NFPA 13D AND NFPA 13R WET AND DRY PIPE HYDRAULIC DESIGN CRITERIA FOR SERIES LFII RESIDENTIAL DRY-TYPE SPRINKLERS (TY2235 AND TY2535)

NOTICE

The Series LFII Dry-Type Residential Sprinklers (TY2235 and TY2535) described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any authorities having jurisdiction. Failure to do so may impair the performance of these devices.

Owners are responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

The Series LFII Dry-Type Residential Sprinklers must only be installed in fittings that meet the requirements of the Design Criteria section.

Model/Sprinkler Identification Number (SIN)

- TY2235
  Pendent with Recessed Escutcheon
- TY2535
  Pendent with Domed Concealed Cover Plate

Technical Data

Approvals
UL Listed

Refer to Table A and Design Criteria.

Maximum Working Pressure
175 psi (12,1 bar)

Discharge Coefficient
K = 4.9 GPM/psi$^{1/2}$ (70,6 LPM/bar$^{1/2}$)

Inlet Thread Connection
1-inch NPT

Sprinkler Temperature Rating
- Recessed Pendent: 155°F (68°C)
- Concealed Pendent: 155°F (68°C) with 139°F (59°C) Cover Plate

Finishes
- Sprinkler:
  White Polyester-Coated, Chrome-Plated, or Natural Brass
- Recessed Escutcheon:
  White, Chrome or Brass
- Domed Concealed Cover Plate:
  Refer to the Ordering Procedure section.

Order Lengths
- TY2235
  Minimum: 3-3/4 inches (95,3 mm)
  Maximum: 24 inches (609,6 mm)
- TY2535
  Minimum: 4-1/2 inches (114,3 mm)
  Maximum: 24 inches (609,6 mm)

Physical Characteristics
Inlet. . . . . Brass
Plug . . . . Brass
Yoke . . . . Stainless Steel
Casing . . . . Galvanized Steel
Insert . . . . Bronze
Bulb Seat. . . . . .Stainless Steel
Bulb . . . . Glass
Compression Screw . . . . Brass
Deflector . . . . Brass
Frame . . . . Brass
Guide Tube . . . . Brass
Water Tube . . . . .Stainless Steel
Bushing . . . . Brass
Plug Spring . . . . .Stainless Steel
Sealing Assembly . . . . Beryllium Nickel with Teflon*
Support Cup. . . . . Steel
Escutcheon . . . . .Carbon Steel
Cover Plate. . . . . Brass
Retainer Ring . . . . Brass
Cover Plate Spring . . .Stainless Steel

Patents
U.S.A. Patent No. 5,188,185
Other patents pending

*DuPont Registered Trademark

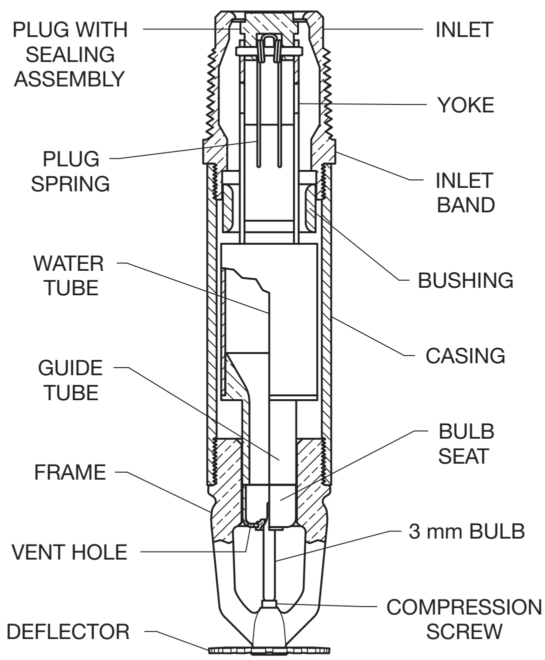


FIGURE 1
ASSEMBLY FOR SERIES LFII DRY-TYPE RESIDENTIAL PENDENT SPRINKLER

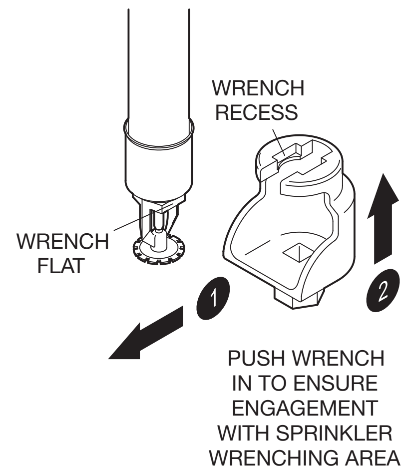


FIGURE 2
W-TYPE 7
SPRINKLER WRENCH

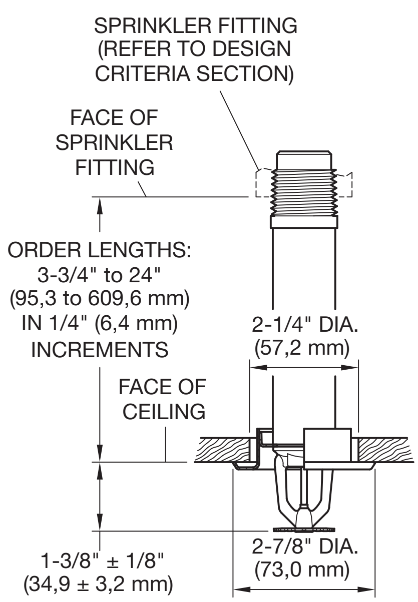


FIGURE 3
TY2235 PENDENT WITH RECESSED ESCUTCHEON (TY2235)

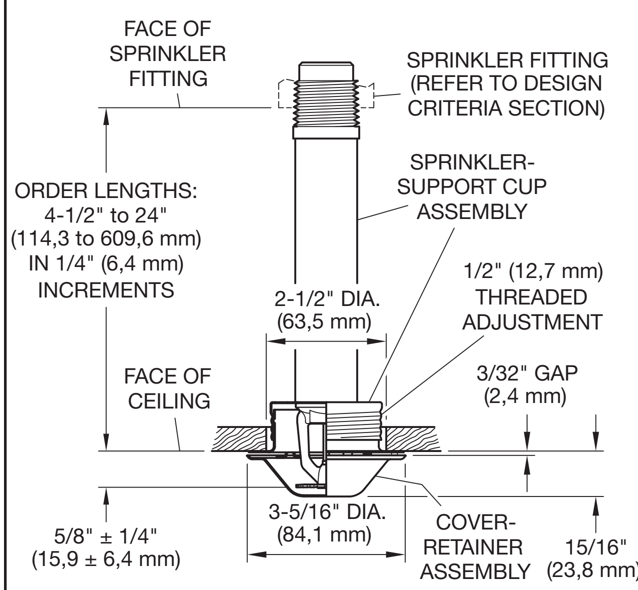


FIGURE 4
TY2235 PENDENT WITH DOMED CONCEALED COVER-RETAINER ASSEMBLY (TY2535)

Operation

When the TYCO Series LFII Dry-Type Residential Sprinkler is in service, water is prevented from entering the assembly by the Plug with Sealing Assembly (Figure 1) in the Inlet of the Sprinkler.

- For recessed pendent sprinklers, the glass Bulb contains a fluid that expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass Bulb then release the Bulb Seat. System water or air pressure then unseats the Plug with Sealing Assembly. The Plug Spring turns the Plug with Sealing Assembly aside, allowing the sprinkler to activate and flow water.
- For domed concealed pendent sprinklers, the Cover Plate, which is soldered to the Retainer at three places, first falls away when exposed to heat from a fire. The sprinkler then operates similar to the recessed pendent sprinklers described above.

Design Criteria

The TYCO Series LFII Dry-Type Residential Sprinklers (TY2235 and TY2535) are UL Listed for installation in accordance with the criteria listed in this section.

When conditions exist that are outside the scope of the criteria provided in this section, refer to the technical data sheet entitled *Residential Sprinkler Design Guide (TFP490)* for the manufacturer's recommendations that may be acceptable to the local authority having jurisdiction.

This section describes the following design characteristics:

- System Types
- Water Delivery
- Hydraulic Design
- Obstruction to Water Distribution
- Operational Sensitivity
- Sprinkler Spacing
- Sprinkler Fitting
- Prevention of Branch Line Freezing

System Types
Wet pipe, dry pipe, and preaction systems may be utilized.

Water Delivery
For dry pipe and preaction systems, water delivery to the most remote sprinkler for a residential hazard shall not exceed 15 seconds as defined in Section 8.3.4.3 of the 2010 edition of NFPA 13D or Section 7.2.3.6.3 of the 2010 edition of NFPA 13.

Using the TYCO SPRINKFDT Water Delivery Calculation Program can help determine whether required delivery times will likely be achieved prior to performing the actual installation.

As an alternative to using a UL Listed water delivery calculation program and method, as referenced in NFPA 13D or NFPA 13, using an inspector's test connection is required to provide flow equivalent to the smallest orifice sprinkler, wherein the test orifice is located on the end of the pipe supplying the most remote sprinkler.

Hydraulic Design
Table A lists the minimum required sprinkler flow rate for systems designed to NFPA 13D or NFPA 13R as a function of temperature rating and the maximum allowable coverage areas. The sprinkler flow rate is the minimum required discharge from each of the total number of "design sprinklers," as specified in NFPA 13D or NFPA 13R.

For systems designed to NFPA 13, the number of required design sprinklers is the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is the greater of the following:

- flow rates listed in Table A for NFPA 13D and 13R as a function of temperature rating and the maximum allowable coverage area.
- minimum discharge of 0.1 GPM/sq. ft. over the design area comprised of the four most hydraulically demanding sprinklers for the actual coverage areas protected by four sprinklers.

Examples of sprinkler designs follow:

- *Example 1* — Protection is planned for a corridor that is 8 feet wide. Consequently, the actual coverage area under consideration is 8 ft. x 20 ft. Using the Series LFII Dry-Type Residential Sprinkler, the flow rate listed in Table A for a 20 ft. x 20 ft. coverage area is 21 GPM. However, based on a minimum discharge of 0.1 GPM/sq. ft., the expected flow rate is 16 GPM (8 ft. x 20 ft = 160 sq.ft.). For this example, a minimum flow rate of 21 GPM for this sprinkler design is required.
- *Example 2* — Protection is planned for a long, narrow room that is 12 feet wide. Consequently, the actual coverage area under consideration is 12 ft. x 20 ft. Using the Series LFII Dry-Type Residential Sprinkler, the flow rate listed in Table A for a 20 ft. x 20 ft. coverage area is 21 GPM. However, based on a minimum discharge of 0.1 GPM/sq. ft., the expected flow rate is 24 GPM (12 ft. x 20 ft = 240 sq.ft.). For this example, a minimum flow rate of 24 GPM for this sprinkler design is required.

Obstruction to Water Distribution
Sprinklers are to be located in accordance with the obstruction rules of NFPA 13 for residential sprinklers as well as with the obstruction criteria described in technical data sheet TFP490.

Operational Sensitivity
The sprinkler must be located relative to the mounting surface as shown in Figures 3 and 4, as applicable.

NOTICE

Do not use the Series LFII Dry-Type Residential Domed Concealed Cover-Retainer Assembly in applications where the air pressure above the ceiling is greater than that below. Down-drafts through the Support Cup could delay sprinkler operation in a fire situation.

Sprinkler Spacing
The minimum spacing between sprinklers is 8 feet (2,4 m). The maximum spacing between sprinklers cannot exceed the length of the hydraulically-calculated coverage area (refer to Table A); for example, a maximum of 12 feet for a 12 ft. x 12 ft. coverage area or 20 feet for a 20 ft. x 20 ft. coverage area.

Sprinkler Fittings
Install the 1-inch NPT Series LFII Dry-Type Residential Sprinklers in the 1-inch NPT outlet or run of one of the following fittings:

- malleable or ductile iron threaded tee fittings that meet the dimensional requirements of ANSI B16.3 (Class 150).
- cast iron threaded tee fittings that meet the dimensional requirements of ANSI B16.4 (Class 125).

For dry pipe systems, only use the side outlet of maximum 2-1/2 inch size reducing tees when locating the Series LFII Dry-Type Residential Sprinklers directly below the branch line. Otherwise, use the configuration shown in Figure 6 to assure complete drainage from above the Series LFII Sprinklers and the branch line.

Do not install the Series LFII Dry-Type Residential Sprinklers into elbow fittings. The Inlet of the sprinkler can contact the interior of the elbow, potentially damaging the Inlet seal.

Typically, the end sprinkler fitting on a branch line is plugged as shown in Figure 6.

The Series LFII Dry-Type Sprinklers can also be installed in the 1-inch NPT outlet of a GRINNELL Figure 730 Mechanical Tee. However, the use of the Figure 730 for this arrangement is limited to wet pipe systems.

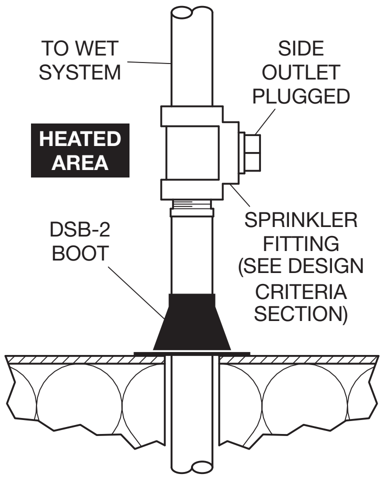


FIGURE 5
FITTING IN HEATED AREA

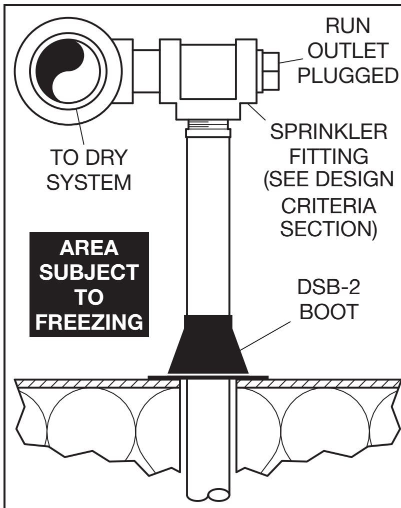


FIGURE 6
FITTING IN UNHEATED AREA

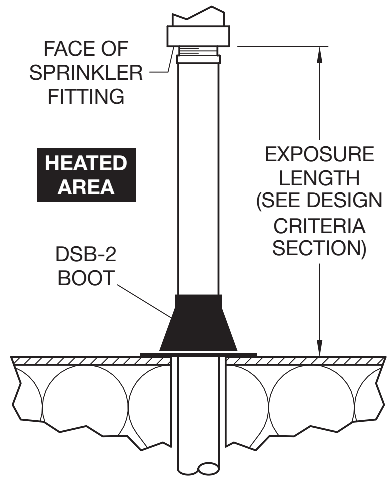


FIGURE 7
EXPOSURE LENGTH

Only use the configuration in Figure 5 where the sprinkler fitting and water-filled pipe above the sprinkler fitting are not subject to freezing and where the length of the Series LFII Sprinkler has the minimum exposure length per Figure 7. Refer to the Exposure Length section and Table B.

For wet pipe system installations of the 1-inch NPT Series LFII Dry-Type Residential Sprinklers connected to CPVC piping, use only the following TYCO CPVC fittings:

- 1” x 1” x 1” NPT Sprinkler Head Adapter Tee (P/N 80259)
- 1” x 1” NPT Female Adapter (P/N 80145)

NOTICE

Do not install the Series LFII Dry-Type Residential Sprinklers into any other type fitting without first consulting the Technical Services Department. Failure to use the appropriate fitting may result in the following:

- *failure of the sprinkler to operate properly due to formation of ice over the Inlet Plug or binding of the Inlet Plug.*
- *insufficient engagement of the inlet pipe threads with consequent leakage.*

Drainage

Branch, cross, and feed-main piping connected to Series LFII Dry-Type Residential Sprinklers and subject to freezing temperatures must be pitched to allow proper drainage, in accordance with the minimum requirements of the National Fire Protection Association for dry pipe sprinkler systems.

Exposure Length

When using Series LFII Dry-Type Residential Sprinklers in wet pipe sprinkler systems to protect areas subject to freezing temperatures, use Table B to determine a sprinkler’s appropriate exposed barrel length to prevent water from freezing in the connecting pipes due to conduction. The exposed barrel length measurement must be taken from the face of the sprinkler fitting to the surface of the structure or insulation that is exposed to the heated area. Refer to Figure 7 for an example.

Clearance Space

When connecting an area subject to freezing and an area containing a wet pipe sprinkler system, the clearance space around the sprinkler barrel of Dry-Type Residential Sprinklers must be sealed, in accordance with the National Fire Protection Association. Due to temperature differences between two areas, the potential for the formation of condensation in the sprinkler and subsequent ice build-up is increased. If this condensation is not controlled, ice build-up can occur that might damage the dry-type sprinkler and/or prevent proper operation in a fire situation.

Use of the Model DSB-2 Dry Sprinkler Boot, described in technical data sheet TFP591 and shown in Figures 5 through 7, can provide the recommended seal.

Ambient Temperature Exposed to Discharge End of Sprinkler	Temperatures for Heated Area[a]		
	40°F (4°C)	50°F (10°C)	60°F (16°C)
	Minimum Exposed Barrel Length, Inches (mm)[b]		
40°F (4°C)	0	0	0
30°F (-1°C)	0	0	0
20°F (-7°C)	4 (100)	0	0
10°F (-12°C)	8 (200)	1 (25)	0
0°F (-18°C)	12 (305)	3 (75)	0
-10°F (-23°C)	14 (355)	4 (100)	1 (25)
-20°F (-29°C)	14 (355)	6 (150)	3 (75)
-30°F (-34°C)	16 (405)	8 (200)	4 (100)
-40°F (-40°C)	18 (455)	8 (200)	4 (100)
-50°F (-46°C)	20 (510)	10 (255)	6 (150)
-60°F (-51°C)	20 (510)	10 (255)	6 (150)

Notes:
(a) For protected area temperatures that occur between values listed above, use the next cooler temperature.
(b) These lengths are inclusive of wind velocities up to 30 mph (18,6 kph).

TABLE B
MINIMUM RECOMMENDED LENGTHS OF EXPOSED SPRINKLER BARRELS IN WET PIPE SYSTEMS

Installation

The TYCO Series LFII Dry-Type Residential Sprinklers must be installed in accordance with the following instructions.

NOTICE

The Series LFII Dry-Type Residential Sprinklers must only be installed in fittings that meet the requirements of the Design Criteria section. For other important requirements regarding piping design and sealing of the clearance space around the Sprinkler Casing, refer to the Design Criteria section.

Do not install any bulb type sprinkler if the Bulb is cracked or there is a loss of liquid from the Bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm).

Obtain a leak-tight 1-inch NPT sprinkler joint by applying a minimum-to-maximum torque of 20 to 30 ft.-lbs. (26,8 to 40,2 Nm). Higher levels of torque can distort the sprinkler Inlet or Frame with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in an Escutcheon Plate or Cover-Retainer Assembly by under- or over-tightening the Sprinkler. Re-adjust the position of the sprinkler fitting to suit.

1. Install pendent sprinklers only in the pendent position with the deflector parallel to the ceiling.
2. With a non-hardening pipe-thread sealant such as Teflon tape applied to the inlet threads, hand-tighten the sprinkler into the sprinkler fitting.
3. Wrench-tighten the sprinkler using a pipe wrench on the Inlet Band or the Casing (refer to Figure 1) or using the W-Type 7 Sprinkler Wrench on the Wrench Flat (refer to Figure 2). Apply the Wrench Recess of the W-Type 7 Sprinkler Wrench to the Wrench Flat.

   Note: *If sprinkler removal is necessary, remove the sprinkler using the same wrenching method noted above. Sprinkler removal is easier when a non-hardening sealant was used and torque guidelines were followed. After removal, inspect the sprinkler for damage.*
4. After installing the ceiling or applying a ceiling finish, install the Recessed Escutcheon or the Domed Concealed Cover-Retainer Assembly, as applicable.

   In the case of the Domed Concealed Cover-Retainer Assembly, push the Cover-Retainer Assembly into the Support Cup. As necessary, make the final adjustment of the Cover-Retainer Assembly with respect to the ceiling by turning the Cover-Retainer Assembly clockwise or counter-clockwise until its flange comes into contact with the ceiling.

   To remove the Cover-Retainer Assembly, unscrew the Cover-Retainer Assembly in a counter-clockwise direction. The sprinkler fitting requires repositioning when:

   - engaging the Cover-Retainer Assembly with the Support Cup is unsuccessful.
   - making sufficient contact between the Cover-Retainer Assembly and the ceiling is unsuccessful.

Care and Maintenance

The TYCO Series LFII Dry-Type Residential Sprinklers (TY2235 and TY2535) must be maintained and serviced in accordance with the following instructions. Otherwise, inadvertent sprinkler operation or non-operation in the event of a fire can result.

NOTICE

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, obtain permission to shut down the affected fire protection systems from the proper authorities and notify all personnel who may be affected by this action.

Absence of a Recessed Escutcheon Plate or a Domed Concealed Cover Plate to cover a clearance hole can delay sprinkler operation in a fire situation.

A Vent Hole is provided in the Bulb Seat (Figure 1) to indicate if the Series LFII Dry-Type Residential Sprinkler is remaining dry. Evidence of leakage from the Vent Hole indicates potential leakage past the Plug with Sealing Assembly and the need to remove the sprinkler to determine the cause of leakage (for example, an improper installation or an ice plug). Close the fire protection system control valve and drain the system before removing the sprinkler.

Exercise care to avoid damage to sprinklers before, during, and after installation. Never paint, plate, coat, or otherwise alter automatic sprinklers after they leave the factory.

Replace sprinklers that:

- were modified or over-heated.
- were damaged by dropping, striking, wrench twisting, wrench slippage, or the like.
- are leaking or exhibiting visible signs of corrosion.
- were exposed to corrosive products of combustion but have not operated, if you cannot easily remove combustion by-products with a cloth.
- have a cracked Bulb or have lost liquid from the Bulb. Refer to the Installation section in this data sheet.

For the Domed Concealed Cover-Retainer Assembly, the following items apply:

- When properly installed, a nominal 3/32 inch (2,4 mm) air gap exists between the lip of the Cover and the ceiling, as shown in Figure 4. This air gap is necessary for proper sprinkler operation. The air gap allows heat flow from a fire to pass below and above the Cover, helping to assure appropriate release of the Cover in a fire situation. If repainting the ceiling after installation is required, exercise care to ensure that new paint does not seal off any of the air gap.
- Do not pull the Cover relative to the Retainer. Separation may result.
- Never repaint factory-painted Covers. When necessary, replace Covers with factory-painted units.

Responsibility lies with the owner for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (for example, NFPA 25), in addition to the standards of any authorities having jurisdiction. Contact the installing contractor or sprinkler manufacturer regarding any questions.

Automatic sprinkler systems are recommended to be inspected, tested, and maintained by a qualified Inspection Service.

Limited Warranty

Products manufactured by Tyco Fire Suppression & Building Products (TFSBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFSBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFSBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFSBP to be defective shall be either repaired or replaced, at TFSBP's sole option. TFSBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFSBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFSBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFSBP was informed about the possibility of such damages, and in no event shall TFSBP's liability exceed an amount equal to the sales price.

The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

P/N 63 – XXX – X – XXX

		MODEL/SIN
10	Pendent w/ Recessed Escutcheon	TY2235 (Figure 3)
11	Pendent for Use with Domed Concealed Cover Plate	TY2535 (Figure 4)

	TEMPERATURE RATING
1	155°F (68°C)

	SPRINKLER FINISH	RECESSED ESCUTCHEON FINISH*
9	Chrome Plated	Chrome
4	White Ployester Coated	White
2	Natural Brass	Brass Plated

* The Domed Concealed Cover Plate is Separately Ordered.

	ORDER LENGTH (EXAMPLES)
055	5.50”
082	8.25”
180	18.00”
187	18.75”
240	24.00”

TABLE C
PART NUMBER SELECTION FOR
SERIES LFII DRY-TYPE RESIDENTIAL SPRINKLERS

Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and Part Number (P/N). Refer to the Price List for a complete listing of P/Ns.

Pendent Sprinkler with Recessed Escutcheon
Specify the following information:

- Series LFII Dry-Type Residential Sprinkler (TY2235),
- with Recessed Escutcheon,
- 4.9 K-Factor,
- 155°F (68°C) Temperature Rating,
- Sprinkler Finish (value from Table C),
- Recessed Escutcheon Finish (value from Table C),
- Order Length (value from Figure 3 or 4), and
- P/N (from Table C).

Pendent Sprinkler for Use with Domed Concealed Cover Plate
Specify the following information:

- Series LFII Dry-Type Residential Pendent Sprinkler for use with Domed Concealed Cover Plate (TY2535),
- 4.9 K-Factor,
- 155°F (68°C) Temperature Rating,
- Natural Brass Sprinkler Finish,
- Order Length (value from Figure 4), and
- P/N (from Table C).

Separately Ordered Cover-Retainer Assembly
Specify: Cover-Retainer Assembly for the Series LFII Dry-Type Residential Concealed Pendent Sprinkler (TY2235), Sprinkler Finish (value from below), and P/N (below):

Chrome . . . . .P/N 56-873-9-135

Signal White
(RAL9003) . . . . P/N 56-873-4-135

Pure White
(RAL9010). . . . . P/N 56-873-3-135

Custom. . . . . P/N 56-873-X-135

Separately Ordered Sprinkler Wrench
Specify: W-Type 7 Sprinkler Wrench (Figure 2), P/N 56-850-4-001.

tyco Fire Suppression & Building Products

For more information, contact your local sales office or visit www.tyco-fsbp.com.

Ultra Low Flow AQUAMIST Nozzles Type ULF AM29 Automatic (Closed)

General Description

The TYCO Ultra Low Flow AQUAMIST Nozzles Type ULF AM29 are closed (automatic) nozzles intended for use with engineered, water-mist systems. They are low-pressure nozzles that utilize a single fluid jet impinging on a diffuser to produce a spray having a range of water droplet sizes suitable for the control of Class A fires.

It is recommended that the end user be consulted with respect to the suitability of the materials of construction and finish for any given corrosive environment. The effects of ambient temperature, concentration of chemicals, and gas/chemical velocity should be considered, at a minimum, along with the corrosive nature to which the nozzles may be exposed.

NOTICE

The Type ULF AM29 AQUAMIST Nozzles described herein must be installed and maintained in compliance with this document and with the applicable standards of the National Fire Protection Association, in addition to the standards of any authorities having jurisdiction. Failure to do so may impair the performance of these devices.

The design of individual water mist systems can vary considerably, depending on the characteristics and nature of the hazard and the basic purpose of the water mist system. Because of these variations, the design of water mist systems for fire protection must only be performed by experienced designers who thoroughly understand the limitations as well as capabilities of such systems.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or nozzle manufacturer should be contacted with any questions.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

Approvals

The TYCO Type ULF AM29 AQUAMIST Nozzles in a 57°C/135°F temperature rating and in a natural brass finish are Factory Mutual Approved when used as part of an engineered, wet pipe water mist system. In particular, the FM Approval testing was performed in accordance with FM Class 5560, Approval Standard for Water Mist Systems.

Technical Data

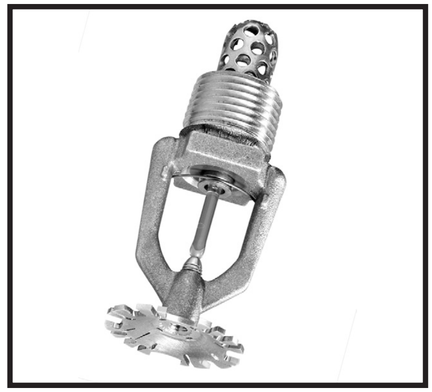
Discharge Coefficient
K = 8,5 LPM/bar$^{1/2}$
(K = 0.59 GPM/psi$^{1/2}$)

Thread Connection
1/2 inch NPT

Finish
Natural Brass, Chrome Plated, or White Coated

Temperature Ratings
Refer to Table A.

Physical Characteristics
Frame . . . . Brass
Strainer . . . . .Copper
Orifice Insert . . . . Bronze
Button . . . . Bronze
Sealing Assembly . . . . Beryllium Nickel w/Teflon†



Ejection Spring . . . . . .Stainless Steel
Bulb . . . . Glass
Diffuser . . . . Bronze
Loading Screw . . . . Bronze

The smallest waterway (orifice) diameter of the Orifice Insert is nominally 4,4 mm (0.172 inches). The diameter of the Inlet Strainer perforations is nominally 3,2 mm (0.125 inches).

Patent
Patent pending

† DuPont Registered Trademark

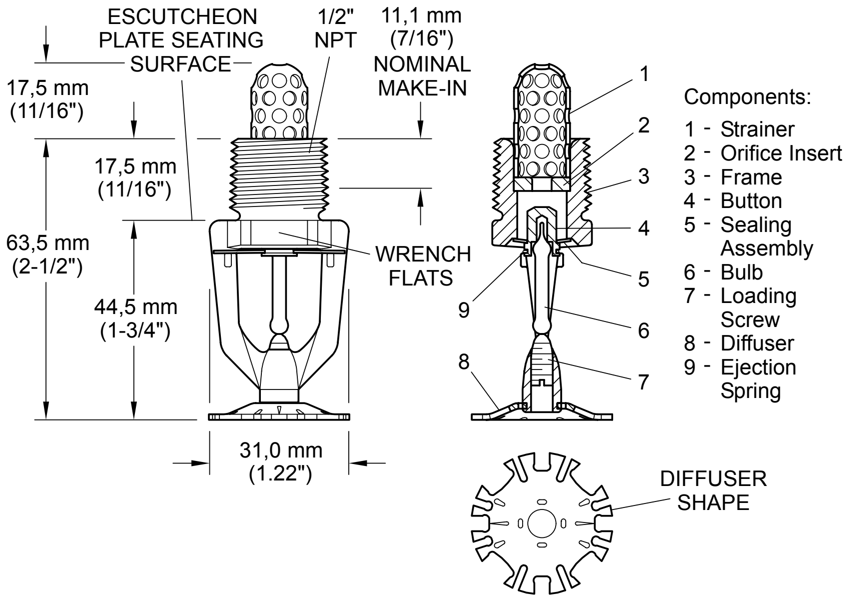


FIGURE 1
TYPE ULF AM29 AQUAMIST NOZZLE
NOMINAL DIMENSIONS

Temperature Rating	Bulb Fluid Color
57°C/135°F	Orange
68°C/155°F	Red
79°C/175°F	Yellow
93°C/200°F	Green

TABLE A
SELECTION OF
TEMPERATURE RATINGS

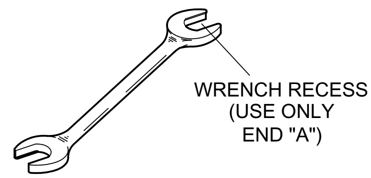


FIGURE 3
TYPE W6 WRENCH

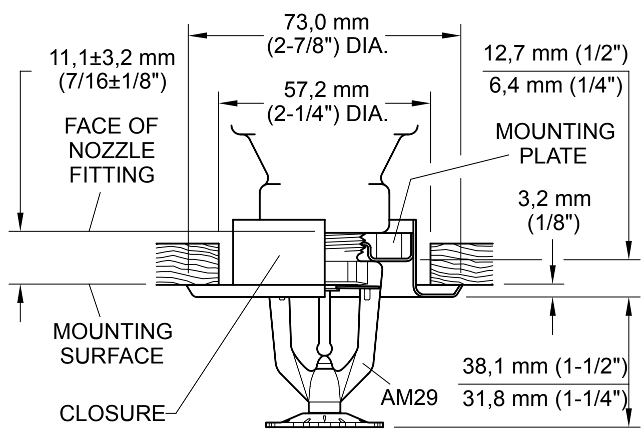


FIGURE 2
TYPE ULF AM29 AQUAMIST NOZZLE
WITH STYLE 20 RECESSED ESCUTCHEON

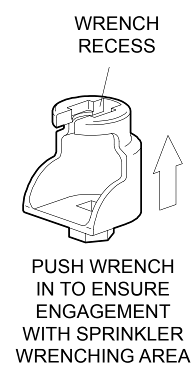


FIGURE 4
TYPE W7 WRENCH

Design Criteria

Obtain guidance for the design of a water-mist system that utilizes the TYCO Type ULF AM29 AQUAMIST Nozzles from the Technical Services department.

Installation

The TYCO Type ULF AM29 AQUAMIST Nozzles must be installed in accordance with the following instructions.

NOTICE

Do not install any bulb type nozzle if the bulb is cracked or there is a loss of liquid from the bulb. With the nozzle held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1,6 mm (1/16 inch) for the 57°C/135°F to 2,4 mm (3/32 inch) for the 93°C/200°F temperature ratings.

Obtain a leak-tight 1/2 inch NPT nozzle joint by applying a minimum-to-maximum torque of 9,5 to 19,0 Nm (7 to 14 ft.-lbs.). Higher levels of torque can distort the nozzle inlet and cause leakage or impairment of the nozzle.

Do not attempt to compensate for insufficient adjustment in the escutcheon plate by under or over-tightening the nozzle. Re-adjust the position of the nozzle fitting to suit.

Type ULF AM29

The Type ULF AM29 AQUAMIST Nozzles must be installed in accordance with the following instructions.

Step 1. Install the Type ULF AM29 in the pendent position as shown in Figure 1.

Step 2. With pipe-thread sealant applied to the pipe threads, hand-tighten the nozzle into the nozzle fitting.

Step 3. Tighten the nozzle into the nozzle fitting using only the W-Type 6 Wrench (refer to Figure 3). With reference to Figure 1, apply the W-Type 6 Wrench to the Wrench Flats.

Type ULF AM29 Recessed

The Type ULF AM29 AQUAMIST Recessed Nozzles must be installed in accordance with the following instructions.

Step 1. Install the Recessed Type ULF AM29 in the pendent position as shown in Figure 2.

Step 2. After installing the Style 20 Mounting Plate, as applicable, over the nozzle threads and with pipe-thread sealant applied to the pipe threads, hand-tighten the nozzle into the nozzle fitting.

Step 3. Tighten the nozzle into the nozzle fitting using only the W-Type 7 Wrench (refer to Figure 4). With reference to Figure 1, apply the W-Type 7 Wrench to the nozzle Wrench Flats.

Step 4. After the ceiling has been installed or the finish coat has been applied, slide on the Style 20 Closure over the Type ULF AM29 Nozzle and push the Closure over the Mounting Plate until its flange comes in contact with the ceiling.

Care and Maintenance

The TYCO Type ULF AM29 AQUAMIST Nozzles must be maintained and serviced in accordance with the following instructions.

NOTICE

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, obtain permission to shut down the affected fire protection system from the proper authorities and notify all personnel who may be affected by this action.

Absence of an escutcheon, which is used to cover a clearance hole, can delay the time to nozzle operation in a fire situation.

Exercise care to avoid damage to Type ULF AM29 Nozzles before, during and after installation. Never paint, plate, coat, or otherwise alter nozzles after they leave the factory.

To prevent impaired performance, replace nozzles that:

- were modified or over-heated.
- were damaged by dropping, striking, wrench twisting, wrench slippage, or the like.
- are leaking or showing visible signs of corrosion.
- were exposed to corrosive products of combustion but not operated if they cannot be completely cleaned by wiping the nozzle with a cloth or by brushing it with a soft bristle brush.
- have a cracked bulb or have lost liquid from the bulb. (Refer to the Installation section.)

Frequent visual inspections are recommended to be initially performed for nozzles installed in potentially corrosive atmospheres to verify the integrity of the materials of construction and finish as they may be affected by the corrosive conditions present for a given installation. Thereafter, annual inspections per NFPA 25 are required, in addition to inspections required by the authority having jurisdiction.

Responsibility lies with the owner for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (for example, NFPA 20, 25, and 750), in addition to the standards of any other authorities having jurisdiction. Contact the installing contractor or sprinkler manufacturer regarding any questions.

Water-mist fixed systems should be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire Suppression & Building Products (TFSBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFSBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFSBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFSBP to be defective shall be either repaired or replaced, at TFSBP's sole option. TFSBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFSBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFSBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFSBP was informed about the possibility of such damages, and in no event shall TFSBP's liability exceed an amount equal to the sales price.

The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and P/N.

Type ULF AM29 AQUAMIST Nozzles

Specify: Type ULF AM29 AQUAMIST Nozzle with (type of) finish and (specify) temperature rating, P/N (specify).

Natural Brass
57°C/135°F. . . . . P/N 49-029-1-135
68°C/155°F. . . . . P/N 49-029-1-155
79°C/175°F. . . . . P/N 49-029-1-175
93°C/200°F . . . . P/N 49-029-1-200

Chrome Plated
57°C/135°F. . . . . P/N 49-029-9-135
68°C/155°F. . . . . P/N 49-029-9-155
79°C/175°F. . . . . P/N 49-029-9- 175
93°C/200°F . . . . P/N 49-029-9-200

Signal White*
(RAL 9003)
57°C/135°F. . . . . P/N 49-029-4-135
68°C/155°F. . . . . P/N 49-029-4-155
79°C/175°F. . . . . P/N 49-029-4-175
93°C/200°F . . . . P/N 49-029-4-200
* Previously known as Bright White

Pure White**
(RAL 9010)
57°C/135°F. . . . . P/N 49-029-3-135
68°C/155°F. . . . . P/N 49-029-3-155
79°C/175°F . . . . P/N 49-029-3-175
93°C/200°F . . . . P/N 49-029-3-200
** Eastern Hemisphere sales only

Recessed Escutcheon
Specify: Style 20 Recessed Escutcheon with (specify*) finish, P/N (specify*).

* Refer to Technical Data Sheet TFP770.

Wrench

Specify: Type W6 Wrench,
P/N 56-000-6-387.

Specify: Type W7 Wrench,
P/N 56-850-4-001.

tyco Fire & Building Products

Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

ILLUSION™
We Cover All The Action

ILLUSION™ — 11.2 K-factor Extra Large Orifice Concealed Pendent Sprinklers Quick Response, Standard Coverage

General Description

The Tyco® ILLUSION™, 11.2 K-factor, Standard Coverage, Extra Large Orifice Concealed Pendent Sprinklers are decorative, fast response solder type sprinklers featuring a flat cover plate designed to conceal the sprinkler. When limited water pressure is available and a higher applied water density is necessary, the ILLUSION is the best choice for architecturally sensitive areas such as casinos, hotel lobbies, office buildings, churches, and restaurants.

Each unit includes a Cover Plate Assembly that conceals the sprinkler operating components above the ceiling. The separable two-piece design of the Cover Plate and Support Cup Assemblies allows installation of the sprinklers and pressure testing of the fire protection system prior to installation of a suspended ceiling or application of the finish coating to a fixed ceiling. They also permit removal of suspended ceiling panels for access to building service equipment without having to first shut down the fire protection system and remove sprinklers.

Also, the separable two-piece design of the Sprinkler provides for 3/4 inch (19,1 mm) of vertical adjustment to provide a measure of flexibility with regard to which the length of fixed pipe drops to the sprinklers must be cut.

The ILLUSION Sprinklers are shipped with a Disposable Protective Cap. The Protective Cap is temporarily removed for installation, and it can be replaced to help protect the sprinkler while the ceiling is being installed or finished. The tip of the Protective Cap can also be used to mark the center of the ceiling hole into plaster board, ceiling tiles, etc. by gently pushing the ceiling product against the Protective Cap. When the ceiling installation is complete, the Protective Cap is removed and the Cover Plate Assembly installed.

As an option, the ILLUSION Pendent Sprinklers may be fitted with a silicone Air and Dust Seal (Ref. Fig. 4). The Air and Dust Seal is intended for sensitive areas where it is desirable to stop air and dust travel through the cover plate from the area above the ceiling.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

NOTICE

The ILLUSION Concealed Pendent Sprinklers described herein must be installed and maintained in compliance with this document and with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Sprinkler Identification Number

TY5521

Technical Data

Approvals
UL and C-UL Listed.
(The listings apply only to the service conditions indicated in the Design Criteria section.)

Approvals for Air & Dust Seal
UL and C-UL Listed for use with the ILLUSION (TY5521); however, use of the Air & Dust Seal changes the sprinkler response rating from quick to standard.

Maximum Working Pressure
175 psi (12,1 bar)

Discharge Coefficient
K = 11.2 GPM/psi$^{1/2}$
(161,3 LPM/bar$^{1/2}$)

Temperature Ratings
160°F/71°C Sprinkler/
139°F/59°C Plate
212°F/100°C Sprinkler/
165°F/74°C Plate

Adjustment
3/4 inch (19,1 mm)

Finishes
Cover Plate: Refer to Ordering Procedure section.

Physical Characteristics
Body . . . . Brass
Cap . . . . Bronze
Saddle . . . . Brass
Sealing Assembly . . . .
. . . . . Beryllium Nickel w/Teflon*
Solder Link Halves . . . . Nickel
Lever . . . . Bronze
Compression Screw . . . . . . Brass
Deflector . . . . Bronze/Brass
Guide Pin Housing . . . . . . Bronze
Guide Pins . . . . . . Stainless Steel
Support Cup . . . . . . Plated Steel
Cover Plate . . . . Brass
Retainer . . . . Brass
Cover Plate Ejection Spring . . . . .
. . . . Stainless Steel
* DuPont registered trademark.

Patents
U.S.A. Patent No. 4,014,388.

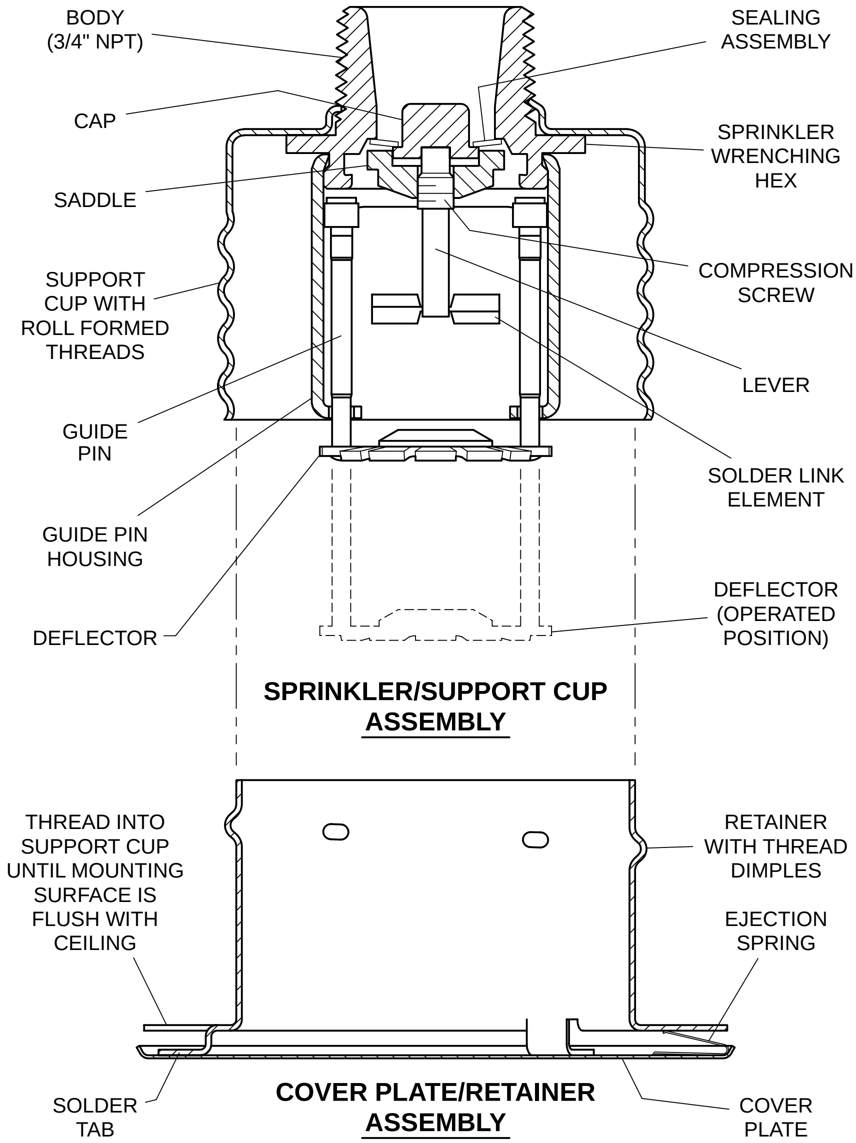


FIGURE 1
THE ILLUSION (TY5521)
CONCEALED PENDENT SPRINKLER ASSEMBLY

Operation

When exposed to heat from a fire, the Cover Plate, soldered to the Retainer at three points, falls away to expose the Sprinkler Assembly. At this point the Deflector supported by the Guide Pins drops down to its operational position.

When the rated temperature of the Solder Link Element is reached, the Link Element separates, allowing the sprinkler to activate and flow water.

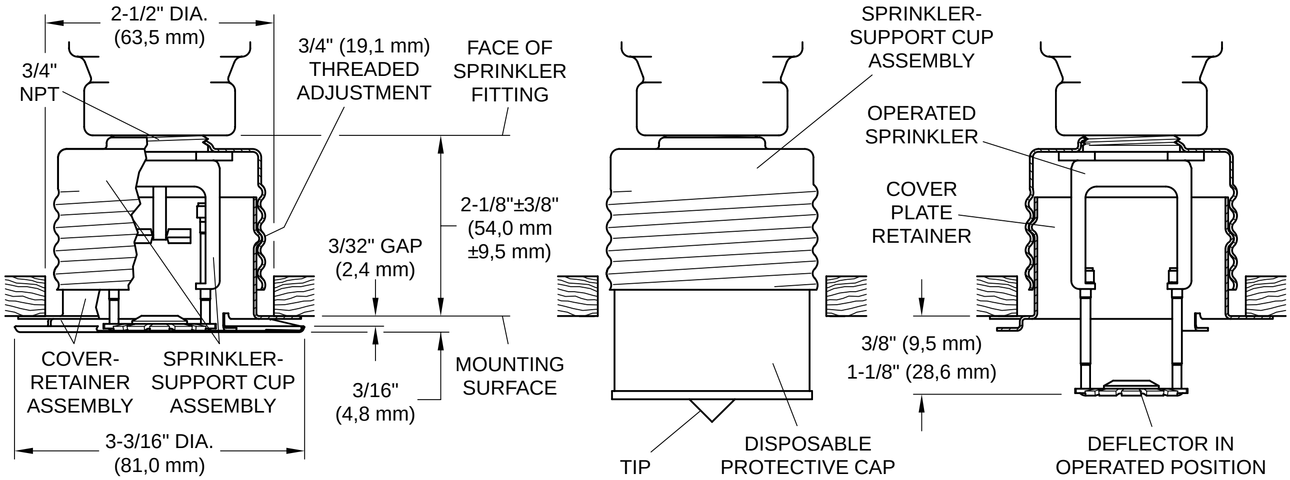


FIGURE 2
THE ILLUSION PENDENT SPRINKLER INSTALLATION DIMENSIONS

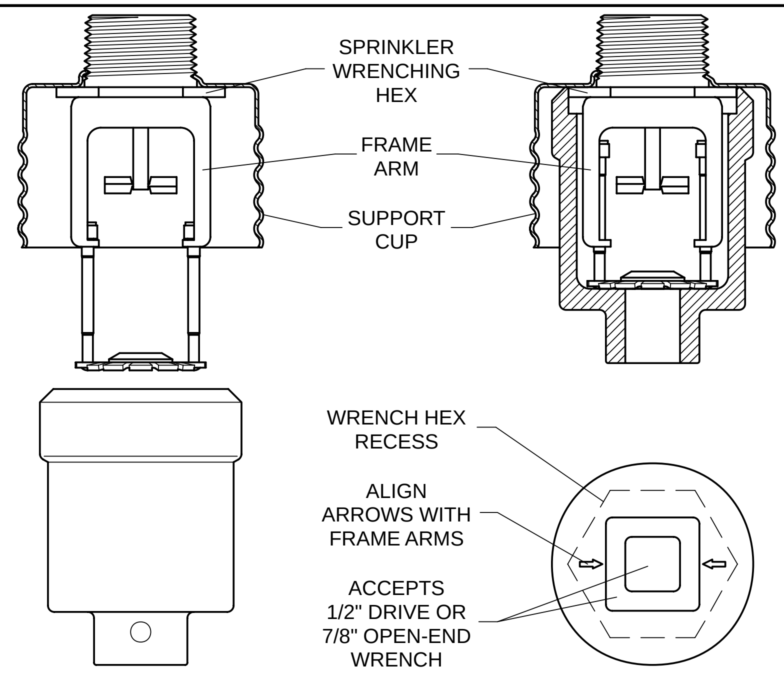


FIGURE 3
W-TYPE 18 SPRINKLER WRENCH

Design Criteria

The Tyco® ILLUSION™ (TY5521) Concealed Pendent Sprinklers are UL and C-UL Listed as quick response - standard spray sprinklers for use in accordance with the current NFPA standard; however, in accordance with its UL and C-UL Listing it cannot be used for the protection of storage.

The ILLUSION Concealed Pendent Sprinklers are only listed and approved with the ILLUSION Concealed Cover Plates having a factory applied finish.

The ILLUSION must not be used in applications where the air pressure above the ceiling is greater than that below. Down drafts through the Support Cup could delay sprinkler operation in a fire situation.

Installation

The Tyco® ILLUSION™ must be installed in accordance with the following instructions:

NOTICE

A 3/4 inch NPT sprinkler joint should be obtained with a minimum to maximum torque of 10 to 20 ft.lbs. (13,4 to 26,8 Nm). Higher levels of torque may distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in the Sprinkler Assembly by under- or over-tightening the Sprinkler/Support Cup Assembly. Readjust the position of the sprinkler fitting to suit.

Step 1. The sprinkler must only be installed in the pendent position and with the centerline of the sprinkler perpendicular to the mounting surface.

Step 2. Remove the Protective Cap.

Step 3. With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step 4. Wrench tighten the sprinkler using only the W-Type 18 Sprinkler Wrench (Ref. Figure 3). The W-Type 18 Sprinkler Wrench is to be applied to the Sprinkler as shown in Figure 3.

Step 5. Replace the Protective Cap (Ref. Figure 2) by pushing it upwards until it bottoms out against the Support Cup. The Protective Cap helps prevent damage to the Deflector and Arms during ceiling installation and/or during application of the finish coating of the ceiling. It may also be used to locate the center of the clearance hole by gently pushing the ceiling material against the center point of the Protective Cap.

NOTICE

As long as the Protective Cap remains in place, the system is considered to be "Out of Service".

Step 6. After the ceiling has been completed with the 2-1/2 inch (63,5 mm) diameter clearance hole and in preparation for installing the Cover Plate Assembly, remove and discard the Protective Cap, and verify that the Deflector moves up and down freely. If the Sprinkler has been damaged and the Deflector does not move up and down freely, replace the entire Sprinkler assembly. Do not attempt to modify or repair a damaged sprinkler.

Step 7. When installing an Air and Dust Seal, refer to Figure 4, otherwise proceed to Step 8. To attach the Air and Dust Seal, verify the angle of the outside edge of the seal is oriented according to Figure 4. Start the edge of the Retainer in the grooved slot of the Air and Dust Seal and continue around the retainer until the entire Air and Dust Seal is engaged.

Step 8. Screw on the Cover Plate/Retainer Assembly until the Retainer - Figure 2 (or Air and Dust Seal - Figure 4) makes contact with the ceiling. Do not continue to screw on the Cover Plate/Retainer Assembly such that it lifts a ceiling panel out of its normal position. If the Cover Plate/Retainer Assembly cannot be engaged with the Support Cup or the Cover Plate/Retainer Assembly cannot be engaged sufficiently to contact the ceiling, the Sprinkler Fitting must be repositioned.

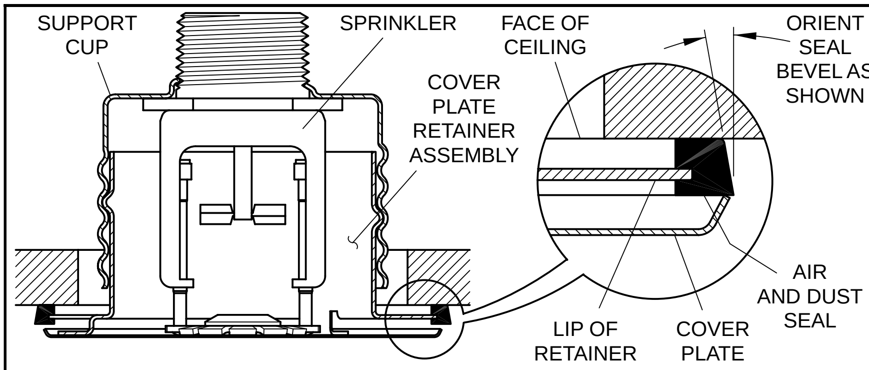


FIGURE 4
OPTIONAL AIR AND DUST SEAL FOR THE ILLUSION (TY5521)

Care and Maintenance

The Tyco® ILLUSION™ must be maintained and serviced in accordance with the following instructions:

NOTICE

Absence of the Cover Plate Assembly may delay sprinkler operation in a fire situation.

When properly installed, there is a nominal 3/32 inch (2,4 mm) air gap between the lip of the Cover Plate and the ceiling, as shown in Figure 2. This air gap is necessary for proper operation of the sprinkler by allowing heat flow from a fire to pass below and above the Cover Plate to help assure appropriate release of the Cover Plate in a fire situation. If the ceiling is to be repainted after the installation of the Sprinkler, care must be exercised to ensure that the new paint does NOT seal off any of the air gap.

Factory painted Cover Plates MUST NOT be repainted. They should be replaced, if necessary, by factory painted units. Non-factory applied paint may adversely delay or prevent sprinkler operation in the event of a fire.

Do not pull the Cover Plate relative to the Enclosure. Separation may result.

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Sprinklers that are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated or otherwise altered after leaving the factory. Modified or over heated sprinklers must be replaced.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section).

If a sprinkler must be removed, do not reinstall it or a replacement without reinstalling the Cover Plate Assembly. If a Cover Plate Assembly becomes dislodged during service, replace it immediately.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

Automatic sprinkler systems should be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

<u>The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.</u>

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

When placing an order, indicate the full product name. Contact your local distributor for availability.

Sprinkler Assembly:
Specify: TY5521, (specify temperature rating) ILLUSION Pendent Sprinkler, P/N (specify).

	160°F/71°C	212°F/100°C
TY5521	50-711-1-160	50-711-1-212

Separately Ordered Cover Plate:
Specify: (specify temperature rating) ILLUSION Cover Plate with (specify finish), P/N (specify).

	139°F/59°C(a)	165°F/74°C(b)
Brass	56-892-1-135	56-892-1-165
Chrome	56-892-9-135	56-892-9-165
Signal White (c) (RAL 9003)	56-892-4-135	56-892-4-165
Grey White (d) (RAL 9002)	56-892-0-135	56-892-0-165
Pure White (e) (RAL 9010)	56-892-3-135	56-892-3-165
Custom	56-892-X-135	56-892-X-165

(a) For use with 160°F/71°C sprinklers.

(b) For use with 212°F/100°C sprinklers.

(c) Previously known as Bright White.

(d) Previously known as Standard White.

(e) Eastern Hemisphere sales only.

Sprinkler Wrench:
Specify: W-Type 18 Sprinkler Wrench, P/N 56-000-1-265.

Air and Dust Seal:
Specify: Air and Dust Seal, P/N 56-908-1-001.

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Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

rapidresponse® HOME FIRE SPRINKLER SYSTEM

Series LFII Residential Pendent Sprinklers 3.0 K-factor

General Description

The Tyco® Rapid Response™, Series LFII (TY1234) Residential Pendent Sprinklers are decorative, fast response, frangible bulb sprinklers designed for use in residential occupancies such as homes, apartments, dormitories, and hotels. When aesthetics and optimized flow characteristics are the major consideration, the Series LFII (TY1234) should be the first choice.

The 3.0 (43,2) K-factor of the Series LFII (TY1234) has been selected to optimize flows (i.e., avoid over discharging) specifically for small coverage areas up to 14 ft x 14 ft. (4,3 m x 4,3 m). The required residential flow rates can then be delivered with the use of smaller pipe sizes and reduced water supply requirements.

The Series LFII are to be used in wet pipe residential sprinkler systems for one- and two-family dwellings and mobile homes per NFPA 13D; wet pipe residential sprinkler systems for residential occupancies up to and including four stories in height per NFPA 13R; or, wet pipe sprinkler systems for the residential portions of any occupancy per NFPA 13.

The recessed version of the Series LFII (TY1234) is intended for use in areas with finished ceilings. It employs a two-piece Style 20 Recessed Escutcheon. The Recessed Escutcheon provides 1/4 inch (6,4 mm) of recessed adjustment or up to 1/2 inch (12,7 mm) of total adjustment from the flush ceiling position. The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the pipe nipples to the sprinklers must be cut.

The Series LFII (TY1234) has been designed with heat sensitivity and water distribution characteristics proven to help in the control of residential fires and to improve the chance for occupants to escape or be evacuated.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

WARNINGS

The Series LFII (TY1234) Residential Pendent Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. ***Failure to do so may impair the performance of these devices.***

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Sprinkler/Model Identification Number

SIN TY1234

Maximum Coverage Area [(a)] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	Minimum Flow [(b)] and Residual Pressure For Horizontal Ceiling (Max. 2 Inch Rise for 12 Inch Run)
		155°F/68°C or 175°F/79°C
12 x 12 (3,7 x 3,7)	12 (3,7)	8 GPM (30,3 LPM) 7.1 psi (0,49 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	11 GPM (41,6 LPM) 13.4 psi (0,92 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	13 GPM (49,2 LPM) 18.8 psi (1,29 bar)

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) Requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design Criteria Section for details.

TABLE A
NFPA 13D AND NFPA 13R WET PIPE HYDRAULIC DESIGN CRITERIA FOR THE SERIES LFII (TY1234) RESIDENTIAL PENDENT AND RECESSED PENDENT SPRINKLERS

Technical Data

Approvals:
UL and C-UL Listed.

Maximum Working Pressure:
175 psi (12,1 bar)

Discharge Coefficient:
K = 3.0 GPM/psi$^{1/2}$ (43,2 LPM/bar$^{1/2}$)

Temperature Rating:
155°F/68°C or 175°F/79°C

Finishes:
White Polyester Coated,
Chrome Plated, or Natural Brass

Physical Characteristics:
Frame . . . . Brass
Button . . . . Bronze
Sealing Assembly . . . . Beryllium Nickel w/Teflon†
Bulb . . . . 3 mm dia. Glass
Compression Screw . . . . . Bronze
Deflector . . . . Bronze
Ejection Spring . . . . Stainless Steel
†DuPont Registered Trademark

Operation

The glass Bulb contains a fluid that expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass Bulb allowing the sprinkler to activate and flow water.

Design Criteria

The Tyco® Rapid Response™, Series LFII (TY1234) Residential Pendent Sprinklers are UL and C-UL Listed for installation in accordance with the following criteria.

NOTE
When conditions exist that are outside the scope of the provided criteria, refer to the Residential Sprinkler Design Guide TFP490 for the manufacturer's recommendations that may be acceptable to the local Authority having Jurisdiction.

System Type. Only wet pipe systems may be utilized.

Hydraulic Design. The minimum required sprinkler flow rate for systems designed to NFPA 13D or NFPA 13R are given in Table A as a function of temperature rating and the maximum allowable coverage areas. The sprinkler flow rate is the minimum required discharge from each of the total number of "design sprinklers" as specified in NFPA 13D or NFPA 13R.

For systems designed to NFPA 13, the number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in Table A for NFPA 13D and 13R as a function of temperature rating and the maximum allowable coverage area.
- A minimum discharge of 0.1 gpm/sq. ft. over the "design area" comprised of the four most hydraulically demanding sprinklers for the actual coverage areas being protected by the four sprinklers.

Obstruction To Water Distribution. Locations of sprinklers are to be in accordance with the obstruction rules of NFPA 13 for residential sprinklers.

Operational Sensitivity.

For "Horizontal Ceilings" (maximum 2 inch rise for 12 inch run), the sprinklers are to be installed with a deflector to ceiling distance of 1-3/8 to 4 inches or in the recessed position using only the Style 20 Recessed Escutcheon as shown in Figure 2.

NOTE
To avoid obstructions to water distribution, a maximum 12 inch deflector-to-ceiling distance is permitted for NFPA 13D and NFPA 13R applications where the sprinklers are located in closets.

Sprinkler Spacing. The minimum spacing between sprinklers is 8 feet (2,4 m). The maximum spacing between sprinklers cannot exceed the length of the coverage area (Ref. Table A) being hydraulically calculated (e.g., maximum 12 feet for a 12 ft. x 12 ft. coverage area, or 16 feet for a 16 ft. x 16 ft. coverage area).

Installation

The Series LFII (TY1234) must be installed in accordance with the following instructions:

NOTES
Do not install any bulb type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm).

A 1/2 inch NPT sprinkler joint should be obtained with a minimum to maximum torque of 7 to 14 ft.lbs. (9,5 to 19,0 Nm). Higher levels of torque may distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in an Escutcheon Plate by under- or over-tightening the

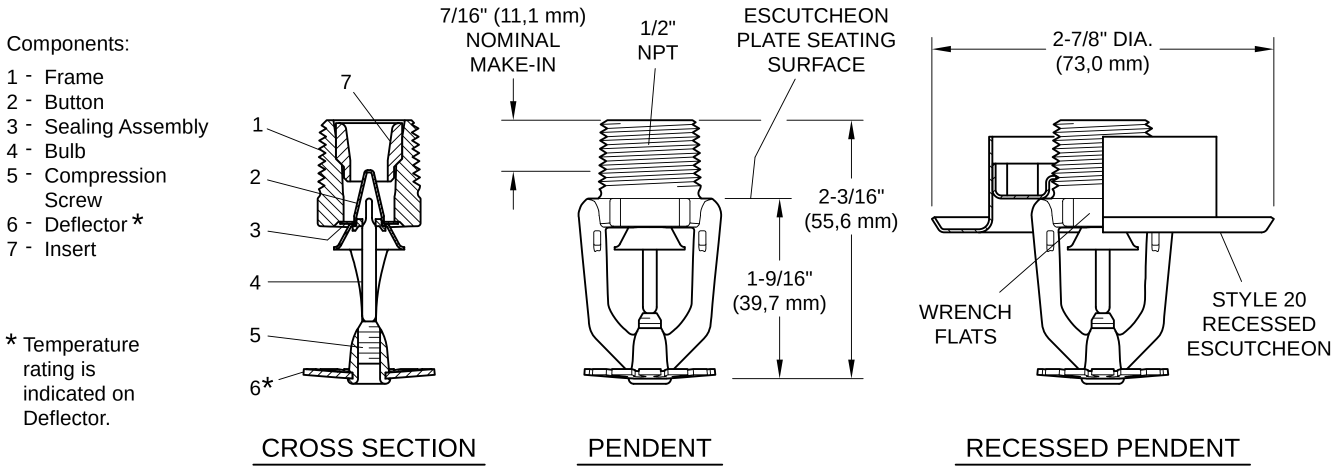


FIGURE 1
SERIES LFII (TY1234) RESIDENTIAL
PENDENT AND RECESSED PENDENT SPRINKLERS

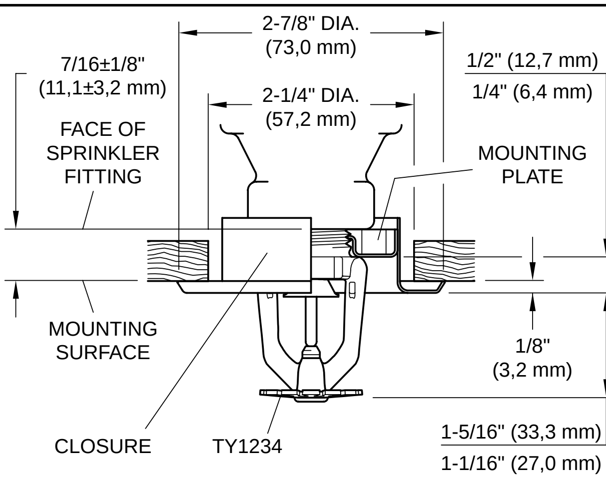


FIGURE 2
STYLE 20 RECESSED ESCUTCHEON
FOR USE WITH THE SERIES LFII (TY1234)
RESIDENTIAL PENDENT SPRINKLER

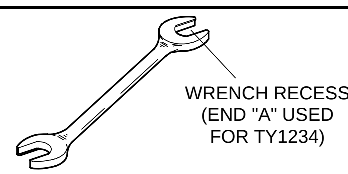


FIGURE 3
W-TYPE 6
SPRINKLER WRENCH

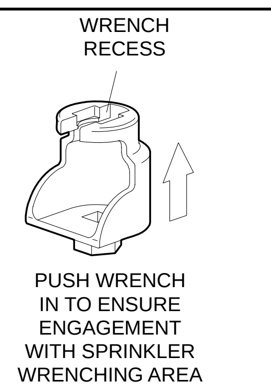


FIGURE 4
W-TYPE 7 RECESSED
SPRINKLER WRENCH

Sprinkler. Readjust the position of the sprinkler fitting to suit.

The Series LFII Pendent Sprinklers must be installed in accordance with the following instructions.

Step 1. Pendent sprinklers are to be installed in the pendent position with the deflector parallel to the ceiling.

Step 2. With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step 3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 6 Sprinkler Wrench (Ref. Figure 3). With reference to Figure 1, the W-Type 6 Sprinkler Wrench is to be applied to the wrench flats.

The **Series LFII Recessed Pendent Sprinklers** must be installed in accordance with the following instructions.

Step A. Recessed pendent sprinklers are to be installed in the pendent position with the deflector parallel to the ceiling.

Step B. After installing the Style 20 Mounting Plate over the sprinkler threads and with pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step C. Tighten the sprinkler into the sprinkler fitting using only the W-Type 7 Recessed Sprinkler Wrench (Ref. Figure 4). With reference to Figure 1, the W-Type 7 Recessed Sprinkler Wrench is to be applied to the sprinkler wrench flats.

Step D. After the ceiling has been installed or the finish coat has been applied, slide on the Style 20 Closure over the Series LFII Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the ceiling.

Care and Maintenance

The Tyco® Rapid Response™, Series LFII (TY1234) must be maintained and serviced in accordance with the following instructions:

NOTES

Absence of an Escutcheon Plate may delay the sprinkler operation in a fire situation.

Before closing a fire protection system main control valve for maintenance work on the fire protection system which it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section).

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

NOTE

The owner must assure that the sprinklers are not used for hanging of any objects and that the sprinklers are only cleaned by means of gently dusting with a feather duster; otherwise, non-operation in the event of a fire or inadvertent operation may result.

Automatic sprinkler systems should be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

When placing an order, indicate the full product name. Contact your local distributor for availability..

Sprinkler Assembly:

Series LFII (TY1234), K=3.0, Residential Pendent Sprinkler with (specify) temperature rating and (specify) finish, P/N (specify).

155°F/68°C or Chrome Plated	P/N 51-010-9-155
155°F/68°C White Polyester	P/N 51-010-4-155
155°F/68°C White (RAL9010)*	P/N 51-010-3-155
155°F/68°C Natural Brass	P/N 51-010-1-155
175°F/79°C or Chrome Plated	P/N 51-010-9-175
175°F/79°C White Polyester	P/N 51-010-4-175
175°F/79°C White (RAL9010)*	P/N 51-010-3-175
175°F/79°C Natural Brass	P/N 51-010-1-175

*Eastern Hemisphere sales only.

Recessed Escutcheon:

Specify: Style 20 Recessed Escutcheon with (specify*) finish, P/N (specify*).

*Refer to Technical Data Sheet TFP770.

Sprinkler Wrench:

Specify: W-Type 6 Sprinkler Wrench, P/N 56-000-6-387.

Specify: W-Type 7 Sprinkler Wrench, P/N 56-850-4-001.

tyco / Fire & Building Products

Technical Services: Tel: (800) 381-9312 / Fax: (800) 791-5500

rapid response™
HOME FIRE SPRINKLER SYSTEM

Series LFII Residential, NFPA 13 Optimized Horizontal Sidewall Sprinklers 5.6 K-factor

General Description

The Series LFII (TY3334) Residential Horizontal Sidewall Sprinklers are decorative, fast response, frangible bulb sprinklers designed for use in residential occupancies such as homes, apartments, dormitories, and hotels. When enhanced flow characteristics for residential portions of any occupancy per NFPA 13 is the major consideration, the Series LFII (TY3334) should be the first choice.

When higher flow demands are required for residential sprinklers used in an NFPA 13 design, the large 5.6 K-factor of the Series LFII (TY3334) is an attractive choice. Although mostly intended where residential sprinklers are to be used in an NFPA 13 design, the Series LFII (TY3334) can also be used in wet pipe residential sprinkler systems for one- and two-family dwellings and mobile homes per NFPA 13D, and wet pipe residential sprinkler systems for residential occupancies up to and including four stories in height per NFPA 13R.

The recessed version of the Series LFII (TY3334) is intended for use in areas with finished walls. It employs a two-piece Style 20 Recessed Escutcheon. The Recessed Escutcheon provides 1/4 inch (6,4 mm) of recessed adjustment or up to 1/2 inch (12,7 mm) of total adjustment from the flush mounting surface position. The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the pipe nipples to the sprinklers must be cut.

The Series LFII (TY3334) has been designed with heat sensitivity and water distribution characteristics proven to help in the control of residential fires and to improve the chance for occupants to escape or be evacuated.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

WARNINGS

The Series LFII (TY3334) Residential Horizontal Sidewall Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. ***Failure to do so may impair the performance of these devices.***

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Sprinkler/Model Identification Number

SIN TY3334

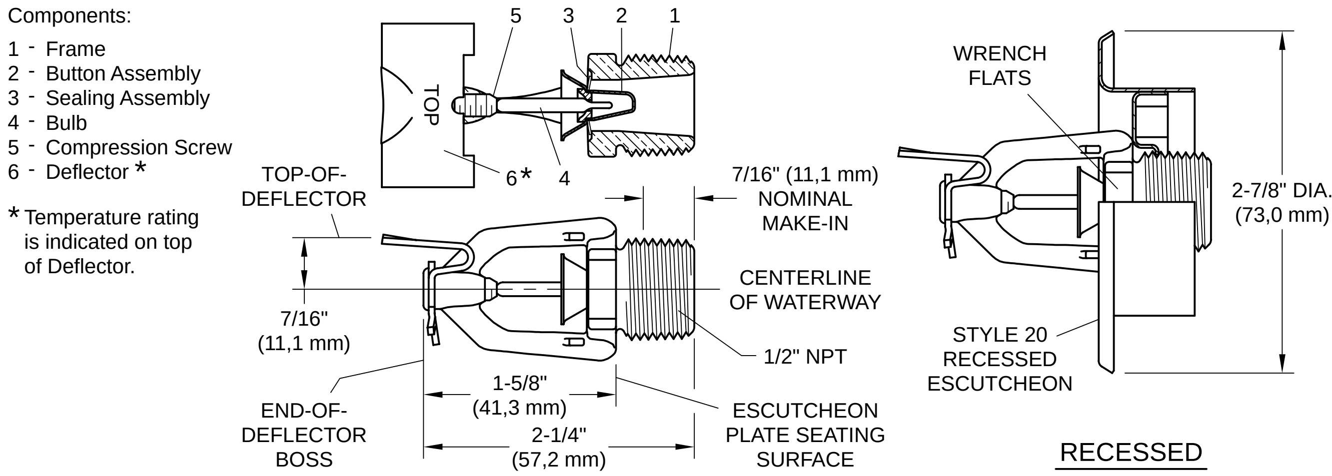


FIGURE 1
SERIES LFII (TY3334) RESIDENTIAL
HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS

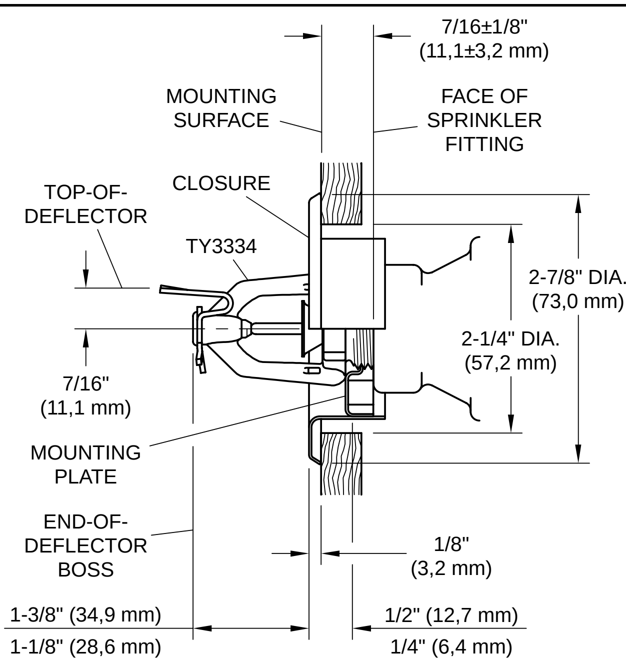


FIGURE 2
STYLE 20 RECESSED ESCUTCHEON
FOR USE WITH THE SERIES LFII (TY3334)
RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER

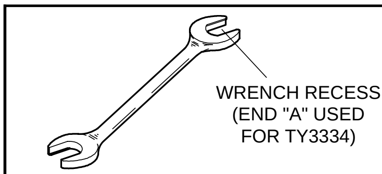


FIGURE 3
W-TYPE 6 SPRINKLER WRENCH

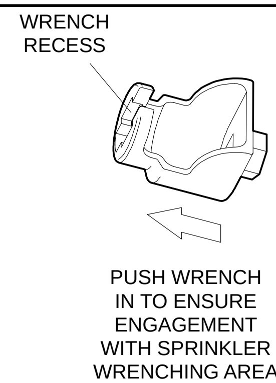


FIGURE 4
W-TYPE 7 RECESSED SPRINKLER WRENCH

Technical Data

Approvals:
UL and C-UL Listed.

Maximum Working Pressure:
175 psi (12,1 bar)

Discharge Coefficient:
K = 5.6 GPM/psi$^{1/2}$ (80,6 LPM/bar$^{1/2}$)

Temperature Rating:
155°F/68°C or 175°F/79°C

Finishes:
White Polyester Coated,
Chrome Plated, or Natural Brass

Physical Characteristics:
Frame . . . . Brass
Button . . . . Bronze
Sealing Assembly . . . . Beryllium Nickel w/Teflon†
Bulb . . . . 3 mm dia. Glass
Compression Screw . . . . . Bronze
Deflector . . . . Copper

†Dupont Registered Trademark

Operation

The glass Bulb contains a fluid that expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass Bulb allowing the sprinkler to activate and flow water.

Design Criteria

The Series LFII (TY3334) Residential Horizontal Sidewall Sprinklers are UL and C-UL Listed for installation in accordance with the following criteria.

NOTE

When conditions exist that are outside the scope of the provided criteria, refer to the Residential Sprinkler Design Guide TFP490 for the manufacturer's recommendations that may be acceptable to the local Authority Having Jurisdiction.

System Type. Only wet pipe systems may be utilized.

Hydraulic Design. The minimum required sprinkler flow rate for systems designed to NFPA 13D or NFPA 13R are given in Table A and B as a function of temperature rating and the maximum allowable coverage areas. The sprinkler flow rate is the minimum required discharge from each of the total number of "design sprinklers" as specified in NFPA 13D or NFPA 13R.

For systems designed to NFPA 13, the number of design sprinklers is to be the four most hydraulically demanding sprinklers. The minimum required discharge from each of the four sprinklers is to be the greater of the following:

- The flow rates given in Tables A and B for NFPA 13D and 13R as a function of temperature rating and the maximum allowable coverage area.
- A minimum discharge of 0.1 gpm/sq. ft. over the "design area" comprised of the four most hydraulically demanding sprinklers for the actual coverage areas being protected by the four sprinklers.

Obstruction To Water Distribution. Locations of sprinklers are to be in accordance with the obstruction rules of NFPA 13 for residential sprinklers.

Operational Sensitivity. The sprinklers are to be installed with an end-of-deflector-boss to wall distance of 1-3/8 to 6 inches or in the recessed position using only the Style 20 Recessed Escutcheon as shown in Figure 2.

In addition the top-of-deflector-to-ceiling distance is to be within the range (Ref. Table A or B) being hydraulically calculated.

Sprinkler Spacing. The minimum spacing between sprinklers is 8 feet (2,4 m) when installed with a top-of-deflector-to-ceiling distance of 4 to 6 inches (100 to 150 mm). The minimum spacing between sprinklers is 9 feet (2,7 m) when installed with a top-of-deflector-to-ceiling distance of 6 to 12 inches (150 to 300 mm). The maximum spacing between sprinklers cannot exceed the width of the coverage area (Ref. Table A) being hydraulically calculated (e.g., maximum 12 feet for a 12 ft. x 12 ft. coverage area, or 16 feet for a 16 ft. x 20 ft. coverage area).

Installation

The Series LFII (TY3334) must be installed in accordance with the following instructions:

NOTES

Do not install any bulb type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm).

A leak tight 1/2 inch NPT sprinkler joint should be obtained with a torque of 7 to 14 ft.lbs. (9,5 to 19,0 Nm). A maximum of 21 ft.lbs. (28,5 Nm) of torque is to be used to install sprinklers. Higher levels of torque may distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in an Escutcheon Plate by under- or over-tightening the Sprinkler. Readjust the position of the sprinkler fitting to suit.

The Series LFII Horizontal Sidewall Sprinklers must be installed in accordance with the following instructions.

Step 1. Horizontal sidewall sprinklers are to be installed in the horizontal position with their centerline of waterway perpendicular to the back wall and parallel to the ceiling. The word "TOP" on the Deflector is to face towards the ceiling with the front edge of the Deflector parallel to the ceiling.

Step 2. With pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step 3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 6 Sprinkler Wrench (Ref. Figure 3). With reference to Figure 1, the W-Type 6 Sprinkler Wrench is to be applied to the wrench flats.

The **Series LFII Recessed Horizontal Sidewall Sprinklers** must be installed in accordance with the following instructions.

Step A. Recessed horizontal sidewall sprinklers are to be installed in the horizontal position with their centerline of waterway perpendicular to the back wall and parallel to the ceiling. The word "TOP" on the Deflector is to face towards the ceiling.

Step B. After installing the Style 20 Mounting Plate over the sprinkler threads and with pipe thread sealant applied to the pipe threads, hand tighten the sprinkler into the sprinkler fitting.

Step C. Tighten the sprinkler into the sprinkler fitting using only the W-Type 7 Recessed Sprinkler Wrench (Ref. Figure 4). With reference to Figure 1, the W-Type 7 Recessed Sprinkler Wrench is to be applied to the sprinkler wrench flats.

Step C. After the wall has been installed or the finish coat has been applied, slide on the Style 20 Closure over the Series LFII Sprinkler and push the Closure over the Mounting Plate until its flange comes in contact with the wall.

Care and Maintenance

The Series LFII (TY3334) must be maintained and serviced in accordance with the following instructions:

NOTES

Absence of an Escutcheon Plate may delay the sprinkler operation in a fire situation.

Before closing a fire protection system main control valve for maintenance work on the fire protection system which it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and all personnel who may be affected by this action must be notified.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned

(Continued on Page 6)

ELEVATION

Maximum Coverage Area (a) Width x Length (b) Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	Minimum Flow (c) and Residual Pressure			
		Top-Of-Deflector- To- Ceiling: 4 to 6 Inches (100 to 150 mm)		Top-Of-Deflector- To- Ceiling: 6 to 12 Inches (150 to 300 mm)	
		155°F/68°C	175°F/79°C	155°F/68°C	175°F/79°C
12 x 12 (3,7 x 3,7)	12 (3,7)	17 GPM (64,3 LPM) 9.2 psi (0,63 bar)	17 GPM (64,3 LPM) 9.2 psi (0,63 bar)	20 GPM (75,7 LPM) 12.8 psi (0,88 bar)	20 GPM (75,7 LPM) 12.8 psi (0,88 bar)
14 x 14 (4,3 x 4,3)	14 (4,3)	19 GPM (71,9 LPM) 11.5 psi (0,79 bar)	19 GPM (71,9 LPM) 11.5 psi (0,79 bar)	22 GPM (83,3 LPM) 15.4 psi (1,06 bar)	22 GPM (83,3 LPM) 15.4 psi (1,06 bar)
16 x 14 (4,9 x 4,3)	16 (4,9)	20 GPM (75,7 LPM) 12.8 psi (0,88 bar)	20 GPM (75,7 LPM) 12.8 psi (0,88 bar)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)
16 x 16 (4,9 x 4,9)	16 (4,9)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)	28 GPM (106,0 LPM) 25.0 psi (1,72 bar)	28 GPM (106,0 LPM) 25.0 psi (1,72 bar)
16 x 18 (4,9 x 5,5)	16 (4,9)	26 GPM (98,4 LPM) 21.6 psi (1,49 bar)	26 GPM (98,4 LPM) 21.6 psi (1,49 bar)	31 GPM (117,3 LPM) 30.6 psi (2,11 bar)	31 GPM (117,3 LPM) 30.6 psi (2,11 bar)
16 x 20 (4,9 x 6,1)	16 (4,9)	29 GPM (109,8 LPM) 26.8 psi (1,85 bar)	29 GPM (109,8 LPM) 26.8 psi (1,85 bar)	37 GPM (140,0 LPM) 43.7 psi (3,01 bar)	37 GPM (140,0 LPM) 43.7 psi (3,01 bar)

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

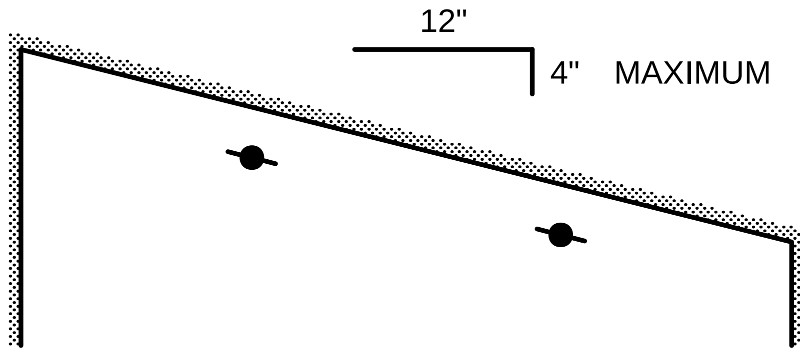
(b) Width (backwall where sprinkler is located) x Length (horizontal throw of sprinkler).

(c) Requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design Criteria Section for details.

(d) Sidewall sprinklers, where installed under a ceiling with a slope greater than 0 inch rise for a 12 inch run to a slope up to 2 inch rise for 12 inch run, must be located per one of the following:

- Locate the sprinklers at the high point of the slope and positioned to discharge down the slope.
- Locate the sprinklers along the slope and positioned to discharge across the slope.

TABLE A
NFPA 13D AND NFPA 13R WET PIPE HYDRAULIC DESIGN CRITERIA
FOR THE SERIES LFII (TY3334)
RESIDENTIAL HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS
FOR HORIZONTAL CEILING (Maximum 2 Inch Rise for 12 Inch Run)



ELEVATION

Maximum Coverage Area [a] Width x Length [b] Ft. x Ft. (m x m)	Maximum Spacing Ft. (m)	Minimum Flow [c] and Residual Pressure Two sprinkler design with the sprinklers located along the slope and positioned to discharge across the slope.			
		Top-Of-Deflector- To- Ceiling: 4 to 6 Inches (100 to 150 mm)		Top-Of-Deflector- To- Ceiling: 6 to 12 Inches (150 to 300 mm)	
		155°F/68°C	175°F/79°C	155°F/68°C	175°F/79°C
16 x 16 (4,9 x 4,9)	16 (4,9)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)	24 GPM (90,8 LPM) 18.4 psi (1,27 bar)

(a) For coverage area dimensions less than or between those indicated, it is necessary to use the minimum required flow for the next highest coverage area for which hydraulic design criteria are stated.

(b) Width (backwall where sprinkler is located) x Length (horizontal throw of sprinkler).

(c) Requirement is based on minimum flow in GPM (LPM) from each sprinkler. The associated residual pressures are calculated using the nominal K-factor. Refer to Hydraulic Design Criteria Section for details..

TABLE B
NFPA 13D AND NFPA 13R WET PIPE HYDRAULIC DESIGN CRITERIA
FOR THE SERIES LFII (TY3334)
RESIDENTIAL HORIZONTAL SIDEWALL AND RECESSED HORIZONTAL SIDEWALL SPRINKLERS
FOR SPRINKLERS LOCATED ALONG A SLOPE AND DISCHARGING ACROSS THE SLOPE
(Greater Than 2 Inch Rise for 12 Inch Run Up To 4 Inch Rise for 12 Inch Run)

by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section).

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. The installing contractor or sprinkler manufacturer should be contacted relative to any questions.

NOTE

The owner must assure that the sprinklers are not used for hanging of any objects and that the sprinklers are only cleaned by means of gently dusting with a feather duster; otherwise, non-operation in the event of a fire or inadvertent operation may result.

It is recommended that automatic sprinkler systems be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national code.

Limited Warranty

Products manufactured by Tyco Fire & Building Products (TFBP) are warranted solely to the original Buyer for ten (10) years against defects in material and workmanship when paid for and properly installed and maintained under normal use and service. This warranty will expire ten (10) years from date of shipment by TFBP. No warranty is given for products or components manufactured by companies not affiliated by ownership with TFBP or for products and components which have been subject to misuse, improper installation, corrosion, or which have not been installed, maintained, modified or repaired in accordance with applicable Standards of the National Fire Protection Association, and/or the standards of any other Authorities Having Jurisdiction. Materials found by TFBP to be defective shall be either repaired or replaced, at TFBP's sole option. TFBP neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of products or parts of products. TFBP shall not be responsible for sprinkler system design errors or inaccurate or incomplete information supplied by Buyer or Buyer's representatives.

In no event shall TFBP be liable, in contract, tort, strict liability or under any other legal theory, for incidental, indirect, special or consequential damages, including but not limited to labor charges, regardless of whether TFBP was informed about the possibility of such damages, and in no event shall TFBP's liability exceed an amount equal to the sales price.

<u>The foregoing warranty is made in lieu of any and all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.</u>

This limited warranty sets forth the exclusive remedy for claims based on failure of or defect in products, materials or components, whether the claim is made in contract, tort, strict liability or any other legal theory.

This warranty will apply to the full extent permitted by law. The invalidity, in whole or part, of any portion of this warranty will not affect the remainder.

Ordering Procedure

When placing an order, indicate the full product name. Contact your local distributor for availability..

Sprinkler Assembly:

Series LFII (TY3334), K=5.6, Residential Horizontal Sidewall Sprinkler with (specify) temperature rating and (specify) finish, P/N (specify).

155°F/68°C

Chrome Plated	P/N 51-524-9-155
White Coated	P/N 51-524-4-155
White (RAL9010)*	P/N 51-524-3-155
Natural Brass	P/N 51-524-1-155

175°F/79°C

Chrome Plated	P/N 51-524-9-175
White Coated	P/N 51-524-4-175
White (RAL9010)*	P/N 51-524-3-175
Natural Brass	P/N 51-524-1-175

* Eastern Hemisphere sales only.

Recessed Escutcheon:

Specify: Style 20 Recessed Escutcheon with (specify*) finish, P/N (specify*).

* Refer to Technical Data Sheet TFP770.

Sprinkler Wrench:

Specify: W-Type 6 Sprinkler Wrench, P/N 56-000-6-387.

Specify: W-Type 7 Sprinkler Wrench, P/N 56-850-4-001.

Appendix J: Instrumentation Data Sheets

Thermocouple Wire

Duplex Insulated

"SLE" Special Limits of Error Available

MADE IN USA

ANSI color code shown

To order IEC color code visit omega.com

K — Duplex Insulated CHROMEGA®-ALOMEGA® Duplex ANSI Type K

ANSI Color Code: Positive Wire, Yellow; Negative Wire, Red; Overall, Brown

OMEGA Engineering does not use reprocessed PFA or PVC in manufacturing thermocouple wire

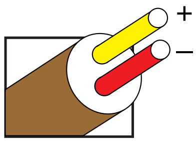
MOST POPULAR MODELS HIGHLIGHTED!

Insulation	AWG No.	Model Number	Price/ 1000'	SLE/ 1000'†††	Type Wire	Insulation Conductor	Insulation Overall	Max. Temp °C	Max. Temp °F	Nominal Size mm (")	Wt.† kg/300 m (lb/1000')
Ceramic*	14	**XC-K-14**	**$3575**	**$4115**	Solid	Nextel Ceramic	Nextel Ceramic	1090	2000	3.6 x 5.0 (0.140 x 0.200)	18 (38)
	20	**XC-K-20**	**2530**	**2910**	Solid			980	1800	3.4 x 4.8 (0.135 x 0.190)	8 (16)
	20	**XT-K-20**	**2420**	**2785**	Solid			980	1800	2.7 x 3.9 (0.105 x 0.155)	7 (15)
	20	**XL-K-20**	**2365**	**2725**	Solid			980	1800	2.4 x 3.4 (0.095 x 0.135)	7 (14)
	24	**XC-K-24**	**2420**	**2785**	Solid			870	1600	2.9 x 4.4 (0.115 x 0.175)	6 (12)
	24	**XT-K-24**	**2200**	**2530**	Solid			870	1600	2.2 x 3.4 (0.088 x 0.132)	5 (11)
	24	**XL-K-24**	**2145**	**2470**	Solid			870	1600	2.0 x 3.0 (0.078 x 0.116)	5 (10)
Vitreous Silica*	20	**XR-K-20**	**1870**	**2150**	Solid	Refrasil	Refrasil	870	1600	2.9 x 4.6 (0.115 x 0.180)	6 (14)
Silica*	14	**XS-K-14**	**2420**	**2785**	Solid	Silica	Silica	1090	2000	3.6 x 5.0 (0.140 x 0.200)	16 (35)
	20	**XS-K-20**	**1430**	**1645**	Solid			980	1800	2.7 x 3.9 (0.105 x 0.155)	6 (12)
	24	**XS-K-24**	**1295**	**1485**	Solid			870	1600	2.2 x 3.4 (0.088 x 0.132)	5 (10)
High Temp. Glass**	20	**HH-K-20**	**635**	**735**	Solid	High Temp Glass	High Temp Glass	704	1300	1.5 x 2.7 (0.060 x 0.105)	4 (9)
	24	**HH-K-24**	**420**	**480**	Solid			704	1300	1.4 x 2.3 (0.055 x 0.090)	3 (5)
Glass	20	**GG-K-20**	**535**	**610**	Solid	Glass Braid	Glass Braid	482	900	1.5 x 2.1 (0.060 x 0.095)	4 (9)
	20S	**GG-K-20S**	**780**	**935**	7 x 28	Glass Braid		482	900	1.5 x 2.5 (0.060 x 0.100)	4 (9)
	24	**GG-K-24**	**350**	**400**	Solid	Glass Braid		482	900	1.3 x 2.0 (0.050 x 0.080)	3 (5)
	24S	**GG-K-24S**	**475**	**570**	7 x 32	Glass Braid		482	900	1.3 x 2.2 (0.050 x 0.085)	3 (5)
	26	**GG-K-26**	**285**	**325**	Solid	Glass Braid		482	900	1.1 x 1.9 (0.045 x 0.075)	2 (4)
	28	**GG-K-28**	**230**	**265**	Solid	Glass Wrap		482	900	1.0 x 1.4 (0.040 x 0.055)	2 (3)
	30	**GG-K-30**	**240**	**275**	Solid	Glass Wrap		482	900	0.9 x 1.3 (0.037 x 0.050)	2 (3)
	36	**GG-K-36**	**320**	**355**	Solid	Glass Wrap		482	900	0.8 x 1.1 (0.033 x 0.045)	1 (2)
Glass with Stainless Steel Overbraid	20	**GG-K-20-SB**	**895**	**975**	Solid	Glass	Stainless Steel Braid over Glass	482	900	2.3 x 3.0 (0.090 x 0.120)	6 (14)
	20S	**GG-K-20S-SB**	**1145**	**1300**	7 x 28			482	900	2.3 x 3.2 (0.090 x 0.127)	7 (15)
	24	**GG-K-24-SB**	**600**	**655**	Solid			482	900	2.2 x 3.0 (0.085 x 0.117)	5 (11)
	24S	**GG-K-24S-SB**	**725**	**820**	7 x 32			482	900	2.0 x 2.8 (0.080 x 0.110)	5 (11)
Kapton Fused Polymide Tape	20	**KK-K-20**	**1010**	**1150**	Solid	Fused Polymide Tape	Fused Polymide Tape	260	500	1.5 x 2.5 (0.060 x 0.100)	5 (11)
	20S	**KK-K-20S**	**1270**	**1450**	7 x 28			260	500	1.5 x 2.7 (0.060 x 0.105)	5 (11)
	24	**KK-K-24**	**750**	**850**	Solid			260	500	1.3 x 1.9 (0.050 x 0.075)	3 (6)
	24S	**KK-K-24S**	**930**	**1060**	7 x 32			260	500	1.3 x 2.2 (0.050 x 0.085)	3 (6)
	30	**KK-K-30**	**650**	**750**	Solid			260	500	1.0 x 1.4 (0.040 x 0.055)	3 (5)
PFA Glass	30	**TG-K-30**	**530**	-	Solid	PFA	Glass Braid	260	500	0.9 x 1.2 (0.034 x 0.047)	1 (2)
	36	**TG-K-36**	**590**	-	Solid			260	500	0.7 x 1.0 (0.028 x 0.038)	1 (2)
	40	**TG-K-40**	**650**	-	Solid			260	500	0.7 x 0.9 (0.026 x 0.035)	1 (2)
Neoflon PFA (High Performance)	20	**TT-K-20**	**645**	**750**	Solid	PFA	PFA	260	500	1.7 x 3.0 (0.068 x 0.116)	5 (11)
	20	**TT-K-20S**	**980**	**1175**	7 x 28			260	500	1.9 x 3.2 (0.073 x 0.126)	5 (11)
	22	**TT-K-22S**	**955**	**1145**	7 x 30			260	500	1.7 x 3.4 (0.065 x 0.133)	4 (9)
	24	**TT-K-24**	**445**	**510**	Solid			260	500	1.4 x 2.4 (0.056 x 0.093)	3 (6)
	24	**TT-K-24S**	**620**	**745**	7 x 32			260	500	1.6 x 2.6 (0.063 x 0.102)	3 (6)
	30	**TT-K-30††**	**335**	**370**	Solid			260	500	0.6 x 1.0 (0.024 x 0.040)	1 (2)
	36	**TT-K-36††**	**375**	**415**	Solid			260	500	0.5 x 0.8 (0.019 x 0.030)	1 (2)
	40	**TT-K-40††**	**500**	**550**	Solid			260	500	0.4 x 0.7 (0.017 x 0.026)	1 (2)
PFA Polymer w/Twisted and Shielded Conductors	20	**TT-K-20-TWSH**	**1140**	**1305**	Solid	PFA Polymer	PFA Polymer and Shielding	260	500	3.7 (0.15)	9 (20)
	20S	**TT-K-20S-TWSH**	**1365**	**1640**	7 x 28			260	500	3.8 (0.15)	9 (20)
	24	**TT-K-24-TWSH**	**685**	**785**	Solid			260	500	2.7 (0.11)	4 (9)
	24S	**TT-K-24S-TWSH**	**820**	**980**	7 x 32			260	500	2.9 (0.12)	4 (9)
Neoflon FEP	20	**FF-K-20**	**635**	**735**	Solid	FEP	FEP	200	392	1.7 x 3.0 (0.068 x 0.116)	5 (11)
	24	**FF-K-24**	**420**	**485**	Solid			200	392	1.7 x 3.0 (0.056 x 0.092)	3 (6)
FEP Polymer w/Twisted and Shielded Conductors	20	**FF-K-20-TWSH**	**905**	**1040**	Solid	FEP Polymer	FEP Polymer and Shielding	200	392	3.7 (0.15)	9 (20)
	20S	**FF-K-20S-TWSH**	**1090**	**1315**	7 x 28			200	392	3.8 (0.15)	9 (20)
	24	**FF-K-24-TWSH**	**515**	**590**	Solid			200	392	2.7 (0.11)	4 (9)
	24S	**FF-K-24S-TWSH**	**620**	**740**	7 x 32			200	392	2.9 (0.12)	4 (9)
TFE Tape Polymer	20	**TFE-K-20**	**620**	**695**	Solid	TFE Tape Polymer	Fused TFE Tape Polymer	260	500	1.5 x 2.5 (0.060 x 0.100)	5 (11)
	20S	**TFE-K-20S**	**955**	**1085**	7 x 28			260	500	1.5 x 2.7 (0.060 x 0.105)	5 (11)
	24	**TFE-K-24**	**420**	**470**	Solid			260	500	1.3 x 1.9 (0.050 x 0.075)	3 (6)
	24S	**TFE-K-24S**	**570**	**650**	7 x 32			260	500	1.3 x 2.2 (0.050 x 0.085)	3 (6)
Polyvinyl	24	**PR-K-24**	**275**	**320**	Solid	Polyvinyl	(Rip Cord)***	105	221	1.4 x 2.3 (0.050 x 0.086)	3 (5)
	24	**PP-K-24S**	**355**	**425**	7 x 32		(Polyvinyl)	105	221	2.0 x 3.4 (0.082 x 0.134)	3 (5)

† Weight of spool and wire rounded to the next highest kg (lb) (does not include packing material). †† Overall color clear.
*††† To order special limits of error wire, add "-SLE" to model number before spool length. * Has color tracers on jacket and conductors*
*** HH Wire has trace thread in Positive leg, Negative leg is red, overall has trace thread. *** Two insulated leads bonded together, but with no overwrap.*
Additional Type K insulated wires are available. See Fused Tape Insulated TFE-K and KK-K Series.
Ordering Example: XC-K-20-SLE-1000,** 1000' (300 m) of Type K duplex insulated special limits of error thermocouple wire, **$2910.

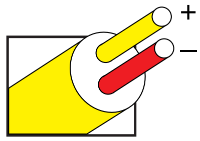
Revised Thermocouple Reference Tables

MAXIMUM TEMPERATURE RANGE
Thermocouple Grade
– 328 to 2282°F
– 200 to 1250°C
Extension Grade
32 to 392°F
0 to 200°C
LIMITS OF ERROR
(whichever is greater)
Standard: 2.2°C or 0.75% Above 0°C
2.2°C or 2.0% Below 0°C
Special: 1.1°C or 0.4%
COMMENTS, BARE WIRE ENVIRONMENT:
Clean Oxidizing and Inert; Limited Use in Vacuum or Reducing; Wide Temperature Range; Most Popular Calibration
TEMPERATURE IN DEGREES °C
REFERENCE JUNCTION AT 0°C



Thermocouple Grade

Nickel-Chromium vs. Nickel-Aluminum



Extension Grade

TYPE K

Reference Tables
N.I.S.T. Monograph 175
Revised to ITS-90

Z

Thermoelectric Voltage in Millivolts

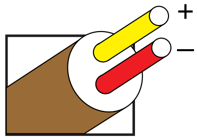
°C	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	°C
-260	-6.458	-6.457	-6.456	-6.455	-6.453	-6.452	-6.450	-6.448	-6.446	-6.444	-6.441	-260
-250	-6.441	-6.438	-6.435	-6.432	-6.429	-6.425	-6.421	-6.417	-6.413	-6.408	-6.404	-250
-240	-6.404	-6.399	-6.393	-6.388	-6.382	-6.377	-6.370	-6.364	-6.358	-6.351	-6.344	-240
-230	-6.344	-6.337	-6.329	-6.322	-6.314	-6.306	-6.297	-6.289	-6.280	-6.271	-6.262	-230
-220	-6.262	-6.252	-6.243	-6.233	-6.223	-6.213	-6.202	-6.192	-6.181	-6.170	-6.158	-220
-210	-6.158	-6.147	-6.135	-6.123	-6.111	-6.099	-6.087	-6.074	-6.061	-6.048	-6.035	-210
-200	-6.035	-6.021	-6.007	-5.994	-5.980	-5.965	-5.951	-5.936	-5.922	-5.907	-5.891	-200
-190	-5.891	-5.876	-5.861	-5.845	-5.829	-5.813	-5.797	-5.780	-5.763	-5.747	-5.730	-190
-180	-5.730	-5.713	-5.695	-5.678	-5.660	-5.642	-5.624	-5.606	-5.588	-5.569	-5.550	-180
-170	-5.550	-5.531	-5.512	-5.493	-5.474	-5.454	-5.435	-5.415	-5.395	-5.374	-5.354	-170
-160	-5.354	-5.333	-5.313	-5.292	-5.271	-5.250	-5.228	-5.207	-5.185	-5.163	-5.141	-160
-150	-5.141	-5.119	-5.097	-5.074	-5.052	-5.029	-5.006	-4.983	-4.960	-4.936	-4.913	-150
-140	-4.913	-4.889	-4.865	-4.841	-4.817	-4.793	-4.768	-4.744	-4.719	-4.694	-4.669	-140
-130	-4.669	-4.644	-4.618	-4.593	-4.567	-4.542	-4.516	-4.490	-4.463	-4.437	-4.411	-130
-120	-4.411	-4.384	-4.357	-4.330	-4.303	-4.276	-4.249	-4.221	-4.194	-4.166	-4.138	-120
-110	-4.138	-4.110	-4.082	-4.054	-4.025	-3.997	-3.968	-3.939	-3.911	-3.882	-3.852	-110
-100	-3.852	-3.823	-3.794	-3.764	-3.734	-3.705	-3.675	-3.645	-3.614	-3.584	-3.554	-100
-90	-3.554	-3.523	-3.492	-3.462	-3.431	-3.400	-3.368	-3.337	-3.306	-3.274	-3.243	-90
-80	-3.243	-3.211	-3.179	-3.147	-3.115	-3.083	-3.050	-3.018	-2.986	-2.953	-2.920	-80
-70	-2.920	-2.887	-2.854	-2.821	-2.788	-2.755	-2.721	-2.688	-2.654	-2.620	-2.587	-70
-60	-2.587	-2.553	-2.519	-2.485	-2.450	-2.416	-2.382	-2.347	-2.312	-2.278	-2.243	-60
-50	-2.243	-2.208	-2.173	-2.138	-2.103	-2.067	-2.032	-1.996	-1.961	-1.925	-1.889	-50
-40	-1.889	-1.854	-1.818	-1.782	-1.745	-1.709	-1.673	-1.637	-1.600	-1.564	-1.527	-40
-30	-1.527	-1.490	-1.453	-1.417	-1.380	-1.343	-1.305	-1.268	-1.231	-1.194	-1.156	-30
-20	-1.156	-1.119	-1.081	-1.043	-1.006	-0.968	-0.930	-0.892	-0.854	-0.816	-0.778	-20
-10	-0.778	-0.739	-0.701	-0.663	-0.624	-0.586	-0.547	-0.508	-0.470	-0.431	-0.392	-10
0	-0.392	-0.353	-0.314	-0.275	-0.236	-0.197	-0.157	-0.118	-0.079	-0.039	0.000	0
0	0.000	0.039	0.079	0.119	0.158	0.198	0.238	0.277	0.317	0.357	0.397	0
10	0.397	0.437	0.477	0.517	0.557	0.597	0.637	0.677	0.718	0.758	0.798	10
20	0.798	0.838	0.879	0.919	0.960	1.000	1.041	1.081	1.122	1.163	1.203	20
30	1.203	1.244	1.285	1.326	1.366	1.407	1.448	1.489	1.530	1.571	1.612	30
40	1.612	1.653	1.694	1.735	1.776	1.817	1.858	1.899	1.941	1.982	2.023	40
50	2.023	2.064	2.106	2.147	2.188	2.230	2.271	2.312	2.354	2.395	2.436	50
60	2.436	2.478	2.519	2.561	2.602	2.644	2.685	2.727	2.768	2.810	2.851	60
70	2.851	2.893	2.934	2.976	3.017	3.059	3.100	3.142	3.184	3.225	3.267	70
80	3.267	3.308	3.350	3.391	3.433	3.474	3.516	3.557	3.599	3.640	3.682	80
90	3.682	3.723	3.765	3.806	3.848	3.889	3.931	3.972	4.013	4.055	4.096	90
100	4.096	4.138	4.179	4.220	4.262	4.303	4.344	4.385	4.427	4.468	4.509	100
110	4.509	4.550	4.591	4.633	4.674	4.715	4.756	4.797	4.838	4.879	4.920	110
120	4.920	4.961	5.002	5.043	5.084	5.124	5.165	5.206	5.247	5.288	5.328	120
130	5.328	5.369	5.410	5.450	5.491	5.532	5.572	5.613	5.653	5.694	5.735	130
140	5.735	5.775	5.815	5.856	5.896	5.937	5.977	6.017	6.058	6.098	6.138	140
150	6.138	6.179	6.219	6.259	6.299	6.339	6.380	6.420	6.460	6.500	6.540	150
160	6.540	6.580	6.620	6.660	6.701	6.741	6.781	6.821	6.861	6.901	6.941	160
170	6.941	6.981	7.021	7.060	7.100	7.140	7.180	7.220	7.260	7.300	7.340	170
180	7.340	7.380	7.420	7.460	7.500	7.540	7.579	7.619	7.659	7.699	7.739	180
190	7.739	7.779	7.819	7.859	7.899	7.939	7.979	8.019	8.059	8.099	8.138	190
200	8.138	8.178	8.218	8.258	8.298	8.338	8.378	8.418	8.458	8.499	8.539	200
210	8.539	8.579	8.619	8.659	8.699	8.739	8.779	8.819	8.860	8.900	8.940	210
220	8.940	8.980	9.020	9.061	9.101	9.141	9.181	9.222	9.262	9.302	9.343	220
230	9.343	9.383	9.423	9.464	9.504	9.545	9.585	9.626	9.666	9.707	9.747	230
240	9.747	9.788	9.828	9.869	9.909	9.950	9.991	10.031	10.072	10.113	10.153	240
°C	0	1	2	3	4	5	6	7	8	9	10	°C

°C	0	1	2	3	4	5	6	7	8	9	10	°C
250	10.153	10.194	10.235	10.276	10.316	10.357	10.398	10.439	10.480	10.520	10.561	250
260	10.561	10.602	10.643	10.684	10.725	10.766	10.807	10.848	10.889	10.930	10.971	260
270	10.971	11.012	11.053	11.094	11.135	11.176	11.217	11.259	11.300	11.341	11.382	270
280	11.382	11.423	11.465	11.506	11.547	11.588	11.630	11.671	11.712	11.753	11.795	280
290	11.795	11.836	11.877	11.919	11.960	12.001	12.043	12.084	12.126	12.167	12.209	290
300	12.209	12.250	12.291	12.333	12.374	12.416	12.457	12.499	12.540	12.582	12.624	300
310	12.624	12.665	12.707	12.748	12.790	12.831	12.873	12.915	12.956	12.998	13.040	310
320	13.040	13.081	13.123	13.165	13.206	13.248	13.290	13.331	13.373	13.415	13.457	320
330	13.457	13.498	13.540	13.582	13.624	13.665	13.707	13.749	13.791	13.833	13.874	330
340	13.874	13.916	13.958	14.000	14.042	14.084	14.126	14.167	14.209	14.251	14.293	340
350	14.293	14.335	14.377	14.419	14.461	14.503	14.545	14.587	14.629	14.671	14.713	350
360	14.713	14.755	14.797	14.839	14.881	14.923	14.965	15.007	15.049	15.091	15.133	360
370	15.133	15.175	15.217	15.259	15.301	15.343	15.385	15.427	15.469	15.511	15.554	370
380	15.554	15.596	15.638	15.680	15.722	15.764	15.806	15.849	15.891	15.933	15.975	380
390	15.975	16.017	16.059	16.102	16.144	16.186	16.228	16.270	16.313	16.355	16.397	390
400	16.397	16.439	16.482	16.524	16.566	16.608	16.651	16.693	16.735	16.778	16.820	400
410	16.820	16.862	16.904	16.947	16.989	17.031	17.074	17.116	17.158	17.201	17.243	410
420	17.243	17.285	17.328	17.370	17.413	17.455	17.497	17.540	17.582	17.624	17.667	420
430	17.667	17.709	17.752	17.794	17.837	17.879	17.921	17.964	18.006	18.049	18.091	430
440	18.091	18.134	18.176	18.218	18.261	18.303	18.346	18.388	18.431	18.473	18.516	440
450	18.516	18.558	18.601	18.643	18.686	18.728	18.771	18.813	18.856	18.898	18.941	450
460	18.941	18.983	19.026	19.068	19.111	19.154	19.196	19.239	19.281	19.324	19.366	460
470	19.366	19.409	19.451	19.494	19.537	19.579	19.622	19.664	19.707	19.750	19.792	470
480	19.792	19.835	19.877	19.920	19.962	20.005	20.048	20.090	20.133	20.175	20.218	480
490	20.218	20.261	20.303	20.346	20.389	20.431	20.474	20.516	20.559	20.602	20.644	490
500	20.644	20.687	20.730	20.772	20.815	20.857	20.900	20.943	20.985	21.028	21.071	500
510	21.071	21.113	21.156	21.199	21.241	21.284	21.326	21.369	21.412	21.454	21.497	510
520	21.497	21.540	21.582	21.625	21.668	21.710	21.753	21.796	21.838	21.881	21.924	520
530	21.924	21.966	22.009	22.052	22.094	22.137	22.179	22.222	22.265	22.307	22.350	530
540	22.350	22.393	22.435	22.478	22.521	22.563	22.606	22.649	22.691	22.734	22.776	540
550	22.776	22.819	22.862	22.904	22.947	22.990	23.032	23.075	23.117	23.160	23.203	550
560	23.203	23.245	23.288	23.331	23.373	23.416	23.458	23.501	23.544	23.586	23.629	560
570	23.629	23.671	23.714	23.757	23.799	23.842	23.884	23.927	23.970	24.012	24.055	570
580	24.055	24.097	24.140	24.182	24.225	24.267	24.310	24.353	24.395	24.438	24.480	580
590	24.480	24.523	24.565	24.608	24.650	24.693	24.735	24.778	24.820	24.863	24.905	590
600	24.905	24.948	24.990	25.033	25.075	25.118	25.160	25.203	25.245	25.288	25.330	600
610	25.330	25.373	25.415	25.458	25.500	25.543	25.585	25.627	25.670	25.712	25.755	610
620	25.755	25.797	25.840	25.882	25.924	25.967	26.009	26.052	26.094	26.136	26.179	620
630	26.179	26.221	26.263	26.306	26.348	26.390	26.433	26.475	26.517	26.560	26.602	630
640	26.602	26.644	26.687	26.729	26.771	26.814	26.856	26.898	26.940	26.983	27.025	640
650	27.025	27.067	27.109	27.152	27.194	27.236	27.278	27.320	27.363	27.405	27.447	650
660	27.447	27.489	27.531	27.574	27.616	27.658	27.700	27.742	27.784	27.826	27.869	660
670	27.869	27.911	27.953	27.995	28.037	28.079	28.121	28.163	28.205	28.247	28.289	670
680	28.289	28.332	28.374	28.416	28.458	28.500	28.542	28.584	28.626	28.668	28.710	680
690	28.710	28.752	28.794	28.835	28.877	28.919	28.961	29.003	29.045	29.087	29.129	690
700	29.129	29.171	29.213	29.255	29.297	29.338	29.380	29.422	29.464	29.506	29.548	700
710	29.548	29.589	29.631	29.673	29.715	29.757	29.798	29.840	29.882	29.924	29.965	710
720	29.965	30.007	30.049	30.090	30.132	30.174	30.216	30.257	30.299	30.341	30.382	720
730	30.382	30.424	30.466	30.507	30.549	30.590	30.632	30.674	30.715	30.757	30.798	730
740	30.798	30.840	30.881	30.923	30.964	31.006	31.047	31.089	31.130	31.172	31.213	740
750	31.213	31.255	31.296	31.338	31.379	31.421	31.462	31.504	31.545	31.586	31.628	750
760	31.628	31.669	31.710	31.752	31.793	31.834	31.876	31.917	31.958	32.000	32.041	760
770	32.041	32.082	32.124	32.165	32.206	32.247	32.289	32.330	32.371	32.412	32.453	770
780	32.453	32.495	32.536	32.577	32.618	32.659	32.700	32.742	32.783	32.824	32.865	780
790	32.865	32.906	32.947	32.988	33.029	33.070	33.111	33.152	33.193	33.234	33.275	790
°C	0	1	2	3	4	5	6	7	8	9	10	°C

Revised Thermocouple Reference Tables

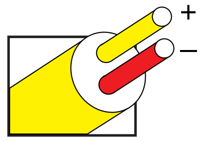
TYPE K

Reference Tables N.I.S.T. Monograph 175 Revised to ITS-90



Thermocouple Grade

Nickel-Chromium vs. Nickel-Aluminum



Extension Grade

MAXIMUM TEMPERATURE RANGE
Thermocouple Grade
– 328 to 2282°F
– 200 to 1250°C
Extension Grade
32 to 392°F
0 to 200°C

LIMITS OF ERROR
(whichever is greater)
Standard: 2.2°C or 0.75% Above 0°C
2.2°C or 2.0% Below 0°C
Special: 1.1°C or 0.4%

COMMENTS, BARE WIRE ENVIRONMENT:
Clean Oxidizing and Inert; Limited Use in Vacuum or Reducing; Wide Temperature Range; Most Popular Calibration

TEMPERATURE IN DEGREES °C
REFERENCE JUNCTION AT 0°C

Thermoelectric Voltage in Millivolts

°C	0	1	2	3	4	5	6	7	8	9	10	°C
800	33.275	33.316	33.357	33.398	33.439	33.480	33.521	33.562	33.603	33.644	33.685	800
810	33.685	33.726	33.767	33.808	33.848	33.889	33.930	33.971	34.012	34.053	34.093	810
820	34.093	34.134	34.175	34.216	34.257	34.297	34.338	34.379	34.420	34.460	34.501	820
830	34.501	34.542	34.582	34.623	34.664	34.704	34.745	34.786	34.826	34.867	34.908	830
840	34.908	34.948	34.989	35.029	35.070	35.110	35.151	35.192	35.232	35.273	35.313	840
850	35.313	35.354	35.394	35.435	35.475	35.516	35.556	35.596	35.637	35.677	35.718	850
860	35.718	35.758	35.798	35.839	35.879	35.920	35.960	36.000	36.041	36.081	36.121	860
870	36.121	36.162	36.202	36.242	36.282	36.323	36.363	36.403	36.443	36.484	36.524	870
880	36.524	36.564	36.604	36.644	36.685	36.725	36.765	36.805	36.845	36.885	36.925	880
890	36.925	36.965	37.006	37.046	37.086	37.126	37.166	37.206	37.246	37.286	37.326	890
900	37.326	37.366	37.406	37.446	37.486	37.526	37.566	37.606	37.646	37.686	37.725	900
910	37.725	37.765	37.805	37.845	37.885	37.925	37.965	38.005	38.044	38.084	38.124	910
920	38.124	38.164	38.204	38.243	38.283	38.323	38.363	38.402	38.442	38.482	38.522	920
930	38.522	38.561	38.601	38.641	38.680	38.720	38.760	38.799	38.839	38.878	38.918	930
940	38.918	38.958	38.997	39.037	39.076	39.116	39.155	39.195	39.235	39.274	39.314	940
950	39.314	39.353	39.393	39.432	39.471	39.511	39.550	39.590	39.629	39.669	39.708	950
960	39.708	39.747	39.787	39.826	39.866	39.905	39.944	39.984	40.023	40.062	40.101	960
970	40.101	40.141	40.180	40.219	40.259	40.298	40.337	40.376	40.415	40.455	40.494	970
980	40.494	40.533	40.572	40.611	40.651	40.690	40.729	40.768	40.807	40.846	40.885	980
990	40.885	40.924	40.963	41.002	41.042	41.081	41.120	41.159	41.198	41.237	41.276	990
1000	41.276	41.315	41.354	41.393	41.431	41.470	41.509	41.548	41.587	41.626	41.665	1000
1010	41.665	41.704	41.743	41.781	41.820	41.859	41.898	41.937	41.976	42.014	42.053	1010
1020	42.053	42.092	42.131	42.169	42.208	42.247	42.286	42.324	42.363	42.402	42.440	1020
1030	42.440	42.479	42.518	42.556	42.595	42.633	42.672	42.711	42.749	42.788	42.826	1030
1040	42.826	42.865	42.903	42.942	42.980	43.019	43.057	43.096	43.134	43.173	43.211	1040
1050	43.211	43.250	43.288	43.327	43.365	43.403	43.442	43.480	43.518	43.557	43.595	1050
1060	43.595	43.633	43.672	43.710	43.748	43.787	43.825	43.863	43.901	43.940	43.978	1060
1070	43.978	44.016	44.054	44.092	44.130	44.169	44.207	44.245	44.283	44.321	44.359	1070
1080	44.359	44.397	44.435	44.473	44.512	44.550	44.588	44.626	44.664	44.702	44.740	1080
1090	44.740	44.778	44.816	44.853	44.891	44.929	44.967	45.005	45.043	45.081	45.119	1090
°C	0	1	2	3	4	5	6	7	8	9	10	°C

°C	0	1	2	3	4	5	6	7	8	9	10	°C
1100	45.119	45.157	45.194	45.232	45.270	45.308	45.346	45.383	45.421	45.459	45.497	1100
1110	45.497	45.534	45.572	45.610	45.647	45.685	45.723	45.760	45.798	45.836	45.873	1110
1120	45.873	45.911	45.948	45.986	46.024	46.061	46.099	46.136	46.174	46.211	46.249	1120
1130	46.249	46.286	46.324	46.361	46.398	46.436	46.473	46.511	46.548	46.585	46.623	1130
1140	46.623	46.660	46.697	46.735	46.772	46.809	46.847	46.884	46.921	46.958	46.995	1140
1150	46.995	47.033	47.070	47.107	47.144	47.181	47.218	47.256	47.293	47.330	47.367	1150
1160	47.367	47.404	47.441	47.478	47.515	47.552	47.589	47.626	47.663	47.700	47.737	1160
1170	47.737	47.774	47.811	47.848	47.884	47.921	47.958	47.995	48.032	48.069	48.105	1170
1180	48.105	48.142	48.179	48.216	48.252	48.289	48.326	48.363	48.399	48.436	48.473	1180
1190	48.473	48.509	48.546	48.582	48.619	48.656	48.692	48.729	48.765	48.802	48.838	1190
1200	48.838	48.875	48.911	48.948	48.984	49.021	49.057	49.093	49.130	49.166	49.202	1200
1210	49.202	49.239	49.275	49.311	49.348	49.384	49.420	49.456	49.493	49.529	49.565	1210
1220	49.565	49.601	49.637	49.674	49.710	49.746	49.782	49.818	49.854	49.890	49.926	1220
1230	49.926	49.962	49.998	50.034	50.070	50.106	50.142	50.178	50.214	50.250	50.286	1230
1240	50.286	50.322	50.358	50.393	50.429	50.465	50.501	50.537	50.572	50.608	50.644	1240
1250	50.644	50.680	50.715	50.751	50.787	50.822	50.858	50.894	50.929	50.965	51.000	1250
1260	51.000	51.036	51.071	51.107	51.142	51.178	51.213	51.249	51.284	51.320	51.355	1260
1270	51.355	51.391	51.426	51.461	51.497	51.532	51.567	51.603	51.638	51.673	51.708	1270
1280	51.708	51.744	51.779	51.814	51.849	51.885	51.920	51.955	51.990	52.025	52.060	1280
1290	52.060	52.095	52.130	52.165	52.200	52.235	52.270	52.305	52.340	52.375	52.410	1290
1300	52.410	52.445	52.480	52.515	52.550	52.585	52.620	52.654	52.689	52.724	52.759	1300
1310	52.759	52.794	52.828	52.863	52.898	52.932	52.967	53.002	53.037	53.071	53.106	1310
1320	53.106	53.140	53.175	53.210	53.244	53.279	53.313	53.348	53.382	53.417	53.451	1320
1330	53.451	53.486	53.520	53.555	53.589	53.623	53.658	53.692	53.727	53.761	53.795	1330
1340	53.795	53.830	53.864	53.898	53.932	53.967	54.001	54.035	54.069	54.104	54.138	1340
1350	54.138	54.172	54.206	54.240	54.274	54.308	54.343	54.377	54.411	54.445	54.479	1350
1360	54.479	54.513	54.547	54.581	54.615	54.649	54.683	54.717	54.751	54.785	54.819	1360
1370	54.819	54.852	54.886									1370
°C	0	1	2	3	4	5	6	7	8	9	10	°C

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  Air Velocity Indicators, Doppler Flowmeters, Level Measurement, Magnetic Flowmeters, Mass Flowmeters, Pitot Tubes, Pumps, Rotameters, Turbine and Paddle Wheel Flowmeters, Ultrasonic Flowmeters, Valves, Variable Area Flowmeters, Vortex Shedding Flowmeters

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EPG05

HIGHLY ACCURATE, LOW-PRESSURE LABORATORY TRANSMITTER

PX655 Series

0-0.1 to 0-50 inH₂O
0-25 Pa to 0-1.25 kPa

Starts at **$395**

PX655-01DI, $395, with DP3002-E meter, $285, shown smaller than actual size, see section D.

Ideal Applications:

- Clean Rooms
- HVAC
- Fume Hoods
- Laboratory Monitoring

SPECIFICATIONS

Excitation: 12 to 36 Vdc
Output: 4 to 20 mA (2 wire)
Linearity: 0.3% FS (BFSL)
Hysteresis: 0.02% FS
Repeatability: 0.05% FS
Operating Temp: -29 to 72°C (-20 to 160°F)
Compensated Temp: 2 to 57°C (35 to 135°F)
Thermal Effects:
  Zero: 0.015% FS/°F
  Span: 0.015% rdg/°F
Proof Pressure: 15 psi
Burst Pressure: 20 psi
Static Pressure: 25 psi
Gage Type: Capacitance
Max Loop Resistance: (Supply voltage – 12) x 50 Ω
Calibration Report: NIST cal at 25, 50, 75 and 100% FS; upscale and downscale provided
Response Time: 250 ms
Wetted Parts: Dry, clean, non-corrosive gases only
Enclosure: NEMA 2 (IP62), 107 H x 117 W x 53 mm D (4.2 x 4.6 x 2.1")
Pressure Port: ¼ barbed fittings (tubing TY-316-100)
Electrical Conn.: Screw terminal
Weight: 368 g (13 oz)

MOST POPULAR MODELS HIGHLIGHTED!

To Order *(Specify Model Number)*

RANGE inH₂O	RANGE Pa/kPa	MODEL NO.	PRICE	COMPATIBLE METERS*
0 to 0.1	0 to 25	PX655-0.1DI	$495	DP25B-E, DP41-E, DP460-E
0 to 0.25	0 to 62	PX655-0.25DI	620	DP25B-E, DP41-E, DP460-E
0 to 0.50	0 to 125	PX655-0.5DI	425	DP25B-E, DP41-E, DP460-E
0 to 0.75	0 to 187	PX655-0.75DI	395	DP25B-E, DP41-E, DP460-E
0 to 1	0 to 249	PX655-01DI	395	DP25B-E, DP41-E, DP3002-E
0 to 1.5	0 to 374	PX655-01.5DI	395	DP25B-E, DP41-E, DP3002-E
0 to 2	0 to 498	PX655-02DI	395	DP25B-E, DP41-E, DP460-E
0 to 3	0 to 748	PX655-03DI	395	DP25B-E, DP41-E, DP460-E
0 to 5	0 to 1.25	PX655-05DI	395	DP25B-E, DP41-E, DP460-E
0 to 10	0 to 2.49	PX655-10DI	395	DP25B-E, DP41-E, DP3002-E
0 to 25	0 to 6.23	PX655-25DI	395	DP25B-E, DP41-E, DP460-E
0 to 50	0 to 12.5	PX655-50DI	395	DP25B-E, DP41-E, DP460-E
BIDIRECTIONAL RANGES				
±0.1	25	PX655-0.1BDI	$455	DP25B-E, DP41-E, DP460-E
±0.25	62	PX655-0.25BDI	425	DP25B-E, DP41-E, DP460-E
±0.50	125	PX655-0.5BDI	395	DP25B-E, DP41-E, DP460-E
±1	249	PX655-01BDI	395	DP25B-E, DP41-E, DP460-E
±2.5	623	PX655-2.5BDI	395	DP25B-E, DP41-E, DP460-E
±5	1.25	PX655-05BDI	395	DP25B-E, DP41-E, DP460-E
±10	2.49	PX655-10BDI	395	DP25B-E, DP41-E, DP460-E
±25	6.23	PX655-25BDI	395	DP25B-E, DP41-E, DP460-E
±50	12.5	PX655-50BDI	395	DP25B-E, DP41-E, DP460-E

Comes with complete operator's manual. ** See section D for compatible meters.*
Ordering Example: PX655-01DI, 0 to 1 inH₂O low-pressure differential pressure transmitter, $395.

ACCESSORY

MODEL NO.	PRICE	DESCRIPTION
OP-6	$340	Reference Book: Fundamentals of Temperature, Pressure, and Air Flow Measurement

TELEDYNE HASTINGS INSTRUMENTS

MEDIUM CAPACITY FLOWMETERS AND CONTROLLERS

Models HFM-301, HFC-303

FEATURES

- ±1.0% of Full-Scale Accuracy[1]
- Rapid Settling Times
  HFM-301 ≤ 0.4 sec
  HFC-303 ≤ 2.0 sec
- Range — 25 to 1000 slm (Air Equivalent)
- Operating Pressures to 500 PSI or Higher
- NIST Traceable Calibration

APPLICATIONS

- Leak Testing
- Research
- Vapor Deposition
- R&D and Process Flows
- Semiconductor Processes
- Pollution Monitoring
- Gas Blending
- Chromatography

HFM-301

HFC-303

Power Supplies Available

DESIGN FEATURES

Teledyne Hastings Instruments (THI) products represent over 60 years of experience in the design and manufacture of mass flow products. The 300 Series is a culmination of this experience with patented technologies that make these the finest flowmeters and controllers available today.

The THI Mass Flow 300 Series meters and controllers are designed to accurately measure mass flow without corrections or compensations for gas pressure and temperature. They are accurate to better than ±1.0% of full scale. THI mass flow instruments do not require any periodic maintenance under normal operating conditions with clean gases. No damage will occur from the use of moderate overpressures (~500 psi) or overflows. Instruments are normally calibrated with the appropriate standard calibration gas (air & N_2), then a gas conversion factor (GCF) is used to adjust the output for the intended gas. Special calibrations for other gases, such as oxygen, helium and argon, are available upon special order.

These products contain a number of features that set them apart from other available instruments: (1) They are inherently linear; no linearization circuitry is employed. Should recalibration in the field be desired (a calibration standard is required), the customer needs to simply set the zero and span points. (2) The output signal is linear for very large overflows and will not come back on scale when a flow an order of magnitude over the full scale flow rate is measured. (3) The instrument incorporates a removable/replaceable sensor module. (4) The unit has very fast settling times.

TELEDYNE INSTRUMENTS
Hastings Instruments
A Teledyne Technologies Company

MODELS HFM-301, HFC-303

Optional Features
Fittings–VCR, VCO and Swagelok®
High pressure rating (1000 psig)
Cleaned for oxygen service

Accessories
Power Supplies with integral Flow Totalizers
& Alarm Set Points
Interconnecting cables

*Note: After changing components, instruments require recalibration to meet accuracy specifications.

COMMON SPECIFICATIONS HFM-301/HFC-303

Accuracy [1]	± 1.0% of F.S.
Repeatability	± 0.07% of F.S.
Standard Operating Pressure	500 psi
High-Pressure Option	1000 psi (proof tested to 1500 psi)
Pressure Coefficient	<0.026% of readings/psi (N_2) (0-1000 psig)
Leak Integrity	< $1x10^{-9}$ sccs He
Temperature Coefficient (zero) **Temperature Coefficient** (span)	< 0.085%/°C of F.S. (0-60°C) < 0.11%/°C of reading (15-60°C)
Standard Output	0-5 VDC
Optional Output	4-20 mA
Connector	15-pin subminiature D
***Attitude Sensitivity of Zero**	< 0.25% of F.S.
***Attitude Sensitivity of Span**	< 0.06% of reading

*N_2 @ 19.7 psia

SPECIFICATIONS HFM-301

Settling Time	≤ 0.4 sec (0% to 100% F.S.)
Power Requiremen	± 15 VDC @ ± 55 mA
Wetted Materials	Viton®, 316 SS, 302 SS, Nickel 200
Weight (approx.)	3.5 lb (1.6 kg) (0-300 slm) 3.4 lb (1.5 kg) (300-1000 slm)

SPECIFICATIONS HFC-303

Settling Time	≤ 2.0 sec (10% to 100% F.S.)
Power Requirement	± 15 VDC @ 150 mA
Wetted Materials [2]	302SS, 316L SS, Nickel 200, Viton, Teflon®, Kalrez® (valve seat)
Setpoint Input	0-5 VDC (standard)/4-20 mA (optional)
Weight (approx.)	5.3 lb (2.4 kg) (0-300 slm) 5.2 lb (2.3 kg) (300-1000 slm)

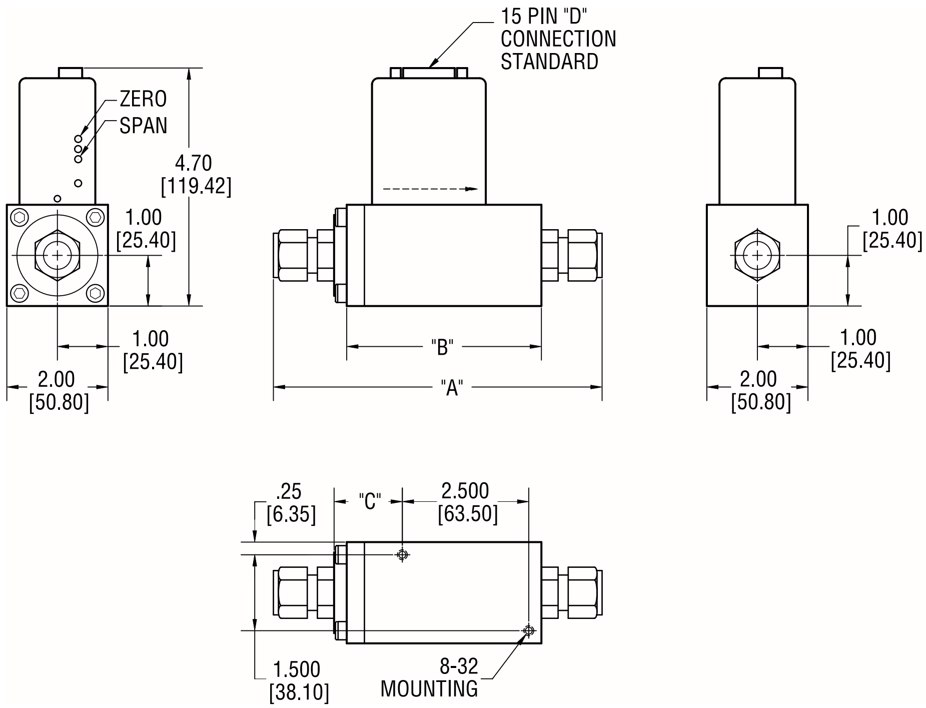
Teledyne Hastings Instruments reserves the right to change or modify the design of its equipment without any obligation to provide notification of change or intent to change.

[1] See Product Manual for critical information on instrument accuracy and the use of GCFs (gas conversion factors). Stated accuracy is for nitrogen or other gas specific calibration and use with this gas only.

[2] See Selection Chart for optional materials. Viton is standard O-Ring option.

MODELS HFM-301, HFC-303

Model HFM-301



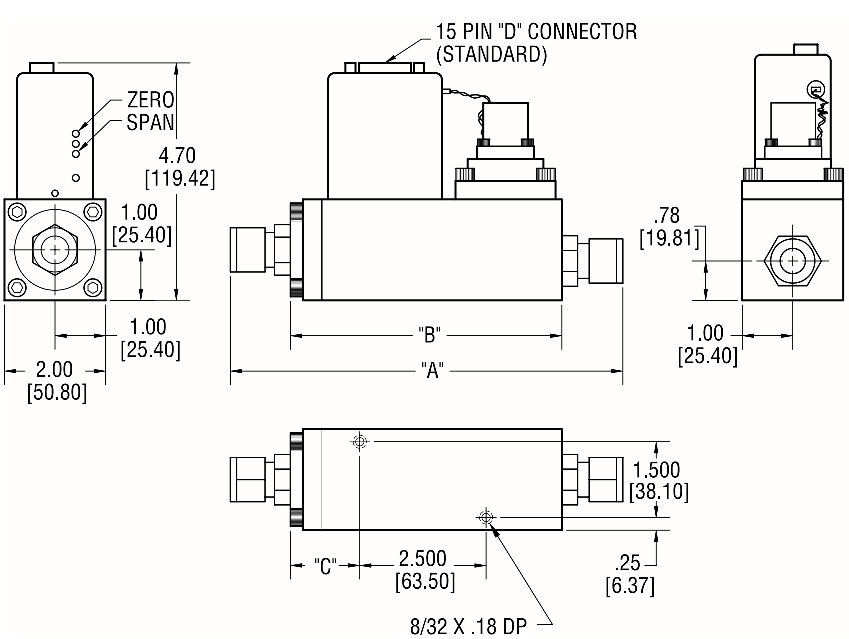
HFM-301 1/2 FITTING

FITTING TYPE	DIM "A"
3/4"-16 FEMALE	4.11 [104.39]
SWAG. 1/2" W NUT	6.31 [160.27]
SWAG. 1/2" BARE	5.73 [145.54]
VCO FACE 1/2"	6.17 [156.72]
VCR FACE 1/2"	6.55 [166.37]
DIM "B"	4.11 [104.39]
DIM "C"	1.36 [34.59]

HFM-301 3/4 FITTING

FITTING TYPE	DIM "A"
1 1/16"-12 FEMALE	4.31 [109.47]
SWAG. 3/4" W NUT	6.99 [177.55]
SWAG. 3/4" BARE	6.19 [157.23]
VCO FACE 3/4"	6.59 [167.39]
DIM "B"	4.31 [109.47]
DIM "C"	1.56 [39.67]

Model HFC-303



HFC-303 1/2" FITTING

FITTING TYPE	DIM "A"
3/4"-16 FEMALE	5.36 [136.14]
SWAG. 1/2" W NUT	7.56 [192.02]
SWAG. 1/2" BARE	6.98 [177.29]
VCO FACE 1/2"	7.42 [188.47]
VCR FACE 1/2"	7.80 [198.12]
DIM "B"	5.36 [136.14]
DIM "C"	1.36 [4.59]

HFC-303 3/4" FITTING

FITTING TYPE	DIM "A"
1 1/16"-12 FEMALE	5.76 [146.30]
SWAG. 3/4" W NUT	8.44 [214.38]
SWAG. 3/4" BARE	7.64 [194.06]
VCO FACE 3/4"	8.04 [204.22]
DIM "B"	5.76 [146.30]
DIM "C"	1.56 [39.67]

All dimensions shown are in inches [mm].

MODELS HFM-301, HFC-303

Selection Chart

Typical instrument ordering/options number:

Model No.	Circuit Board	Output	Fittings	Seals	Pressure	Calibration Type
HFM-301	01	01	02	01	01	01

Order No.	Options
	Circuit Board
01	Pinout H (Standard)
02	Pinout U
03	Pinout M
	Output
01	0-5 Volts (Standard)
02	4-20mA

**3/4" Swagelok required for flows above 300 slm

Order No.	Options
	Fittings**
01	1/2" VCR®
02	1/2" Swagelok (Standard < 300 slm)
03	1/2" VCO®
04	3/4" Swagelok (Standard > 300 slm)
	Seals
01	Viton (Standard)
02	Kalrez®
03	Neoprene
04	Buna-N

Order No.	Options
	Pressure
01	500 psi (Standard)
02	1000 psi (1500 proof)
	Calibration Type
01	NIST 5 Point (Standard)
02	NIST 10 Point
03	NIST 20 Point
04	Curve

Range Information

Range ______________________________

Flow Units ___________________________

Gas _________________________________

Standard Conditions* _______________

*Referenced to standard temperature and pressure (0°C and 760 Torr, respectively).

Selection Chart

Typical instrument ordering/options number:

Model No.	Circuit Board	Output	Fittings	Seals	Pressure	Calibration Type
HFC-303	01	01	02	01	01	01

Order No.	Options
	Circuit Board
01	Pinout H (Standard)
02	Pinout U
03	Pinout M
	Output
01	0-5 Volts (Standard)
02	4-20mA
03	I/O 4-20mA

Order No.	Options
	Fittings**
01	1/2" VCR®
02	1/2" Swagelok (Standard < 300 slm)
03	1/2" VCO®
04	3/4" Swagelok (Standard > 300 slm)
	Seals
01	Viton (Standard)
02	Kalrez®
03	Neoprene
04	Buna-N

**3/4" Swagelok required for flows above 300 slm

Order No.	Options
	Pressure
01	500 psi (Standard)
02	1000 psi (1500 proof)
	Calibration Type
01	NIST 5 Point (Standard)
02	NIST 10 Point
03	NIST 20 Point
04	Curve

Range Information

Range ______________________________

Flow Units ___________________________

Gas _________________________________

Upstream Pressure ___________________

Downstream Pressure__________________

Is downstream pressure dependent on flow resistance? Y/N ___________________

Standard Conditions* _______________

*Referenced to standard temperature and pressure (0°C and 760 Torr, respectively).

Your Customer Service Representative

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Appendix K: Capstone Design Exercise

Design of a Thermocouple

In order to incorporate Capstone Design into this Major Qualifying Project (MQP), a temperature measuring device was designed by Valerie Adams and Steven Southard using a 5 step design process. This appendix outlines the design process for this temperature measurement device.

The Design Process

Design Process[1]:

1. Needs assessment
2. Problem formulation
3. Abstraction & Synthesis
4. Analysis
5. Implementation

This design process fits the ABET definition of design. Since no official definition is available from ABET, the definition was found on the University of Las Vegas website and is reproduced below[2]:

Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation. The engineering design component of a curriculum must include most of the following features: development of student creativity, use of open-ended problems, development and use of modern design theory and methodology, formulation of design problem statements and specification, consideration of alternative solutions, feasibility considerations, production processes, concurrent engineering design, and detailed system description. Further it is essential to include a variety of realistic constraints, such as economic factors, safety, reliability, aesthetics, ethics and social impact." Elsewhere in the ABET criteria for accreditation, they stress the use of teams in solving problems and performing designs.

Intellectual Property

If WPI pursues a patent it will absorb the costs of obtaining the patent and royalties will be shared 50-50 after the costs of obtaining the patent are recovered. WPI has 1 year to decide whether or not to pursue the patent.

Needs Assessment

The Need

The true gas temperature has needs to be measured in a fire environment which is subject to water spray, varying humidity, and an incident radiation field. Due to the environment that this device will be used in, the device needs to be robust, durable and able to work correctly in temperatures up to 1,100^{o}C.

Customers and Stakeholders

This product is primarily being designed for use in sprinkler cooling coefficient research that is being conducted at Tyco Fire Suppression. However, if this device can be defined to meet the aforementioned needs at reasonable cost, it could be potentially used to measure temperatures in full scale fire tests.

Identify Resources and External Constraints

WPI will supply limited funding for this project. Lab space will be available for the construction and testing of this product. Approximately one to two thousand dollars will be available to purchase materials in order develop a prototype.

Problem Formulation

Clarify goals and objectives

- Measure true gas temperature
- Make sure temperature measurement is not impacted by water spray
- Compensate for changes in humidity
- Radiation must not effect temperature readout
- Keep the total probe cost in the range for that of an aspirated thermocouple
- Work for temperatures up to 1,100^{o}C
- Device is able to withstand the rigors of fire testing

- Resolution of the device is comparable to an aspirated thermocouple

Abstraction and Synthesis

Based on the problem statement, there are 3 main concerns that must be addressed in the design of this temperature measuring device. These concerns are: radiation effects (incident and loss from bead), water spray effects, and humidity effects. A modified aspirated thermocouple will be used in order to accomplish the design goals.

Temperature Measuring Devices

Thermocouples

Thermocouples are formed when two different metals are joined together. When the temperature at the thermocouple bead is at a different then the temperature at the end of the two wires, a potential difference in the voltage is created across the bead. This voltage is able to be related to temperature when the thermocouple is surrounded by a gas with known temperature. Since these thermocouples are able to withstand a high temperature, they are used in a lot of experiments that involve fire. In these experiments there is an error in the temperature reading of the gas due to the radiation of the heat that comes from the fire. The difference between the actual temperature of the gas (T_g) and the temperature of the thermocouple bead (T_j) can be represented as

$$T_g - T_j = \frac{\sigma\varepsilon}{hc}(T_j^4 - T_g^4)$$

Where T_g is the temperature of the gas, T_j is the temperature of the thermocouple, σ is the Stefan-Boltzmann constant, ε is the probe emissivity and the h_c is the convective heat transfer coefficient. The difference between the temperatures can also be represented as

$$T_g - T_j = \frac{d^{0.55}}{u^{0.45}}(T_j^4 - T_g^4)$$

Where d is the diameter of the thermocouple bead and u is the flow velocity over the thermocouple. In order to correct this error, an aspirated thermocouple was designed. An aspirated thermocouple has a shield over the bead and the gas moved through between the bead and shield by a pump. The shield is heated or cooled by the radiation to a temperature that is in between T_g and T_j. This shield significantly reduces the effects of the radiation on the bead. The gas flow over the shield and the thermocouple increases the convective heat transfer rate and brings both the surface of the bead and the shield closer to T_g. As the aspiration velocity is increased, T_g-T_j becomes smaller

Resistance Temperature Detectors (RTDs)

RTDs are temperature sensors that contain a resistor which varies resistance with temperature. RTDs are typically used in processes that are between -200^{o}C and 600^{o}C, but can be used up to 850^{o}C. RTDs are typically made of platinum and are priced significantly higher than typical thermocouples. Another benefit of RTDs is that they are not prone to corrosion or oxidation [3].

Other Temperature Detectors

There are many other types of temperature detectors such as infrared, laser, and thermistor detectors. These devices were considered for use in this design but were eliminated from consideration based on cost, accuracy, and working temperature range.

Selection of Thermocouple over RTD

Thermocouples were selected over RTDs or other temperature measurement devices because they operate over the required range of temperatures for this use. Thermocouples are less expensive than RTDs and are more rugged. RTDs are more accurate and have a more linear response than do thermocouples, but price, durability, and operating range are more important for this use. The benefits of a thermocouple outweigh its disadvantages, so a thermocouple will be used as part of this device.

Selection of Thermocouple

There are a large variety of available thermocouples which are classified by letters that describe the type of thermocouple. Type K and N thermocouples are the only types of thermocouples that are suitable for the temperature range of 0 to 1100^{o}C; all other types will be removed from consideration. Type K thermocouples are the least expensive, most commonly used, and most widely available probes. Type N thermocouples are newer and more accurate then type K, however, they are more expensive than type K thermocouples and because of their lower sensitivity, they are not recommended for temperatures under 300^{o}C [4]. Because of this, we will use a type K thermocouple.

We have decided to use a modified aspirated thermocouple due to the fact that aspirated thermocouples are able to effectively minimize radiation effects. A type TJ aspirated probe design available from United Sensor Corporation was selected because it meets all of our design requirements[5]:

- Aspirated
- Temperatures up to 1100^{o}C
- Multi-shielded
- Suitable for a wide range of aspiration velocities

A multi-shielded, aspirated design may be best for a final design because a multi-shielded design is more effective in minimizing radiation effects than a single shielded design is. However, for prototyping, we will use a single shielded aspirated design since this product is approximately half the price of the double shielded model and is more readily available. We expect temperature readings from the double-walled probe to be closer to the true gas temperature than the single-walled probe. In analysis and testing, we may want to vary the range of the aspiration velocity to determine its effect, so it is good that this probe can be used over a wide range of velocities. A type K thermocouple will be used as the temperature sensor. The thermocouple can be removed from the sheath for calibration.

Radiation Effects (both incident and radiation loss)

The equations below from Blevins and Pitts describe the basic principles of an aspirated thermocouple [6]. These equations are not valid for environments where high levels of smoke obscuration are expected. There are two main types of aspirated thermocouples, either single shielded or double shielded. The two modes of heat transfer that are present are convection and radiation. Convection is present due to the fact that there is air flowing at some velocity over both the shield and the thermocouple bead. Radiation is present due to the high heat in the environment and potential temperature differences between different components.

Single Shielded Thermocouple

$$h_{bu}(T_g - T_b) = \varepsilon_b \sigma (T_b^4 - T_o^4)$$

$$h_{ou}(T_g - T_o) + h_{oU}(T_g - T_o) = -\varepsilon_b \sigma \left(\frac{A_b}{A_o}\right)(T_b^4 - T_o^4) + \sigma(T_o^4 - T^4)$$

Double Shielded Thermocouple

$$h_{bu}(T_g - T_b) = \varepsilon_b \sigma (T_b^4 - T_i^4)$$

$$h_{iu}(T_g - T_i) + h_{iw}(T_g - T_i) = -\varepsilon_b \sigma \left(\frac{A_b}{A_i}\right)(T_b^4 - T_i^4) + C_{i\to o}\sigma(T_i^4 - T_o^4)$$

$$h_{ow}(T_g - T_o) + h_{oU}(T_g - T_o) = -C_{i\to o}\sigma \left(\frac{A_i}{A_o}\right)(T_i^4 - T_o^4) + \varepsilon_o \sigma(T_o^4 - T^4)$$

$$C_{i\to o} = \frac{1}{\frac{1}{\varepsilon_i} + (A_i/A_o) * (1 - \varepsilon_o)/\varepsilon_o}$$

An aspirated thermocouple uses a high speed airflow to keep the thermocouple bead as close to the true gas temperature as possible. Since the temperature of the thermocouple bead will potentially reach high temperatures, there is the potential that the bead will lose heat to its surroundings via radiation. This radiation loss can be minimized by shielding the bead inside a tube. When shielded, most of the radiation loss from the bead will re-radiate back to the bead, minimizing any energy loss from the thermocouple bead. In addition to minimizing any radiation losses, the thermocouple bead is also shielded from any incident radiation. Using a double shielded design provides better shielding, which will result in a more accurate reading of the true gas temperature.

Water Spray

Since there will be water spray in the environment that this device will be used in, we must prevent any water from coming into contact with the thermocouple bead. If water were to contact the bead, it would cool the bead temperature, which would result in an incorrect measurement of the gas temperature. In addition to protecting the bead from water spray, the shielding tube should also be shielded from the water spray because the temperature difference between the shield and the bead must be small in order to prevent any radiation losses from the bead to the shield.

Heat Transfer (Water on Bead)

T > 100 C and all water boils off:

$$h_{bu} * A_b(T_g - T_b) = A_b * \varepsilon_b \sigma(T_b^4 - T_o^4) + \Delta H_{vap} * \dot{m}_{H20}$$

T < 100 C

Assumptions:

- Bead is completely covered with water of a uniform thickness
- Mass transfer due to vaporization and mass transport can be ignored
- Water is opaque to radiation

$$\frac{2\pi k L(T_b - T_w)}{\ln\left(\frac{r_o}{r_i}\right)} = \varepsilon_w * A_w * \sigma * (T_w^4 - T_o^4)$$

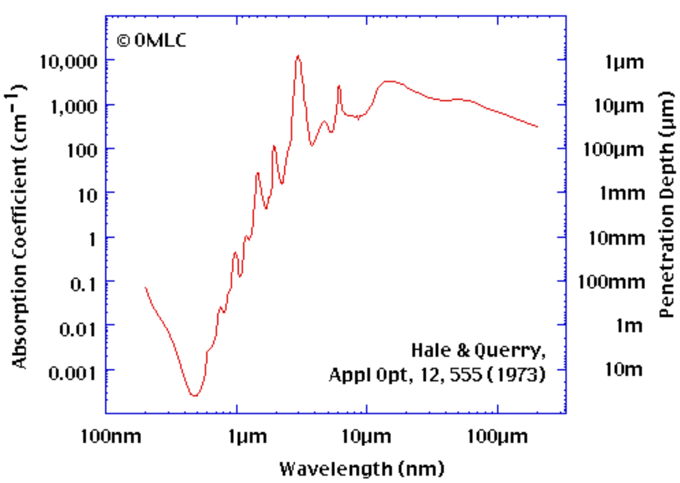

Figure 1: Hale & Querry Spectral Analysis of Water [7]

For visible light, water is nearly transparent because the absorption coefficient is less than 0.001 cm-1 as shown in Figure 1. For radiation heat transfer we are primarily concerned with lower wavelengths of the infrared spectrum (1um to 10um). For this range of wavelengths, the absorption coefficient ranges from $1cm^{-1}$ to $1000cm^{-1}$. Because the absorption coefficient is much higher than that of visible light, we can consider water opaque to radiation.

Humidity effects

An error can occur in the temperature reading made by the thermocouple if the insulation between the wires loses resistance due to moisture or thermal conditions. After researching the issue, there seems to be no reasonable way to compensate for humidity either mechanically or with an empirical equation. Since we don't expect extremely high humidity levels due to the high heat in a fire environment, we feel that the humidity issue does not need to be addressed in our design.

Consideration of Materials

Table 1: Tubing Material Research

Material	Max Rated Temp.	Cost per kg	Fires Useful For
Inconel 625	900 – 1200C	\$28.30 - \$31.10	All
Stainless Steel	750 – 820C	\$6.52 - \$7.17	Up to flashover
Copper	180 – 300C	\$3.16 - \$3.48	Pre-flashover
Low Carbon Steel	350 – 400C	\$0.64 - \$0.70	Pre-flashover
Nylon	100C		Very Low Temperature

Initially, we wanted to use flexible line tubing to connect the aspirated thermocouple to that pump because this would allow for the most flexible use. We chose Nylon 12 Semi Flexible Tubing, 0.058" ID x 0.135" OD x 0.034" W. According to the specs for this product, the inner diameter is ¼ inches with an outer diameter of 3/8 inches. The tubing is made out of nylon with an upper temperature range of 100°C. Since the upper temperature range is not high enough to withstand our experiment environment we looked into covering the tubing with a protective sleeve from Insulflex Corporation. This protective sleeve has a continuous operating temperature of 538°C, which would make the tubing good for most pre-flashover fires, however, the tubing only protects the outside of the nylon flexible tubing. Since there is no feasible way to protect both the inside and the outside, we chose to look at metal piping.

After considering our design objectives and researching the pipe materials shown in the table above, stainless steel tubing was selected for use in the probe. We made this material selection because its temperature range is high enough for flashover conditions and its maximum service temperature is just below the maximum service temperature of the thermocouple probe that was selected. Ideally Inconel-625 would be used, but since temperatures will not exceed 600C in any of our tests, there is not benefit to investing in the substantially more expensive Inconel tubing.

Water Shielding

Our initial design consisted of a double-shielded type K aspirated thermocouple inside of a 2" steel pipe. In order to minimize the effects of the water spray, all water must be shielded from the thermocouple bead. If water were to touch the bead it would cause the temperature to decrease and the true gas temperature would not be accurately measured. We proposed to use a 2" steel pipe as a water shield. This pipe would cover the length of the aspirated thermocouple as well as extend 2-3 inches past the end to prevent water droplets from being sucked into the aspirated thermocouple. If possible, the extended region should be bent so that it is angled downward and less prone to catching water droplets. This design is shown below in Figure 2.

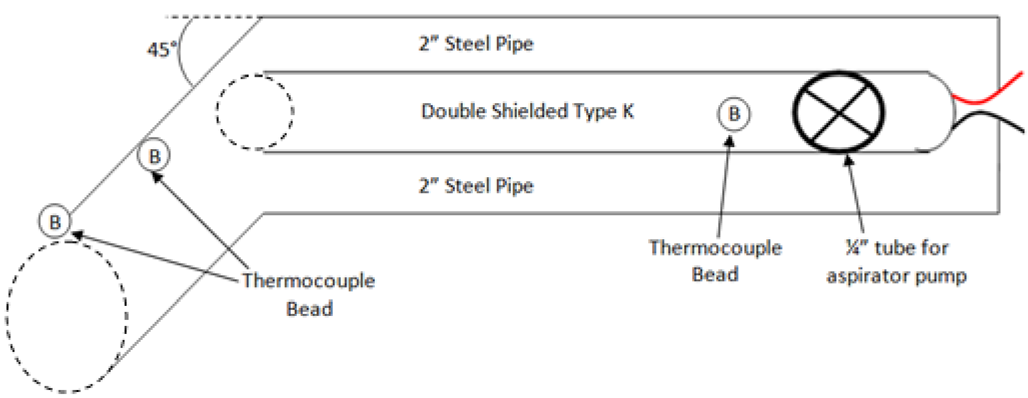

Figure 2: Initial design concept

This design was rejected due to the fact that the 2" pipe around the instrument is extremely bulky, and the same performance can be obtained with less bulky designs.

Next, we developed two design concepts that are much less bulky than the original design concepts. These designs are shown below in Figure 3. Design 1 uses a single-shielded aspirated thermocouple. Attached to the end of the aspirated probe is a ¼" stainless steel elbow and a stainless steel funnel. This design will be prototyped using a 12" long ¼" steel pipe in order to simulate our aspirated probe. The funnel will help to reduce the suction velocity so that water is not sucked into the probe.

Design 2 is identical to design 1 except without the funnel. If no water reaches the probe when the funnel is not in place, then the funnel will not be required.

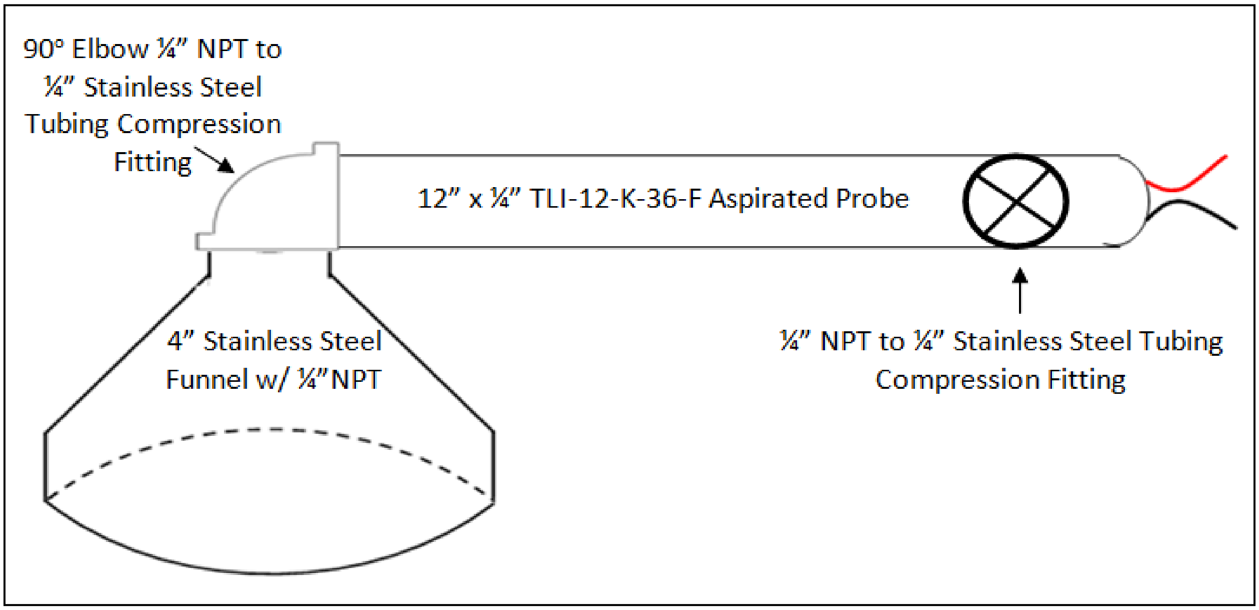

Figure 3: Design 1 (to be prototyped)

Selection of Pump

According to the experiments done by Newman and Croce, a velocity of 7 m/s is a high enough velocity to produce a temperature reading that is approximately equal to the actual temperature of the gas. In their experiment, they developed a prototype of a single shield aspirated thermocouple. The thermocouple had a 6.4mm diameter steel shield that protected a 1.8mm diameter bead enclosed inside. The thermocouple prototype was tested by increasing the flow through the probe until the temperature measurement approached a value that was independent of the aspiration velocity. In addition, the *Standard Guide for Room Fire Experiments* recommends that a velocity of 5m/s should be used, stating that 5m/s is "sufficiently high to allow accurate temperature measurement based on thermocouple voltage alone, even within flame zones [8]."

Since we need a velocity between 5m/s and 7m/s it was determined that we needed a pump that was between 9.5LPM and 13.3LPM. The pump we choose has a maximum free air vacuum suction rate of 11.5LPM. It was also determined that there would be a maximum pressure drop of 24.0 mmHg from the aspirated thermocouple to the end of the 50ft of the pipe. The pump that has been chosen is an adjustable aspirator pump with a maximum vacuum pressure of 630 mmHg, which will be enough to overcome the pressure drop through the maximum length of the pipe. This pump will give us the required velocity at the thermocouple and is within our budget only costing $116.00.

Proposed Layout

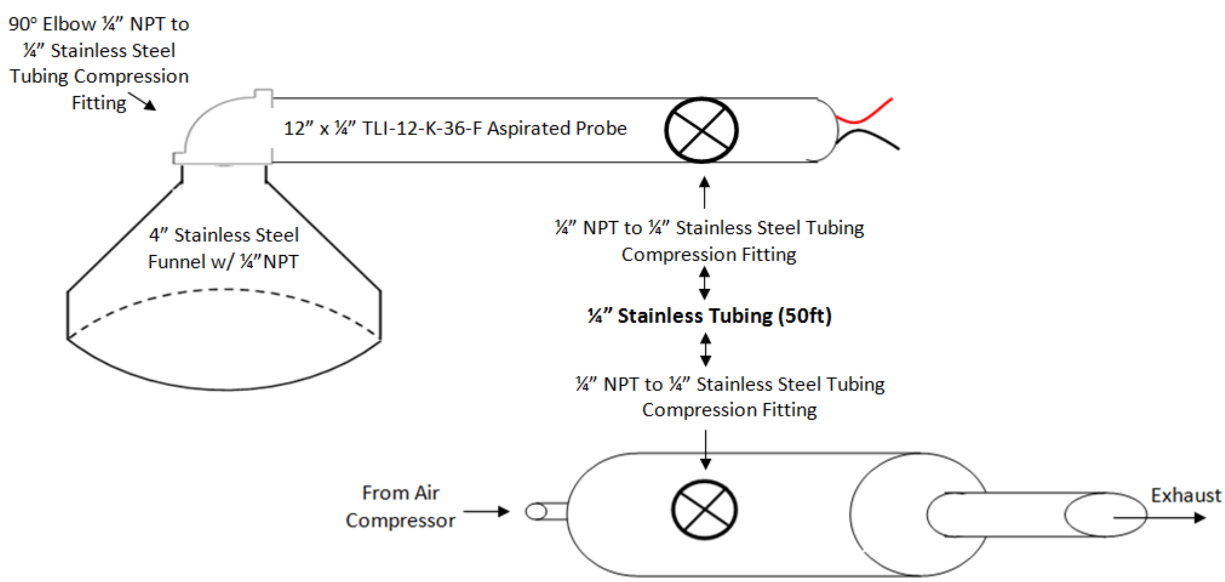

Figure 4: Proposed Design

Analysis

In order to analyze the effectiveness of the design, a prototype was built. Since the actual aspirated thermocouple is expensive and considered to be reliable, a simple prototype was desinged without using the aspirated probe. In place of the aspirated probe, a 12 inch long section of ¼" clear plastic tubing was used. A quantitative experiment was performed using the prototype shown in Figure 5.

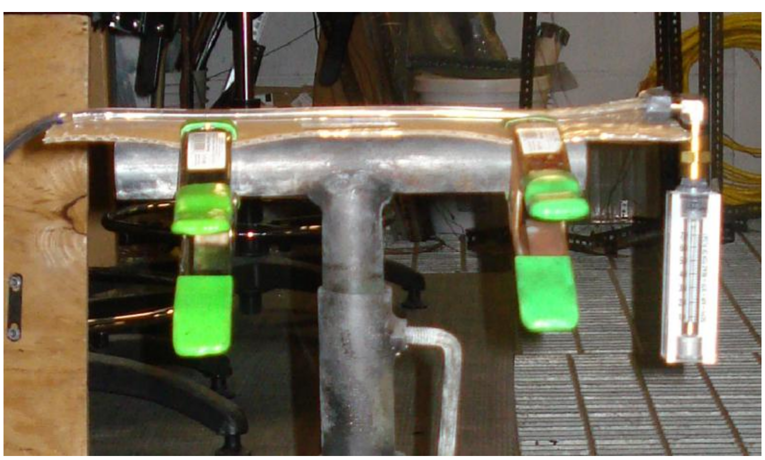

Figure 5: Prototype of temperature measuring device. Device is attached to mass flow meter in order to set air velocity.

In the experiment, mass flow of air was measured directly using an analog mass flow meter in line with the probe. This mass flow was then converted into a velocity. Once the airflow was set, a garden hose nozzle was used to create a spray pattern similar to that of a sprinkler. The prototype was put into the spray and the test was run for 2 minutes. For each test, a different funnel size was used at the end of the probe. Throughout the 2 minutes of the experiment, the tubing was carefully examined to see if any water was pulled through the prototyped probe due to the aspirator pump. Pictures from the experiment are shown in Figure 5 and 6. It was determined that at 5m/s, a 4” funnel is required to ensure no water is introduced into the probe, and at 7m/s a 6” funnel would be requried. The results of the experiment are shown in Table 2.

Table 2: Experimental Results

Run	Cone	Mass Flow	Velocity	Duration	Time	Water
1	4"	22 cfhr	5m/s	2:00	9:33	None
2	3"	22cfhr	5m/s	2:00	9:37	Very Minor
3	4"	22cfhr	5m/s	2:00	9:42	None
4	4"	28 cfhr	7m/s	2:00	9:48	Very Minor
5	6"	28cfhr	7m/s	2:00	10:03	None
6	None	28cfhr	7m/s	2:00	10:21	Solid Stream

Figure 6: Left: Test setup of prototype showing probe in water spray. Right: Results from Run 4 showing no water in tubing.

Implementation

Based on the analysis of the prototype, we decided to use a 4 inch funnel design with an aspiration velocity of 5 m/s. The 4 inch funnel was the smallest funnel that could be used within the acceptable velocity range that did not cause water to be introduced into the tubing of the prototype. The final design will consist of a 12” x ¼” TLI-12-K-36-F aspirated probe with a 4” funnel as shown in Figure 3. This design will require a McMaster-Carr Supply Co. 8239K75, ¼ in elbow comprssion fitting, a McMaster-Carr Supply Co. 8238K15, ¼ in compression adaptor, and a McMaster-Carr Supply Co. 8239K16, ¼ in compression fitting to a ⅛ in male npt. In addtion, this design will require a McMaster-Carr Supply Co. 13445K81 adjustable flow aspirator pump to create the flow through the aspirated thermocouple. In addition this design will need 50 ft Grainger 3ADC7, ¼ in stainless steal tubing. A 4 in stainless steal funnel is needed to prevent water from traveling into the aspirated thermocouple.

Nomenclature

A_b	surface area of thermocouple bead
A_i	surface area of the innermost shield for a double shielded probe
A_o	surface area of outermost shield for single and double shielded probes
A_w	outer surface area of water coating thermocouple bead
$C_{i \to o}$	geometric constant defined for double-shielded model
ε_b	thermocouple bead emissivity
ε_i	innermost shield emissivity for single shielded probe
ε_o	outermost shield emissivity for double and single shielded probe
h_{bu}	convective heat transfer coefficient between aspirating gas flow and thermocouple bead for single and double shielded probe
h_{iu}	convective heat transfer coefficient between aspirating gas flow and innermost shield for double shielded probe
h_{iw}	convective heat transfer coefficient between annular aspirating gas flow and innermost shield for single shielded probe
h_{bu}	convective heat transfer coefficient between aspirating gas flow and thermocouple bead for single and double shielded probe
h_{ou}	convective heat transfer coefficient between aspirating gas flow and shield for single shielded probe
h_{oU}	convective heat transfer coefficient between external gas flow and outermost shield for single and double shielded probe
h_{ow}	convective heat transfer coefficient between annular aspirating gas flow and outermost shield for double shielded probe
r_i	Inner radius of water droplet (same as radius of the bead)
r_o	Outer radius of water droplet
L	Effective length for heat transfer (same as diameter of the bead)
$\dot{m}_{H20}$	rate of water application onto thermocouple bead
σ	Stephan-Boltzmann coefficient (5.67*10^-11 kw/m^2K^4)
T_b	thermocouple bead temperature
T_g	gas temperature
T_i	innermost shield temperature for double-shielded probe
T_o	outermost shield temperature for single and double shielded probes
T_w	temperature of water at outer edge
T	average ambient temperature

Calculations

Validation of ignorong the emissivity of gases in the aspirated probe

Table 3: Percent concentration for equivalence ratios from 1 to 5

Equivalence	Moles					Concentration				
Ratio	CO2	H20	N2	Air	Total	CO2	H20	N2	Air	Total
1	3	4	18.8	0	25.8	12%	16%	73%	0%	100%
1.2	3	4	18.8	1	26.8	11%	15%	70%	4%	100%
1.4	3	4	18.8	2	27.8	11%	14%	68%	7%	100%
1.6	3	4	18.8	3	28.8	10%	14%	65%	10%	100%
1.8	3	4	18.8	4	29.8	10%	13%	63%	13%	100%
2	3	4	18.8	5	30.8	10%	13%	61%	16%	100%
2.2	3	4	18.8	6	31.8	9%	13%	59%	19%	100%
2.4	3	4	18.8	7	32.8	9%	12%	57%	21%	100%
2.6	3	4	18.8	8	33.8	9%	12%	56%	24%	100%
2.8	3	4	18.8	9	34.8	9%	11%	54%	26%	100%
3	3	4	18.8	10	35.8	8%	11%	53%	28%	100%
3.2	3	4	18.8	11	36.8	8%	11%	51%	30%	100%
3.4	3	4	18.8	12	37.8	8%	11%	50%	32%	100%
3.6	3	4	18.8	13	38.8	8%	10%	48%	34%	100%
3.8	3	4	18.8	14	39.8	8%	10%	47%	35%	100%
4	3	4	18.8	15	40.8	7%	10%	46%	37%	100%
4.2	3	4	18.8	16	41.8	7%	10%	45%	38%	100%
4.4	3	4	18.8	17	42.8	7%	9%	44%	40%	100%
4.6	3	4	18.8	18	43.8	7%	9%	43%	41%	100%
4.8	3	4	18.8	19	44.8	7%	9%	42%	42%	100%
5	3	4	18.8	20	45.8	7%	9%	41%	44%	100%

**concentrattions for equivalence ratios lower than 1 were not considered because there will be sufficient air in the room

Stoichiometric Equation

$$C_3H_8 + 5(O_2 + 3.76N_2) \rightarrow 3C0_2 + 4H_2O + 18.8N_2$$

Next, the partial pressures of CO_2 and H_2O were determined using a pressure of 1 atm, results are shown in Table 3. Based on the mean beam length and a temperature range of 0C to 1000C, the highest emissivity of CO_2 was determined to be 0.012 and the highest emissivity of H_2O vapor was determined to be approximately 0.013. These emissivities are very close to zero, so it is valid to ignore the emissivity of gases in the aspirated probe. The determination of emissivities was determined using Figure 1-4.5 and 1-4.6 in the 4th Edition of the SFPE Handbook. The maximum mean beam length (diameter of the piping) was used because this results in the highest emmisivities.

Table 3: Partial Pressure and Partial Pressure time Mean Beam Length for CO_2 and H_2O vapor

Table 4: Partial Pressure and Partial Pressure time Mean Beam Length for CO_2 and H_2O vapor

Partial Pressure		Partial P * L	
C02	H20	C02	H20
0.116279	0.15503876	0.001477	0.001969
0.11194	0.149253731	0.001422	0.0018955
0.107914	0.143884892	0.001371	0.0018273
0.104167	0.138888889	0.001323	0.0017639
0.100671	0.134228188	0.001279	0.0017047
0.097403	0.12987013	0.001237	0.0016494
0.09434	0.125786164	0.001198	0.0015975
0.091463	0.12195122	0.001162	0.0015488
0.088757	0.118343195	0.001127	0.001503
0.086207	0.114942529	0.001095	0.0014598
0.083799	0.111731844	0.001064	0.001419
0.081522	0.108695652	0.001035	0.0013804
0.079365	0.105820106	0.001008	0.0013439
0.07732	0.103092784	0.000982	0.0013093
0.075377	0.100502513	0.000957	0.0012764
0.073529	0.098039216	0.000934	0.0012451
0.07177	0.09569378	0.000911	0.0012153
0.070093	0.093457944	0.00089	0.0011869
0.068493	0.091324201	0.00087	0.0011598
0.066964	0.089285714	0.00085	0.0011339
0.065502	0.087336245	0.000832	0.0011092
Mean Beam Length (L)		0.0127 m	

References

1 Voland, Gerard. Engineering by Design. Prentice Hall (2003).

2 University of Las Vegas. "ABET Definition of Design." Retrieved June 2010, from unlv.edu: http://www.me.unlv.edu/Undergraduate/coursenotes/meg497/ABETdefinition.htm

3. Omega Data Sheet "Resistance Temperature Detector General Specifications" (2010). Retrieved June 2010, from Omega.com: http://www.omega.com/TEMPERATURE/pdf/RTD_Gen_Specs_Ref.pdf

4 "Thermocouples – A Quick Guide" Retrieved June 2010 from azom.com: http://www.azom.com/details.asp?ArticleID=1208#_Thermocouple_Selection

5 "Temperature Probes & Thermocouples." Retrieved June 2010 from United Sensor Corp: http://www.unitedsensorcorp.com/temperature.html

6 Blevins, Linda G., Pitts, William M. "Modeling of bare and aspirated thermocouples in compartment fires." In Fire Safety Journal 33 pp. 239-259 (1999).

7 Querry, Hale. "Absorbtion Spectra of Water" Retrieved June 2010 from The Optical Obstbtion of Water Compendium: http://people.seas.harvard.edu/~jones/es151/gallery/images/absorp_water.html. Harvard, MA (1973).

8 "ASTM Standard E 603-98" In 1998 Annual Book of ASTM Standards, vol. 04.07. American Society for Testing and Materials, West Conshohcken, PA (1998).