Adelaide Jet Flame 5
Data File

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Adelaide Jet Flame 5
C2H4-H2-N2-D58-08K

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1. Citing data and Disclaimer

Any publications making use of these data should reference:

2. Nomenclature

Adelaide Jet Flame 5 is labelled as follows: C2H4-H2-N2-D## - ## K, where:

C2H4-H2-N2 refers to the fuel mixture

D## refers to the diameter of the pipe jet burner (D44 standing for 5.8mm inner diameter)

##K refers to the exit Reynolds's number of the flame (Re=8,000).

3. Burner Specifications

Adelaide jet flame 5 was stabilised on a straight pipe jet burner made of Aluminium and mounted in the middle of a contraction delivering co-flowing air at an average speed of 1.1 m/sec. The contraction has a square cross-section, at the exit plane, of dimensions 150mm by 150mm, and the pipe jet burner outlet rises above the contraction edge by a distance of 18mm.

The pipe jet burner has a length of 385mm, including a tapered end at the jet outlet. The pipe inner diameter is 5.8 mm, with a wall thickness of 1mm. A schematic of the jet outlet is shown in Figure 1.
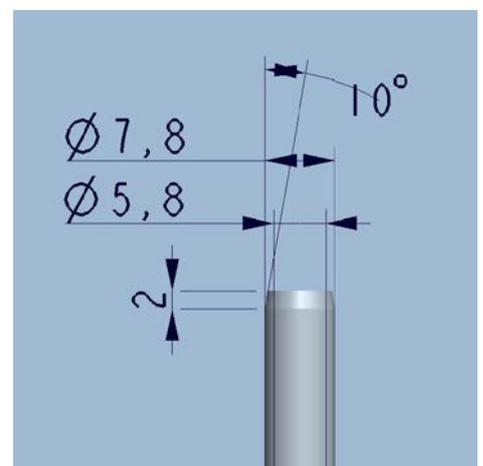
Fig. 1. Front View of the tapered section of the pipe jet burner. All Dimensions are in mm

4. Co-Flow Air

Air is supplied through a centrifugal fan at 294K and is delivered as a co-flow to the central jet flow. The co-flow contraction has an almost uniform velocity of 1.1 m/s at 2mm above the jet nozzle level (20mm higher than tunnel exit plane). The turbulence Intensity of the co-flow is 1.5 % on average. Detailed Information is presented in Section 8.

5. Exhaust Hood

An exhaust hood of a conical section is installed to exhaust fume from the flame. The hood consists of a cone of an 800mm diameter at its larger end, and a 250mm diameter exhaust duct connected to the other end, and is always kept at a minimum distance of 300mm from the tip of the flame at all times during the experiments.

6. Fuel Composition

The fuel mixture of the flame consists of Ethylene, Hydrogen, and Nitrogen. All three gases were supplied from gas bottles, where the fuel composition of each bottle is as follows:

Ethylene: 99.00 % C_2H_4, 50 ppm moisture

Hydrogen: 99.50 % H_2, 4000 ppm O_2, 1000 ppm N_2, 100 ppm moisture

Nitrogen: 99.99 % N_2, 10 ppm O_2, 10 ppm moisture

7. Fuel Jet Composition

The fuel jet mixture by mass for Adelaide Jet flame 5 is 63.9 % C2H4, 4.8 % H2, and 31.3 % N2. And the fuel mixture by volume is 39.0 % Ethylene, 41.6 % Hydrogen, and 19.4 % Nitrogen. The total mixture density at 294K and 101.3 KPa is calculated to be 0.710 Kg/m^3, while the total viscosity (dynamic) is calculated to be 1.2120E-05 kg/m.s

The mass and volumetric flow rates for Adelaide Jet Flame 5 are presented in Table 1 below. (SLM = Standard litre per minute at 294K and 1 Bar). The measurement uncertainty is 1.5%, 1.5% and 2% on the flow rates of Ethylene, Hydrogen, and Nitrogen, respectively

Table 1. Adelaide Jet Flame 5 Composition by Mass and Volume

Adelaide Jet Flame	Composition	C_2H_4	H_2	N_2
	% mixture by Mass	**63.9**	**4.8**	**31.3**
	% mixture by Volume	**39.0**	**41.6**	**19.4**
Jet Flame 5 C2H4-H2-N2-D58-08K	Mass Flow Rate *(kg/s)*	2.8014E-04	2.130E-05	1.374E-04
	Vol. Flow Rate *(SLM)*	14.5	15.5	7.2

8. Flow Conditions

The flow conditions for Adelaide jet Flame 5 are provided in Table 2 below.

Table 2. Flow conditions of Adelaide Jet Flame 5

	Inner Jet Diameter (D)	Total Flow rate	Mean Exit Velocity $V = \dfrac{flow\ rate}{(\pi d^2/4)}$	Exit Strain Rate V/D	Exit Re number Re= $\rho VD/\mu$	Mean Flame Length
	(mm)	*(l/min)*	*(m/sec)*	*(x10³ s⁻¹)*	*(-)*	(mm)
Jet Flame 5	*5.8*	*37.2*	23.5	4.1	**8,000**	910

9. Centreline Temperature Profile

Centreline temperature measurements for Adelaide Jet flame 5 was measured using an R-type thermocouple of 1mm bead diameter. The readings from the thermocouple were corrected for radiation and convection losses. The temperature profile is shown in Figure 2, while the tabulated data is provided in the data excel file sheet labelled "Centreline Temperature". The estimated uncertainty is at a maximum of 4% due to uncertainties in exact centreline location (within 2mm) and the measurement fluctuation at this location.
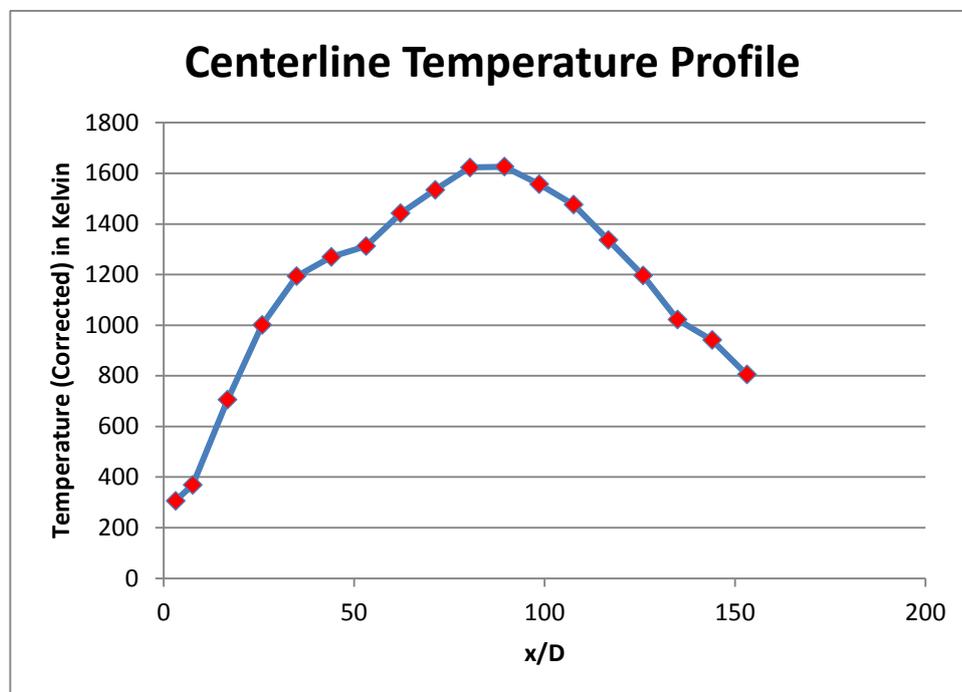
**Fig. 2: Centreline mean temperatures of Adelaide Jet flame 5.
Jet diameter D is 5.8 mm. Tabulated Data are presented in Excel file.**

10. Soot Volume Fraction Measurements

Soot Volume fraction measurements for Adelaide Jet flame 5 were performed at 13 locations in the flame, spanning all the heights where soot was detected, using Laser Induced Incandescence (LII). The tabulated data for all heights are presented in the data excel file in the sheet labelled "Soot Volume Fraction". The mean and RMS data provided are calculated over 500 images collected at each location. The high RMS (standard deviation) values at upstream locations is mainly due to the highly sporadic nature of soot at such locations, which drop further downstream though still reading high values due to the intermittent behaviour of soot at all locations. The high RMS values are proven to be independent of the number of images acquired at the heights. (Please refer to Data file *for Adelaide jet Flame 1* for more details). The minimum detection limit is 3ppb (on a shot by shot basis) and the measurement uncertainty on the mean values is approximated at 25%, due to uncertainty in the extinction and calibration constants. The laser sheet thickness in the flame is measured to be 0.75 mm; therefore data is provided at a cubic spatial resolution of 0.76 mm each side length.

11. Note

For Flame 5, No data are available for:

- **Mean Exit Velocity and Turbulence Intensity Profiles**
- **Global Emissions Measurement**
- **Radiant Intensity Measurements**