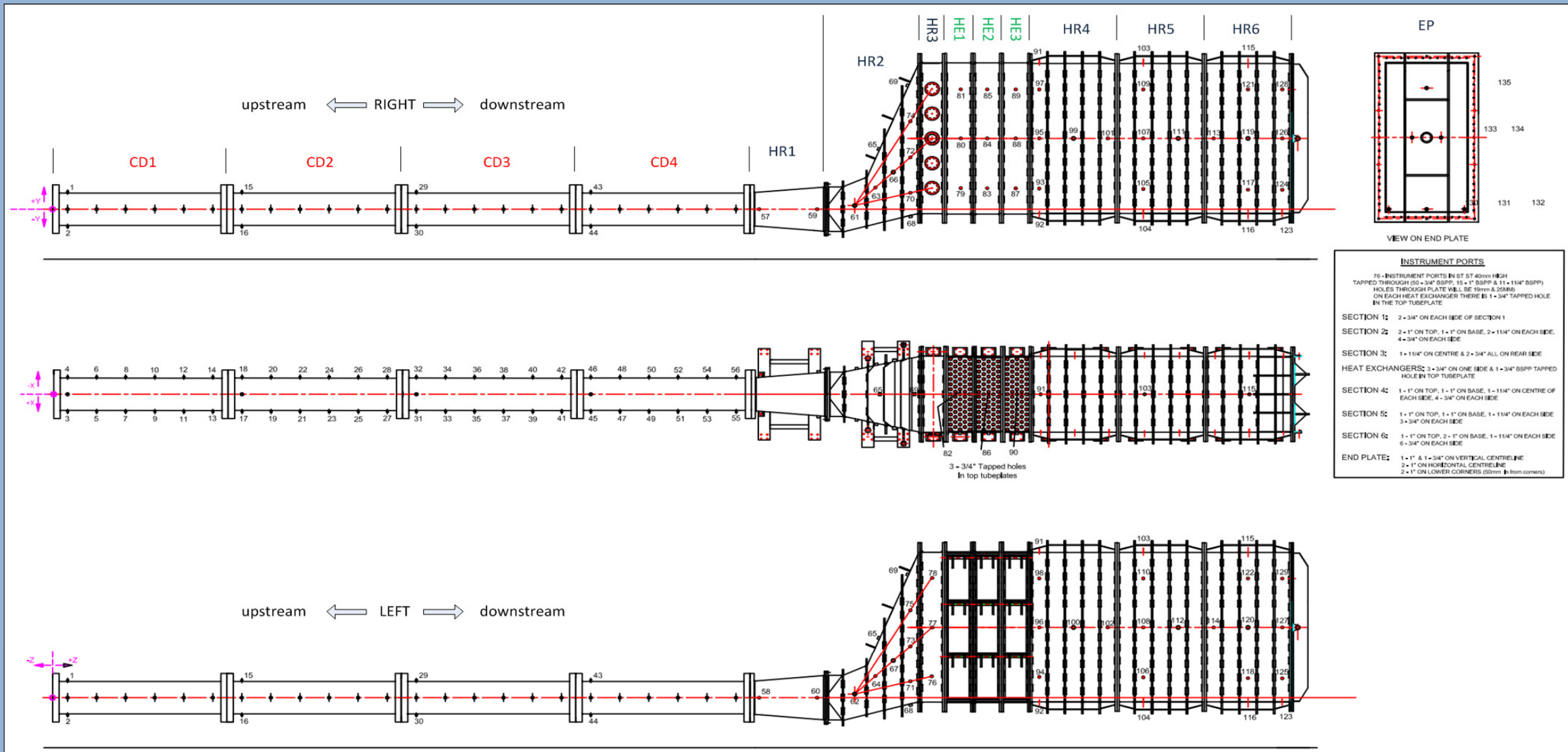


| | | |
|---------------------|---------------------------|--|
| Date | 26 August 2016 | General Comments: (weather, rig configuration) Weather: Rig configuration: 4 x 3m circular duct; expansion section and HRSG attached. End Plate attached. Igniter 258mm from beginning of 2nd circular duct section Engine Speed: 40%; 11,800 rpm 3rd test on mixture containing carbon monoxide (60% CO and 40% H2) at an EQR of 0.59 The test gave a moderate combustion event and most sensors provided an identifiable response. The flame picture is somewhat complex, highlighted by the disparity between calculated flame speeds for each type of sensor. The flame speeds indicated ahead of the HE are between 100 m/s and 200 m/s. As in previous test the picture downstream of the HE is more complex with several downstream IP sensor showing flame arrival times ahead of some farther upstream: this may represent actual flame behaviour. Maximum overpressure of 811 mbar was seen in the circular duct, ahead of the heat exchanger. |
| Time | 15:18:49 | |
| Test Number | 16 | |
| Mixture Composition | 40%H2 60%CO | |
| Ambient Temperature | 15oC | |
| Ambient Pressure | 980 mbar | |
| Wind Speed | 2 m/s | |
| Wind direction | N | |
| Relative Humidity | 65.00% | |
| Mass Flow | <input type="text"/> kg/s | |
| Equivalence Ratio | 0.59 | |

| | Ionisation Probes | | Ionisation Rakes | | Optical Probes | | |
|----------|-------------------------------|------------------------------|-------------------------------|------------------------------|-------------------------------|------------------------------|-------------------------------|
| | Max overpressure | Max. temperature | Max. flame speed | Max. flame speed | Max. flame speed | Max. flame speed | |
| | <input type="text"/> 811 mbar | <input type="text"/> 1080 °C | <input type="text"/> 1357 m/s | <input type="text"/> 225 m/s | <input type="text"/> 352 m/s | <input type="text"/> 352 m/s | |
| | | Initial Temperature | | | | | |
| | | <input type="text"/> 386 °C | | | | | |
| | Location of Max. Overpressure | Location of Max. Temperature | Location of Max. Flame Speed | Location of Max. Flame Speed | Location of Max. Flame Speed | Location of Max. Flame Speed | |
| sensor | <input type="text"/> KU7 | sensor | <input type="text"/> IP20 | sensor | <input type="text"/> RA3 | sensor | <input type="text"/> OP6 |
| label | <input type="text"/> CD4-R2 | label | <input type="text"/> HR6-L5U | label | <input type="text"/> HR4-R3M | label | <input type="text"/> HR4-T1 |
| distance | <input type="text"/> 9758 mm | distance | <input type="text"/> 21165 mm | distance | <input type="text"/> 17575 mm | distance | <input type="text"/> 16985 mm |



Naming Convention

| | | |
|--|---------------------------|--|
| Section Identifier i.e. HE, HR, CD or EP | HR 1 - R 1 U | Vertical position in section (sides only) i.e. U, M or L. Absence of letter denotes centreline |
| Section Number (1-6) Numbered from downstream to upstream | Side i.e. R, L, T or B | Longitudinal position in section (numbered from 1) |

Key

| | |
|--------------------------|--|
| CD Circular duct | U Upper |
| HR HRSG | M Middle |
| HE Heat Exchanger | L Lower |
| EP End Plate | R Right Side (when viewed downstream from engine) |
| | L Left Side |
| | T Top |
| | B Bottom |

There are 13 sections on the rig

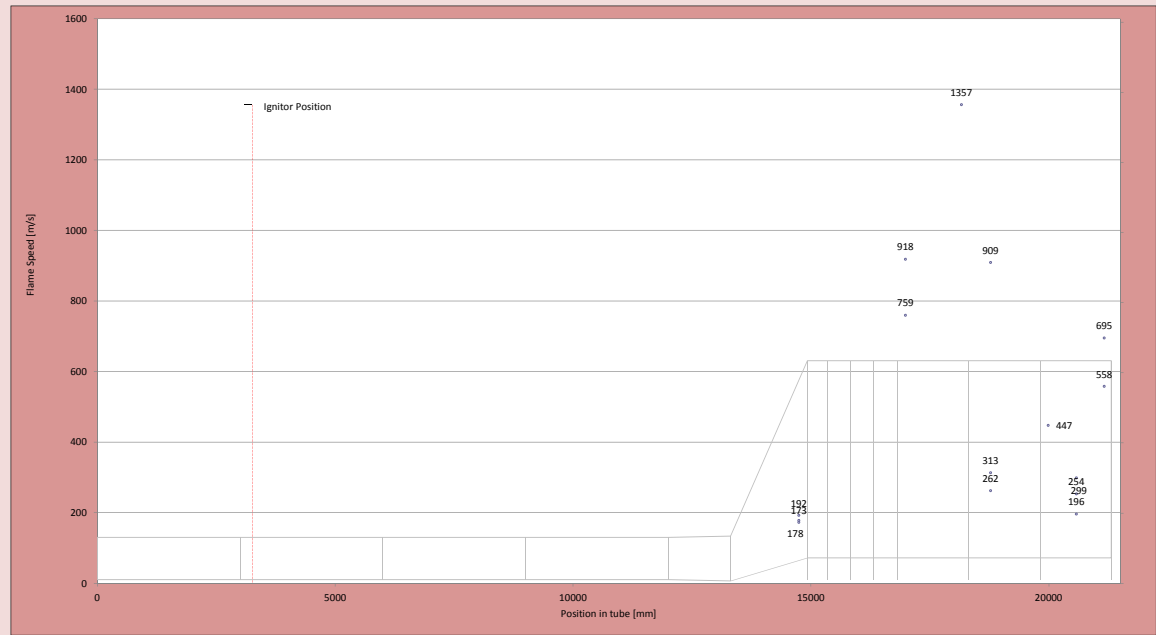
- 4 circular duct sections (CD1 to CD4)
- 6 HRSG sections (HR1 to HR6)
- 3 heat exchanger sections (HE1 to HE3) located between HR3 and HR4

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|---|
| 0 | 3000 | 6000 | 9000 | 12000 | 13310 | 14920 | 15345 | 15835 | 16325 | 16815 | 18315 | 19815 | 21315 | 21315 | 19815 | 16815 | 16325 | 15835 | 15345 | 14920 | 13310 | 12000 | 9000 | 6000 | 3000 | 0 |
| 600 | 600 | 600 | 600 | 600 | 620 | 3120 | 3120 | 3120 | 3120 | 3120 | 3120 | 3120 | 3120 | 310 | 310 | 310 | 310 | 310 | 310 | 310 | -20 | 0 | 0 | 0 | 0 | 0 |

Location of igniter mm Time of ignition seconds

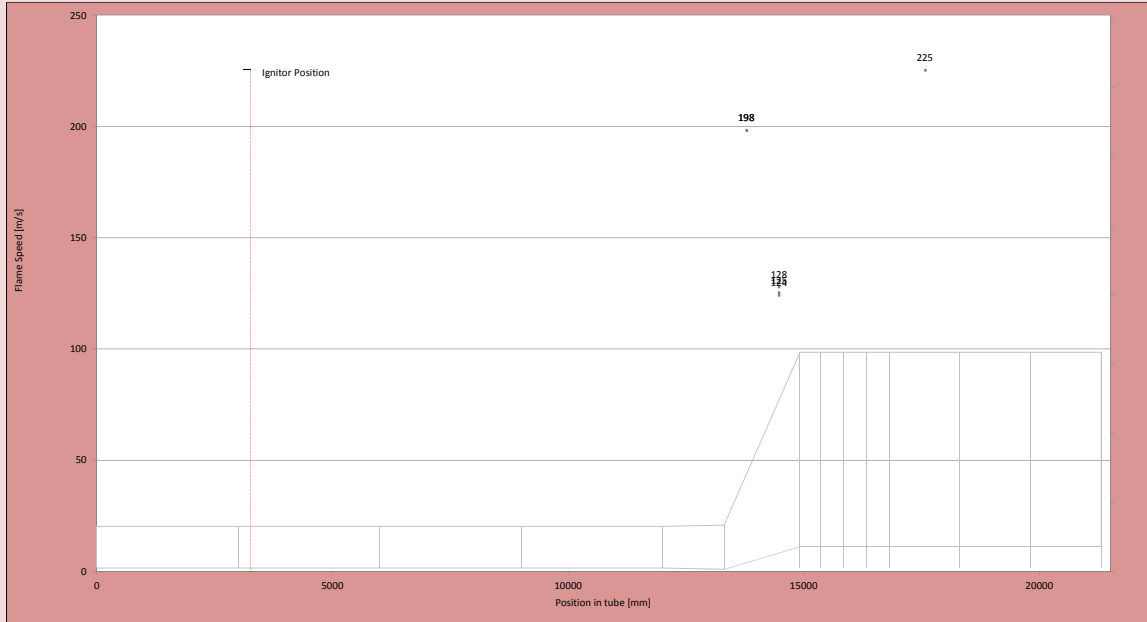
| IP Number | Location label | Data Name | Position in tube (mm) | Flame arrival time (s) | Avg Flame speed from last sensor (m/s) |
|-----------|----------------|-------------|-----------------------|------------------------|--|
| IP11 | HR2-L5U | Flameion_11 | 14745 | 1.53670 | 173 |
| IP8 | HR2-L5M | Flameion_8 | 14745 | 1.53467 | 178 |
| IP9 | HR2-L5L | Flameion_9 | 14745 | 1.53004 | 192 |
| IP7 | HR3-L1U | Flameion_7 | 15140 | 1.53496 | -227 |
| IP10 | HE2-R1U | Flameion_10 | 16090 | | |
| IP12 | HR4-R1U | Flameion_12 | 16985 | | |
| IP13 | HR4-L1U | Flameion_13 | 16985 | NA | |
| IP2 | HR4-L1M | Flameion_2 | 16985 | 1.53711 | 918 |
| IP4 | HR4-L1L | Flameion_4 | 16985 | 1.53299 | 759 |
| IP14 | HR4-R5M | Flameion_14 | 18165 | 1.53719 | 1357 |
| IP21 | HR4-L5M | Flameion_21 | 18165 | NA | |
| IPO | HR5-L2M | Flameion_0 | 18775 | 1.53785 | |
| IP1 | HR5-L2U | Flameion_1 | 18775 | 1.53896 | 909 |
| IP15 | HR5-R2U | Flameion_15 | 18775 | 1.53914 | 313 |
| IP16 | HR5-L2L | Flameion_16 | 18775 | 1.53982 | 262 |
| IP3 | HR6-L1M | Flameion_3 | 19985 | NA | |
| IP5 | HR6-R1M | Flameion_5 | 19985 | 1.54126 | 447 |
| IP18 | HR6-R3U | Flameion_18 | 20575 | 1.54517 | 299 |
| IP19 | HR6-L3L | Flameion_19 | 20575 | NA | |
| IP22 | HR6-L3U | Flameion_22 | 20575 | 1.54606 | 254 |
| IP23 | HR6-L3M | Flameion_23 | 20575 | 1.54704 | 196 |
| IP17 | HR6-R5U | Flameion_17 | 21165 | 1.54258 | 695 |
| IP20 | HR6-L5U | Flameion_20 | 21165 | 1.54324 | 558 |
| IP6 | HR6-L5M | Flameion_6 | 21165 | NA | |

Values highlighted in yellow show flame arrival times that are ambiguous and need further investigation



Location of igniter mm Time of ignition seconds

| Rake Number | IP Number | Location label | Data Name | Position in tube (mm) | Flame arrival time (s) | Avg Flame speed from last sensor (m/s) |
|-------------|-----------|----------------|-----------|-----------------------|------------------------|--|
| RA1 | IP24 | HR2-R2M | IP24 | 13785 | NA | |
| RA1 | IP25 | HR2-R2M | IP25 | 13785 | 1.5233 | 198 |
| RA1 | IP26 | HR2-R2M | IP26 | 13785 | 1.5233 | 198 |
| RA2 | IP27 | HR2-R4M | IP27 | 14475 | 1.5288 | 125 |
| RA2 | IP28 | HR2-R4M | IP28 | 14475 | 1.5287 | 128 |
| RA2 | IP29 | HR2-R4M | IP29 | 14475 | 1.5288 | 124 |
| RA3 | IP30 | HR4-R3M | IP30 | 17575 | NA | |
| RA3 | IP31 | HR4-R3M | IP31 | 17575 | 1.5424 | 225 |
| RA3 | IP32 | HR4-R3M | IP32 | 17575 | NA | |
| RA4 | IP33 | HR5-R4M | IP33 | 19375 | NA | |
| RA4 | IP34 | HR5-R4M | IP34 | 19375 | NA | |
| RA4 | IP35 | HR5-R4M | IP35 | 19375 | NA | |



Location of igniter mm

| Transducer number | Location | Position in tube [mm] | ΔP_{max} [mbar] | Time ΔP_{max} [sec] |
|-------------------|----------|-----------------------|-------------------------|-----------------------------|
| KU6 | CD4-L4 | 10758 | 448 | 1.5644 |
| KU7 | CD4-R2 | 9758 | 811 | 1.5655 |
| KU8 | HR2-T5 | 14745 | 513 | 1.5374 |
| KU9 | HR3-L1L | 15140 | 371 | 1.5591 |
| KU0 | HE2-R1M | 16090 | 428 | 1.5555 |
| KU1 | HE2-R1L | 16090 | 477 | 1.5587 |
| KU4 | HR4-R1L | 16985 | 418 | 1.5561 |
| KU3 | HR5-R2L | 18775 | 425 | 1.5508 |
| KU2 | HR6-R3L | 20575 | 597 | 1.5478 |
| KU5 | HR6-LSL | 21165 | 598 | 1.5471 |
| PCB | EP-1M | 21330 | | |
| KU10 | #N/A | #N/A | | |
| KU11 | #N/A | #N/A | | |

