

Further Instrumentation		
Location	Sensor	Working
TS1-1	TC8	
TS2-1	TC10	
TS3-1	TC12	
TS4-1	TC14	
R1-1	IP3	
R1-2	IP4	
R1-3	IP5	
R2-1	IP7	
R2-2	IP8	
R2-3	IP9	
R3-1	IP11	
R3-2	IP12	
R3-3	IP13	
R4-1	IP15	
R4-2	IP16	
R4-3	IP17	
R5-1	IP19	
R5-2	IP20	
R5-3	IP21	
KU3	TC9	
KU4	#N/A	
KU6	TC5	
pitot	TC11	

Ionisation Probe	
Pressure Transducer	
Thermocouple	
Optical Probe	

Item	Location	DAQ	Channel	Measurement	Instrument	Supplier	Range	Signal	Excitation	S/R
IP0	FS1-3	PXIe	PXI Slot2/ai0	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP1	FS1-6	PXIe	PXI Slot2/ai1	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP2	FS2-3	PXIe	PXI Slot2/ai2	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP3	R1-1	PXIe	PXI Slot2/ai3	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP4	R1-2	PXIe	PXI Slot2/ai4	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP5	R1-3	PXIe	PXI Slot2/ai5	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP6	FS2-6	PXIe	PXI Slot2/ai6	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP7	R2-1	PXIe	PXI Slot2/ai7	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP8	R2-2	PXIe	PXI Slot6/ai0	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP9	R2-3	PXIe	PXI Slot6/ai1	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP10	FS3-4	PXIe	PXI Slot6/ai2	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP11	R3-1	PXIe	PXI Slot6/ai3	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP12	R3-2	PXIe	PXI Slot6/ai4	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP13	R3-3	PXIe	PXI Slot6/ai5	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP14	FS3-6	PXIe	PXI Slot6/ai6	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP15	R4-1	PXIe	PXI Slot6/ai7	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP16	R4-2	PXIe	PXI Slot7/ai0	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP17	R4-3	PXIe	PXI Slot7/ai1	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP18	FS4-2	PXIe	PXI Slot7/ai2	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP19	R5-1	PXIe	PXI Slot7/ai3	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP20	R5-2	PXIe	PXI Slot7/ai4	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP21	R5-3	PXIe	PXI Slot7/ai5	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP22	FS4-5	PXIe	PXI Slot7/ai6	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
IP23	FS4-6	PXIe	PXI Slot7/ai7	Flame Presence	Ionisation Probe	Bruce Ewan	TBC	-5 to 5V	60V	100 kHz
OP0	NS2-5	PXIe	PXI1Slot4/ai0	Flame Presence	Optical Probe	Bruce Ewan	TBC	-5 to 5V	30V	100 kHz
OP1	NS3-5	PXIe	PXI1Slot4/ai1	Flame Presence	Optical Probe	Bruce Ewan	TBC	-5 to 5V	30V	100 kHz
OP2	NS4-2	PXIe	PXI1Slot4/ai2	Flame Presence	Optical Probe	Bruce Ewan	TBC	-5 to 5V	30V	100 kHz
OP3	NS4-5	PXIe	PXI1Slot4/ai3	Flame Presence	Optical Probe	Bruce Ewan	TBC	-5 to 5V	30V	100 kHz
OP4	NS4-5	PXIe	PXI1Slot4/ai4	Flame Presence	Optical Probe	Bruce Ewan	TBC	-5 to 5V	30V	100 kHz
OP5	NS4-5	PXIe	PXI1Slot4/ai5	Flame Presence	Optical Probe	Bruce Ewan	TBC	-5 to 5V	30V	100 kHz
TC0	NS1-3	PXIe	SC1Mod4/Wall	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC1	NS1-5	PXIe	SC1Mod4/ai1	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC2	NS2-2	PXIe	SC1Mod4/ai2	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC3	NS1-4	PXIe	SC1Mod4/ai3	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC4	NS1-6	PXIe	SC1Mod4/ai4	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC5	Ku6	PXIe	SC1Mod4/ai5	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC6	NS3-2	PXIe	SC1Mod4/ai6	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC7	NS3-2	PXIe	SC1Mod4/ai7	Gas Temperature (Wall)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC8	TS1-1	PXIe	SC1Mod4/ai8	Temperature (surface)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC9	KU3	PXIe	SC1Mod4/ai9	Temperature (kulite body)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC10	TS2-1	PXIe	SC1Mod4/ai10	Temperature (surface)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC11	pitot	PXIe	SC1Mod4/ai11	Temperature (kulite body)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC12	TS3-1	PXIe	SC1Mod4/ai12	Temperature (surface)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC13	NS3-1	PXIe	SC1Mod4/ai13	Temperature (kulite body)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC14	TS4-1	PXIe	SC1Mod4/ai14	Temperature (surface)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
TC15	NS4-3	PXIe	SC1Mod4/ai15	Temperature (pitot)	K-Type Thermocouple	TC-Direct	1100°C	Conditioned	None	5 kHz
KU0	NS3-6	PXIe	SC1Mod1/ai0	Pressure	Kulite					100 kHz
KU1	NS3-6	PXIe	SC1Mod1/ai1	Pressure	Kulite					100 kHz
KU2	NS3-6	PXIe	SC1Mod1/ai2	Pressure	Kulite					100 kHz
KU3	NS2-3	PXIe	SC1Mod1/ai3	Pressure	Kulite					100 kHz
KU4	NS3-4	PXIe	SC1Mod1/ai4	Pressure	Kulite					100 kHz
KU5	NS3-4	PXIe	SC1Mod1/ai5	Pressure	Kulite					100 kHz
KU6	NS3-1	PXIe	SC1Mod1/ai6	Pressure	Kulite					100 kHz
KU7	NS4-6	PXIe	SC1Mod1/ai7	Pressure	Kulite					100 kHz
P81	FS3-4	PXIe	PXI Slot3/ai0	Pressure	113824	PCB	68 bar	0-5 V	20-30 V	1 MHz
P82	TS3-6	PXIe	PXI Slot3/ai0	Pressure	113825	PCB	68 bar	0-5 V	20-30 V	1 MHz

Date	13 May 2015
Time	16:12:00
Test Number	60
Mixture Composition	40%H2/35%CO/25%CH4
Ambient Temperature	6 oC
Ambient Pressure	970 mbar
Wind Speed	2 m/s
Wind direction	SW
Relative Humidity	65.00%
Equivalence Ratio	0.45

**General Comments: (weather, rig configuration)**

Weather: Cool but sunny and dry.  
 Tube configuration:  
 4 x 3m tube sections  
 igniter 250mm from beginning of tube section

Test with 15 rows of congestion (row 8 on central flange with 7 rows projecting upstream into tube 2 and 7 rows projecting downstream into tube 3. This test represents the lowest value of EQR of 0.45 tested in order to confirm the lowest peak pressure likely to be achieved by this mixture of H2/CO/CH4. The combustion is very weak as indicated by the limited IP and OP signals. Flame speed is very low at ~100 m/s

**Headlines**

Max overpressure  
 mbar

Max. flame speed  
 m/s  
 [ionisation probes]

Max. temperature  
 °C

Mass Flow  
 kg/s

m/s  
 [optical probes]

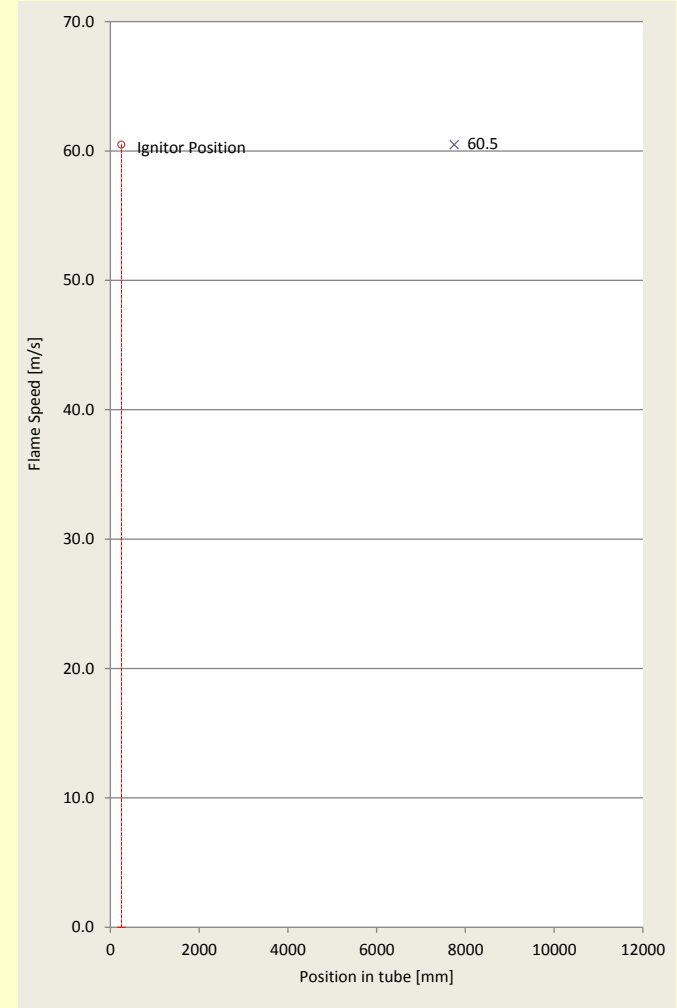
Initial Temperature  
 °C

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)
REF	#N/A	Flameion_0	#N/A		
IP1	FS1-6	Flameion_1	2750		
IP2	FS2-3	Flameion_2	4250	NS	
IP3	R1-1	Flameion_3	4750	NS	
IP4	R1-2	Flameion_4	4750	NS	
IP5	R1-3	Flameion_5	4750	NS	
IP6	FS2-6	Flameion_6	5750	NS	
IP7	R2-1	Flameion_7	6000	14.6468	
IP8	R2-2	Flameion_8	6000	NS	
IP9	R2-3	Flameion_9	6000	NS	
IP10	FS3-4	Flameion_10	7750	14.6325	60.5
IP11	R3-1	Flameion_11	7250	NS	
IP12	R3-2	Flameion_12	7250	14.6441	
IP13	R3-3	Flameion_13	7250	14.6361	
IP14	FS3-6	Flameion_14	8750	NS	
IP15	R4-1	Flameion_15	9250	14.6513	
IP16	R4-2	Flameion_16	9250	NS	
IP17	R4-3	Flameion_17	9250	NS	
IP18	FS4-2	Flameion_18	9750	14.6289	
IP19	R5-1	Flameion_19	10750	14.6431	
IP20	R5-2	Flameion_20	10750	NS	
IP21	R5-3	Flameion_21	10750	NS	
IP22	FS4-5	Flameion_22	11250	14.6361	
IP23	FS4-6	Flameion_23	11750	NS	

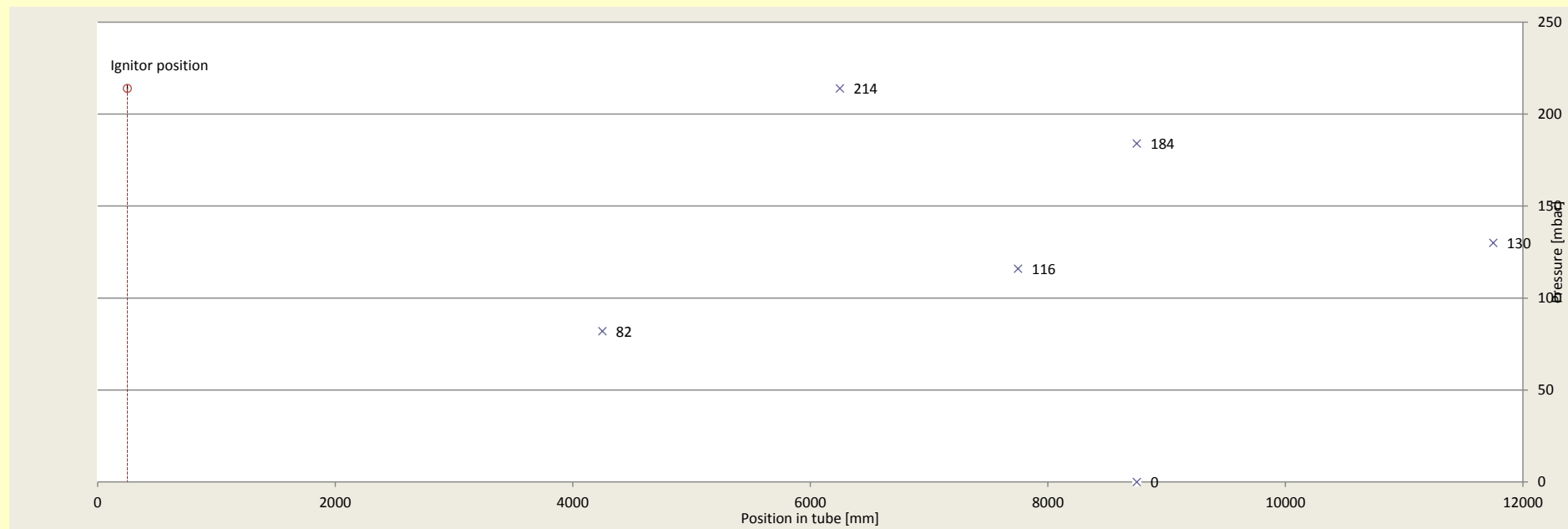
60.5



Location of igniter  mm

Transducer number	Location	Position in tube [mm]	$\Delta P_{max}$ [mbar]
KU0	NS3-6	8750	184
KU1	0	#N/A	
KU2	0	#N/A	
KU3	NS2-3	4250	82
KU4	0	#N/A	
KU5	NS3-4	7750	116
KU6	NS3-1	6250	214
KU7	NS4-6	11750	130
PB2	TS3-6	8750	0

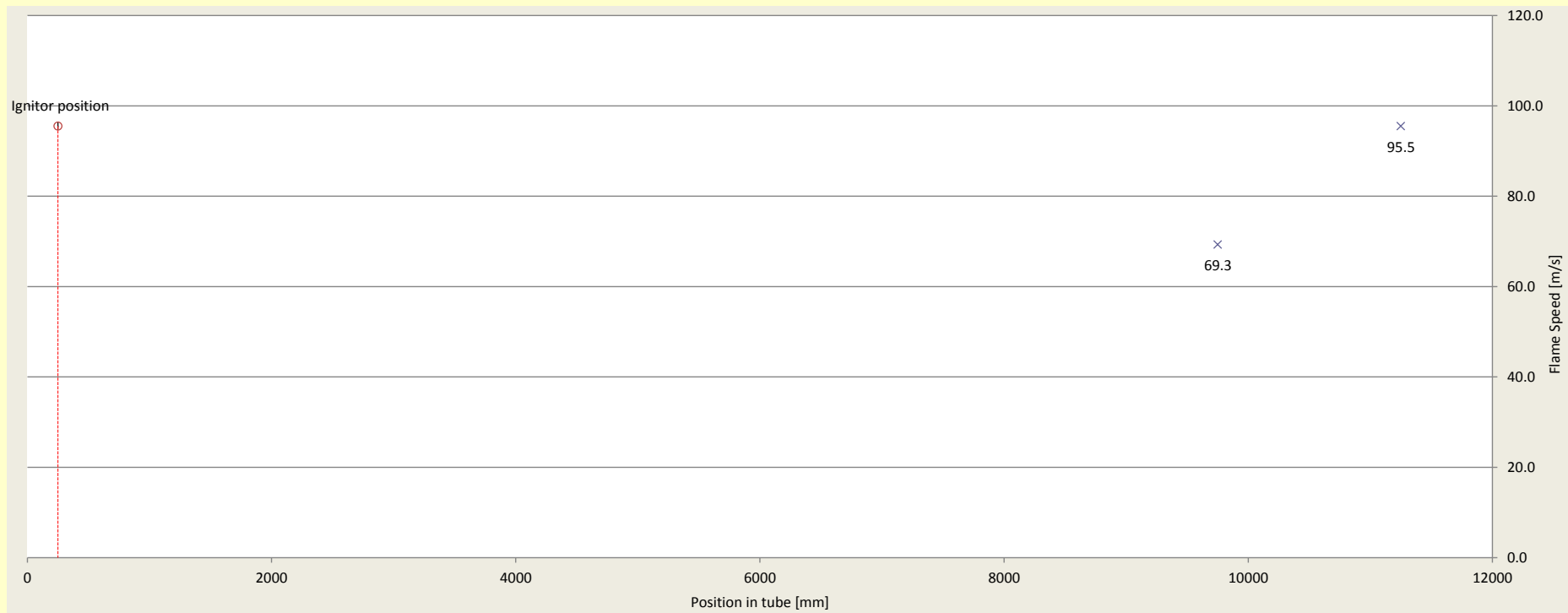
PCB = 0 mbar



Location of igniter  mm

Time of ignition  seconds

OP Number	Location label	Position in tube (mm)	Flame arrival time (s)	Average flame speed (m/s)
OP0	NS2-5	5250		
OP1	NS3-5	8250		
OP2	NS4-2	9750	14.6455	69.3
OP3	NS4-5	11250	14.6612	95.5
OP4	0	#N/A		
OP5	0	#N/A		

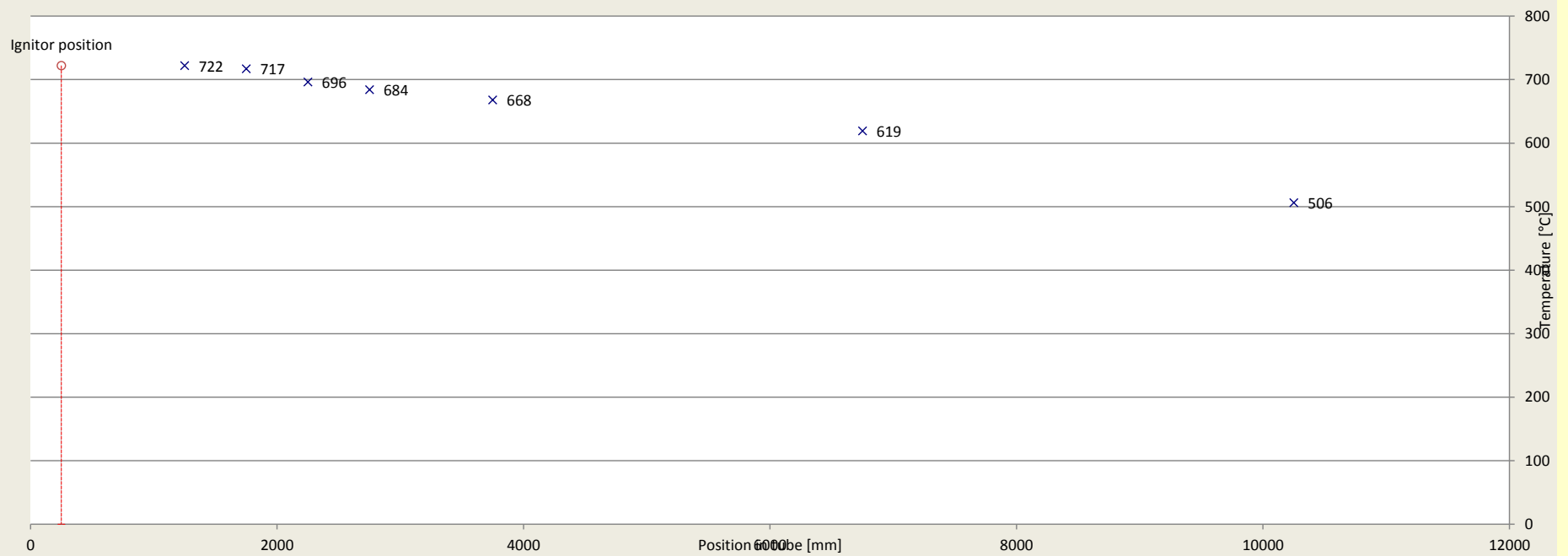


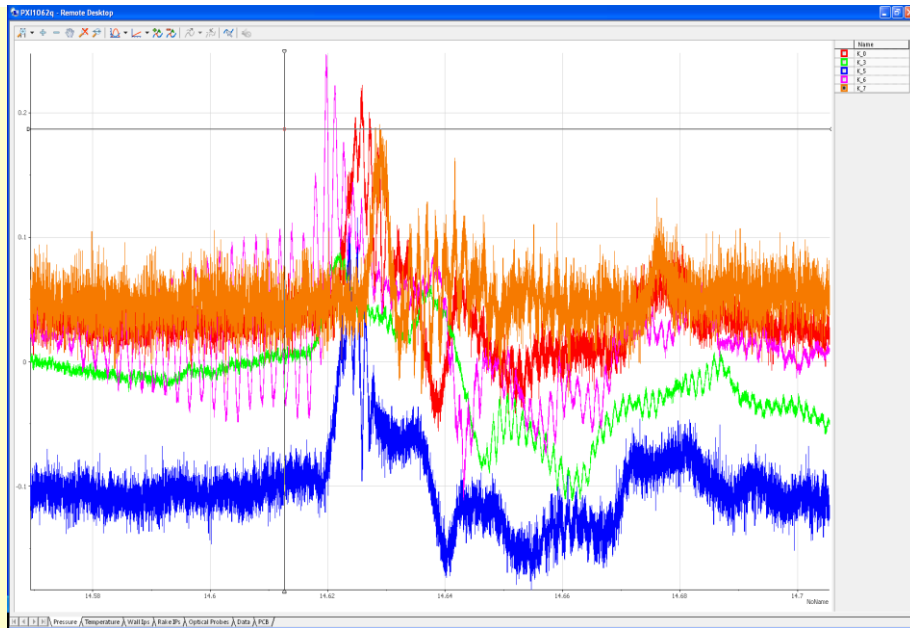
Location of igniter

250 mm

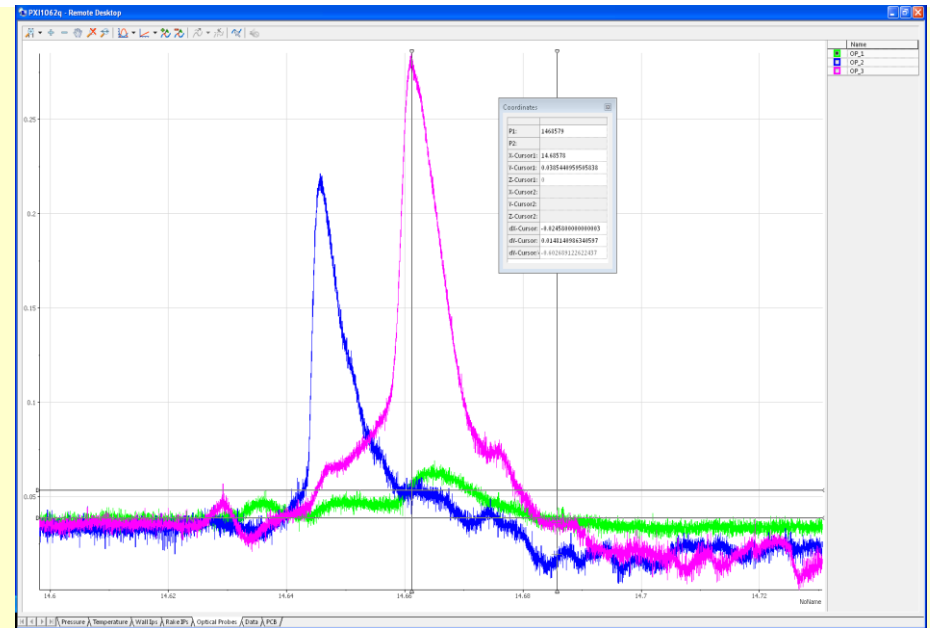
Thermocouple number	Location	Position in tube (mm)	T <sub>max</sub> (deg C)
TC0	NS1-3	1250	722
TC1	NS1-5	2250	696
TC2	NS2-2	3750	668
TC3	NS1-4	1750	717
TC4	NS1-6	2750	684
TC5	Ku6	#N/A	
TC6	NS3-2	6750	619
TC15	NS4-3	10250	506

Peak temperatures not recorded

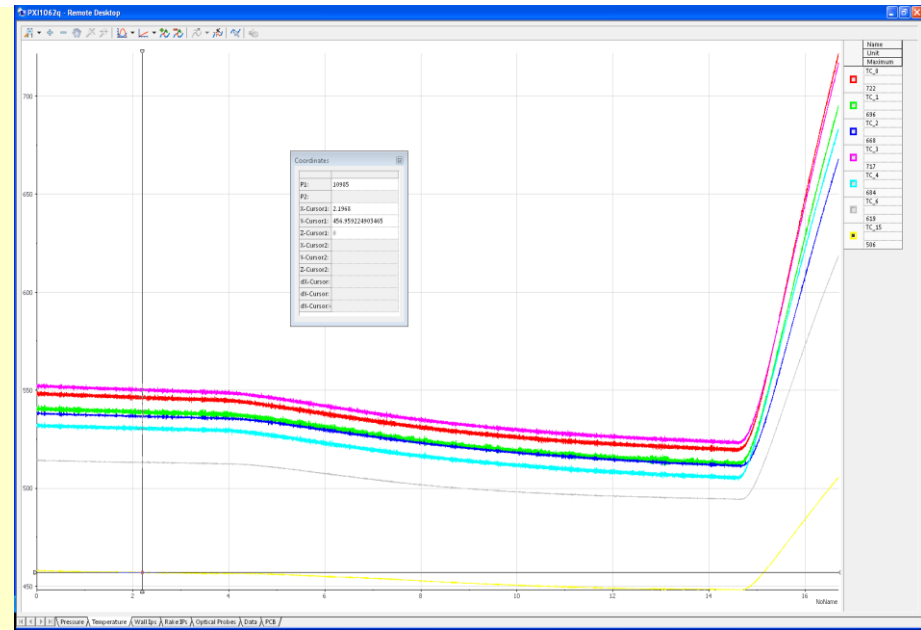
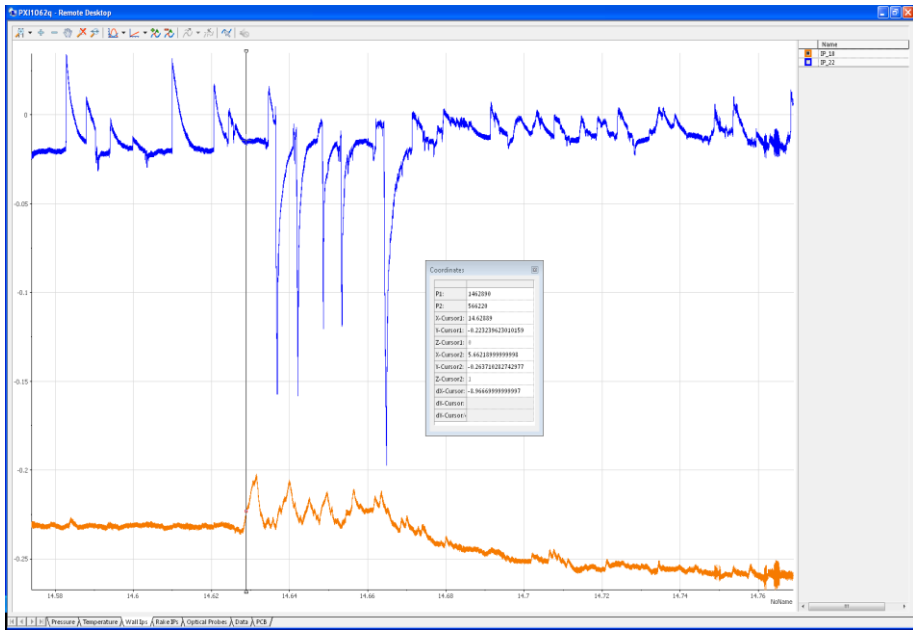




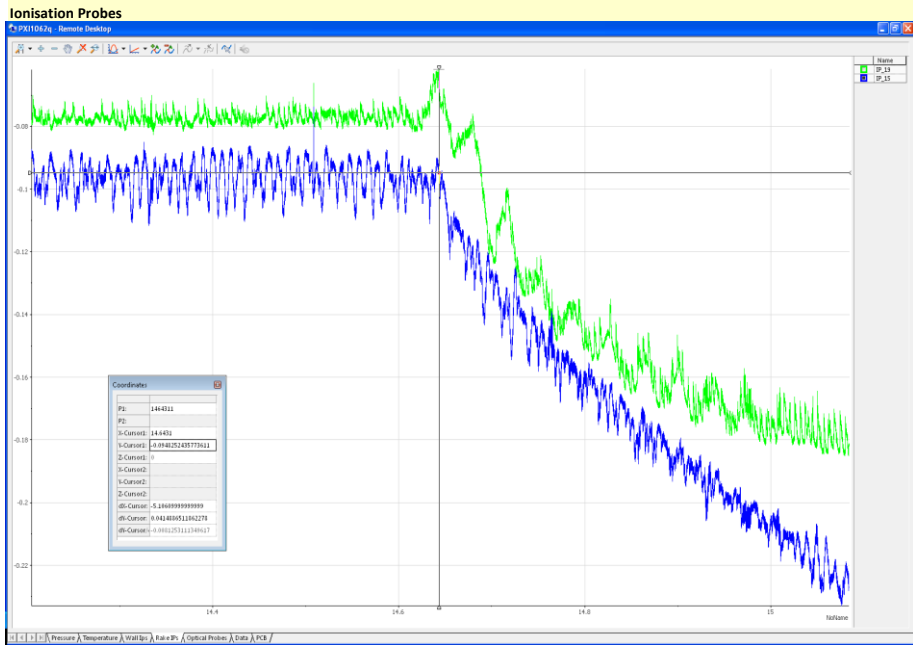
Pressure



Optical Probes



Temperature



Ionisation Probes