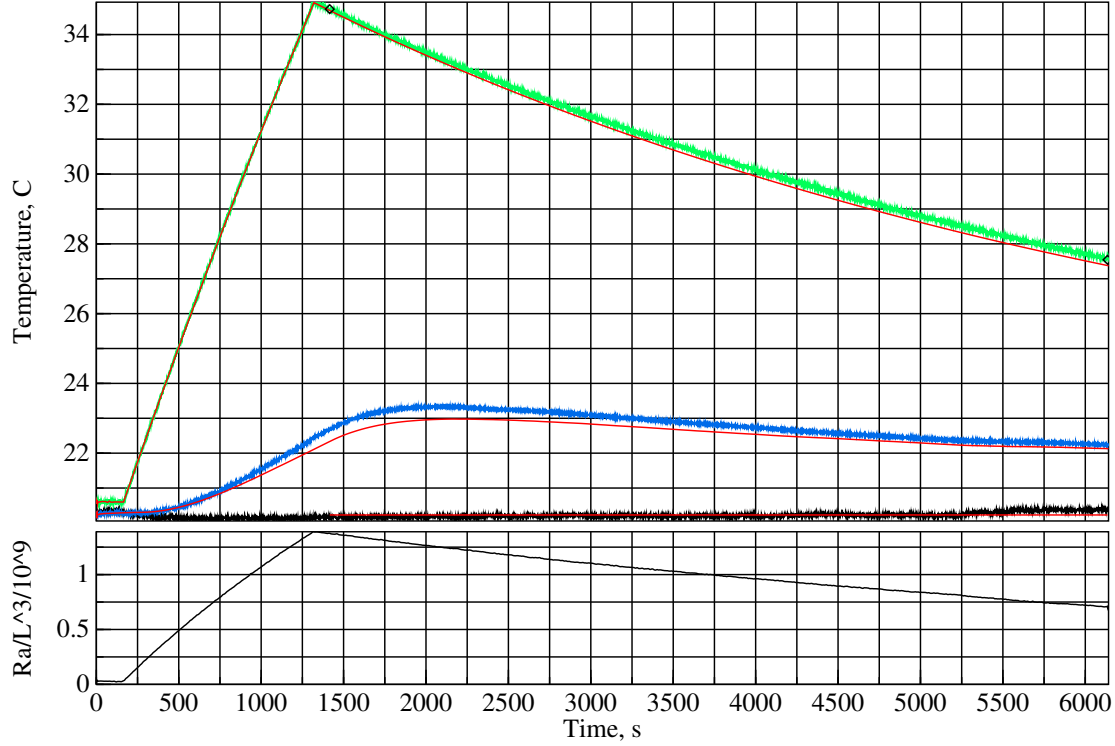


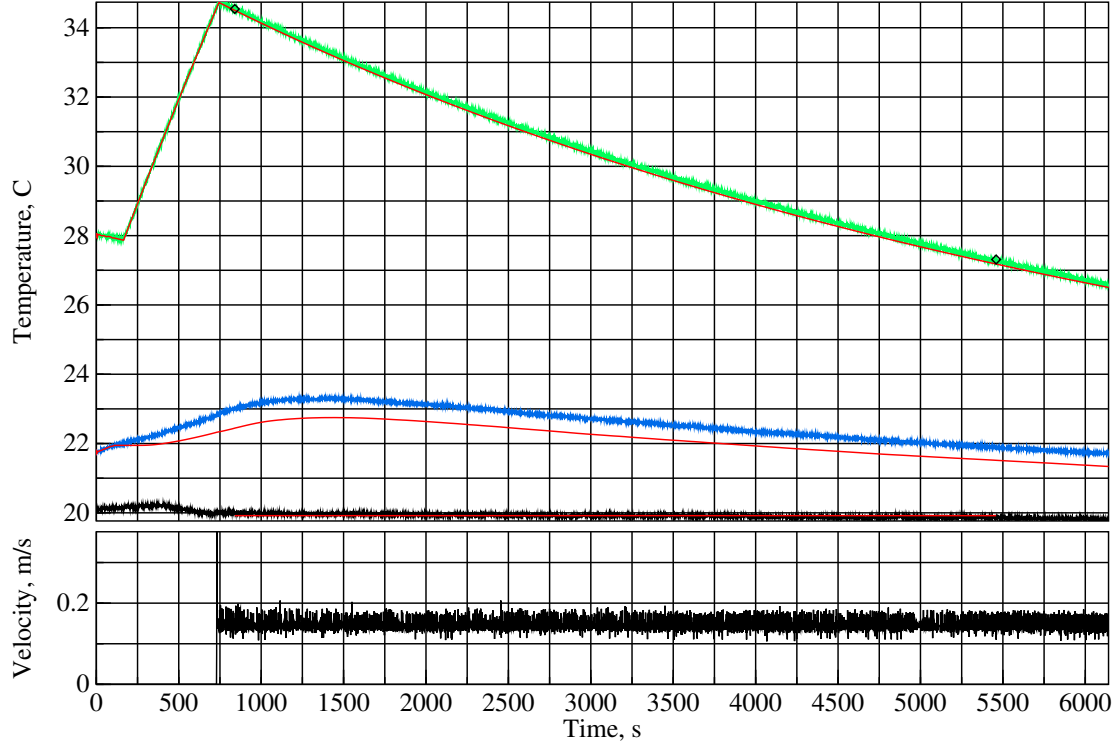
20170905T113019Z – mixed Convection – Roughness=1.04mm; T=20.2+10.4°C; +0.00°
k=0.0256, Ra/L^3=1.007x10^9, h=3.06W/(K.m^2), U=0.285W/K, Nu=36.5, Pr=0.710



Estimated measurement uncertainties of natural convection at $\theta = 0.0$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.4K	+22.8%/K	0.10K	2.28%	LM35C differential
P	100kPa	+0.0007%/Pa	1.5kPa	1.02%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.048%/(J/K)	42J/K	2.04%	plate thermal capacity
C_V	1.000	-14.1%	0.100	1.41%	vertical reuptake
L_c	0.305m	+616%/m	500um	0.31%	characteristic length
D_{PIR}	25.4mm	-541%/m	1.0mm	0.54%	insulation thickness
D_g	1.00mm	-548%/m	500um	0.27%	air gap
L_m	3.57mm	+1185%/m	500um	0.59%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.523%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.58%	PIR thermal conductivity
ϵ_{XPS}	0.515	+39.2%	0.010	0.39%	XPS emissivity
ϵ_{tp}	0.890	+46.9%	0.015	0.70%	tape emissivity
Ω_{tp}	0.540	+31.9%	0.020	0.64%	tape coverage
ϵ_{rs}	0.040	+161%	0.010	1.61%	test-surface emissivity
ϵ_{wt}	0.900	+76.9%	0.025	1.92%	wind-tunnel emissivity
				4.58%	combined bias uncertainty

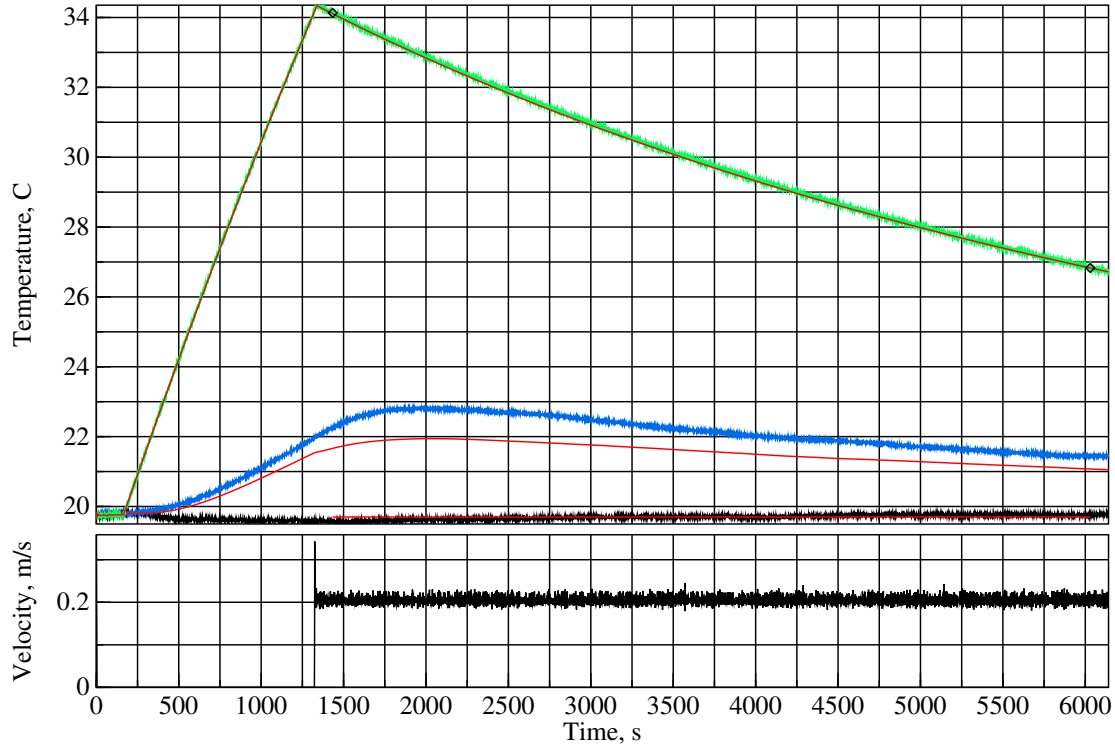
20170904T030735Z – mixed Convection – Roughness=1.04mm; T=19.9+10.5°C; +0.00°
42±4.2r/min, V=0.15m/s, Re=2970, Ra/L^3=1.018x10^9, h=3.29W/(K.m^2), U=0.306W/K, Nu=39.2



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 2970$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.5K	+22.4%/K	0.10K	2.24%	LM35C differential
P	100kPa	+0.0007%/Pa	1.5kPa	1.07%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.048%/(J/K)	42J/K	2.03%	plate thermal capacity
C_V	1.000	−13.9%	0.100	1.39%	vertical reuptake
L_c	0.305m	+605%/m	500um	0.30%	characteristic length
D_{PIR}	25.4mm	−532%/m	1.0mm	0.53%	insulation thickness
D_g	1.00mm	−539%/m	500um	0.27%	air gap
L_m	3.57mm	+1245%/m	500um	0.62%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.522%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.58%	PIR thermal conductivity
ϵ_{XPS}	0.515	+38.4%	0.010	0.38%	XPS emissivity
ϵ_{tp}	0.890	+45.9%	0.015	0.69%	tape emissivity
Ω_{tp}	0.540	+31.3%	0.020	0.63%	tape coverage
ϵ_{rs}	0.040	+158%	0.010	1.58%	test-surface emissivity
ϵ_{wt}	0.900	+75.3%	0.025	1.88%	wind-tunnel emissivity
				4.53%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	41.7r/min	+0.178%/(r/min)	4.2r/min	0.74%	fan rotation rate
				4.76%	RSS combined uncertainty

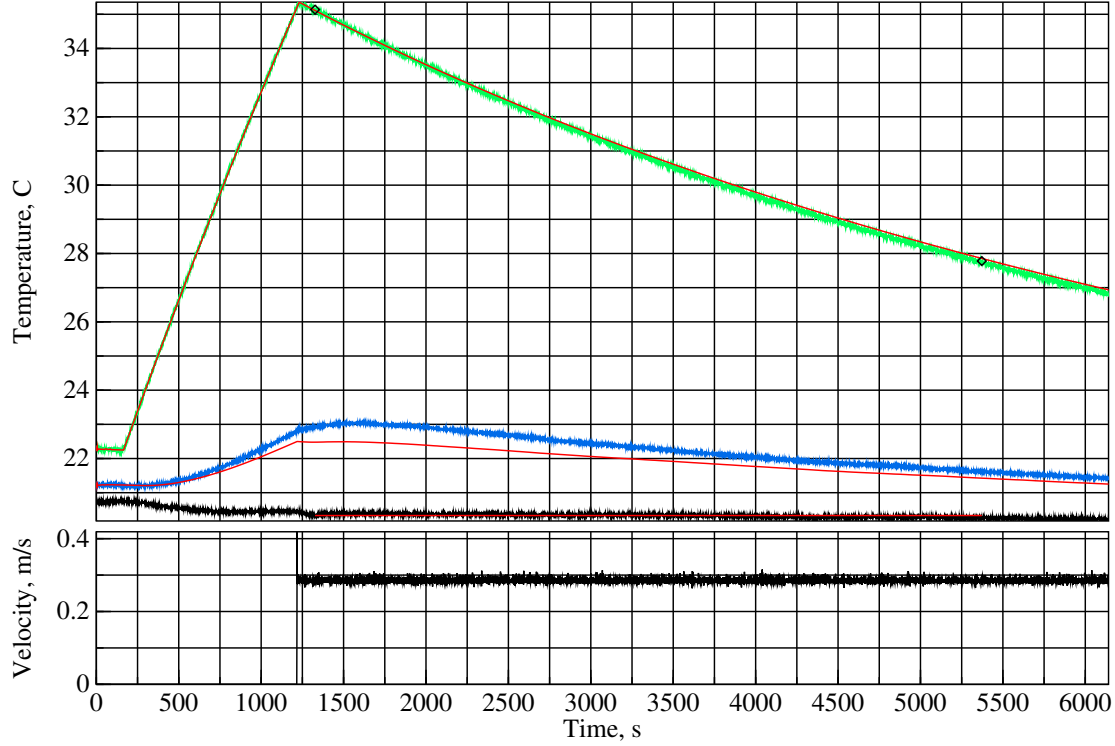
20170904T124824Z – mixed Convection – Roughness=1.04mm; T=19.7+10.3°C; +0.00°
58±2.5r/min, V=0.20m/s, Re=4140, Ra/L^3=1.008x10^9, h=3.50W/(K.m^2), U=0.326W/K, Nu=41.7



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 4140$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	+22.4%/K	0.10K	2.24%	LM35C differential
P	100kPa	+0.0008%/Pa	1.5kPa	1.13%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.047%/(J/K)	42J/K	2.01%	plate thermal capacity
C_V	1.000	−13.5%	0.100	1.35%	vertical reuptake
L_c	0.305m	+596%/m	500um	0.30%	characteristic length
D_{PIR}	25.4mm	−562%/m	1.0mm	0.56%	insulation thickness
D_g	1.00mm	−570%/m	500um	0.29%	air gap
L_m	3.57mm	+1267%/m	500um	0.63%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.555%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.62%	PIR thermal conductivity
ϵ_{XPS}	0.515	+37.2%	0.010	0.37%	XPS emissivity
ϵ_{tp}	0.890	+44.6%	0.015	0.67%	tape emissivity
Ω_{tp}	0.540	+30.3%	0.020	0.61%	tape coverage
ϵ_{rs}	0.040	+154%	0.010	1.54%	test-surface emissivity
ϵ_{wt}	0.900	+72.8%	0.025	1.82%	wind-tunnel emissivity
				4.49%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	57.8r/min	+0.285%/(r/min)	2.5r/min	0.71%	fan rotation rate
				4.71%	RSS combined uncertainty

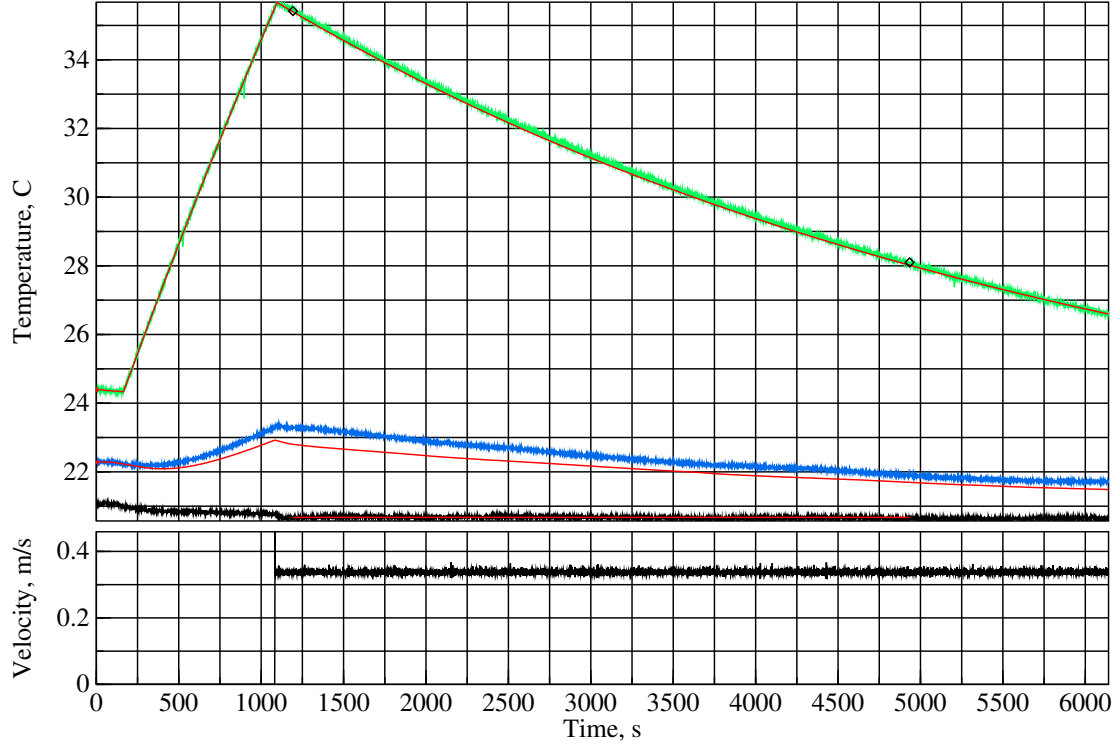
20170904T231856Z – mixed Convection – Roughness=1.04mm; T=20.3+10.7°C; +0.00°
81±1.9r/min, V=0.29m/s, Re=5738, Ra/L^3=1.028x10^9, h=4.16W/(K.m^2), U=0.387W/K, Nu=49.5



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 5738$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.7K	+18.6%/K	0.10K	1.86%	LM35C differential
P	100kPa	+0.0013%/Pa	1.5kPa	1.88%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.045%/(J/K)	42J/K	1.91%	plate thermal capacity
η	0.400	+298%	0.004	1.19%	anemometer calibration
C_V	1.000	-12.0%	0.100	1.20%	vertical reuptake
L_c	0.305m	+757%/m	500um	0.38%	characteristic length
ς	2.00mm	-11614%/m	100um	1.16%	post height
D_{PIR}	25.4mm	-532%/m	1.0mm	0.53%	insulation thickness
D_g	1.00mm	-540%/m	500um	0.27%	air gap
L_m	3.57mm	+1253%/m	500um	0.63%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.533%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.59%	PIR thermal conductivity
ϵ_{XPS}	0.515	+33.0%	0.010	0.33%	XPS emissivity
ϵ_{tp}	0.890	+39.6%	0.015	0.59%	tape emissivity
Ω_{tp}	0.540	+26.9%	0.020	0.54%	tape coverage
ϵ_{rs}	0.040	+137%	0.010	1.37%	test-surface emissivity
ϵ_{wt}	0.900	+64.5%	0.025	1.61%	wind-tunnel emissivity
θ	0.00°	+2.00%/°	0.50°	1.00%	plate angle
				4.73%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	80.6r/min	+1.48%/(r/min)	1.9r/min	2.82%	fan rotation rate
				7.37%	RSS combined uncertainty

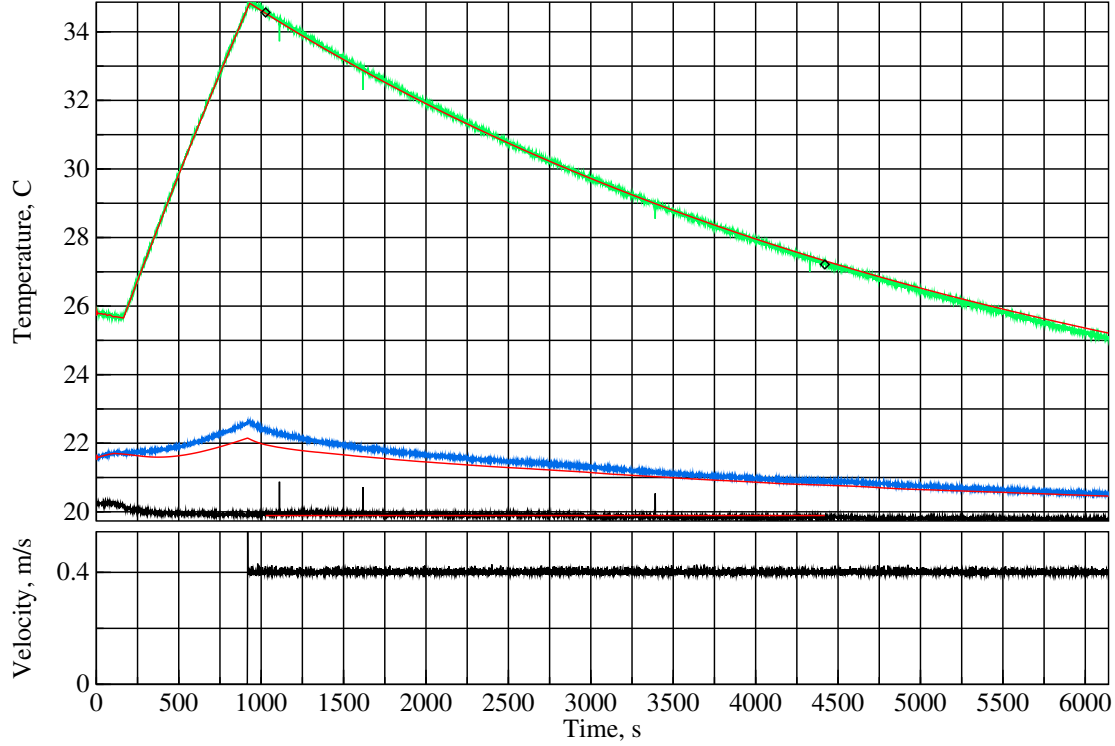
20170905T211144Z – mixed Convection – Roughness=1.04mm; T=20.7+10.6°C; +0.00°
95±1.7r/min, V=0.34m/s, Re=6754, Ra/L^3=1.015x10^9, h=4.79W/(K.m^2), U=0.445W/K, Nu=56.9



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 6753$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.6K	+18.4%/K	0.10K	1.84%	LM35C differential
P	100.0kPa	+0.0010%/Pa	1.5kPa	1.48%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.042%/(J/K)	42J/K	1.76%	plate thermal capacity
η	0.400	+156%	0.004	0.62%	anemometer calibration
C_V	1.000	−9.82%	0.100	0.98%	vertical reuptake
L_c	0.305m	+559%/m	500um	0.28%	characteristic length
L_T	8.34mm	+3115%/m	100um	0.31%	post length
ς	2.00mm	−8256%/m	100um	0.83%	post height
D_{PIR}	25.4mm	−449%/m	1.0mm	0.45%	insulation thickness
D_g	1.00mm	−455%/m	500um	0.23%	air gap
L_m	3.57mm	+1127%/m	500um	0.56%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.454%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.50%	PIR thermal conductivity
ϵ_{XPS}	0.515	+26.9%	0.010	0.27%	XPS emissivity
ϵ_{tp}	0.890	+32.3%	0.015	0.49%	tape emissivity
Ω_{tp}	0.540	+22.0%	0.020	0.44%	tape coverage
ϵ_{rs}	0.040	+113%	0.010	1.13%	test-surface emissivity
ϵ_{wt}	0.900	+52.6%	0.025	1.31%	wind-tunnel emissivity
				3.91%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	95.3r/min	+0.652%/(r/min)	1.7r/min	1.11%	fan rotation rate
				4.49%	RSS combined uncertainty

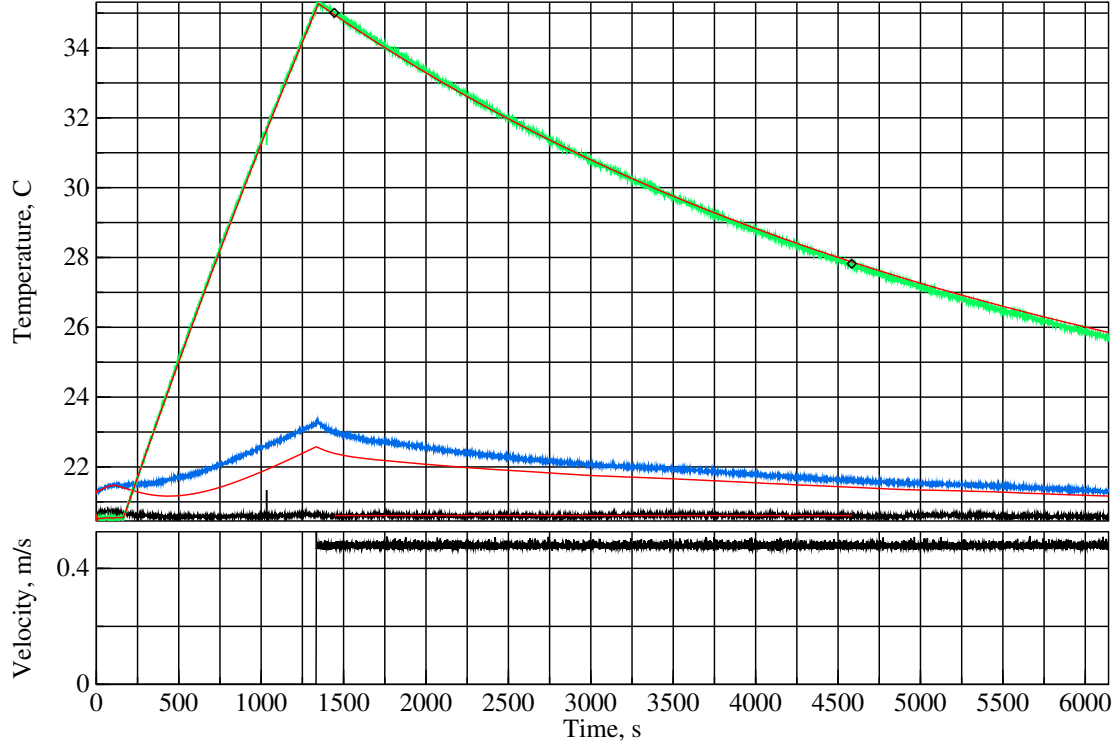
20170904T144811Z – mixed Convection – Roughness=1.04mm; T=19.9+10.6°C; +0.00°
113±1.9r/min, V=0.40m/s, Re=8095, Ra/L^3=1.033x10^9, h=5.59W/(K.m^2), U=0.520W/K, Nu=66.5



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 8096$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.6K	+17.4%/K	0.10K	1.74%	LM35C differential
P	100kPa	+0.0010%/Pa	1.5kPa	1.53%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.040%/(J/K)	42J/K	1.68%	plate thermal capacity
η	0.400	+179%	0.004	0.72%	anemometer calibration
C_V	1.000	−8.75%	0.100	0.87%	vertical reuptake
L_c	0.305m	+528%/m	500um	0.26%	characteristic length
L_T	8.34mm	+4377%/m	100um	0.44%	post length
ς	2.00mm	−11109%/m	100um	1.11%	post height
D_{PIR}	25.4mm	−411%/m	1.0mm	0.41%	insulation thickness
D_g	1.00mm	−417%/m	500um	0.21%	air gap
L_m	3.57mm	+1048%/m	500um	0.52%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.417%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.46%	PIR thermal conductivity
ϵ_{XPS}	0.515	+23.7%	0.010	0.24%	XPS emissivity
ϵ_{tp}	0.890	+28.4%	0.015	0.43%	tape emissivity
Ω_{tp}	0.540	+19.3%	0.020	0.39%	tape coverage
ϵ_{rs}	0.040	+99.4%	0.010	0.99%	test-surface emissivity
ϵ_{wt}	0.900	+46.2%	0.025	1.16%	wind-tunnel emissivity
				3.80%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	113r/min	+0.632%/(r/min)	1.9r/min	1.21%	fan rotation rate
				4.50%	RSS combined uncertainty

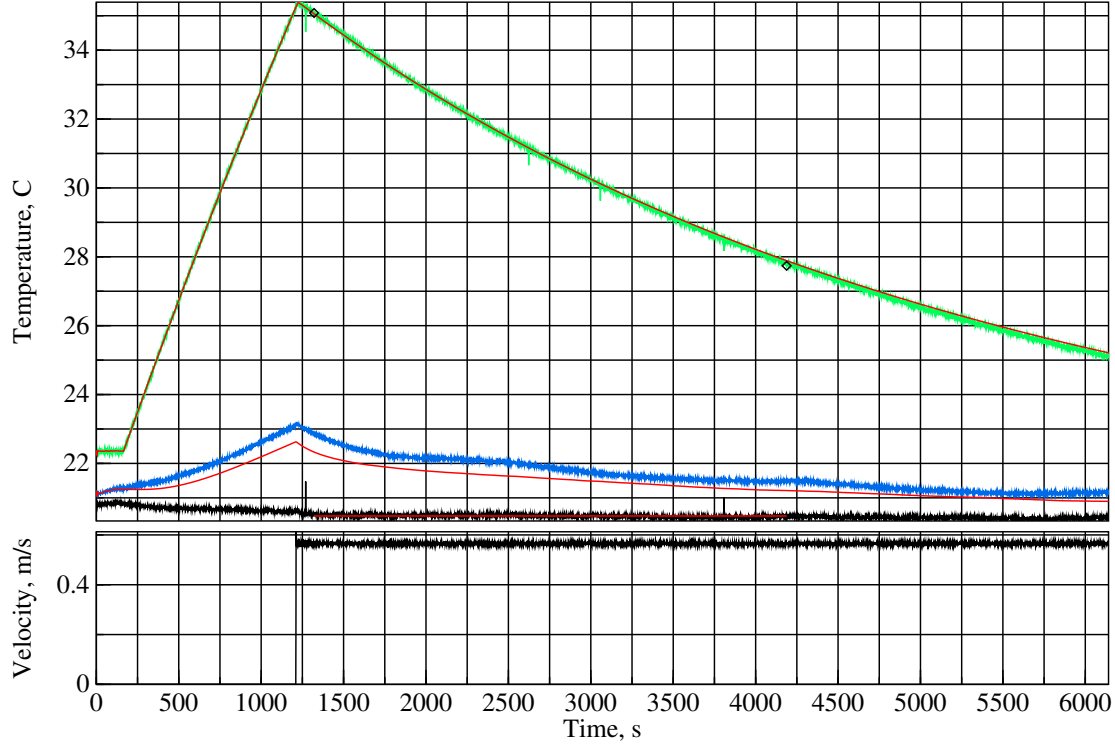
20170908T005847Z – mixed Convection – Roughness=1.04mm; T=20.6+10.4°C; +0.00°
135±2.3r/min, V=0.48m/s, Re=9639, Ra/L^3=1.005x10^9, h=6.49W/(K.m^2), U=0.604W/K, Nu=77.2



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 9640$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.4K	+16.8%/K	0.10K	1.68%	LM35C differential
P	101kPa	+0.0010%/Pa	1.5kPa	1.55%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.038%/(J/K)	42J/K	1.60%	plate thermal capacity
η	0.400	+198%	0.004	0.79%	anemometer calibration
C_V	1.000	-7.67%	0.100	0.77%	vertical reuptake
L_c	0.305m	+484%/m	500um	0.24%	characteristic length
L_T	8.34mm	+5506%/m	100um	0.55%	post length
ς	2.00mm	-12434%/m	100um	1.24%	post height
D_{PIR}	25.4mm	-372%/m	1.0mm	0.37%	insulation thickness
L_m	3.57mm	+977%/m	500um	0.49%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.379%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.42%	PIR thermal conductivity
ϵ_{XPS}	0.515	+21.0%	0.010	0.21%	XPS emissivity
ϵ_{tp}	0.890	+25.2%	0.015	0.38%	tape emissivity
Ω_{tp}	0.540	+17.1%	0.020	0.34%	tape coverage
ϵ_{rs}	0.040	+88.0%	0.010	0.88%	test-surface emissivity
ϵ_{wt}	0.900	+40.9%	0.025	1.02%	wind-tunnel emissivity
				3.70%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	135r/min	+0.584%/(r/min)	2.3r/min	1.32%	fan rotation rate
				4.55%	RSS combined uncertainty

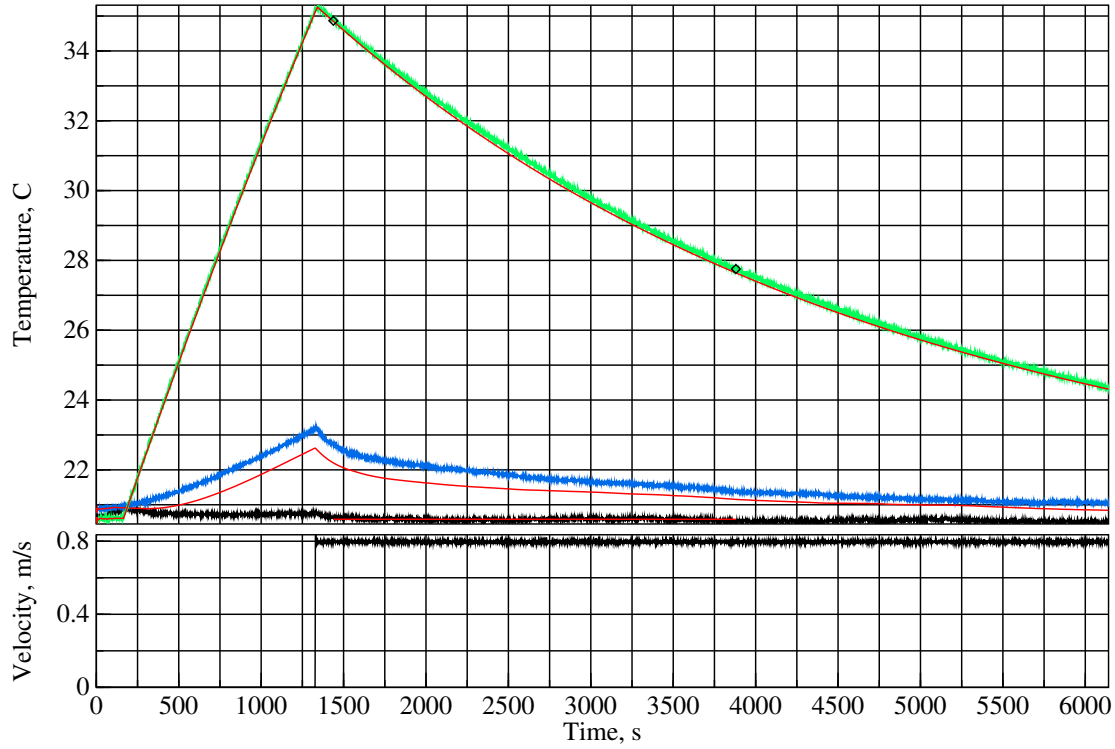
20170905T191045Z – mixed Convection – Roughness=1.04mm; T=20.5+10.5°C; +0.00°
160±0.9r/min, V=0.57m/s, Re=11324, Ra/L^3=1.009x10^9, h=7.18W/(K.m^2), U=0.667W/K, Nu=85.3



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 11324$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.5K	+15.7%/K	0.10K	1.57%	LM35C differential
P	99.9kPa	+0.0010%/Pa	1.5kPa	1.54%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.036%/(J/K)	42J/K	1.53%	plate thermal capacity
η	0.400	+206%	0.004	0.82%	anemometer calibration
C_V	1.000	−6.76%	0.100	0.68%	vertical reuptake
L_c	0.305m	+432%/m	500um	0.22%	characteristic length
L_T	8.34mm	+6330%/m	100um	0.63%	post length
ς	2.00mm	−12294%/m	100um	1.23%	post height
D_{PIR}	25.4mm	−335%/m	1.0mm	0.33%	insulation thickness
L_m	3.57mm	+907%/m	500um	0.45%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.342%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.38%	PIR thermal conductivity
ϵ_{tp}	0.890	+22.1%	0.015	0.33%	tape emissivity
Ω_{tp}	0.540	+15.0%	0.020	0.30%	tape coverage
ϵ_{rs}	0.040	+77.5%	0.010	0.78%	test-surface emissivity
ϵ_{wt}	0.900	+35.9%	0.025	0.90%	wind-tunnel emissivity
				3.53%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	160r/min	+0.515%/(r/min)	0.90r/min	0.46%	fan rotation rate
				3.65%	RSS combined uncertainty

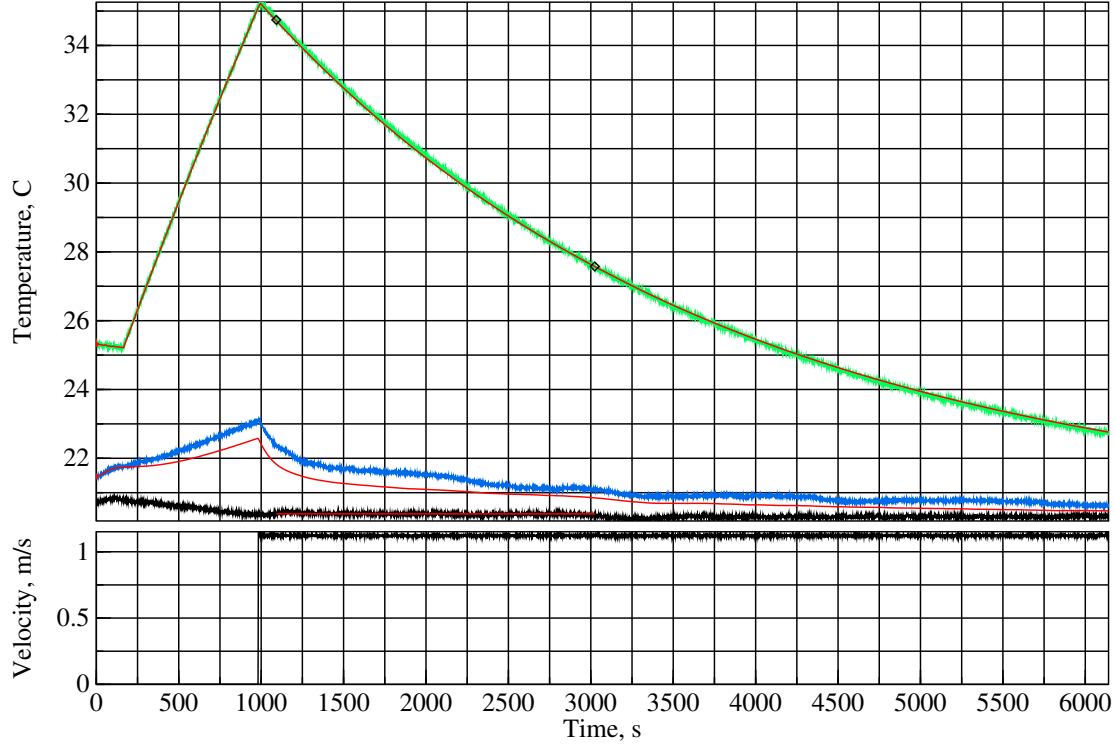
20170906T231528Z – mixed Convection – Roughness=1.04mm; T=20.6+10.3°C; +0.00°
226±1.3r/min, V=0.80m/s, Re=16037, Ra/L^3=1.000x10^9, h=9.01W/(K.m^2), U=0.838W/K, Nu=107.1



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 16038$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	+14.4%/K	0.10K	1.44%	LM35C differential
P	101kPa	+0.0010%/Pa	1.5kPa	1.46%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.033%/(J/K)	42J/K	1.40%	plate thermal capacity
η	0.400	+211%	0.004	0.84%	anemometer calibration
C_V	1.000	-5.06%	0.100	0.51%	vertical reuptake
L_T	8.34mm	+7568%/m	100um	0.76%	post length
ς	2.00mm	-9928%/m	100um	0.99%	post height
D_{PIR}	25.4mm	-261%/m	1.0mm	0.26%	insulation thickness
L_m	3.57mm	+776%/m	500um	0.39%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.268%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.30%	PIR thermal conductivity
ϵ_{tp}	0.890	+16.5%	0.015	0.25%	tape emissivity
Ω_{tp}	0.540	+11.2%	0.020	0.22%	tape coverage
ϵ_{rs}	0.040	+58.1%	0.010	0.58%	test-surface emissivity
ϵ_{wt}	0.900	+26.8%	0.025	0.67%	wind-tunnel emissivity
				3.16%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	226r/min	+0.373%/(r/min)	1.3r/min	0.48%	fan rotation rate
				3.30%	RSS combined uncertainty

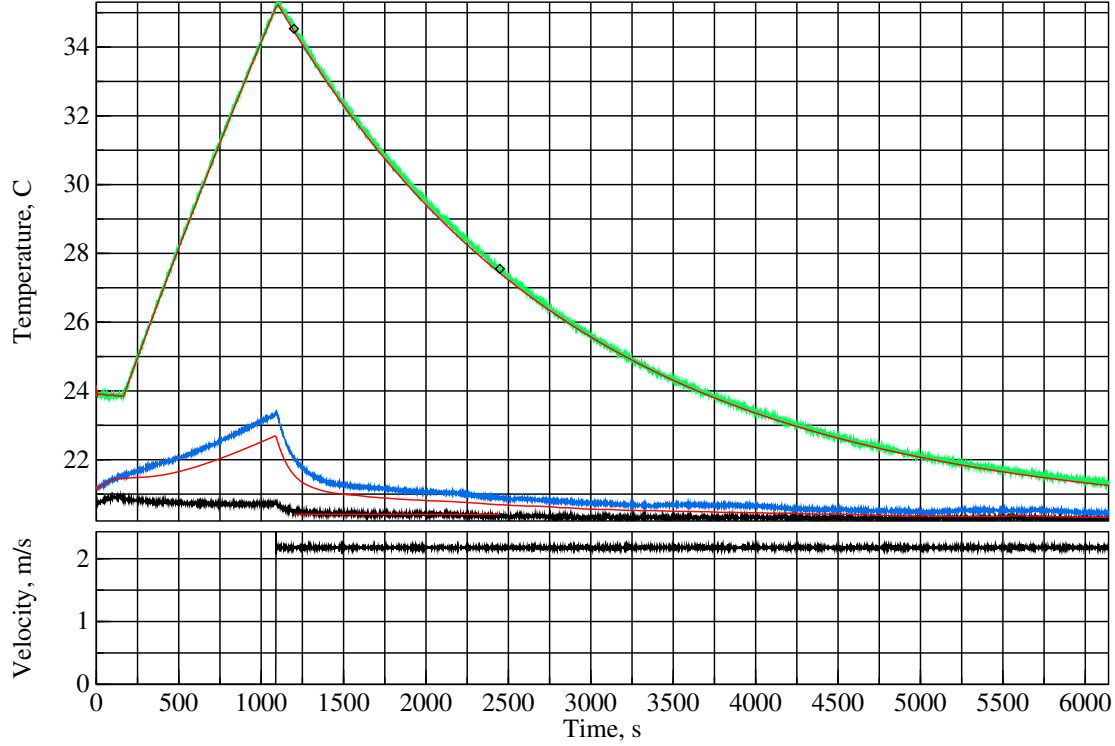
20170906T021026Z – mixed Convection – Roughness=1.04mm; T=20.4+10.4°C; +0.00°
320±1.0r/min, V=1.1m/s, Re=22554, Ra/L^3=1.003x10^9, h=12.3W/(K.m^2), U=1.15W/K, Nu=146.4



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 22552$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.4K	+13.1%/K	0.10K	1.31%	LM35C differential
P	100kPa	+0.0009%/Pa	1.5kPa	1.38%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.031%/(J/K)	42J/K	1.31%	plate thermal capacity
η	0.400	+206%	0.004	0.82%	anemometer calibration
C_V	1.000	−3.81%	0.100	0.38%	vertical reuptake
L_T	8.34mm	+8275%/m	100um	0.83%	post length
ς	2.00mm	−7087%/m	100um	0.71%	post height
D_{PIR}	25.4mm	−203%/m	1.0mm	0.20%	insulation thickness
L_m	3.57mm	+678%/m	500um	0.34%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.210%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.23%	PIR thermal conductivity
ϵ_{rs}	0.040	+43.7%	0.010	0.44%	test-surface emissivity
ϵ_{wt}	0.900	+20.1%	0.025	0.50%	wind-tunnel emissivity
				2.85%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	320r/min	+0.257%/(r/min)	1.0r/min	0.27%	fan rotation rate
				2.90%	RSS combined uncertainty

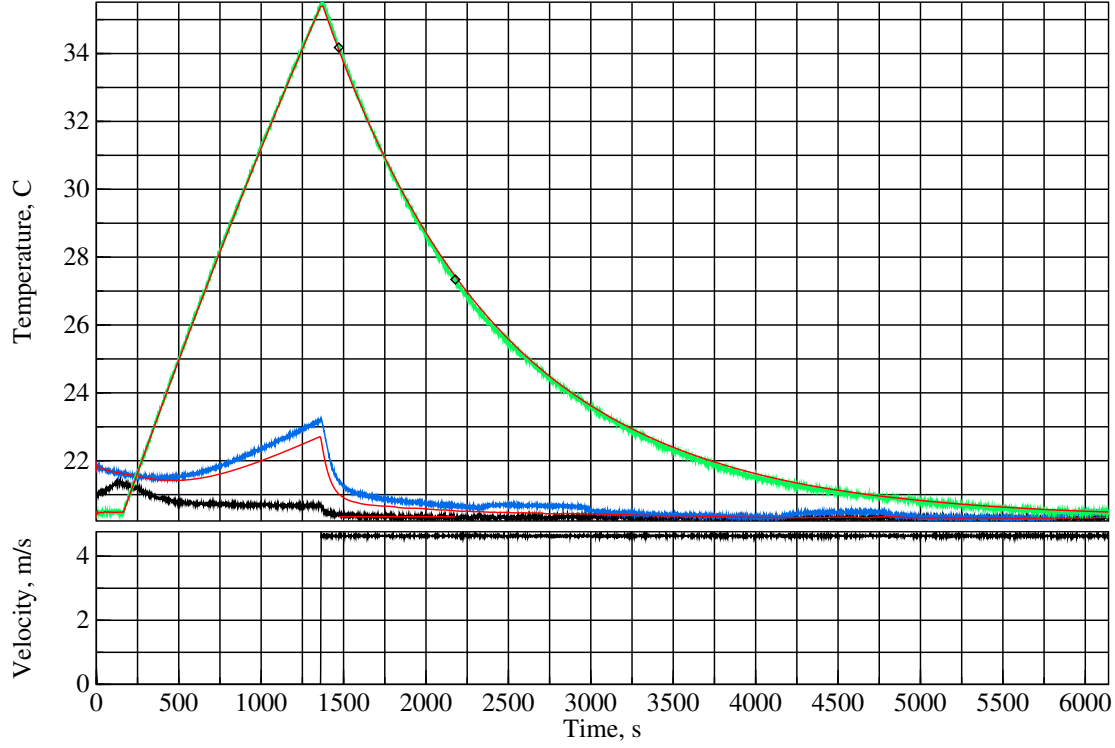
20170907T010459Z – mixed Convection – Roughness=1.04mm; $T=20.4\pm10.2^{\circ}\text{C}$; $+0.00^{\circ}$
 $640\pm4.1\text{r/min}$, $V=2.2\text{m/s}$, $Re=43897$, $Ra/L^3=0.994\times10^9$, $h=20.9\text{W}/(\text{K}\cdot\text{m}^2)$, $U=1.94\text{W}/\text{K}$, $Nu=248.5$



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 43897$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.2K	+11.9%/K	0.10K	1.19%	LM35C differential
P	101kPa	+0.0008%/Pa	1.5kPa	1.26%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.028%/(J/K)	42J/K	1.19%	plate thermal capacity
η	0.400	+186%	0.004	0.74%	anemometer calibration
C_V	1.000	−2.22%	0.100	0.22%	vertical reuptake
L_T	8.34mm	+8963%/m	100um	0.90%	post length
ς	2.00mm	−2888%/m	100um	0.29%	post height
L_m	3.57mm	+561%/m	500um	0.28%	side metal strip width
ϵ_{rs}	0.040	+25.5%	0.010	0.25%	test-surface emissivity
ϵ_{wt}	0.900	+11.5%	0.025	0.29%	wind-tunnel emissivity
				2.50%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	640r/min	+0.117%/(r/min)	4.1r/min	0.47%	fan rotation rate
				2.67%	RSS combined uncertainty

20170907T230723Z – mixed Convection – Roughness=1.04mm; T=20.4+10.0°C; +0.00°
1500±3.3r/min, V=4.6m/s, Re=93318, Ra/L^3=0.972x10^9, h=39.8W/(K.m^2), U=3.70W/K, Nu=473.7



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 93318$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.0K	+11.3%/K	0.10K	1.13%	LM35C differential
P	100kPa	+0.0008%/Pa	1.5kPa	1.19%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.026%/(J/K)	42J/K	1.11%	plate thermal capacity
η	0.400	+126%	0.004	0.50%	anemometer calibration
u_u	7.755	+3.61%	0.100	0.36%	diffuser airflow upper bound
L_T	8.34mm	+9265%/m	100um	0.93%	post length
L_m	3.57mm	+502%/m	500um	0.25%	side metal strip width
				2.31%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	1.50kr/min	+0.056%/(r/min)	3.3r/min	0.18%	fan rotation rate
				2.34%	RSS combined uncertainty