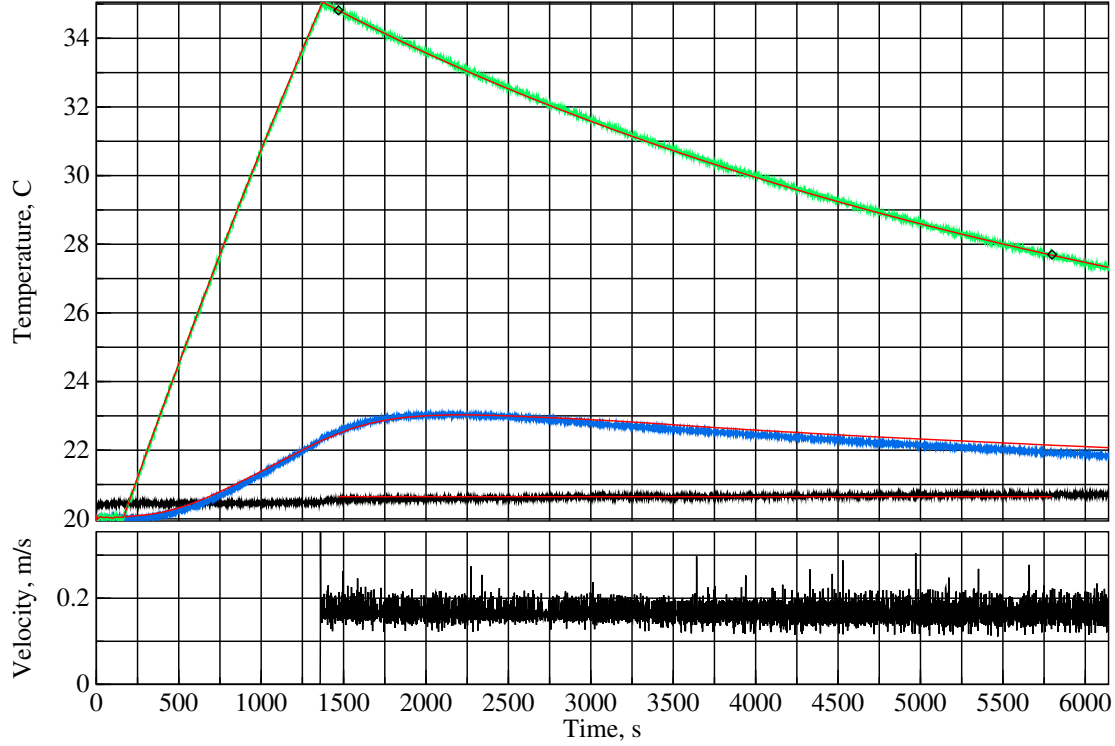


Estimated measurement uncertainties of natural convection at $\theta = 0.0$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	11.0K	+21.0%/K	0.10K	2.10%	LM35C differential
P	100kPa	+0.0007%/Pa	1.5kPa	1.03%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.046%/(J/K)	42J/K	1.96%	plate thermal capacity
C_V	1.000	−13.2%	0.100	1.32%	vertical reuptake
L_c	0.305m	+595%/m	500um	0.30%	characteristic length
D_{PIR}	25.4mm	−511%/m	1.0mm	0.51%	insulation thickness
D_g	1.00mm	−518%/m	500um	0.26%	air gap
L_m	3.57mm	+1093%/m	500um	0.55%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.494%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.55%	PIR thermal conductivity
ϵ_{XPS}	0.515	+35.8%	0.010	0.36%	XPS emissivity
ϵ_{tp}	0.890	+42.9%	0.015	0.64%	tape emissivity
Ω_{tp}	0.540	+29.2%	0.020	0.58%	tape coverage
ϵ_{rs}	0.040	+148%	0.010	1.48%	test-surface emissivity
ϵ_{wt}	0.900	+70.2%	0.025	1.76%	wind-tunnel emissivity
				4.28%	combined bias uncertainty

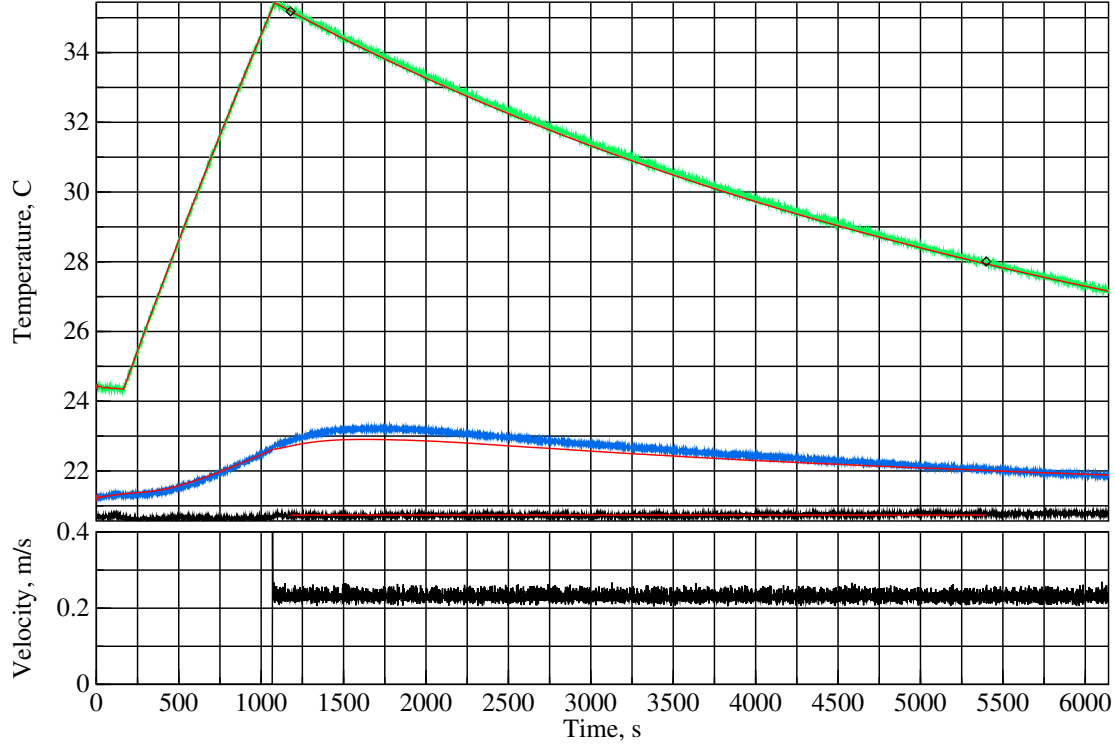
20180724T141352Z – mixed Convection – Roughness=1.04mm; T=20.6+10.1°C; +0.00°
42±5.4r/min, V=0.17m/s, Re=3404, Ra/L^3=1.003x10^9, h=3.81W/(K.m^2), U=0.355W/K, Nu=45.3



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 3404$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.1K	+22.3%/K	0.10K	2.23%	LM35C differential
P	102kPa	+0.0007%/Pa	1.5kPa	1.06%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.046%/(J/K)	42J/K	1.94%	plate thermal capacity
C_V	1.000	−12.5%	0.100	1.25%	vertical reuptake
L_c	0.305m	+549%/m	500um	0.27%	characteristic length
D_{PIR}	25.4mm	−495%/m	1.0mm	0.50%	insulation thickness
D_g	1.00mm	−503%/m	500um	0.25%	air gap
L_m	3.57mm	+1192%/m	500um	0.60%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.492%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.55%	PIR thermal conductivity
ϵ_{XPS}	0.515	+34.4%	0.010	0.34%	XPS emissivity
ϵ_{tp}	0.890	+41.3%	0.015	0.62%	tape emissivity
Ω_{tp}	0.540	+28.1%	0.020	0.56%	tape coverage
ϵ_{rs}	0.040	+143%	0.010	1.43%	test-surface emissivity
ϵ_{wt}	0.900	+67.5%	0.025	1.69%	wind-tunnel emissivity
				4.27%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	41.9r/min	+0.183%/(r/min)	5.4r/min	0.98%	fan rotation rate
				4.70%	RSS combined uncertainty

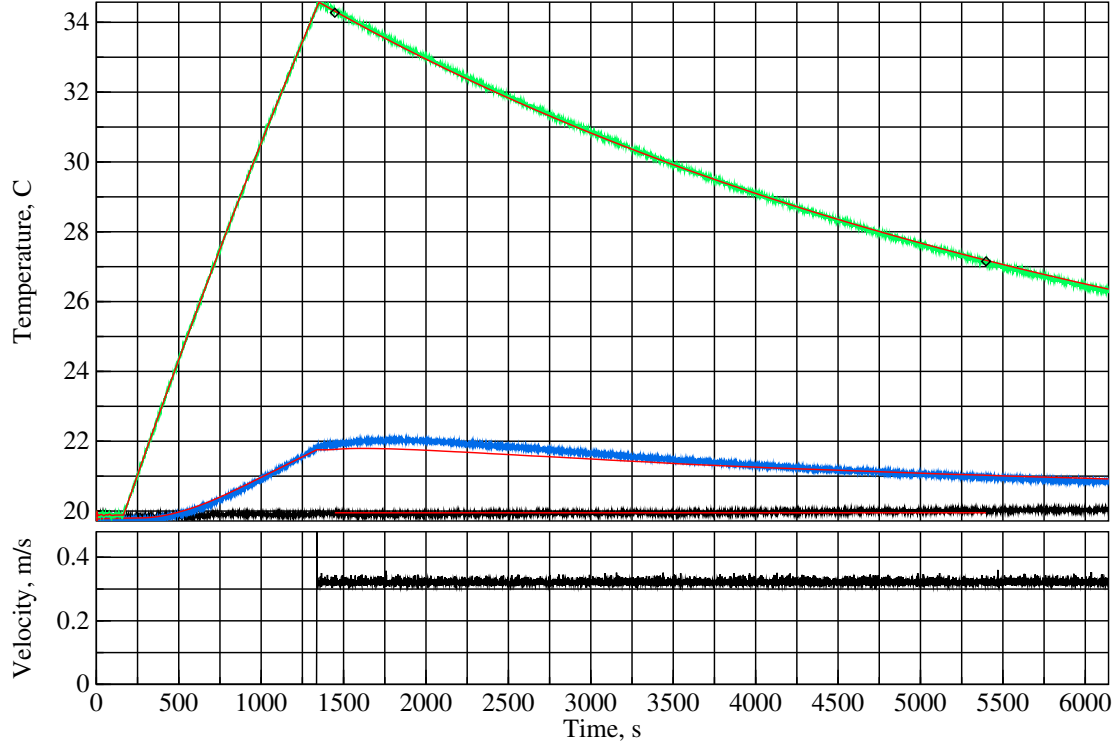
20180724T165900Z – mixed Convection – Roughness=1.04mm; T=20.7+10.4°C; +0.00°
58±2.7r/min, V=0.23m/s, Re=4691, Ra/L^3=1.025x10^9, h=3.94W/(K.m^2), U=0.367W/K, Nu=46.9



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 4691$.

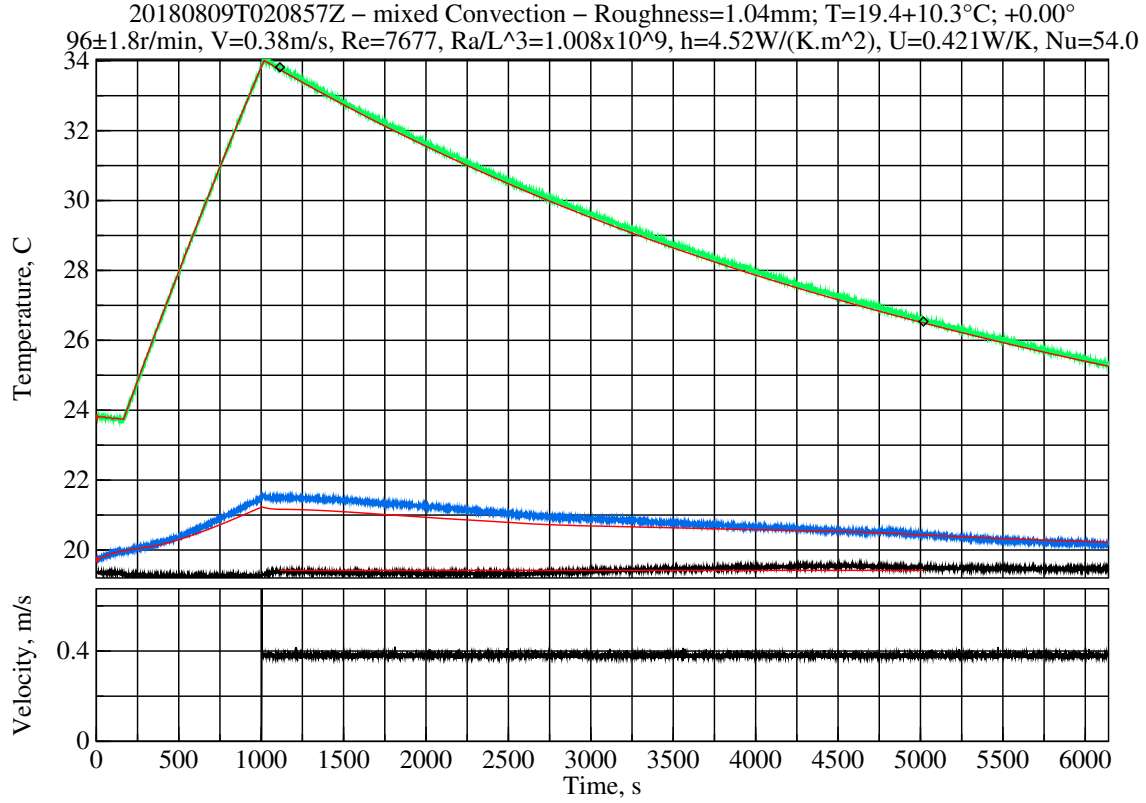
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.4K	+21.3%/K	0.10K	2.13%	LM35C differential
P	101kPa	+0.0007%/Pa	1.5kPa	1.12%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.045%/(J/K)	42J/K	1.91%	plate thermal capacity
C_V	1.000	−12.1%	0.100	1.21%	vertical reuptake
L_c	0.305m	+551%/m	500um	0.28%	characteristic length
D_{PIR}	25.4mm	−514%/m	1.0mm	0.51%	insulation thickness
D_g	1.00mm	−522%/m	500um	0.26%	air gap
L_m	3.57mm	+1191%/m	500um	0.60%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.511%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.57%	PIR thermal conductivity
ϵ_{XPS}	0.515	+33.3%	0.010	0.33%	XPS emissivity
ϵ_{tp}	0.890	+39.9%	0.015	0.60%	tape emissivity
Ω_{tp}	0.540	+27.1%	0.020	0.54%	tape coverage
ϵ_{rs}	0.040	+138%	0.010	1.38%	test-surface emissivity
ϵ_{wt}	0.900	+65.0%	0.025	1.63%	wind-tunnel emissivity
				4.18%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	57.9r/min	+0.295%/(r/min)	2.7r/min	0.80%	fan rotation rate
				4.47%	RSS combined uncertainty

20180724T013253Z – mixed Convection – Roughness=1.04mm; T=20.0+10.3°C; +0.00°
81±1.9r/min, V=0.32m/s, Re=6569, Ra/L^3=1.034x10^9, h=4.39W/(K.m^2), U=0.408W/K, Nu=52.3



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 6568$.

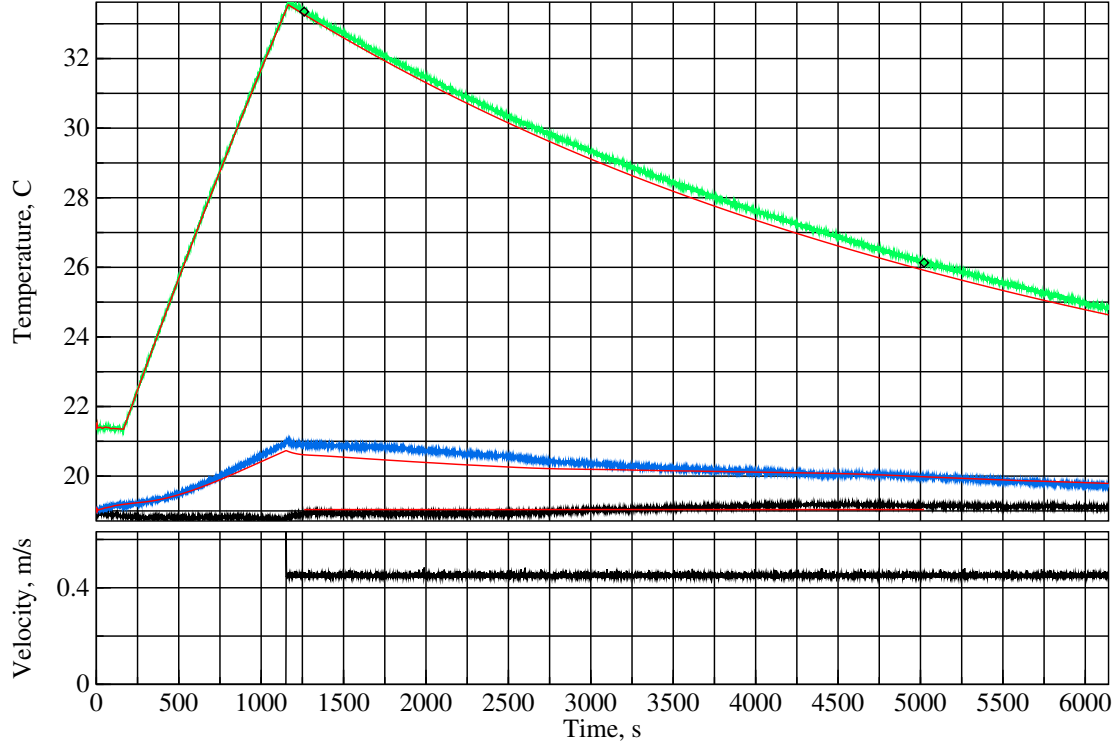
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	+20.1%/K	0.10K	2.01%	LM35C differential
P	102kPa	+0.0009%/Pa	1.5kPa	1.33%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.043%/(J/K)	42J/K	1.84%	plate thermal capacity
η	0.450	+97.5%	0.004	0.44%	anemometer calibration
C_V	1.000	-11.0%	0.100	1.10%	vertical reuptake
L_c	0.305m	+558%/m	500um	0.28%	characteristic length
L_T	8.34mm	+2508%/m	100um	0.25%	post length
ς	2.00mm	-5909%/m	100um	0.59%	post height
D_{PIR}	25.4mm	-501%/m	1.0mm	0.50%	insulation thickness
D_g	1.00mm	-508%/m	500um	0.25%	air gap
L_m	3.57mm	+1142%/m	500um	0.57%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.500%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.55%	PIR thermal conductivity
ϵ_{XPS}	0.515	+30.1%	0.010	0.30%	XPS emissivity
ϵ_{tp}	0.890	+36.1%	0.015	0.54%	tape emissivity
Ω_{tp}	0.540	+24.5%	0.020	0.49%	tape coverage
ϵ_{rs}	0.040	+125%	0.010	1.25%	test-surface emissivity
ϵ_{wt}	0.900	+58.7%	0.025	1.47%	wind-tunnel emissivity
				4.06%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	80.7r/min	+0.544%/(r/min)	1.9r/min	1.05%	fan rotation rate
				4.57%	RSS combined uncertainty



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 7677$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	+19.2%/K	0.10K	1.92%	LM35C differential
P	100kPa	+0.0010%/Pa	1.5kPa	1.48%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.042%/(J/K)	42J/K	1.78%	plate thermal capacity
η	0.450	+137%	0.004	0.62%	anemometer calibration
C_V	1.000	−10.2%	0.100	1.02%	vertical reuptake
L_c	0.305m	+547%/m	500um	0.27%	characteristic length
L_T	8.34mm	+3889%/m	100um	0.39%	post length
ς	2.00mm	−9903%/m	100um	0.99%	post height
D_{PIR}	25.4mm	−478%/m	1.0mm	0.48%	insulation thickness
D_g	1.00mm	−485%/m	500um	0.24%	air gap
L_m	3.57mm	+1096%/m	500um	0.55%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.478%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.53%	PIR thermal conductivity
ϵ_{XPS}	0.515	+27.8%	0.010	0.28%	XPS emissivity
ϵ_{tp}	0.890	+33.3%	0.015	0.50%	tape emissivity
Ω_{tp}	0.540	+22.6%	0.020	0.45%	tape coverage
ϵ_{rs}	0.040	+116%	0.010	1.16%	test-surface emissivity
ϵ_{wt}	0.900	+54.1%	0.025	1.35%	wind-tunnel emissivity
				4.04%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	95.5r/min	+0.645%/(r/min)	1.8r/min	1.15%	fan rotation rate
				4.65%	RSS combined uncertainty

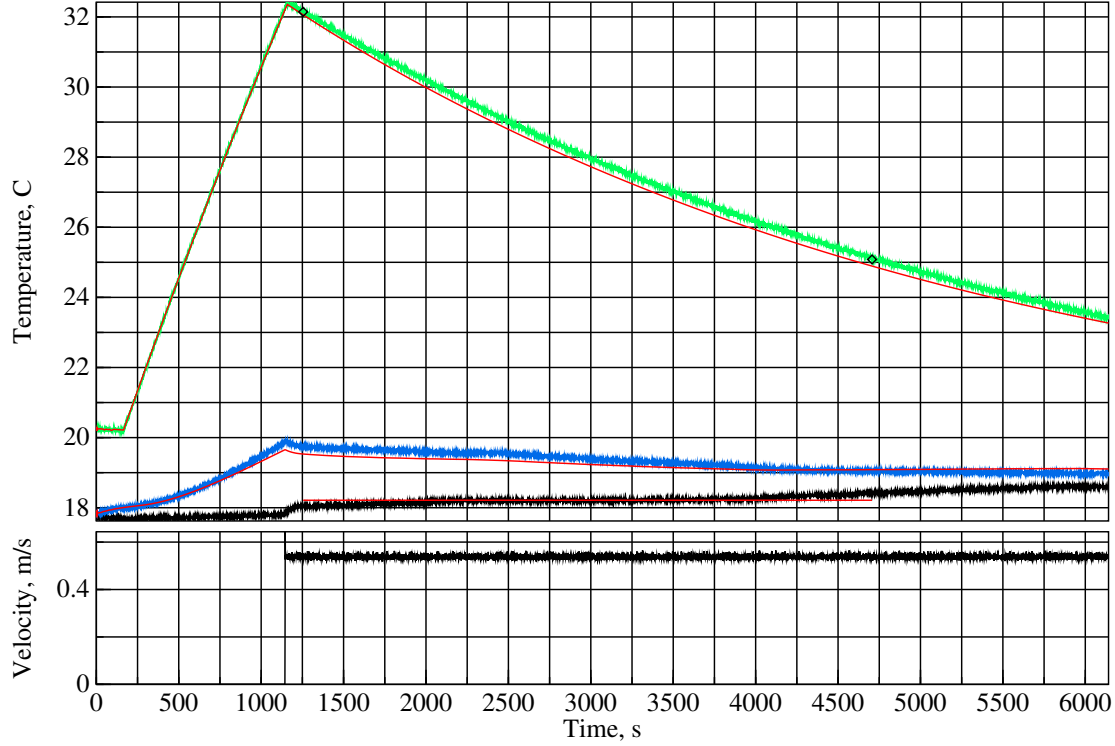
20180809T000900Z – mixed Convection – Roughness=1.04mm; T=19.0+10.3°C; +0.00°
113±1.7r/min, V=0.45m/s, Re=9124, Ra/L^3=1.010x10^9, h=4.93W/(K.m^2), U=0.458W/K, Nu=58.8



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 9127$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	+18.0%/K	0.10K	1.80%	LM35C differential
P	100kPa	+0.0010%/Pa	1.5kPa	1.57%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.040%/(J/K)	42J/K	1.69%	plate thermal capacity
η	0.450	+173%	0.004	0.78%	anemometer calibration
C_V	1.000	−9.05%	0.100	0.90%	vertical reuptake
L_c	0.305m	+511%/m	500um	0.26%	characteristic length
L_T	8.34mm	+5458%/m	100um	0.55%	post length
ς	2.00mm	−12861%/m	100um	1.29%	post height
D_{PIR}	25.4mm	−436%/m	1.0mm	0.44%	insulation thickness
D_g	1.00mm	−442%/m	500um	0.22%	air gap
L_m	3.57mm	+1017%/m	500um	0.51%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.437%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.49%	PIR thermal conductivity
ϵ_{XPS}	0.515	+24.5%	0.010	0.25%	XPS emissivity
ϵ_{tp}	0.890	+29.4%	0.015	0.44%	tape emissivity
Ω_{tp}	0.540	+20.0%	0.020	0.40%	tape coverage
ϵ_{rs}	0.040	+102%	0.010	1.02%	test-surface emissivity
ϵ_{wt}	0.900	+47.8%	0.025	1.19%	wind-tunnel emissivity
				3.96%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	113r/min	+0.686%/(r/min)	1.7r/min	1.15%	fan rotation rate
				4.59%	RSS combined uncertainty

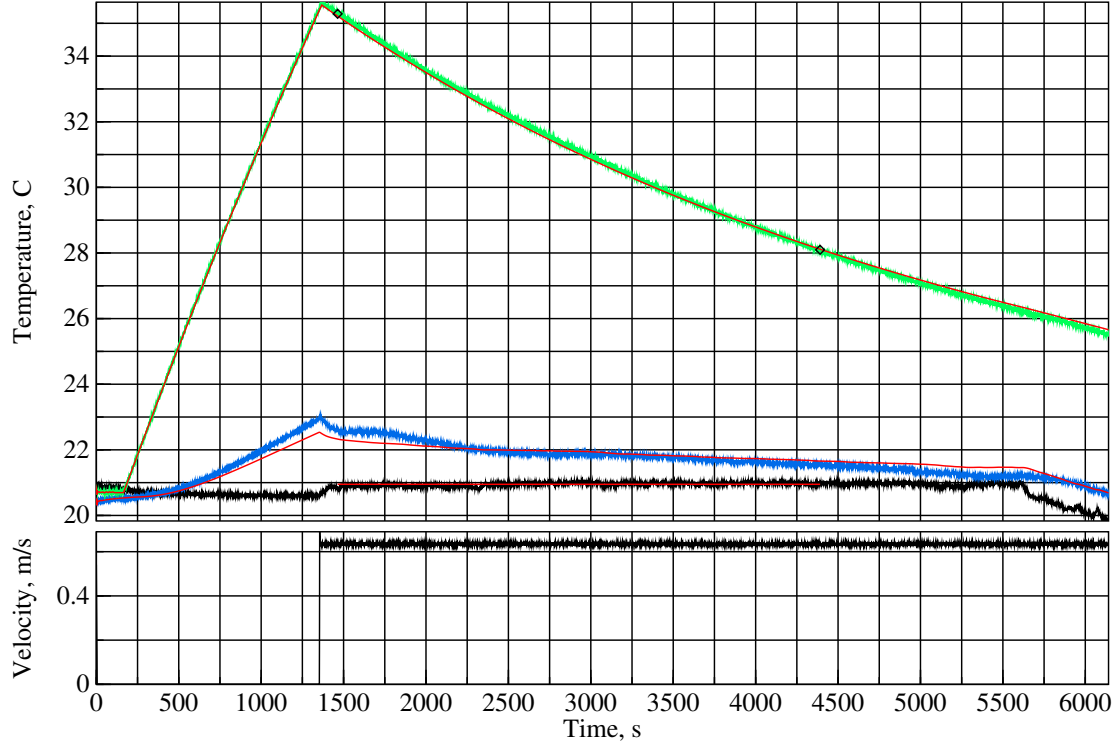
20180808T214326Z – mixed Convection – Roughness=1.04mm; T=18.2+10.0°C; +0.00°
135±2.0r/min, V=0.54m/s, Re=10923, Ra/L^3=0.997x10^9, h=5.76W/(K.m^2), U=0.535W/K, Nu=68.9



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 10922$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.0K	+17.1%/K	0.10K	1.71%	LM35C differential
P	100kPa	+0.0011%/Pa	1.5kPa	1.61%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.038%/(J/K)	42J/K	1.60%	plate thermal capacity
η	0.450	+196%	0.004	0.88%	anemometer calibration
C_V	1.000	-7.79%	0.100	0.78%	vertical reuptake
L_c	0.305m	+451%/m	500um	0.23%	characteristic length
L_T	8.34mm	+6833%/m	100um	0.68%	post length
ς	2.00mm	-13761%/m	100um	1.38%	post height
D_{PIR}	25.4mm	-387%/m	1.0mm	0.39%	insulation thickness
L_m	3.57mm	+927%/m	500um	0.46%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.389%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.43%	PIR thermal conductivity
ϵ_{XPS}	0.515	+20.9%	0.010	0.21%	XPS emissivity
ϵ_{tp}	0.890	+25.1%	0.015	0.38%	tape emissivity
Ω_{tp}	0.540	+17.1%	0.020	0.34%	tape coverage
ϵ_{rs}	0.040	+87.6%	0.010	0.88%	test-surface emissivity
ϵ_{wt}	0.900	+40.8%	0.025	1.02%	wind-tunnel emissivity
				3.82%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	135r/min	+0.654%/(r/min)	2.0r/min	1.32%	fan rotation rate
				4.65%	RSS combined uncertainty

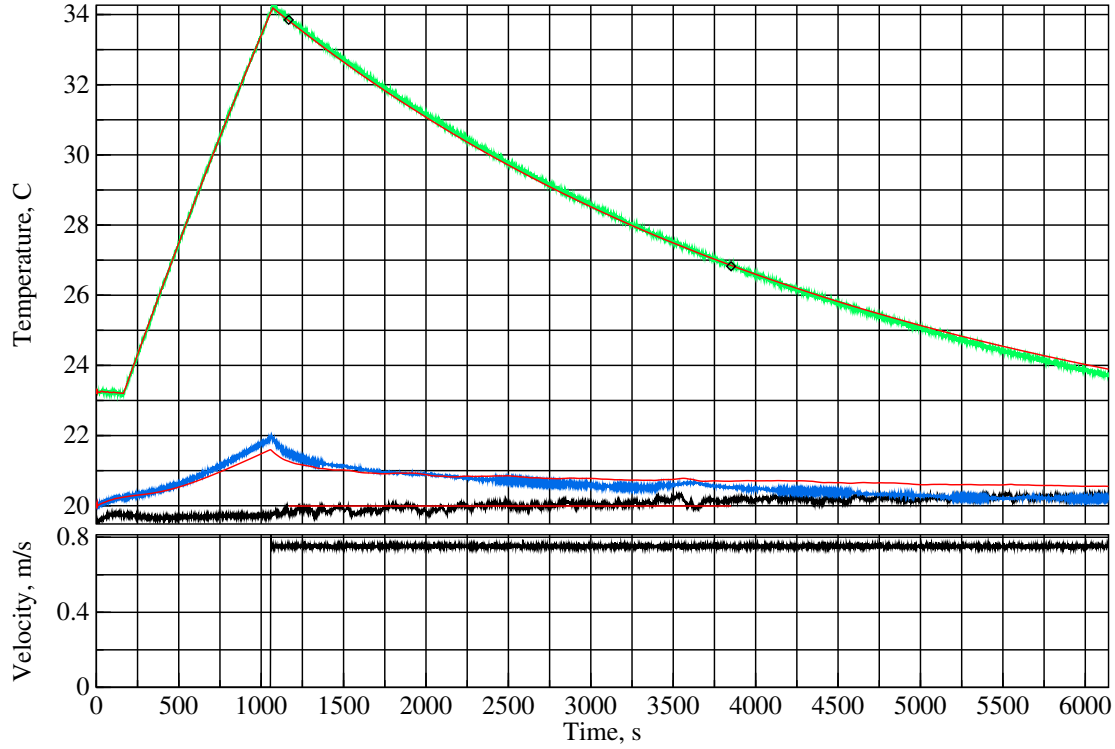
20180802T145744Z – mixed Convection – Roughness=1.04mm; T=20.9+10.3°C; +0.00°
160±1.0r/min, V=0.63m/s, Re=12802, Ra/L^3=1.005x10^9, h=7.31W/(K.m^2), U=0.680W/K, Nu=86.9



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 12804$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	+15.6%/K	0.10K	1.56%	LM35C differential
P	101kPa	+0.0010%/Pa	1.5kPa	1.57%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.036%/(J/K)	42J/K	1.53%	plate thermal capacity
η	0.450	+205%	0.004	0.92%	anemometer calibration
C_V	1.000	−6.76%	0.100	0.68%	vertical reuptake
L_T	8.34mm	+7681%/m	100um	0.77%	post length
ς	2.00mm	−13092%/m	100um	1.31%	post height
D_{PIR}	25.4mm	−340%/m	1.0mm	0.34%	insulation thickness
L_m	3.57mm	+861%/m	500um	0.43%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.343%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.38%	PIR thermal conductivity
ϵ_{tp}	0.890	+22.3%	0.015	0.33%	tape emissivity
Ω_{tp}	0.540	+15.2%	0.020	0.30%	tape coverage
ϵ_{rs}	0.040	+77.7%	0.010	0.78%	test-surface emissivity
ϵ_{wt}	0.900	+36.2%	0.025	0.90%	wind-tunnel emissivity
				3.61%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	160r/min	+0.576%/(r/min)	0.96r/min	0.55%	fan rotation rate
				3.78%	RSS combined uncertainty

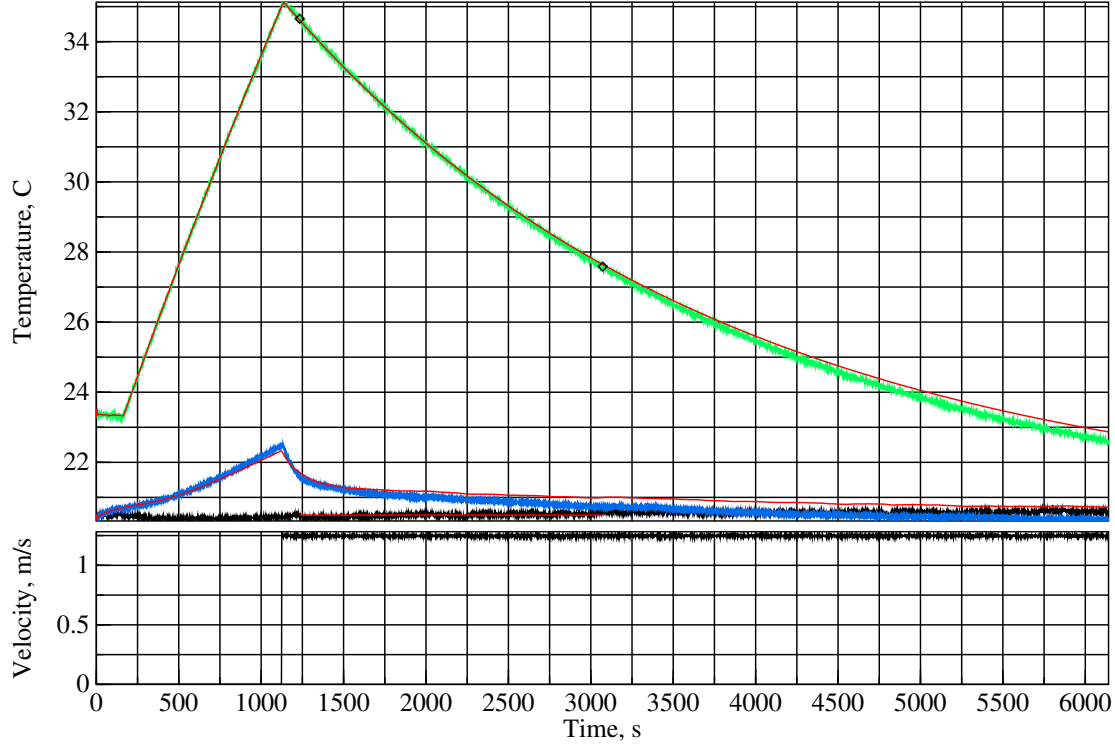
20180802T194026Z – mixed Convection – Roughness=1.04mm; T=20.0+10.0°C; +0.00°
190±1.4r/min, V=0.75m/s, Re=15242, Ra/L^3=0.982x10^9, h=8.42W/(K.m^2), U=0.783W/K, Nu=100.3



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 15243$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	9.97K	+15.2%/K	0.10K	1.52%	LM35C differential
P	101kPa	+0.0010%/Pa	1.5kPa	1.53%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.034%/(J/K)	42J/K	1.45%	plate thermal capacity
η	0.450	+206%	0.004	0.93%	anemometer calibration
C_V	1.000	-5.73%	0.100	0.57%	vertical reuptake
L_T	8.34mm	+8311%/m	100um	0.83%	post length
ς	2.00mm	-11586%/m	100um	1.16%	post height
D_{PIR}	25.4mm	-296%/m	1.0mm	0.30%	insulation thickness
L_m	3.57mm	+786%/m	500um	0.39%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.300%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.33%	PIR thermal conductivity
ϵ_{tp}	0.890	+18.8%	0.015	0.28%	tape emissivity
Ω_{tp}	0.540	+12.8%	0.020	0.26%	tape coverage
ϵ_{rs}	0.040	+65.5%	0.010	0.66%	test-surface emissivity
ϵ_{wt}	0.900	+30.5%	0.025	0.76%	wind-tunnel emissivity
				3.40%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	190r/min	+0.489%/(r/min)	1.4r/min	0.70%	fan rotation rate
				3.68%	RSS combined uncertainty

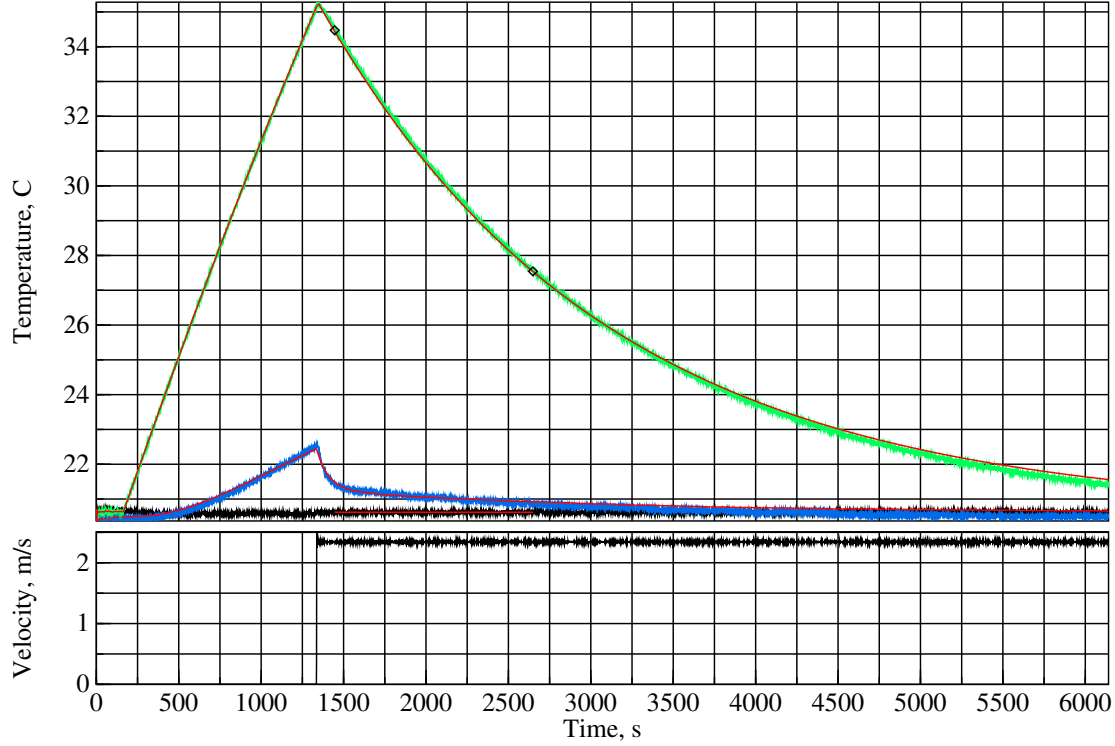
20180803T231608Z – mixed Convection – Roughness=1.04mm; T=20.5+10.2°C; +0.00°
320±1.1r/min, V=1.2m/s, Re=25298, Ra/L^3=1.003x10^9, h=13.3W/(K.m^2), U=1.24W/K, Nu=158.7



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 25299$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.2K	+12.9%/K	0.10K	1.29%	LM35C differential
P	101kPa	+0.0009%/Pa	1.5kPa	1.37%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.030%/(J/K)	42J/K	1.29%	plate thermal capacity
η	0.450	+190%	0.004	0.85%	anemometer calibration
C_V	1.000	-3.63%	0.100	0.36%	vertical reuptake
L_T	8.34mm	+9063%/m	100um	0.91%	post length
ς	2.00mm	-6677%/m	100um	0.67%	post height
L_m	3.57mm	+639%/m	500um	0.32%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.201%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.22%	PIR thermal conductivity
ϵ_{rs}	0.040	+41.6%	0.010	0.42%	test-surface emissivity
ϵ_{wt}	0.900	+19.2%	0.025	0.48%	wind-tunnel emissivity
				2.84%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	320r/min	+0.267%/(r/min)	1.1r/min	0.29%	fan rotation rate
				2.90%	RSS combined uncertainty

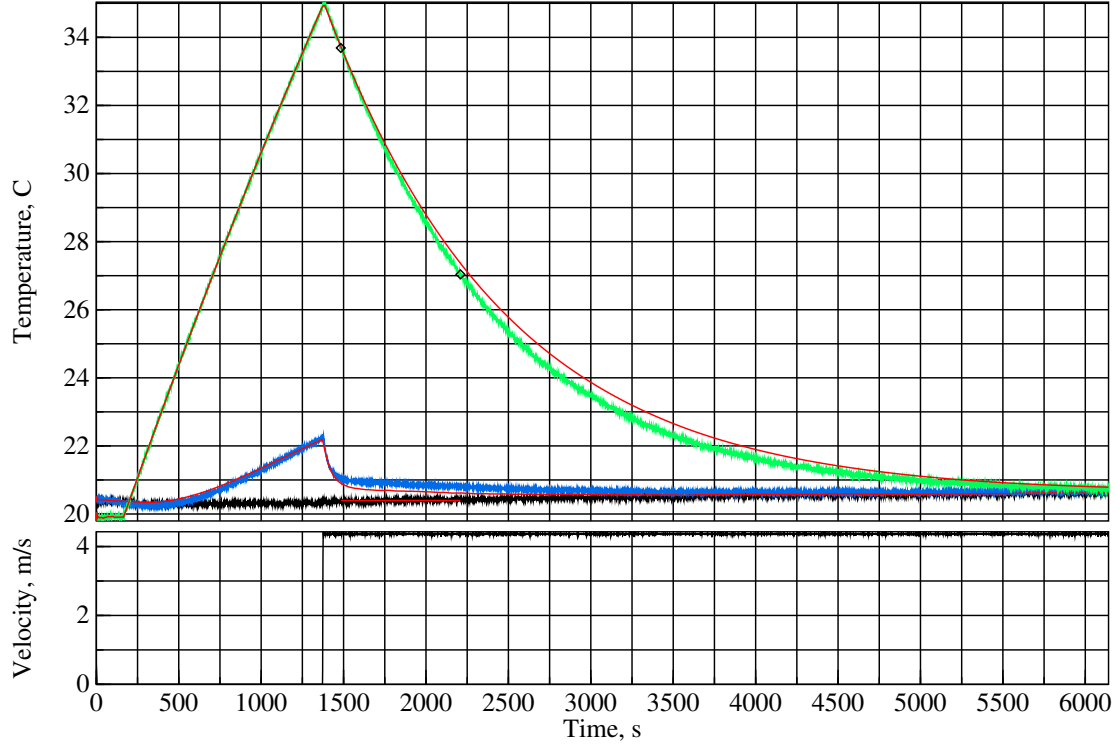
20180722T222208Z – mixed Convection – Roughness=1.04mm; T=20.6+10.0°C; +0.00°
640±4.1r/min, V=2.3m/s, Re=47451, Ra/L^3=0.985x10^9, h=22.5W/(K.m^2), U=2.10W/K, Nu=267.9



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 47451$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.0K	+11.9%/K	0.10K	1.19%	LM35C differential
P	101kPa	+0.0008%/Pa	1.5kPa	1.25%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.028%/(J/K)	42J/K	1.18%	plate thermal capacity
η	0.450	+155%	0.004	0.70%	anemometer calibration
u_u	5.879	+2.24%	0.100	0.22%	diffuser airflow upper bound
C_V	1.000	-2.12%	0.100	0.21%	vertical reuptake
L_T	8.34mm	+9311%/m	100um	0.93%	post length
ς	2.00mm	-2606%/m	100um	0.26%	post height
L_m	3.57mm	+550%/m	500um	0.28%	side metal strip width
ϵ_{rs}	0.040	+24.4%	0.010	0.24%	test-surface emissivity
ϵ_{wt}	0.900	+11.1%	0.025	0.28%	wind-tunnel emissivity
				2.49%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	640r/min	+0.109%/(r/min)	4.1r/min	0.45%	fan rotation rate
				2.65%	RSS combined uncertainty

20180722T202305Z – mixed Convection – Roughness=1.04mm; T=20.4+09.6°C; +0.00°
1500±5.0r/min, V=4.4m/s, Re=88386, Ra/L^3=0.949x10^9, h=39.2W/(K.m^2), U=3.65W/K, Nu=466.7



Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 88388$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	9.64K	+11.7%/K	0.10K	1.17%	LM35C differential
P	101kPa	+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	0.450	+79.5%	0.004	0.36%	anemometer calibration
u_u	5.879	+7.46%	0.100	0.75%	diffuser airflow upper bound
L_T	8.34mm	+9392%/m	100um	0.94%	post length
L_m	3.57mm	+512%/m	500um	0.26%	side metal strip width
				2.40%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	1.50kr/min	+0.040%/(r/min)	5.0r/min	0.20%	fan rotation rate
				2.44%	RSS combined uncertainty