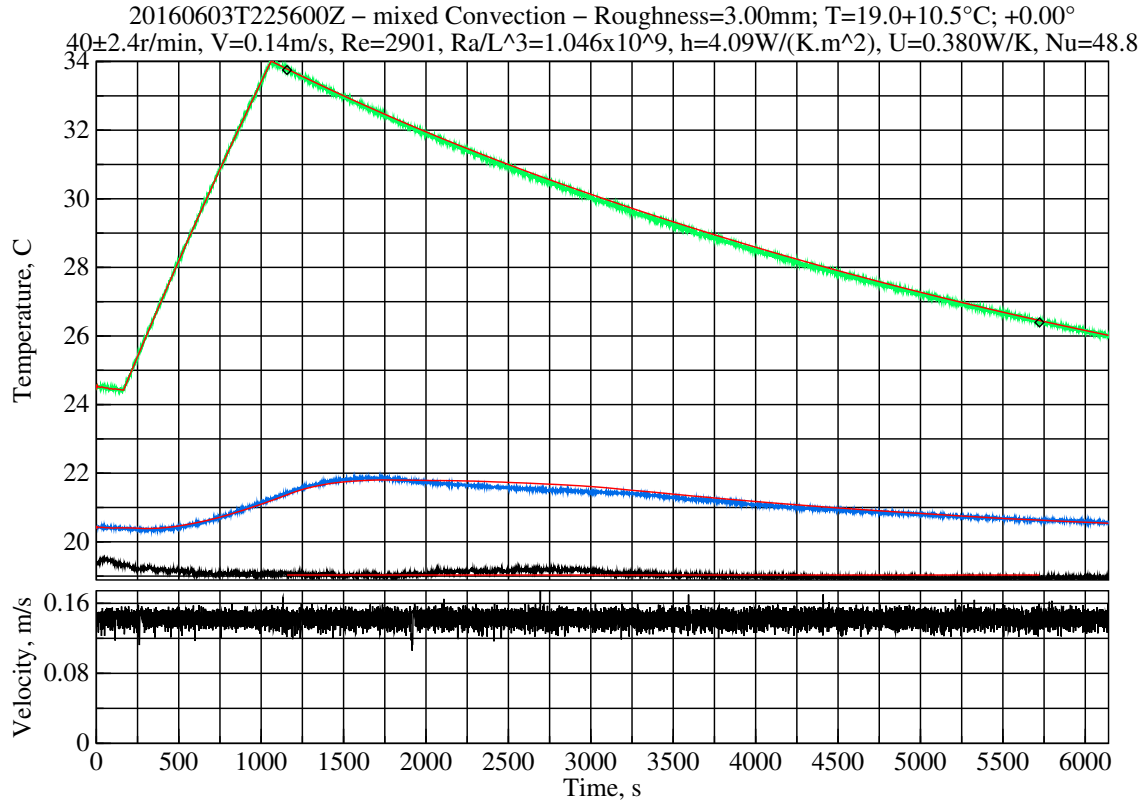


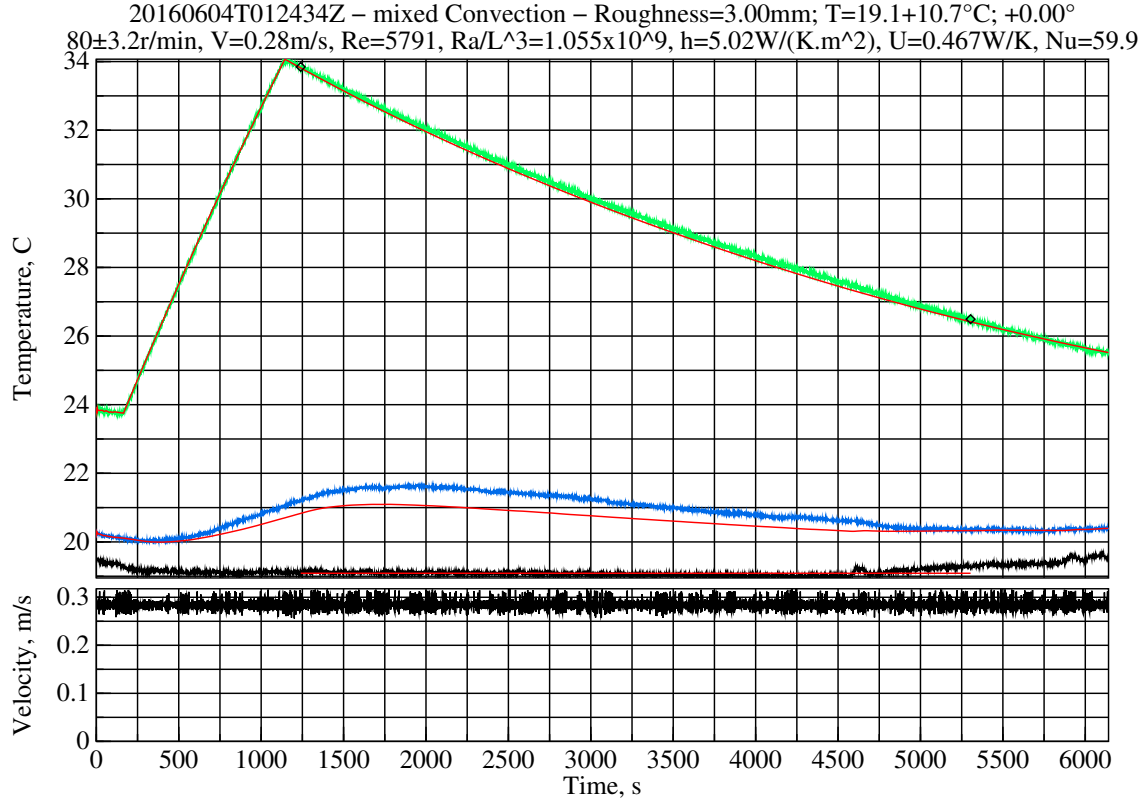
Estimated measurement uncertainties of natural convection at $\theta = 0.0$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	11.0K	+21.3%/K	0.10K	2.13%	LM35C differential
P	101kPa	+0.0007%/Pa	1.5kPa	1.04%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.042%/(J/K)	47J/K	1.98%	plate thermal capacity
C_V	1.000	−14.2%	0.100	1.42%	vertical reuptake
L_c	0.305m	+601%/m	500um	0.30%	characteristic length
D_{PIR}	25.4mm	−510%/m	1.0mm	0.51%	insulation thickness
D_g	1.00mm	−518%/m	500um	0.26%	air gap
L_m	3.57mm	+1103%/m	500um	0.55%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.493%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.55%	PIR thermal conductivity
ϵ_{XPS}	0.515	+35.4%	0.010	0.35%	XPS emissivity
ϵ_{tp}	0.890	+42.5%	0.015	0.64%	tape emissivity
Ω_{tp}	0.540	+28.8%	0.020	0.58%	tape coverage
ϵ_{rs}	0.040	+148%	0.010	1.48%	test-surface emissivity
ϵ_{wt}	0.900	+69.6%	0.025	1.74%	wind-tunnel emissivity
				4.33%	combined bias uncertainty



Estimated measurement uncertainties, bi-level 3mm roughness at $Re = 2901$.

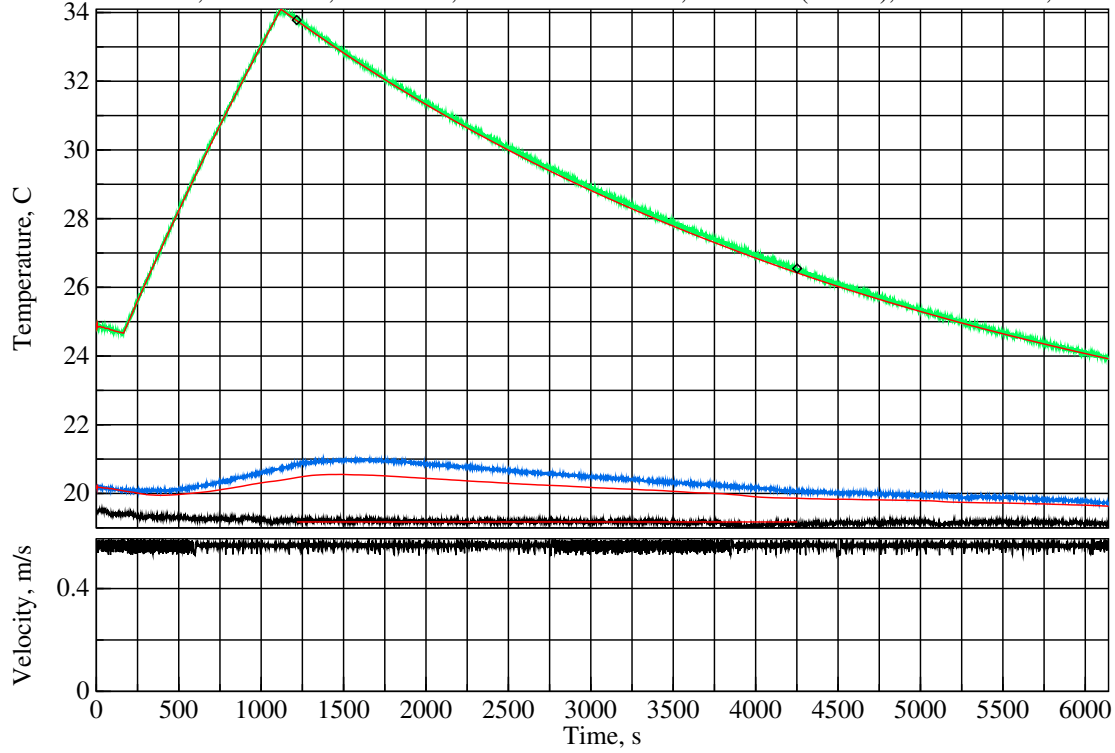
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.5K	+20.6%/K	0.10K	2.06%	LM35C differential
P	101kPa	+0.0008%/Pa	1.5kPa	1.16%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.040%/(J/K)	47J/K	1.89%	plate thermal capacity
η	0.401	+54.5%	0.014	0.76%	anemometer calibration
C_V	1.000	−12.7%	0.100	1.27%	vertical reuptake
L_c	0.305m	+545%/m	500um	0.27%	characteristic length
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	+1024%/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	+31.8%	0.010	0.32%	XPS emissivity
ϵ_{tp}	0.890	+38.2%	0.015	0.57%	tape emissivity
Ω_{tp}	0.540	+25.9%	0.020	0.52%	tape coverage
ϵ_{rs}	0.040	+134%	0.010	1.34%	test-surface emissivity
ϵ_{wt}	0.900	+62.7%	0.025	1.57%	wind-tunnel emissivity
				4.15%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	40.1r/min	+0.545%/(r/min)	2.4r/min	1.28%	fan rotation rate
				4.88%	RSS combined uncertainty



Estimated measurement uncertainties, bi-level 3mm roughness at $Re = 5791$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.7K	+17.9%/K	0.10K	1.79%	LM35C differential
P	101kPa	+0.0009%/Pa	1.5kPa	1.30%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.037%/(J/K)	47J/K	1.72%	plate thermal capacity
η	0.401	+126%	0.014	1.77%	anemometer calibration
C_V	1.000	−10.1%	0.100	1.01%	vertical reuptake
L_c	0.305m	+450%/m	500um	0.22%	characteristic length
ς	6.00mm	+3526%/m	100um	0.35%	post height
D_{PIR}	25.4mm	−417%/m	1.0mm	0.42%	insulation thickness
D_g	1.00mm	−422%/m	500um	0.21%	air gap
L_m	3.57mm	+851%/m	500um	0.43%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.408%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.45%	PIR thermal conductivity
ϵ_{XPS}	0.515	+25.2%	0.010	0.25%	XPS emissivity
ϵ_{tp}	0.890	+30.3%	0.015	0.45%	tape emissivity
Ω_{tp}	0.540	+20.6%	0.020	0.41%	tape coverage
ϵ_{rs}	0.040	+106%	0.010	1.06%	test-surface emissivity
ϵ_{wt}	0.900	+49.3%	0.025	1.23%	wind-tunnel emissivity
				3.99%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	80.1r/min	+0.633%/(r/min)	3.2r/min	2.00%	fan rotation rate
				5.66%	RSS combined uncertainty

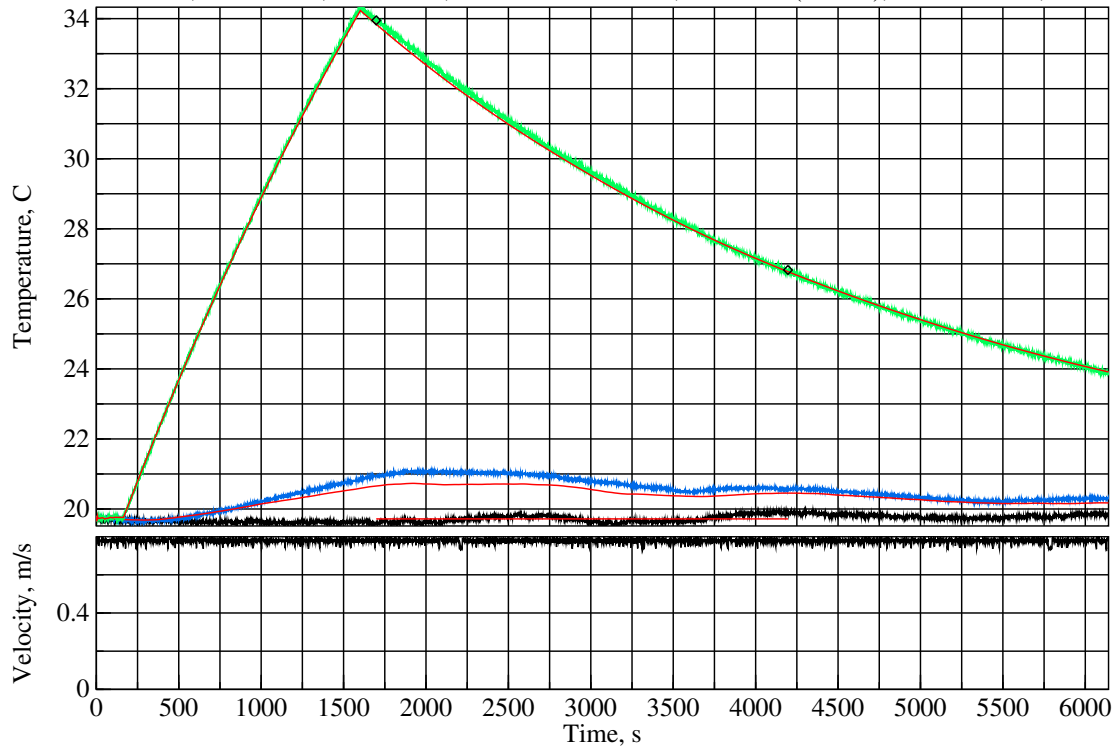
20160604T031539Z – mixed Convection – Roughness=3.00mm; T=19.2+10.6°C; +0.00°
160±3.3r/min, V=0.57m/s, Re=11542, Ra/L^3=1.044x10^9, h=7.83W/(K.m^2), U=0.728W/K, Nu=93.4



Estimated measurement uncertainties, bi-level 3mm roughness at $Re = 11542$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.6K	+14.8%/K	0.10K	1.48%	LM35C differential
P	101kPa	+0.0010%/Pa	1.5kPa	1.44%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.031%/(J/K)	47J/K	1.46%	plate thermal capacity
η	0.401	+199%	0.014	2.80%	anemometer calibration
C_V	1.000	−6.44%	0.100	0.64%	vertical reuptake
ς	6.00mm	+5689%/m	100um	0.57%	post height
D_{PIR}	25.4mm	−296%/m	1.0mm	0.30%	insulation thickness
L_m	3.57mm	+602%/m	500um	0.30%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.292%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.32%	PIR thermal conductivity
ϵ_{tp}	0.890	+19.3%	0.015	0.29%	tape emissivity
Ω_{tp}	0.540	+13.1%	0.020	0.26%	tape coverage
ϵ_{rs}	0.040	+67.6%	0.010	0.68%	test-surface emissivity
ϵ_{wt}	0.900	+31.3%	0.025	0.78%	wind-tunnel emissivity
				4.08%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	160r/min	+0.500%/(r/min)	3.3r/min	1.64%	fan rotation rate
				5.23%	RSS combined uncertainty

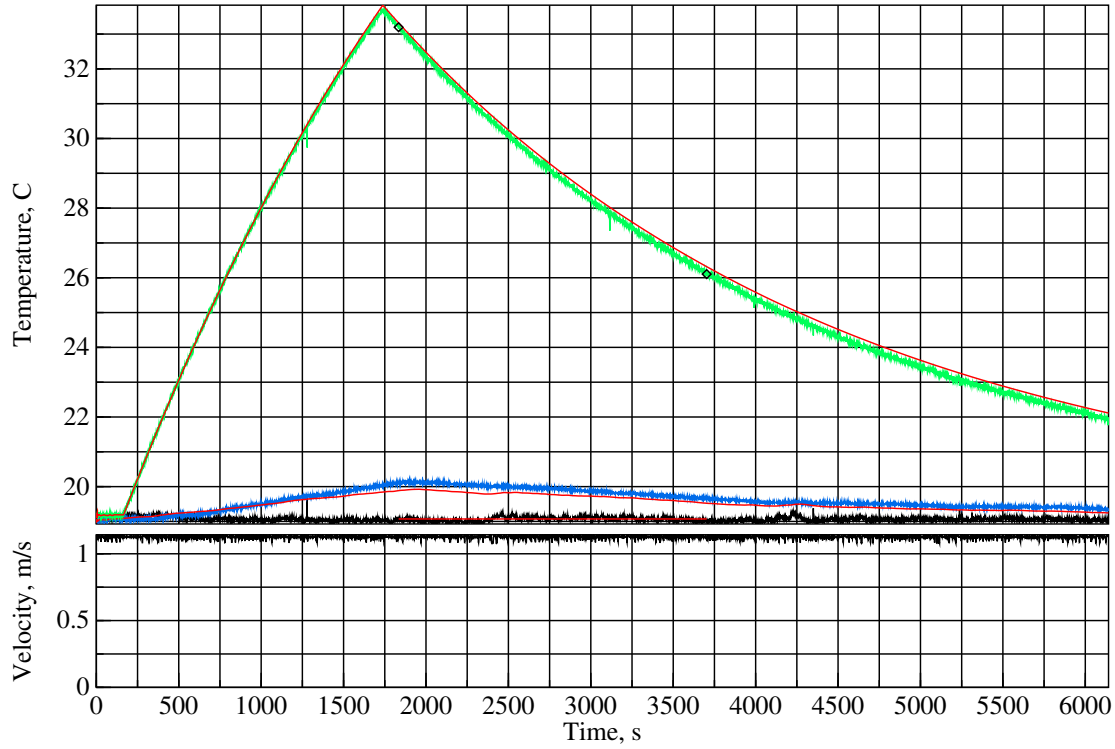
20160604T220844Z – mixed Convection – Roughness=3.00mm; T=19.7+10.2°C; +0.00°
220±2.7r/min, V=0.78m/s, Re=15742, Ra/L^3=1.002x10^9, h=10.6W/(K.m^2), U=0.985W/K, Nu=126.2



Estimated measurement uncertainties, bi-level 3mm roughness at $Re = 15742$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.2K	+14.0%/K	0.10K	1.40%	LM35C differential
P	100kPa	+0.0010%/Pa	1.5kPa	1.48%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.029%/(J/K)	47J/K	1.36%	plate thermal capacity
η	0.401	+219%	0.014	3.08%	anemometer calibration
C_V	1.000	-4.93%	0.100	0.49%	vertical reuptake
ς	6.00mm	+6301%/m	100um	0.63%	post height
D_{PIR}	25.4mm	-237%/m	1.0mm	0.24%	insulation thickness
L_m	3.57mm	+505%/m	500um	0.25%	side metal strip width
k_{PIR}	22.2 $\frac{mW}{K \cdot m}$	+0.234%/ $\frac{mW}{K \cdot m}$	1.1 $\frac{mW}{K \cdot m}$	0.26%	PIR thermal conductivity
ϵ_{tp}	0.890	+14.9%	0.015	0.22%	tape emissivity
Ω_{tp}	0.540	+10.1%	0.020	0.20%	tape coverage
ϵ_{rs}	0.040	+52.3%	0.010	0.52%	test-surface emissivity
ϵ_{wt}	0.900	+24.2%	0.025	0.61%	wind-tunnel emissivity
				4.14%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	220r/min	+0.400%/(r/min)	2.7r/min	1.08%	fan rotation rate
				4.67%	RSS combined uncertainty

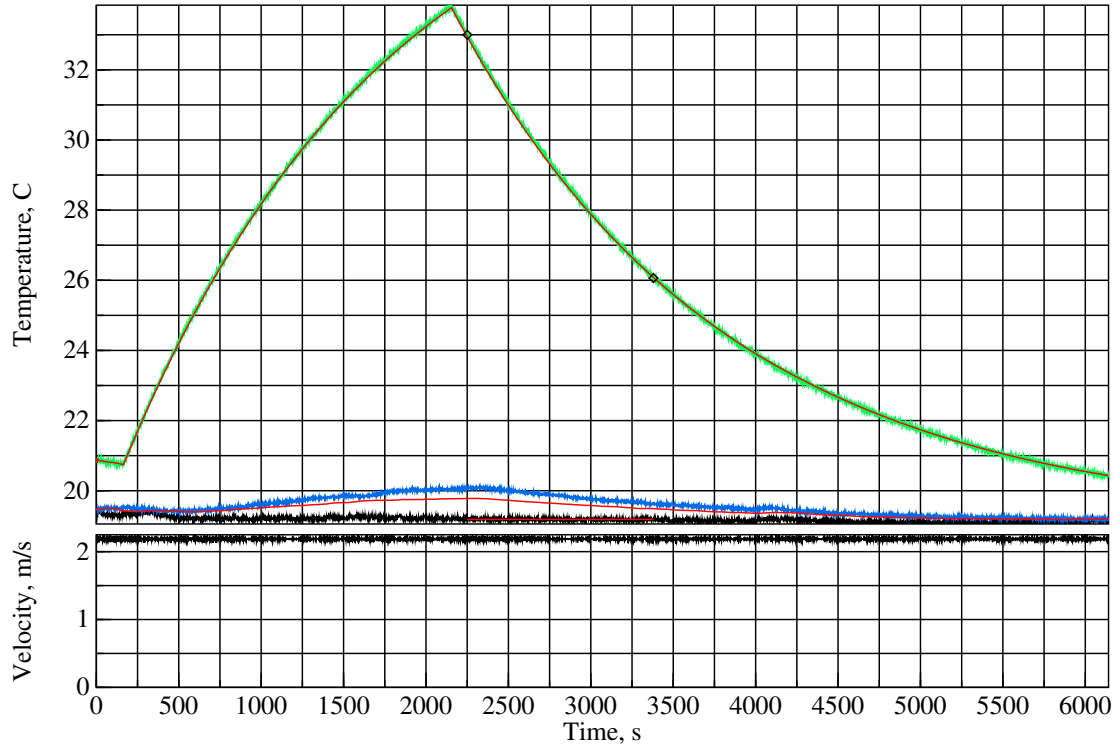
20160604T124012Z – mixed Convection – Roughness=3.00mm; T=19.1+10.2°C; +0.00°
320±2.8r/min, V=1.1m/s, Re=22925, Ra/L^3=1.012x10^9, h=15.0W/(K.m^2), U=1.39W/K, Nu=178.9



Estimated measurement uncertainties, bi-level 3mm roughness at $Re = 22926$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.2K	+12.8%/K	0.10K	1.28%	LM35C differential
P	101kPa	+0.0010%/Pa	1.5kPa	1.49%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.027%/(J/K)	47J/K	1.26%	plate thermal capacity
η	0.401	+230%	0.014	3.23%	anemometer calibration
C_V	1.000	-3.51%	0.100	0.35%	vertical reuptake
ς	6.00mm	+6788%/m	100um	0.68%	post height
L_m	3.57mm	+414%/m	500um	0.21%	side metal strip width
ϵ_{rs}	0.040	+36.9%	0.010	0.37%	test-surface emissivity
ϵ_{wt}	0.900	+17.1%	0.025	0.43%	wind-tunnel emissivity
				4.12%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	320r/min	+0.288%/(r/min)	2.8r/min	0.80%	fan rotation rate
				4.42%	RSS combined uncertainty

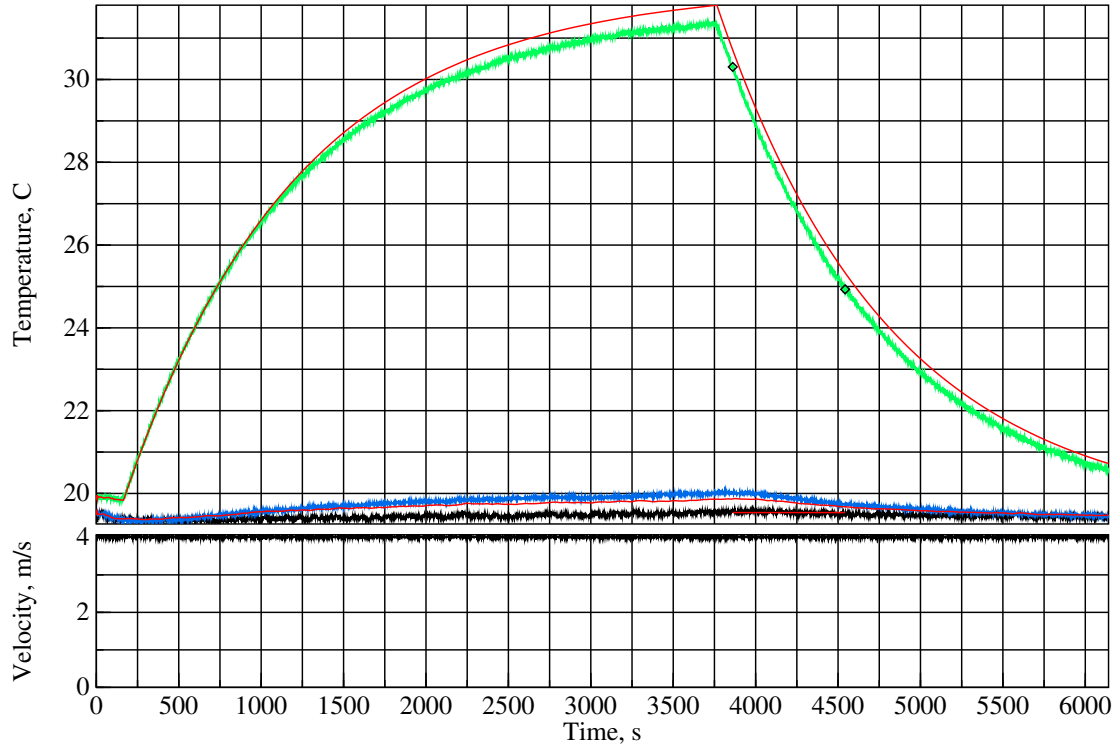
20160604T170841Z – mixed Convection – Roughness=3.00mm; T=19.2+10.0°C; +0.00°
640±4.6r/min, V=2.2m/s, Re=44390, Ra/L^3=0.988x10^9, h=27.2W/(K.m^2), U=2.53W/K, Nu=325.1



Estimated measurement uncertainties, bi-level 3mm roughness at $Re = 44388$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	9.98K	+11.7%/K	0.10K	1.17%	LM35C differential
P	101kPa	+0.0009%/Pa	1.5kPa	1.40%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.024%/(J/K)	47J/K	1.14%	plate thermal capacity
η	0.401	+210%	0.014	2.95%	anemometer calibration
ς	6.00mm	+8980%/m	100um	0.90%	post height
ϵ_{wt}	0.900	+9.12%	0.025	0.23%	wind-tunnel emissivity
				3.79%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	640r/min	+0.132%/(r/min)	4.6r/min	0.61%	fan rotation rate
				3.98%	RSS combined uncertainty

20160604T191826Z – mixed Convection – Roughness=3.00mm; T=19.5+07.8°C; +0.00°
1280±5.0r/min, V=4.0m/s, Re=81245, Ra/L^3=0.777x10^9, h=47.9W/(K.m^2), U=4.45W/K, Nu=570.7



Estimated measurement uncertainties, bi-level 3mm roughness at $Re = 81241$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	7.79K	+14.1%/K	0.10K	1.41%	LM35C differential
P	100kPa	+0.0008%/Pa	1.5kPa	1.16%	MPXH6115A6U air pressure
C_{pt}	4.69kJ/K	+0.023%/(J/K)	47J/K	1.09%	plate thermal capacity
η	0.401	+141%	0.014	1.98%	anemometer calibration
u_u	7.787	+2.62%	0.100	0.26%	diffuser airflow upper bound
ς	6.00mm	+12435%/m	100um	1.24%	post height
				3.19%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	1.28kr/min	+0.052%/(r/min)	5.0r/min	0.26%	fan rotation rate
				3.23%	RSS combined uncertainty