downward facing plate

RMSRE	Bias	Scatter	Used
2.6%	−0.6%	2.6%	12/15

$\varepsilon = 1.04$ mm; $\theta = +90°$; $\psi = 90°$
$L = 305$ mm

theory ± uncertainty
theory
forced only
measured
measured over time halves

average Nusselt number $\overline{Nu}$

forced Reynolds number Re_F

downward facing plate

± uncertainty
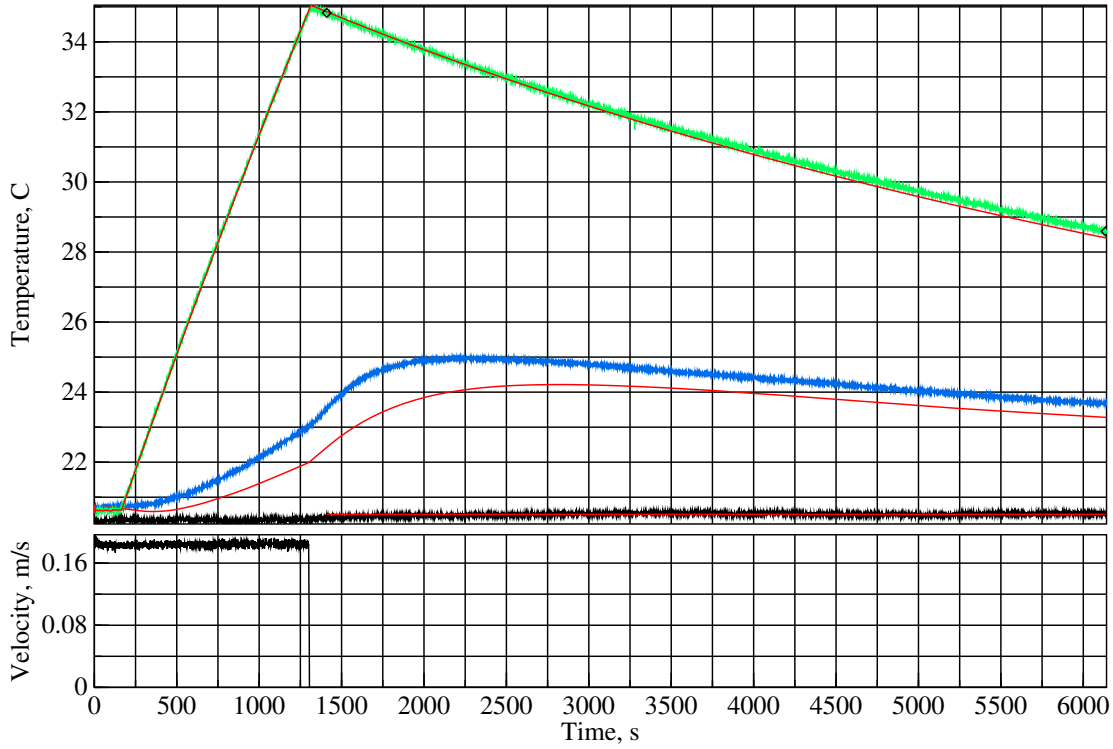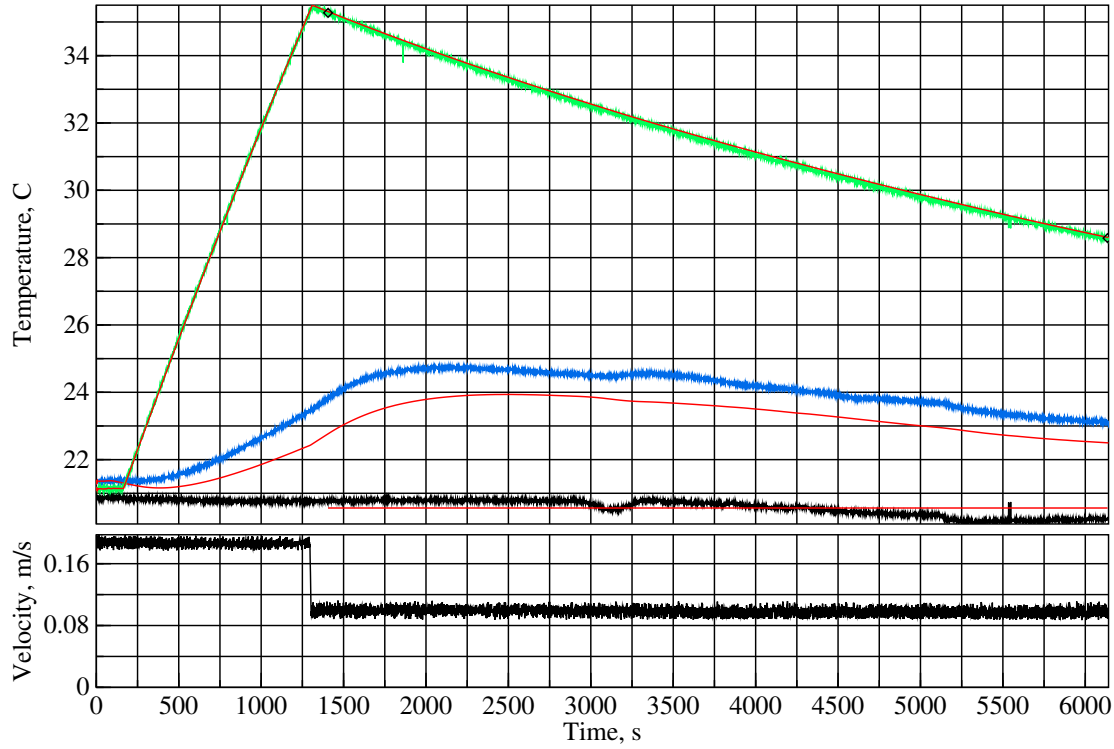measured − theory

forced Reynolds number Re_F

20230630T135252Z − mixed Convection − Roughness=1.04mm; T=20.5+10.8°C; +90.00°
k=0.0256, Ra/L^3=1.054x10^9, h=1.34W/(K.m^2), U=0.124W/K, Nu=15.9, Pr=0.711

Estimated measurement uncertainties of natural convection at $\theta = 90.0$.

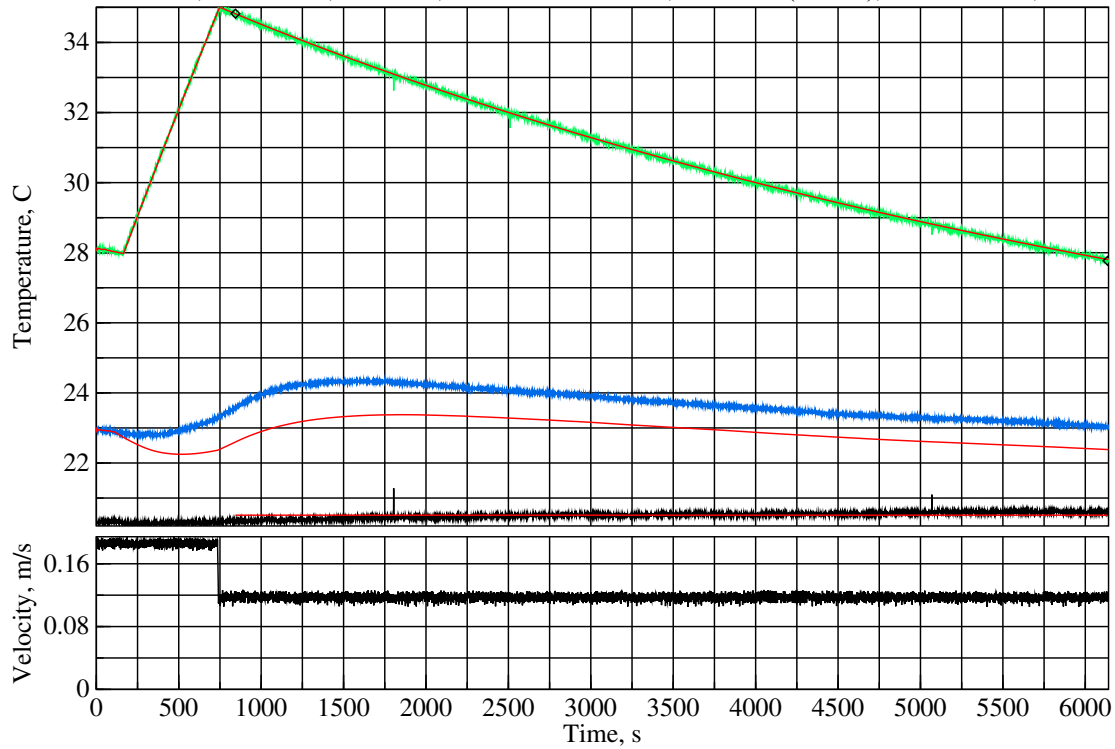| Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
T	299K	$+0.645\%/$K	0.50K	0.32%	LM35C temperature sensor
ΔT	10.8K	$+37.2\%/$K	0.10K	3.72%	LM35C differential
T_{bb}	294K	$+0.709\%/$K	0.50K	0.35%	radiative temperature
P	101kPa	$+0.0008\%/$Pa	1.5kPa	1.20%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.085\%/$(J/K)	42J/K	3.62%	plate thermal capacity
L_c	0.305m	$+1106\%/$m	500um	0.55%	characteristic length
L_w	0.305m	$+401\%/$m	500um	0.20%	plate width
D_{PIR}	25.4mm	$-895\%/$m	1.0mm	0.89%	insulation thickness
D_g	1.00mm	$-908\%/$m	500um	0.45%	air gap
L_m	3.57mm	$+2559\%/$m	500um	1.28%	side metal strip width
k_{PIR}	$22.2\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$+0.865\%/\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$1.1\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	0.96%	PIR thermal conductivity
ϵ_{XPS}	0.515	$+78.8\%$	0.010	0.79%	XPS emissivity
ϵ_{tp}	0.890	$+95.1\%$	0.015	1.43%	tape emissivity
Ω_{tp}	0.540	$+64.3\%$	0.020	1.29%	tape coverage
ϵ_{rs}	0.040	$+339\%$	0.010	3.39%	test-surface emissivity
ϵ_b	0.190	$+22.4\%$	0.020	0.45%	back emissivity
ϵ_{wt}	0.900	$+159\%$	0.025	3.97%	wind-tunnel emissivity
θ	90.0°	$-0.975\%/°$	0.50°	0.49%	plate angle
				8.04%	combined bias uncertainty

20230717T002348Z − mixed Convection − Roughness=1.04mm; T=20.6+11.0°C; +90.00°
33±1.6r/min, V=98mm/s, Re=1964, Ra/L^3=1.048x10^9, h=1.58W/(K.m^2), U=0.147W/K, Nu=18.8

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 1964$.

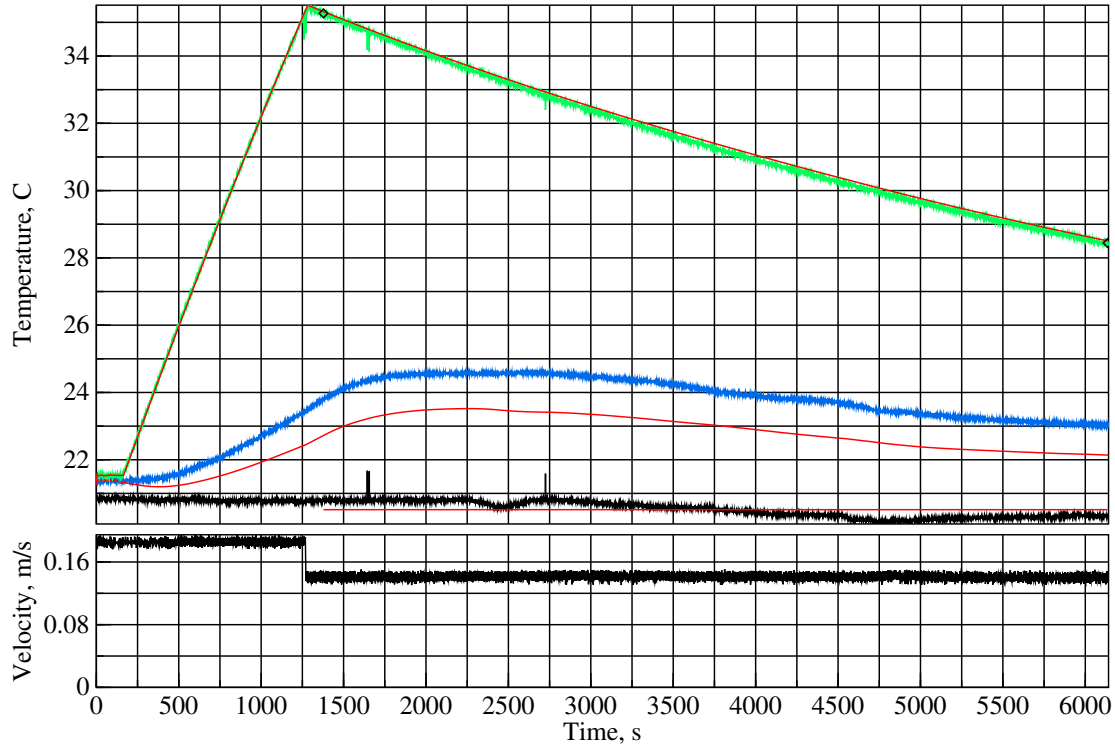| Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
T	299K	+0.614%/K	0.50K	0.31%	LM35C temperature sensor
ΔT	11.0K	+36.8%/K	0.10K	3.68%	LM35C differential
T_{bb}	294K	+0.699%/K	0.50K	0.35%	radiative temperature
P	99.9kPa	+0.0009%/Pa	1.5kPa	1.28%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.086%/(J/K)	42J/K	3.65%	plate thermal capacity
L_c	0.305m	+1095%/m	500um	0.55%	characteristic length
L_w	0.305m	+401%/m	500um	0.20%	plate width
D_{PIR}	25.4mm	−1007%/m	1.0mm	1.01%	insulation thickness
D_g	1.00mm	−1021%/m	500um	0.51%	air gap
L_m	3.57mm	+2674%/m	500um	1.34%	side metal strip width
k_{PIR}	$22.2\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$+0.986\%/\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$1.1\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	1.09%	PIR thermal conductivity
k_{XPS}	$28.5\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$+0.165\%/\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$1.4\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	0.24%	XPS thermal conductivity
ϵ_{XPS}	0.515	+78.6%	0.010	0.79%	XPS emissivity
ϵ_{tp}	0.890	+94.9%	0.015	1.42%	tape emissivity
Ω_{tp}	0.540	+64.1%	0.020	1.28%	tape coverage
ϵ_{rs}	0.040	+339%	0.010	3.39%	test-surface emissivity
ϵ_b	0.190	+14.3%	0.020	0.29%	back emissivity
ϵ_{wt}	0.900	+157%	0.025	3.92%	wind-tunnel emissivity
θ	90.0°	−0.927%/°	0.50°	0.46%	plate angle
				8.05%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	32.6r/min	+0.280%/(r/min)	1.6r/min	0.45%	fan rotation rate
				8.10%	RSS combined uncertainty

20230717T021323Z − mixed Convection − Roughness=1.04mm; T=20.5+10.3°C; +90.00°
39±1.3r/min, V=0.12m/s, Re=2344, Ra/L^3=0.992x10^9, h=1.52W/(K.m^2), U=0.142W/K, Nu=18.1

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 2345$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
T	299K	$+0.598\%/\text{K}$	0.50K	0.30%	LM35C temperature sensor
ΔT	10.3K	$+39.0\%/\text{K}$	0.10K	3.90%	LM35C differential
T_{bb}	293K	$+0.696\%/\text{K}$	0.50K	0.35%	radiative temperature
P	100.0kPa	$+0.0009\%/\text{Pa}$	1.5kPa	1.31%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.086\%/(\text{J/K})$	42J/K	3.65%	plate thermal capacity
L_c	0.305m	$+1084\%/\text{m}$	500um	0.54%	characteristic length
D_{PIR}	25.4mm	$-1061\%/\text{m}$	1.0mm	1.06%	insulation thickness
D_g	1.00mm	$-1076\%/\text{m}$	500um	0.54%	air gap
L_m	3.57mm	$+2697\%/\text{m}$	500um	1.35%	side metal strip width
k_{PIR}	$22.2\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$+1.04\%/\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$1.1\frac{\text{mW}}{\text{K}\cdot\text{m}}$	1.16%	PIR thermal conductivity
k_{XPS}	$28.5\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$+0.179\%/\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$1.4\frac{\text{mW}}{\text{K}\cdot\text{m}}$	0.26%	XPS thermal conductivity
ϵ_{XPS}	0.515	$+78.4\%$	0.010	0.78%	XPS emissivity
ϵ_{tp}	0.890	$+94.5\%$	0.015	1.42%	tape emissivity
Ω_{tp}	0.540	$+63.9\%$	0.020	1.28%	tape coverage
ϵ_{rs}	0.040	$+338\%$	0.010	3.38%	test-surface emissivity
ϵ_b	0.190	$+11.6\%$	0.020	0.23%	back emissivity
ϵ_{wt}	0.900	$+156\%$	0.025	3.90%	wind-tunnel emissivity
θ	90.0°	$-0.724\%/°$	0.50°	0.36%	plate angle
				8.15%	combined bias uncertainty

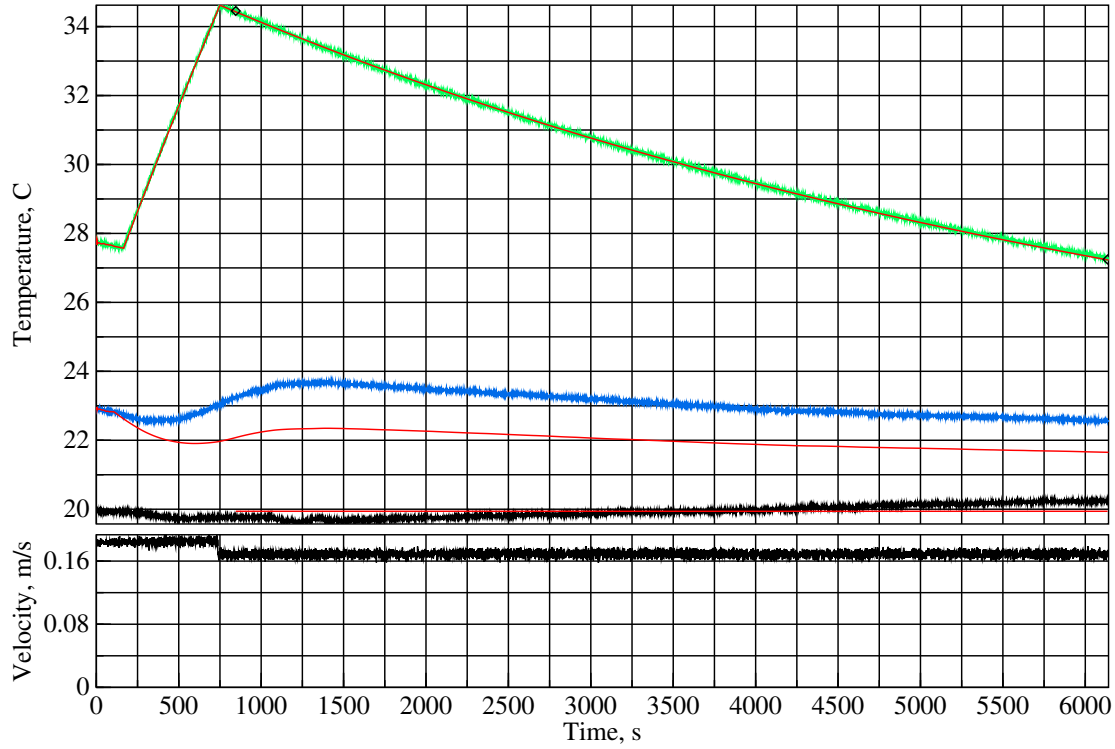| Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	38.8r/min	$+0.346\%/(\text{r/min})$	1.3r/min	0.46%	fan rotation rate
				8.21%	RSS combined uncertainty

20230717T125602Z − mixed Convection − Roughness=1.04mm; T=20.5+10.9°C; +90.00°
47±1.3r/min, V=0.14m/s, Re=2834, Ra/L^3=1.050x10^9, h=1.73W/(K.m^2), U=0.161W/K, Nu=20.5

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 2834$.

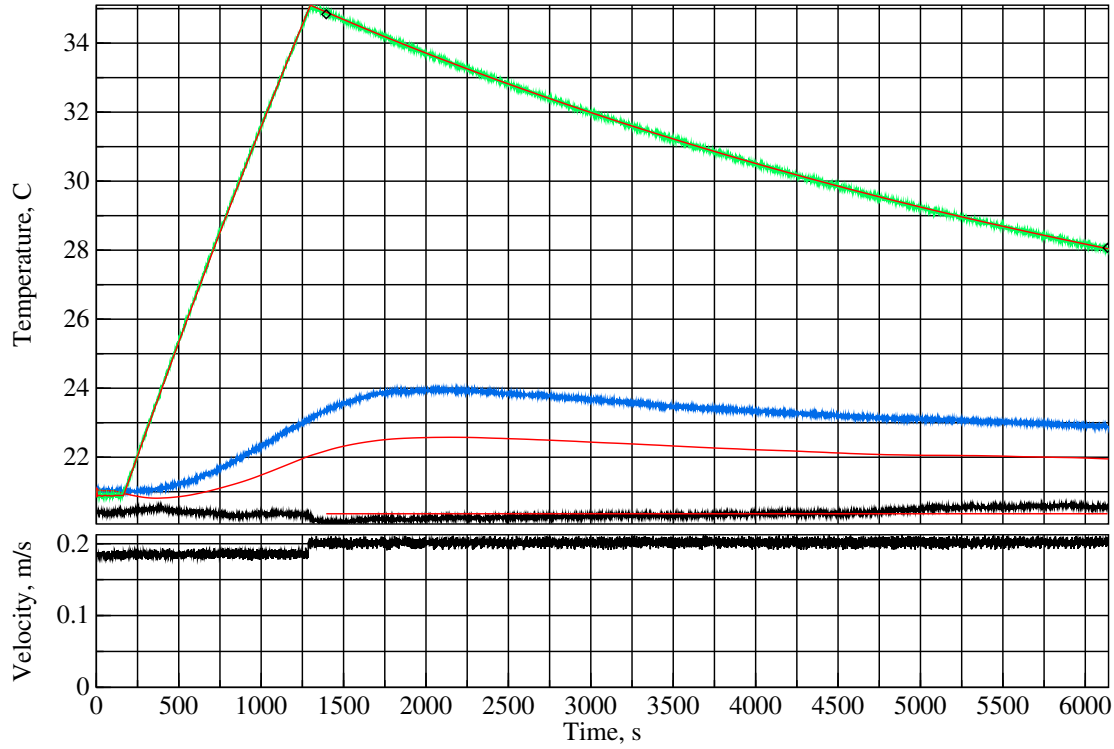| Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
T	299K	$+0.546\%/\text{K}$	0.50K	0.27%	LM35C temperature sensor
ΔT	10.9K	$+36.2\%/\text{K}$	0.10K	3.62%	LM35C differential
T_{bb}	294K	$+0.674\%/\text{K}$	0.50K	0.34%	radiative temperature
P	100kPa	$+0.0009\%/\text{Pa}$	1.5kPa	1.39%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.085\%/(\text{J/K})$	42J/K	3.59%	plate thermal capacity
η	0.340	$+68.2\%$	0.003	0.23%	anemometer calibration
L_c	0.305m	$+1057\%/\text{m}$	500um	0.53%	characteristic length
D_{PIR}	25.4mm	$-1084\%/\text{m}$	1.0mm	1.08%	insulation thickness
D_g	1.00mm	$-1099\%/\text{m}$	500um	0.55%	air gap
L_m	3.57mm	$+2669\%/\text{m}$	500um	1.33%	side metal strip width
k_{PIR}	$22.2\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$+1.07\%/\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$1.1\frac{\text{mW}}{\text{K}\cdot\text{m}}$	1.18%	PIR thermal conductivity
k_{XPS}	$28.5\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$+0.188\%/\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$1.4\frac{\text{mW}}{\text{K}\cdot\text{m}}$	0.27%	XPS thermal conductivity
ϵ_{XPS}	0.515	$+76.3\%$	0.010	0.76%	XPS emissivity
ϵ_{tp}	0.890	$+92.0\%$	0.015	1.38%	tape emissivity
Ω_{tp}	0.540	$+62.2\%$	0.020	1.24%	tape coverage
ϵ_{rs}	0.040	$+329\%$	0.010	3.29%	test-surface emissivity
ϵ_{wt}	0.900	$+151\%$	0.025	3.78%	wind-tunnel emissivity
				7.91%	combined bias uncertainty
Symbol	**Nominal**	**Sensitivity**	**Variability**	**Uncertainty**	**Component**
ω	46.8r/min	$+0.495\%/(\text{r/min})$	1.3r/min	0.64%	fan rotation rate
				8.01%	RSS combined uncertainty

20230717T164125Z − mixed Convection − Roughness=1.04mm; T=19.9+10.4°C; +90.00°
56±1.2r/min, V=0.17m/s, Re=3403, Ra/L^3=1.011x10^9, h=1.76W/(K.m^2), U=0.164W/K, Nu=21.0

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 3403$.

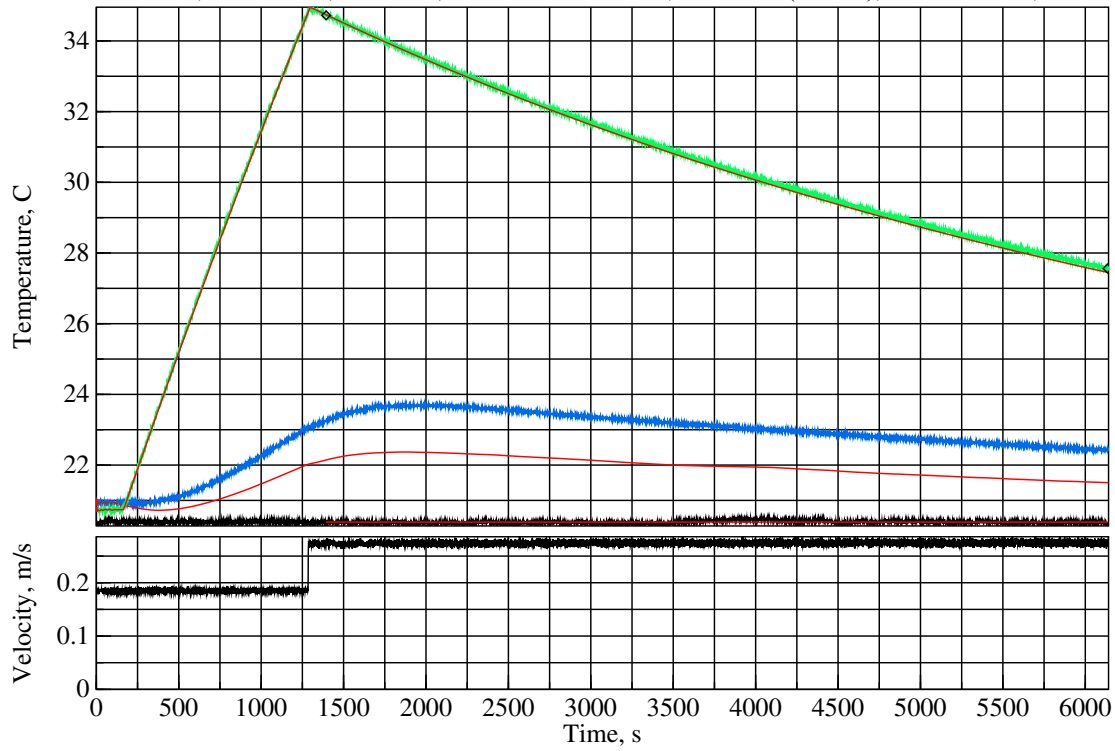| Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
T	298K	+0.434%/K	0.50K	0.22%	LM35C temperature sensor
ΔT	10.4K	+36.5%/K	0.10K	3.65%	LM35C differential
T_{bb}	293K	+0.639%/K	0.50K	0.32%	radiative temperature
P	100kPa	+0.0011%/Pa	1.5kPa	1.59%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.082%/(J/K)	42J/K	3.47%	plate thermal capacity
η	0.340	+138%	0.003	0.47%	anemometer calibration
L_c	0.305m	+1009%/m	500um	0.50%	characteristic length
ς	2.00mm	+2814%/m	100um	0.28%	post height
D_{PIR}	25.4mm	−1086%/m	1.0mm	1.09%	insulation thickness
D_g	1.00mm	−1102%/m	500um	0.55%	air gap
L_m	3.57mm	+2579%/m	500um	1.29%	side metal strip width
k_{PIR}	$22.2\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$+1.07\%/\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$1.1\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	1.19%	PIR thermal conductivity
k_{XPS}	$28.5\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$+0.195\%/\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$1.4\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	0.28%	XPS thermal conductivity
ϵ_{XPS}	0.515	+72.2%	0.010	0.72%	XPS emissivity
ϵ_{tp}	0.890	+87.1%	0.015	1.31%	tape emissivity
Ω_{tp}	0.540	+58.9%	0.020	1.18%	tape coverage
ϵ_{rs}	0.040	+312%	0.010	3.12%	test-surface emissivity
ϵ_{wt}	0.900	+143%	0.025	3.57%	wind-tunnel emissivity
θ	90.0°	+4.89%/°	0.50°	2.45%	plate angle
				8.09%	combined bias uncertainty
Symbol	**Nominal**	**Sensitivity**	**Variability**	**Uncertainty**	**Component**
ω	56.0r/min	+0.837%/(r/min)	1.2r/min	1.01%	fan rotation rate
				8.33%	RSS combined uncertainty

20230718T224330Z − mixed Convection − Roughness=1.04mm; T=20.4+10.7°C; +90.00°
67±1.4r/min, V=0.20m/s, Re=4050, Ra/L^3=1.030x10^9, h=1.89W/(K.m^2), U=0.175W/K, Nu=22.4

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 4051$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.7K	$+32.9\%/$K	0.10K	3.29%	LM35C differential
T_{bb}	294K	$+0.577\%/$K	0.50K	0.29%	radiative temperature
P	100kPa	$+0.0012\%/$Pa	1.5kPa	1.87%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.077\%/$(J/K)	42J/K	3.25%	plate thermal capacity
η	0.340	$+232\%$	0.003	0.79%	anemometer calibration
L_c	0.305m	$+951\%/$m	500um	0.48%	characteristic length
D_{PIR}	25.4mm	$-1022\%/$m	1.0mm	1.02%	insulation thickness
D_g	1.00mm	$-1037\%/$m	500um	0.52%	air gap
L_m	3.57mm	$+2390\%/$m	500um	1.20%	side metal strip width
k_{PIR}	$22.2\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$+1.01\%/\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$1.1\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	1.12%	PIR thermal conductivity
k_{XPS}	$28.5\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$+0.189\%/\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$1.4\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	0.27%	XPS thermal conductivity
ϵ_{XPS}	0.515	$+65.6\%$	0.010	0.66%	XPS emissivity
ϵ_{tp}	0.890	$+79.1\%$	0.015	1.19%	tape emissivity
Ω_{tp}	0.540	$+53.4\%$	0.020	1.07%	tape coverage
ϵ_{rs}	0.040	$+283\%$	0.010	2.83%	test-surface emissivity
ϵ_{wt}	0.900	$+129\%$	0.025	3.23%	wind-tunnel emissivity
θ	90.0°	$+11.7\%/°$	0.50°	5.85%	plate angle
				9.26%	combined bias uncertainty

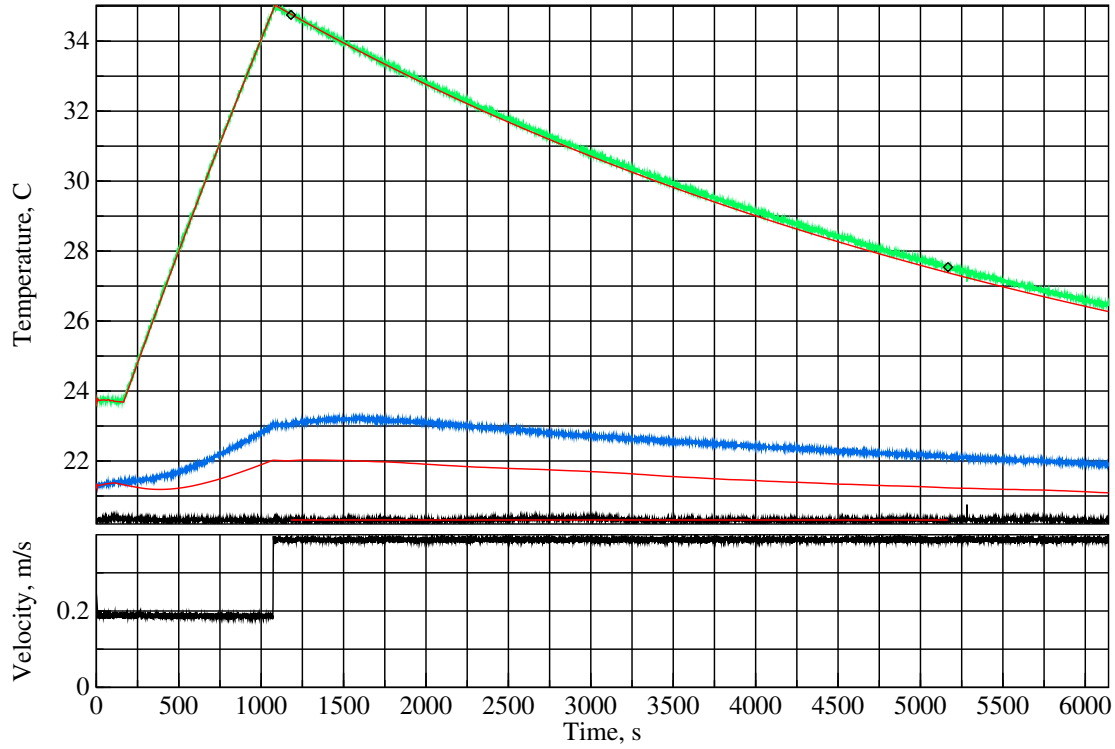| Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	66.8r/min	$+1.18\%/$(r/min)	1.4r/min	1.67%	fan rotation rate
				9.84%	RSS combined uncertainty

20230704T172731Z − mixed Convection − Roughness=1.04mm; T=20.4+10.3°C; +90.00°
91±1.6r/min, V=0.27m/s, Re=5516, Ra/L^3=0.996x10^9, h=2.39W/(K.m^2), U=0.222W/K, Nu=28.4

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 5516$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	$+27.6\%/\text{K}$	0.10K	2.76%	LM35C differential
T_{bb}	294K	$+0.427\%/\text{K}$	0.50K	0.21%	radiative temperature
P	100kPa	$+0.0014\%/\text{Pa}$	1.5kPa	2.16%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.063\%/(\text{J/K})$	42J/K	2.68%	plate thermal capacity
η	0.340	$+345\%$	0.003	1.17%	anemometer calibration
L_c	0.305m	$+845\%/\text{m}$	500um	0.42%	characteristic length
L_T	8.34mm	$+4622\%/\text{m}$	100um	0.46%	post length
ς	2.00mm	$-10095\%/\text{m}$	100um	1.01%	post height
D_{PIR}	25.4mm	$-810\%/\text{m}$	1.0mm	0.81%	insulation thickness
D_g	1.00mm	$-821\%/\text{m}$	500um	0.41%	air gap
L_m	3.57mm	$+1854\%/\text{m}$	500um	0.93%	side metal strip width
k_{PIR}	$22.2\frac{\text{mW}}{\text{K·m}}$	$+0.803\%/\frac{\text{mW}}{\text{K·m}}$	$1.1\frac{\text{mW}}{\text{K·m}}$	0.89%	PIR thermal conductivity
k_{XPS}	$28.5\frac{\text{mW}}{\text{K·m}}$	$+0.158\%/\frac{\text{mW}}{\text{K·m}}$	$1.4\frac{\text{mW}}{\text{K·m}}$	0.23%	XPS thermal conductivity
ϵ_{XPS}	0.515	$+48.6\%$	0.010	0.49%	XPS emissivity
ϵ_{tp}	0.890	$+58.6\%$	0.015	0.88%	tape emissivity
Ω_{tp}	0.540	$+39.6\%$	0.020	0.79%	tape coverage
ϵ_{rs}	0.040	$+210\%$	0.010	2.10%	test-surface emissivity
ϵ_{wt}	0.900	$+95.6\%$	0.025	2.39%	wind-tunnel emissivity
θ	90.0°	$+11.3\%/°$	0.50°	5.64%	plate angle
				8.27%	combined bias uncertainty

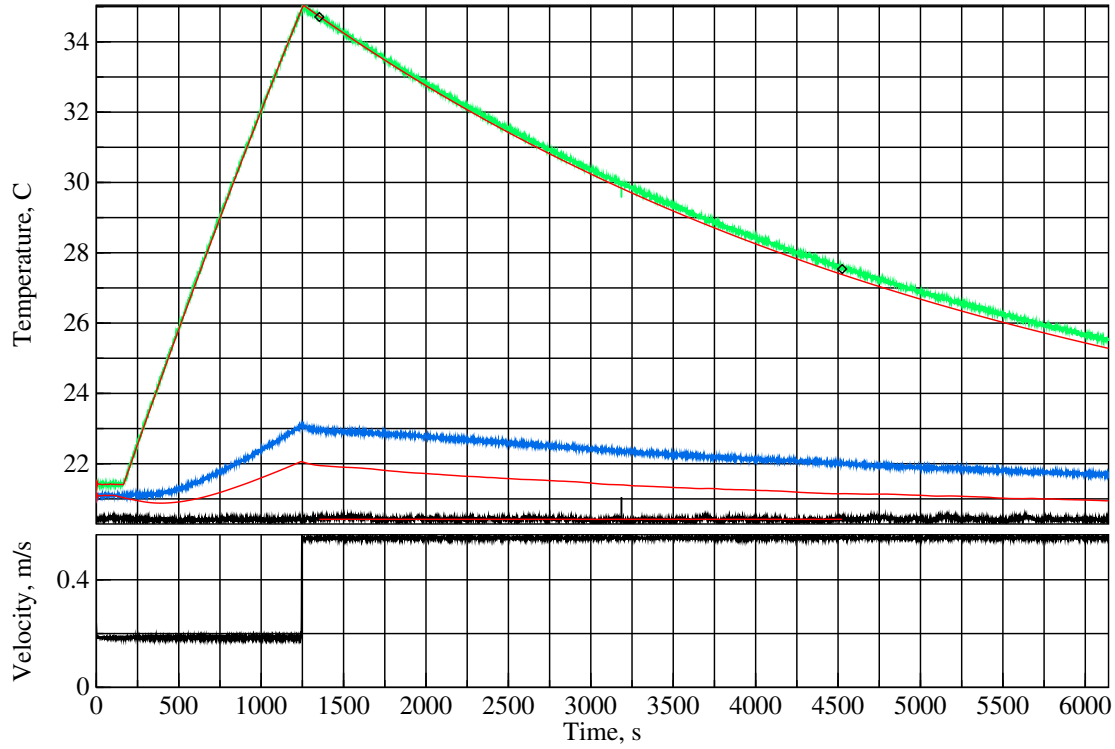| Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	91.1r/min	$+1.29\%/(\text{r/min})$	1.6r/min	2.00%	fan rotation rate
				9.18%	RSS combined uncertainty

20230703T003733Z − mixed Convection − Roughness=1.04mm; T=20.3+10.4°C; +90.00°
128±1.6r/min, V=0.39m/s, Re=7758, Ra/L^3=1.001x10^9, h=3.61W/(K.m^2), U=0.336W/K, Nu=43.0

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 7759$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.4K	$+21.5\%$/K	0.10K	2.15%	LM35C differential
P	100kPa	$+0.0014\%$/Pa	1.5kPa	2.12%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.050\%$/(J/K)	42J/K	2.12%	plate thermal capacity
η	0.340	$+366\%$	0.003	1.25%	anemometer calibration
L_c	0.305m	$+695\%$/m	500um	0.35%	characteristic length
L_T	8.34mm	$+7457\%$/m	100um	0.75%	post length
ς	2.00mm	-19317%/m	100um	1.93%	post height
D_{PIR}	25.4mm	-571%/m	1.0mm	0.57%	insulation thickness
D_g	1.00mm	-579%/m	500um	0.29%	air gap
L_m	3.57mm	$+1314\%$/m	500um	0.66%	side metal strip width
k_{PIR}	$22.2\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$+0.569\%/\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$1.1\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	0.63%	PIR thermal conductivity
ϵ_{XPS}	0.515	$+32.1\%$	0.010	0.32%	XPS emissivity
ϵ_{tp}	0.890	$+38.8\%$	0.015	0.58%	tape emissivity
Ω_{tp}	0.540	$+26.2\%$	0.020	0.52%	tape coverage
ϵ_{rs}	0.040	$+139\%$	0.010	1.39%	test-surface emissivity
ϵ_{wt}	0.900	$+63.2\%$	0.025	1.58%	wind-tunnel emissivity
θ	90.0°	$+5.03\%$/°	0.50°	2.51%	plate angle
				5.69%	combined bias uncertainty

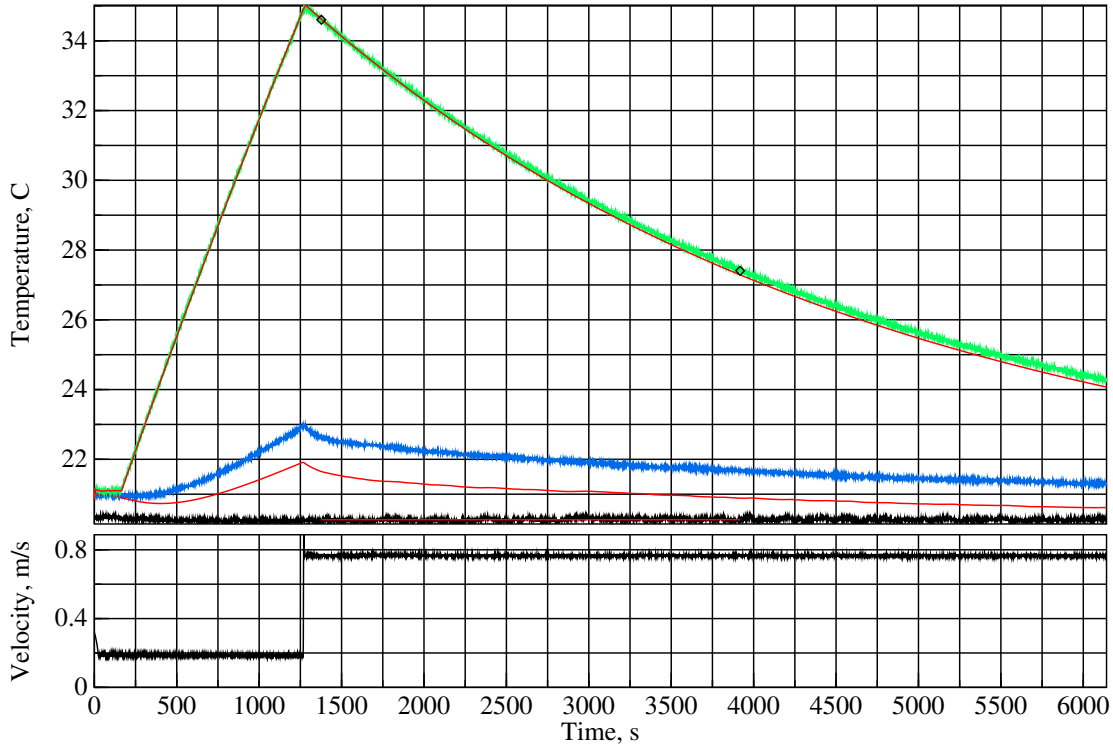| Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	128r/min	$+0.969\%$/(r/min)	1.6r/min	1.56%	fan rotation rate
				6.49%	RSS combined uncertainty

20230705T012225Z − mixed Convection − Roughness=1.04mm; T=20.4+10.3°C; +90.00°
185±1.1r/min, V=0.56m/s, Re=11184, Ra/L^3=0.997x10^9, h=5.75W/(K.m^2), U=0.534W/K, Nu=68.4

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 11187$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	$+17.6\%$/K	0.10K	1.76%	LM35C differential
P	100kPa	$+0.0012\%$/Pa	1.5kPa	1.85%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.041\%$/(J/K)	42J/K	1.73%	plate thermal capacity
η	0.340	$+333\%$	0.003	1.13%	anemometer calibration
L_c	0.305m	$+492\%$/m	500um	0.25%	characteristic length
L_T	8.34mm	$+8728\%$/m	100um	0.87%	post length
ς	2.00mm	-17208%/m	100um	1.72%	post height
D_{PIR}	25.4mm	-391%/m	1.0mm	0.39%	insulation thickness
L_m	3.57mm	$+937\%$/m	500um	0.47%	side metal strip width
k_{PIR}	$22.2\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$+0.392\%/\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	$1.1\frac{\mathrm{mW}}{\mathrm{K \cdot m}}$	0.43%	PIR thermal conductivity
ϵ_{XPS}	0.515	$+20.8\%$	0.010	0.21%	XPS emissivity
ϵ_{tp}	0.890	$+25.2\%$	0.015	0.38%	tape emissivity
Ω_{tp}	0.540	$+17.0\%$	0.020	0.34%	tape coverage
ϵ_{rs}	0.040	$+90.4\%$	0.010	0.90%	test-surface emissivity
ϵ_{wt}	0.900	$+40.9\%$	0.025	1.02%	wind-tunnel emissivity
θ	90.0°	$+1.96\%$/°	0.50°	0.98%	plate angle
				4.29%	combined bias uncertainty

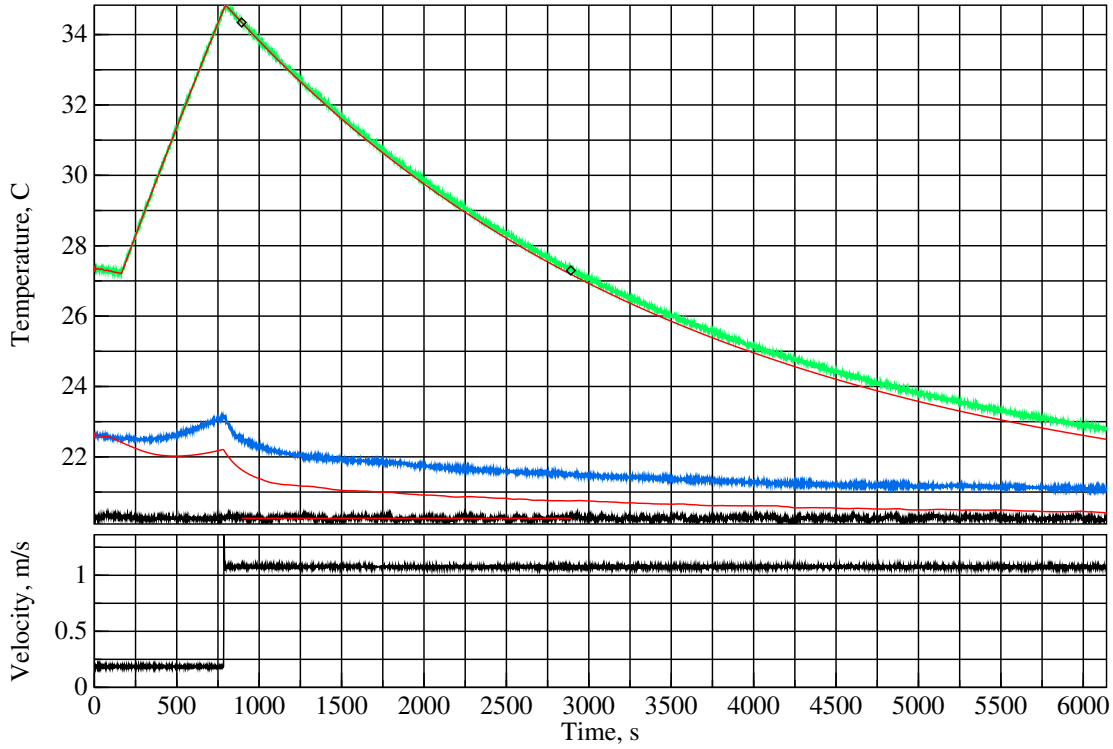| Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	185r/min	$+0.611\%$/(r/min)	1.1r/min	0.68%	fan rotation rate
				4.50%	RSS combined uncertainty

20230702T224545Z − mixed Convection − Roughness=1.04mm; T=20.3+10.3°C; +90.00°
256±1.1r/min, V=0.77m/s, Re=15402, Ra/L^3=0.992x10^9, h=8.15W/(K.m^2), U=0.758W/K, Nu=97.1

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 15401$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.3K	$+15.4\%/K$	0.10K	1.54%	LM35C differential
P	99.9kPa	$+0.0011\%/Pa$	1.5kPa	1.65%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.036\%/(J/K)$	42J/K	1.53%	plate thermal capacity
η	0.340	$+298\%$	0.003	1.01%	anemometer calibration
L_T	8.34mm	$+9071\%/m$	100um	0.91%	post length
ς	2.00mm	$-12521\%/m$	100um	1.25%	post height
D_{PIR}	25.4mm	$-289\%/m$	1.0mm	0.29%	insulation thickness
L_m	3.57mm	$+738\%/m$	500um	0.37%	side metal strip width
k_{PIR}	$22.2\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$+0.291\%/\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	$1.1\frac{\mathrm{mW}}{\mathrm{K\cdot m}}$	0.32%	PIR thermal conductivity
ϵ_{tp}	0.890	$+17.8\%$	0.015	0.27%	tape emissivity
Ω_{tp}	0.540	$+12.0\%$	0.020	0.24%	tape coverage
ϵ_{rs}	0.040	$+64.2\%$	0.010	0.64%	test-surface emissivity
ϵ_{wt}	0.900	$+28.9\%$	0.025	0.72%	wind-tunnel emissivity
θ	90.0°	$+0.922\%/°$	0.50°	0.46%	plate angle
				3.54%	combined bias uncertainty

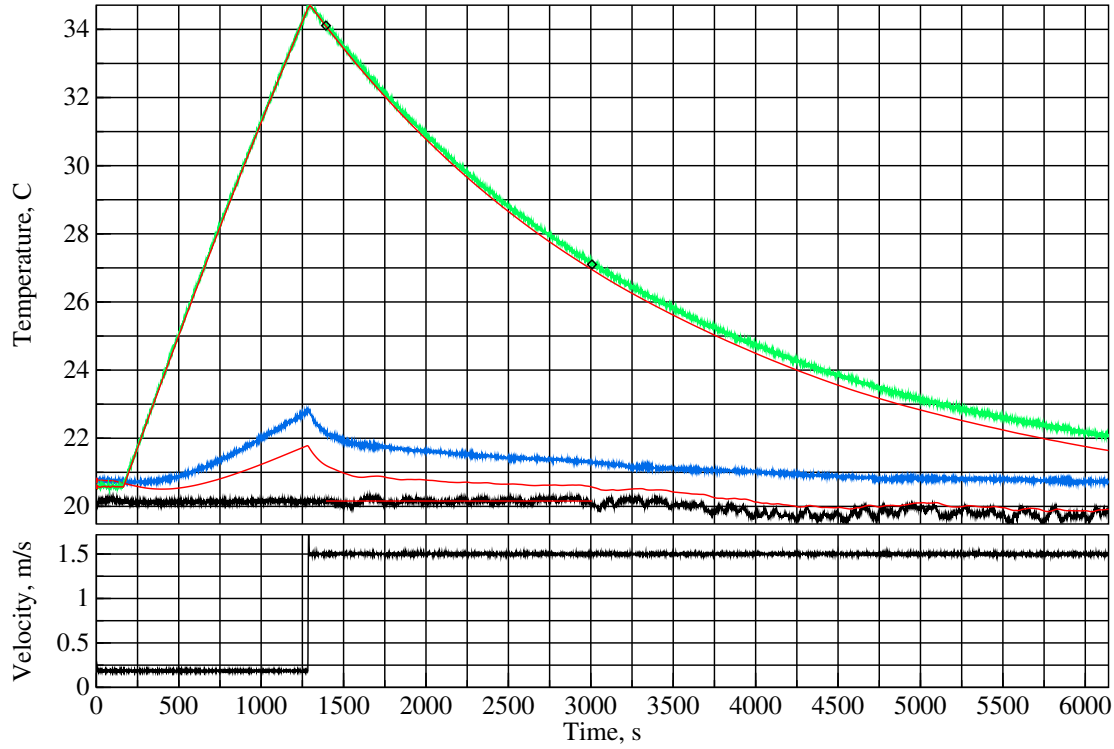| Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	256r/min	$+0.395\%/(r/min)$	1.1r/min	0.44%	fan rotation rate
				3.65%	RSS combined uncertainty

20230704T015123Z − mixed Convection − Roughness=1.04mm; T=20.3+10.2°C; +90.00°
362±2.3r/min, V=1.1m/s, Re=21646, Ra/L^3=0.984x10^9, h=11.5W/(K.m^2), U=1.07W/K, Nu=137.1

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 21645$.

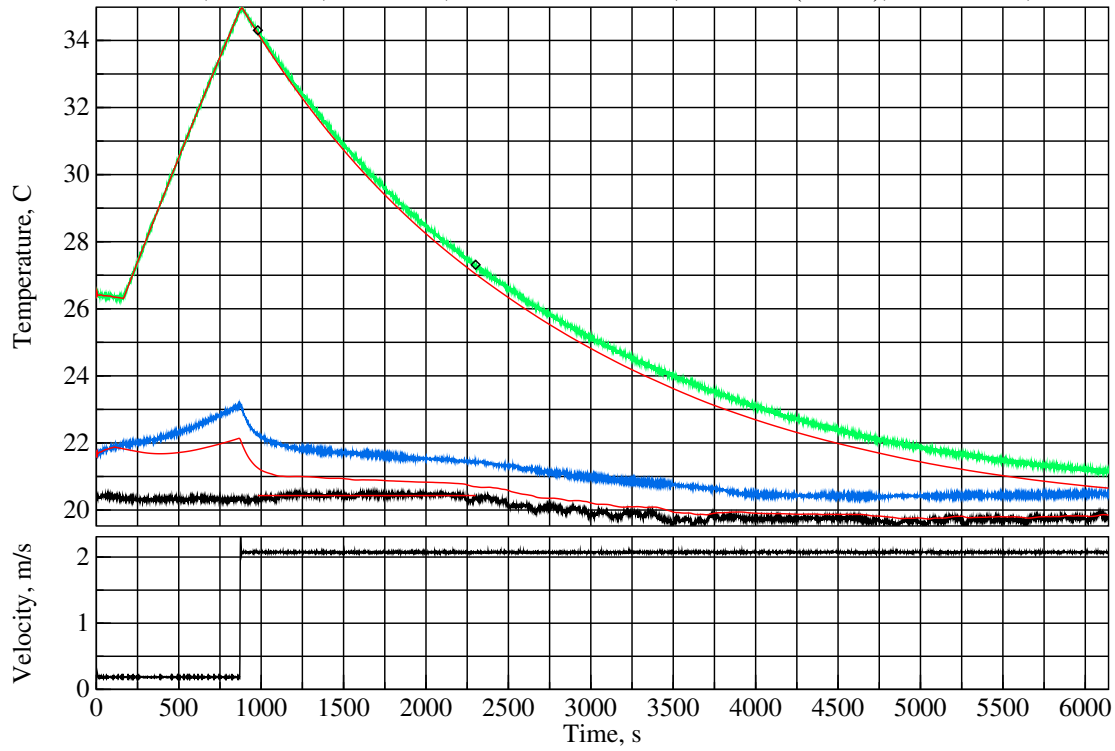| Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.2K	$+14.0\%/\text{K}$	0.10K	1.40%	LM35C differential
P	100kPa	$+0.0010\%/\text{Pa}$	1.5kPa	1.48%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.033\%/(\text{J/K})$	42J/K	1.38%	plate thermal capacity
η	0.340	$+269\%$	0.003	0.91%	anemometer calibration
L_T	8.34mm	$+9215\%/\text{m}$	100um	0.92%	post length
ς	2.00mm	$-8349\%/\text{m}$	100um	0.83%	post height
D_{PIR}	25.4mm	$-214\%/\text{m}$	1.0mm	0.21%	insulation thickness
L_m	3.57mm	$+608\%/\text{m}$	500um	0.30%	side metal strip width
k_{PIR}	$22.2\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$+0.217\%/\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$1.1\frac{\text{mW}}{\text{K}\cdot\text{m}}$	0.24%	PIR thermal conductivity
ϵ_{rs}	0.040	$+46.1\%$	0.010	0.46%	test-surface emissivity
ϵ_{wt}	0.900	$+20.7\%$	0.025	0.52%	wind-tunnel emissivity
θ	90.0°	$+0.434\%/°$	0.50°	0.22%	plate angle
				3.05%	combined bias uncertainty
Symbol	**Nominal**	**Sensitivity**	**Variability**	**Uncertainty**	**Component**
ω	362r/min	$+0.252\%/(\text{r/min})$	2.3r/min	0.57%	fan rotation rate
				3.26%	RSS combined uncertainty

20230702T182824Z − mixed Convection − Roughness=1.04mm; T=20.2+10.1°C; +90.00°
512±2.1r/min, V=1.5m/s, Re=30147, Ra/L^3=0.973x10^9, h=15.2W/(K.m^2), U=1.41W/K, Nu=181.0

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 30151$.

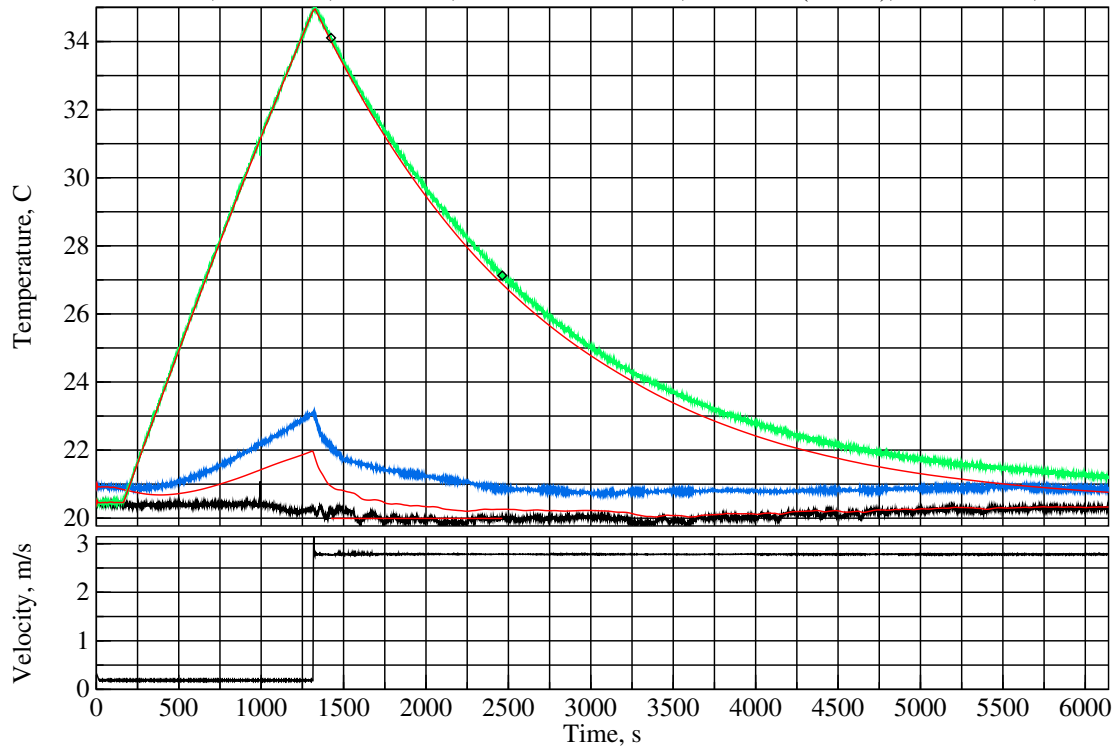| Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.1K	$+13.1\%/K$	0.10K	1.31%	LM35C differential
P	100.0kPa	$+0.0009\%/Pa$	1.5kPa	1.38%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.030\%/(J/K)$	42J/K	1.29%	plate thermal capacity
η	0.340	$+245\%$	0.003	0.83%	anemometer calibration
L_T	8.34mm	$+9288\%/m$	100um	0.93%	post length
ς	2.00mm	$-5394\%/m$	100um	0.54%	post height
L_m	3.57mm	$+529\%/m$	500um	0.26%	side metal strip width
ϵ_{rs}	0.040	$+34.2\%$	0.010	0.34%	test-surface emissivity
ϵ_{wt}	0.900	$+15.3\%$	0.025	0.38%	wind-tunnel emissivity
				2.76%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	512r/min	$+0.163\%/(r/min)$	2.1r/min	0.35%	fan rotation rate
				2.85%	RSS combined uncertainty

20230703T215438Z − mixed Convection − Roughness=1.04mm; T=20.4+09.9°C; +90.00°
727±2.0r/min, V=2.1m/s, Re=41550, Ra/L^3=0.956x10^9, h=19.6W/(K.m^2), U=1.82W/K, Nu=233.1

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 41552$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	9.93K	$+12.6\%/K$	0.10K	1.26%	LM35C differential
P	100.0kPa	$+0.0009\%/Pa$	1.5kPa	1.30%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	$+0.029\%/(J/K)$	42J/K	1.22%	plate thermal capacity
η	0.340	$+222\%$	0.003	0.75%	anemometer calibration
L_T	8.34mm	$+9335\%/m$	100um	0.93%	post length
ς	2.00mm	$-3320\%/m$	100um	0.33%	post height
L_m	3.57mm	$+482\%/m$	500um	0.24%	side metal strip width
ϵ_{rs}	0.040	$+26.0\%$	0.010	0.26%	test-surface emissivity
ϵ_{wt}	0.900	$+11.6\%$	0.025	0.29%	wind-tunnel emissivity
				2.58%	combined bias uncertainty

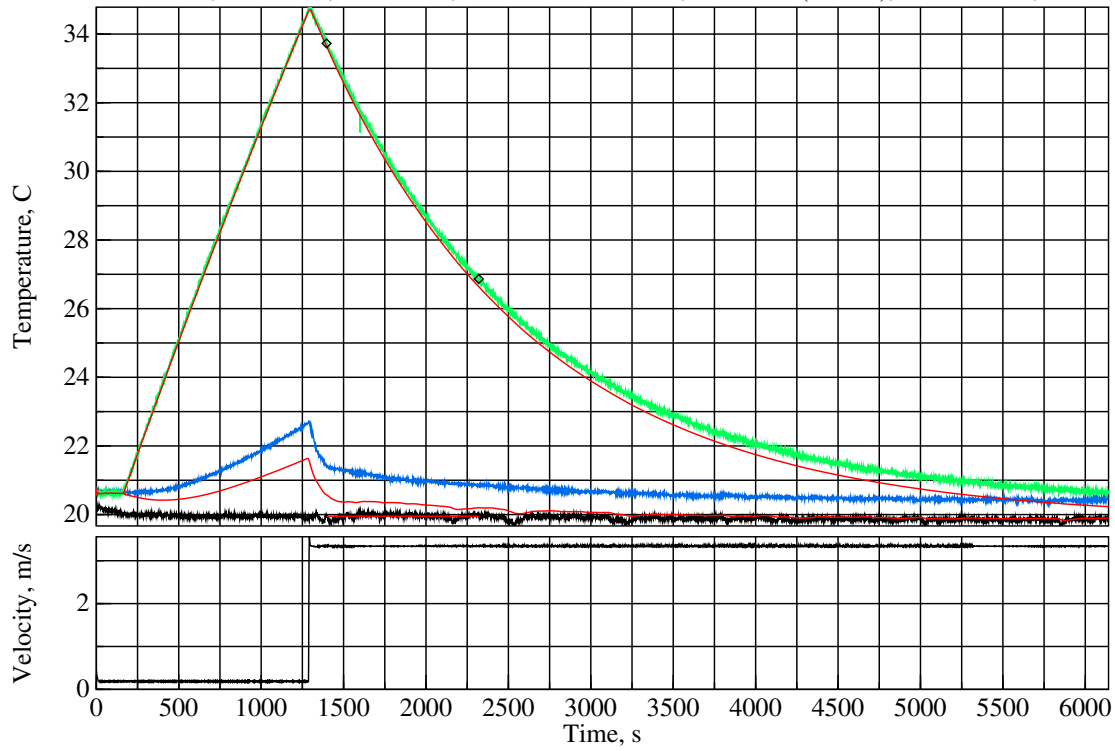| Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	727r/min	$+0.104\%/(r/min)$	2.0r/min	0.21%	fan rotation rate
				2.61%	RSS combined uncertainty

20230712T011216Z − mixed Convection − Roughness=1.04mm; T=20.0+10.2°C; +90.00°
1025±2.5r/min, V=2.8m/s, Re=55931, Ra/L^3=0.992x10^9, h=25.2W/(K.m^2), U=2.34W/K, Nu=299.9

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 55935$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	10.2K	+11.7%/K	0.10K	1.17%	LM35C differential
P	100.0kPa	+0.0008%/Pa	1.5kPa	1.26%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.028%/(J/K)	42J/K	1.17%	plate thermal capacity
η	0.340	+195%	0.003	0.66%	anemometer calibration
u_u	6.381	+2.44%	0.100	0.24%	diffuser airflow upper bound
L_T	8.34mm	+9365%/m	100um	0.94%	post length
L_m	3.57mm	+454%/m	500um	0.23%	side metal strip width
ϵ_{rs}	0.040	+20.4%	0.010	0.20%	test-surface emissivity
ϵ_{wt}	0.900	+9.05%	0.025	0.23%	wind-tunnel emissivity
				2.44%	combined bias uncertainty

Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	1.03kr/min	+0.065%/(r/min)	2.5r/min	0.16%	fan rotation rate
				2.46%	RSS combined uncertainty

20230624T185943Z − mixed Convection − Roughness=1.04mm; T=20.0+09.9°C; +90.00°
1300±2.2r/min, V=3.3m/s, Re=67010, Ra/L^3=0.959x10^9, h=29.3W/(K.m^2), U=2.73W/K, Nu=349.3

Estimated measurement uncertainties, bi-level 1mm roughness at $Re = 67089$.

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
ΔT	9.93K	+11.8%/K	0.10K	1.18%	LM35C differential
P	99.9kPa	+0.0008%/Pa	1.5kPa	1.24%	MPXH6115A6U air pressure
C_{pt}	4.24kJ/K	+0.027%/(J/K)	42J/K	1.15%	plate thermal capacity
η	0.340	+173%	0.003	0.59%	anemometer calibration
u_u	6.381	+3.47%	0.100	0.35%	diffuser airflow upper bound
L_T	8.34mm	+9379%/m	100um	0.94%	post length
L_m	3.57mm	+445%/m	500um	0.22%	side metal strip width
				2.41%	combined bias uncertainty

Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
ω	1.30kr/min	+0.045%/(r/min)	2.2r/min	0.10%	fan rotation rate
				2.42%	RSS combined uncertainty