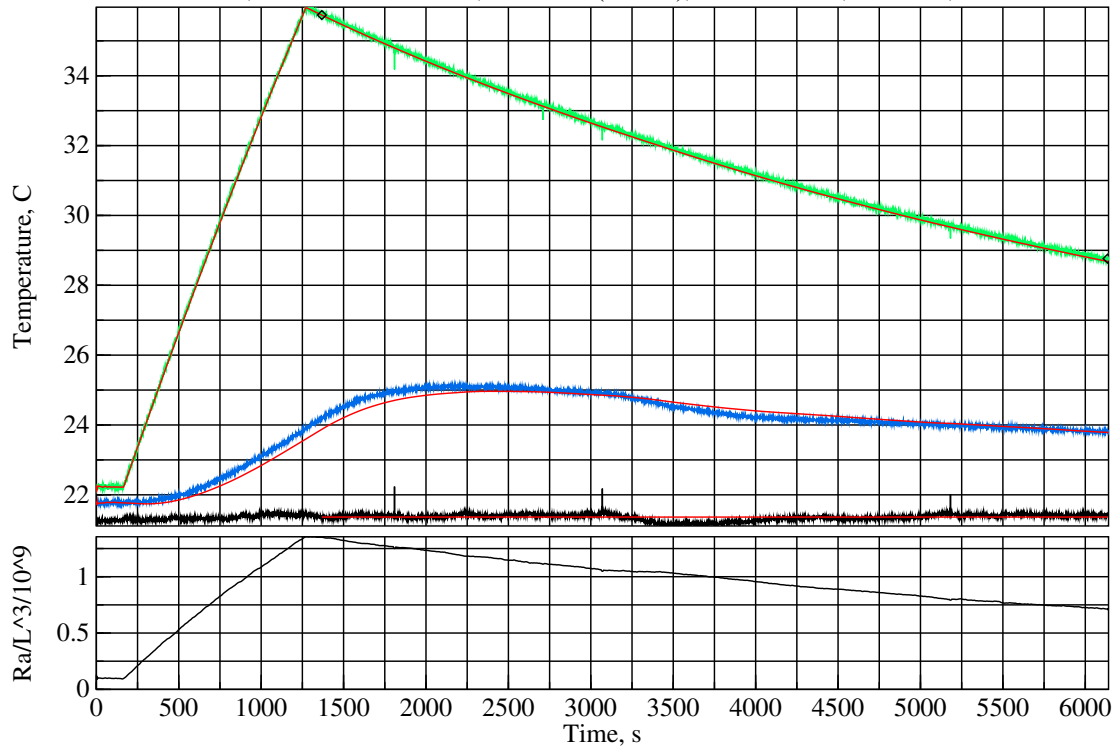


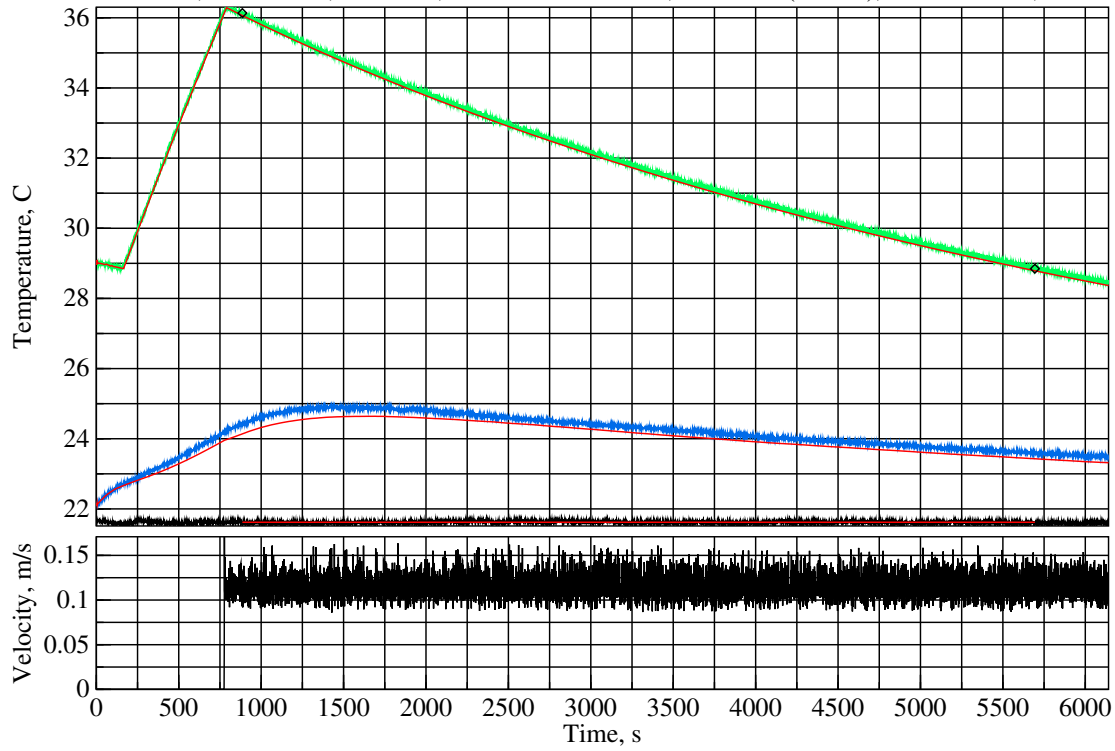
20170702T234939Z – mixed Convection – Roughness=1.04mm; T=21.4+10.4°C; -90.00°  
k=0.0257, Ra/L^3=0.996x10^9, h=4.91W/(K.m^2), U=0.457W/K, Nu=58.3, Pr=0.710



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

| Symbol           | Nominal  | Sensitivity   | Bias   | Uncertainty | Component                 |
|------------------|----------|---------------|--------|-------------|---------------------------|
| $\Delta T$       | 10.4K    | +14.6%/K      | 0.10K  | 1.46%       | LM35C differential        |
| $P$              | 101kPa   | +0.0005%/Pa   | 1.5kPa | 0.80%       | MPXH6115A6U air pressure  |
| $C_{pt}$         | 4.24kJ/K | +0.030%/(J/K) | 42J/K  | 1.25%       | plate thermal capacity    |
| $C_S$            | 1.000    | -35.9%        | 0.050  | 1.80%       | side reuptake             |
| $C_B$            | 1.000    | -10.7%        | 0.100  | 1.07%       | back reuptake             |
| $L_m$            | 3.57mm   | +542%/m       | 500um  | 0.27%       | side metal strip width    |
| $\epsilon_{XPS}$ | 0.515    | +47.6%        | 0.010  | 0.48%       | XPS emissivity            |
| $\epsilon_{rs}$  | 0.040    | +109%         | 0.010  | 1.09%       | test-surface emissivity   |
| $\epsilon_{wt}$  | 0.900    | +34.2%        | 0.025  | 0.86%       | wind-tunnel emissivity    |
|                  |          |               |        | 3.31%       | combined bias uncertainty |

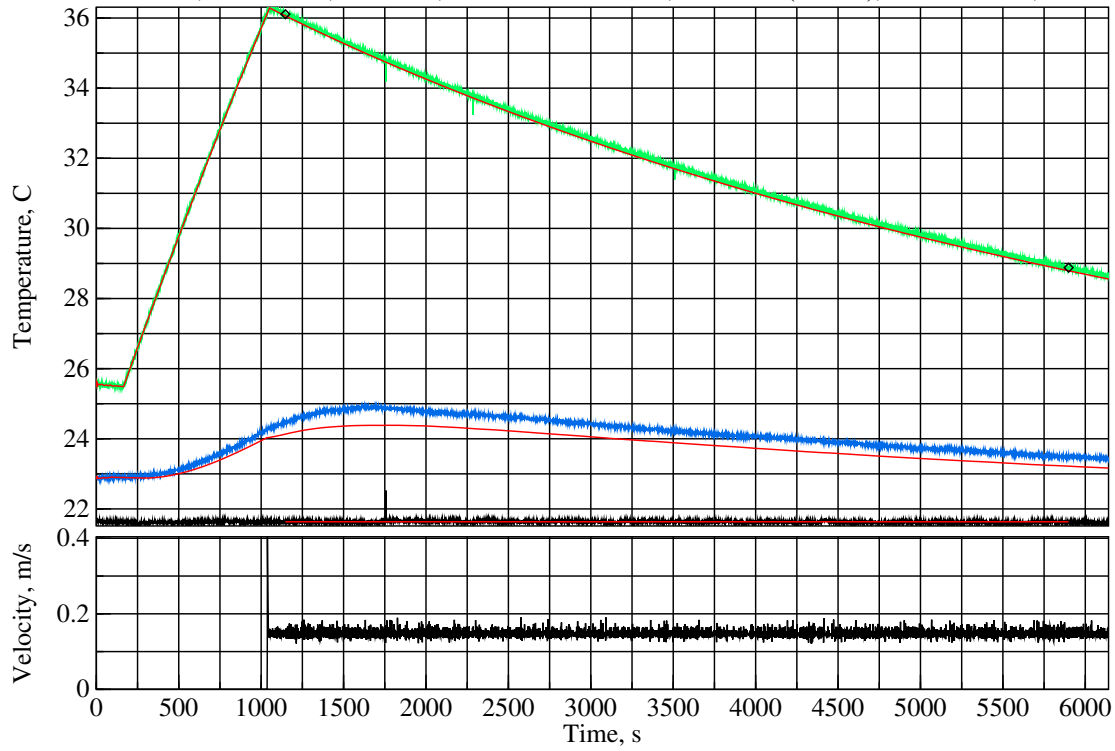
20170703T034246Z – mixed Convection – Roughness=1.04mm; T=21.6+10.4°C; -90.00°  
 32±4.1r/min, V=0.12m/s, Re=2317, Ra/L^3=0.989×10^9, h=5.01W/(K.m^2), U=0.466W/K, Nu=59.4



Estimated measurement uncertainties, bi-level 1mm roughness at  $Re = 2317$ .

| Symbol           | Nominal   | Sensitivity     | Bias        | Uncertainty | Component                 |
|------------------|-----------|-----------------|-------------|-------------|---------------------------|
| $\Delta T$       | 10.4K     | +14.6%/K        | 0.10K       | 1.46%       | LM35C differential        |
| $P$              | 101kPa    | +0.0005%/Pa     | 1.5kPa      | 0.82%       | MPXH6115A6U air pressure  |
| $C_{pt}$         | 4.24kJ/K  | +0.030%/(J/K)   | 42J/K       | 1.25%       | plate thermal capacity    |
| $C_S$            | 1.000     | -35.3%          | 0.050       | 1.77%       | side reuptake             |
| $C_B$            | 1.000     | -11.4%          | 0.100       | 1.14%       | back reuptake             |
| $L_m$            | 3.57mm    | +591%/m         | 500um       | 0.30%       | side metal strip width    |
| $\epsilon_{XPS}$ | 0.515     | +46.9%          | 0.010       | 0.47%       | XPS emissivity            |
| $\epsilon_{rs}$  | 0.040     | +107%           | 0.010       | 1.07%       | test-surface emissivity   |
| $\epsilon_{wt}$  | 0.900     | +33.7%          | 0.025       | 0.84%       | wind-tunnel emissivity    |
|                  |           |                 |             | 3.32%       | combined bias uncertainty |
| Symbol           | Nominal   | Sensitivity     | Variability | Uncertainty | Component                 |
| $\omega$         | 32.0r/min | +0.119%/(r/min) | 4.1r/min    | 0.49%       | fan rotation rate         |
|                  |           |                 |             | 3.47%       | RSS combined uncertainty  |

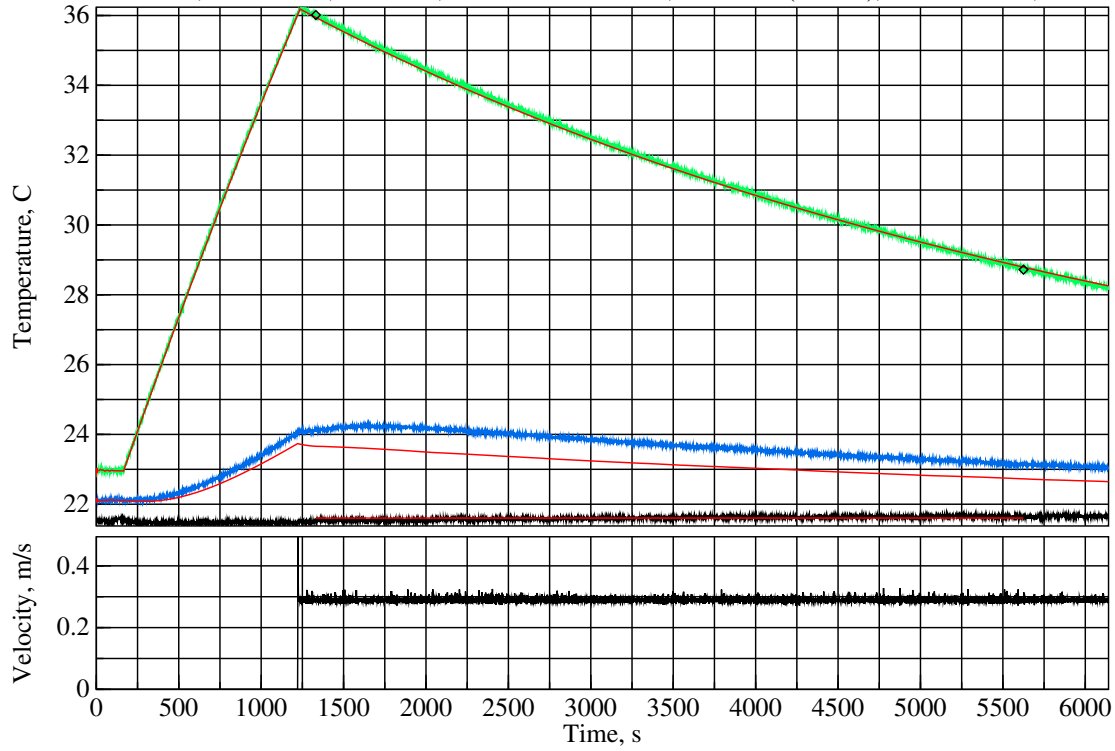
20170703T063741Z – mixed Convection – Roughness=1.04mm; T=21.6+10.4°C; -90.00°  
 41±2.9r/min, V=0.15m/s, Re=2962, Ra/L^3=0.987x10^9, h=5.04W/(K.m^2), U=0.469W/K, Nu=59.8



Estimated measurement uncertainties, bi-level 1mm roughness at  $Re = 2962$ .

| Symbol           | Nominal   | Sensitivity     | Bias        | Uncertainty | Component                 |
|------------------|-----------|-----------------|-------------|-------------|---------------------------|
| $\Delta T$       | 10.4K     | +14.5%/K        | 0.10K       | 1.45%       | LM35C differential        |
| $P$              | 101kPa    | +0.0006%/Pa     | 1.5kPa      | 0.84%       | MPXH6115A6U air pressure  |
| $C_{pt}$         | 4.24kJ/K  | +0.030%/(J/K)   | 42J/K       | 1.25%       | plate thermal capacity    |
| $C_S$            | 1.000     | -35.0%          | 0.050       | 1.75%       | side reuptake             |
| $C_B$            | 1.000     | -11.7%          | 0.100       | 1.17%       | back reuptake             |
| $L_m$            | 3.57mm    | +605%/m         | 500um       | 0.30%       | side metal strip width    |
| $\epsilon_{XPS}$ | 0.515     | +46.4%          | 0.010       | 0.46%       | XPS emissivity            |
| $\epsilon_{rs}$  | 0.040     | +106%           | 0.010       | 1.06%       | test-surface emissivity   |
| $\epsilon_{wt}$  | 0.900     | +33.3%          | 0.025       | 0.83%       | wind-tunnel emissivity    |
|                  |           |                 |             | 3.32%       | combined bias uncertainty |
| Symbol           | Nominal   | Sensitivity     | Variability | Uncertainty | Component                 |
| $\omega$         | 41.0r/min | +0.150%/(r/min) | 2.9r/min    | 0.43%       | fan rotation rate         |
|                  |           |                 |             | 3.43%       | RSS combined uncertainty  |

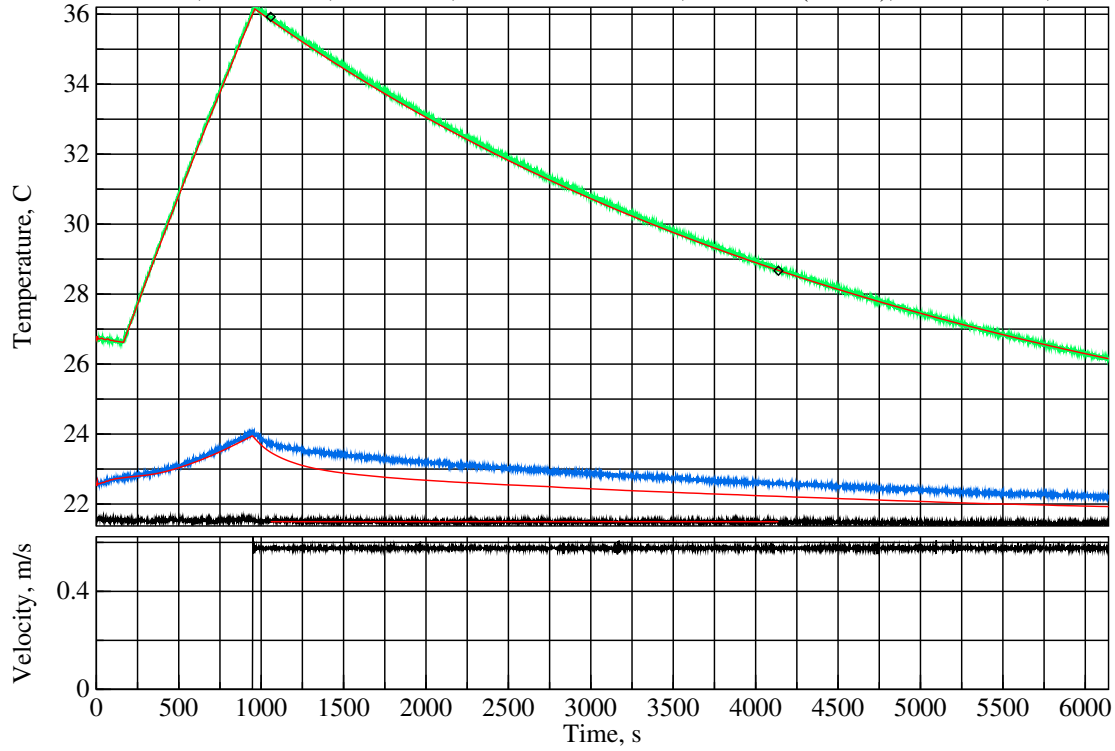
20170703T121949Z – mixed Convection – Roughness=1.04mm; T=21.6+10.3°C; -90.00°  
 80±2.2r/min, V=0.29m/s, Re=5808, Ra/L^3=0.985x10^9, h=5.72W/(K.m^2), U=0.532W/K, Nu=67.8



Estimated measurement uncertainties, bi-level 1mm roughness at  $Re = 5809$ .

| Symbol           | Nominal   | Sensitivity     | Bias        | Uncertainty | Component                 |
|------------------|-----------|-----------------|-------------|-------------|---------------------------|
| $\Delta T$       | 10.3K     | +14.0%/K        | 0.10K       | 1.40%       | LM35C differential        |
| $P$              | 101kPa    | +0.0007%/Pa     | 1.5kPa      | 1.02%       | MPXH6115A6U air pressure  |
| $C_{pt}$         | 4.24kJ/K  | +0.029%/(J/K)   | 42J/K       | 1.23%       | plate thermal capacity    |
| $\eta$           | 0.408     | +65.5%          | 0.004       | 0.27%       | anemometer calibration    |
| $C_S$            | 1.000     | -32.0%          | 0.050       | 1.60%       | side reuptake             |
| $C_B$            | 1.000     | -11.5%          | 0.100       | 1.15%       | back reuptake             |
| $\zeta$          | 2.00mm    | -2713%/m        | 100um       | 0.27%       | post height               |
| $L_m$            | 3.57mm    | +634%/m         | 500um       | 0.32%       | side metal strip width    |
| $\epsilon_{XPS}$ | 0.515     | +42.2%          | 0.010       | 0.42%       | XPS emissivity            |
| $\epsilon_{rs}$  | 0.040     | +97.1%          | 0.010       | 0.97%       | test-surface emissivity   |
| $\epsilon_{wt}$  | 0.900     | +30.4%          | 0.025       | 0.76%       | wind-tunnel emissivity    |
|                  |           |                 |             | 3.23%       | combined bias uncertainty |
| Symbol           | Nominal   | Sensitivity     | Variability | Uncertainty | Component                 |
| $\omega$         | 80.3r/min | +0.333%/(r/min) | 2.2r/min    | 0.73%       | fan rotation rate         |
|                  |           |                 |             | 3.54%       | RSS combined uncertainty  |

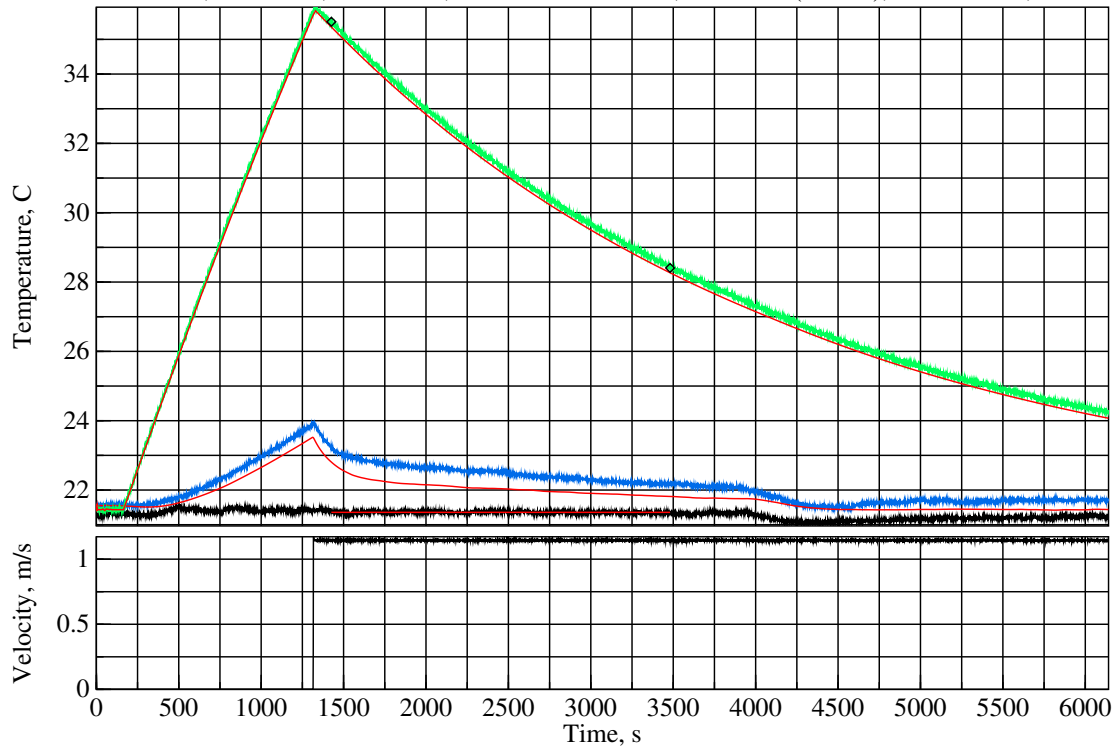
20170701T031434Z – mixed Convection – Roughness=1.04mm; T=21.5+10.4°C; -90.00°  
 160±1.0r/min, V=0.58m/s, Re=11562, Ra/L^3=0.993x10^9, h=7.99W/(K.m^2), U=0.743W/K, Nu=94.8



Estimated measurement uncertainties, bi-level 1mm roughness at  $Re = 11562$ .

| Symbol          | Nominal  | Sensitivity     | Bias        | Uncertainty | Component                 |
|-----------------|----------|-----------------|-------------|-------------|---------------------------|
| $\Delta T$      | 10.4K    | +13.1%/K        | 0.10K       | 1.31%       | LM35C differential        |
| $P$             | 101kPa   | +0.0009%/Pa     | 1.5kPa      | 1.30%       | MPXH6115A6U air pressure  |
| $C_{pt}$        | 4.24kJ/K | +0.029%/(J/K)   | 42J/K       | 1.24%       | plate thermal capacity    |
| $\eta$          | 0.408    | +163%           | 0.004       | 0.66%       | anemometer calibration    |
| $C_S$           | 1.000    | -23.1%          | 0.050       | 1.16%       | side reuptake             |
| $C_B$           | 1.000    | -8.80%          | 0.100       | 0.88%       | back reuptake             |
| $L_T$           | 8.34mm   | +5204%/m        | 100um       | 0.52%       | post length               |
| $\varsigma$     | 2.00mm   | -9912%/m        | 100um       | 0.99%       | post height               |
| $L_m$           | 3.57mm   | +729%/m         | 500um       | 0.36%       | side metal strip width    |
| $\epsilon_{tp}$ | 0.860    | +19.5%          | 0.015       | 0.29%       | tape emissivity           |
| $\Omega_{tp}$   | 0.540    | +12.1%          | 0.020       | 0.24%       | tape coverage             |
| $\epsilon_{rs}$ | 0.040    | +70.2%          | 0.010       | 0.70%       | test-surface emissivity   |
| $\epsilon_{wt}$ | 0.900    | +31.0%          | 0.025       | 0.77%       | wind-tunnel emissivity    |
|                 |          |                 |             | 3.20%       | combined bias uncertainty |
| Symbol          | Nominal  | Sensitivity     | Variability | Uncertainty | Component                 |
| $\omega$        | 160r/min | +0.414%/(r/min) | 0.95r/min   | 0.39%       | fan rotation rate         |
|                 |          |                 |             | 3.29%       | RSS combined uncertainty  |

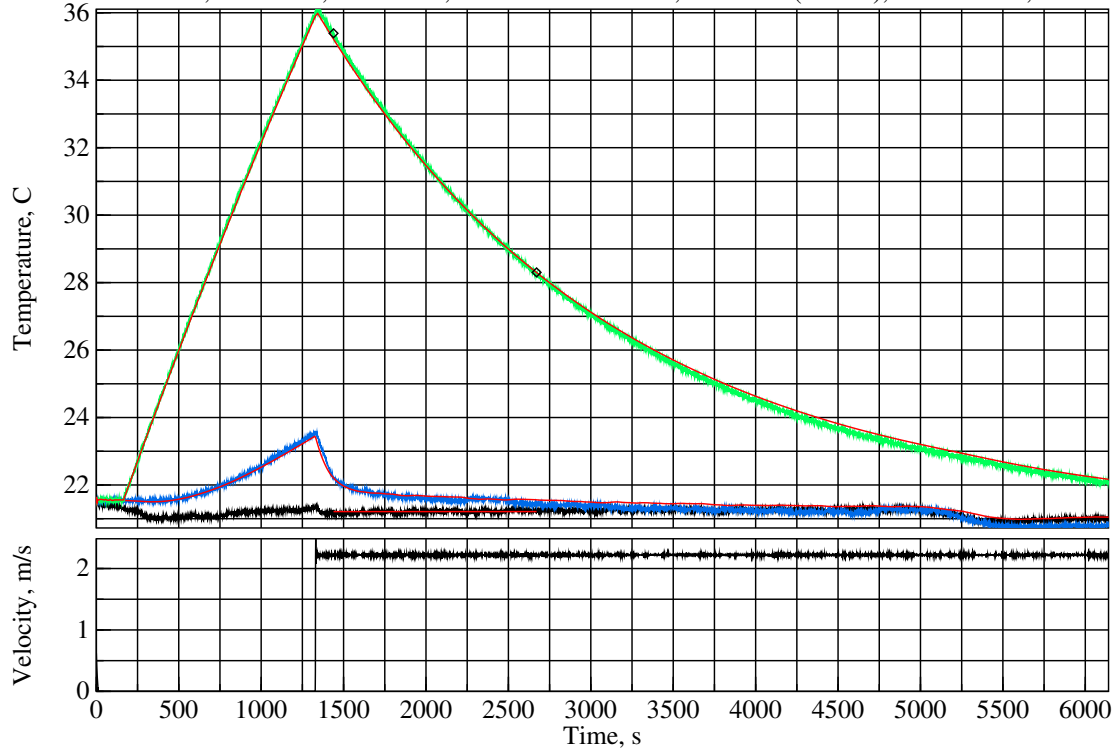
20170701T152213Z – mixed Convection – Roughness=1.04mm; T=21.4+10.2°C; -90.00°  
 320±1.0r/min, V=1.1m/s, Re=22966, Ra/L^3=0.979x10^9, h=12.9W/(K.m^2), U=1.20W/K, Nu=152.5



Estimated measurement uncertainties, bi-level 1mm roughness at  $Re = 22968$ .

| Symbol          | Nominal  | Sensitivity     | Bias        | Uncertainty | Component                 |
|-----------------|----------|-----------------|-------------|-------------|---------------------------|
| $\Delta T$      | 10.2K    | +11.7%/K        | 0.10K       | 1.17%       | LM35C differential        |
| $P$             | 101kPa   | +0.0009%/Pa     | 1.5kPa      | 1.29%       | MPXH6115A6U air pressure  |
| $C_{pt}$        | 4.24kJ/K | +0.027%/(J/K)   | 42J/K       | 1.15%       | plate thermal capacity    |
| $\eta$          | 0.408    | +196%           | 0.004       | 0.80%       | anemometer calibration    |
| $C_S$           | 1.000    | -13.7%          | 0.050       | 0.69%       | side reuptake             |
| $C_B$           | 1.000    | -5.43%          | 0.100       | 0.54%       | back reuptake             |
| $L_T$           | 8.34mm   | +8145%/m        | 100um       | 0.81%       | post length               |
| $\varsigma$     | 2.00mm   | -6829%/m        | 100um       | 0.68%       | post height               |
| $L_m$           | 3.57mm   | +561%/m         | 500um       | 0.28%       | side metal strip width    |
| $\epsilon_{rs}$ | 0.040    | +41.8%          | 0.010       | 0.42%       | test-surface emissivity   |
| $\epsilon_{wt}$ | 0.900    | +18.3%          | 0.025       | 0.46%       | wind-tunnel emissivity    |
|                 |          |                 |             | 2.73%       | combined bias uncertainty |
| Symbol          | Nominal  | Sensitivity     | Variability | Uncertainty | Component                 |
| $\omega$        | 320r/min | +0.250%/(r/min) | 1.0r/min    | 0.26%       | fan rotation rate         |
|                 |          |                 |             | 2.78%       | RSS combined uncertainty  |

20170701T212313Z – mixed Convection – Roughness=1.04mm; T=21.2+10.2°C; -90.00°  
 640±4.3r/min, V=2.2m/s, Re=44524, Ra/L^3=0.977x10^9, h=22.7W/(K.m^2), U=2.11W/K, Nu=269.5

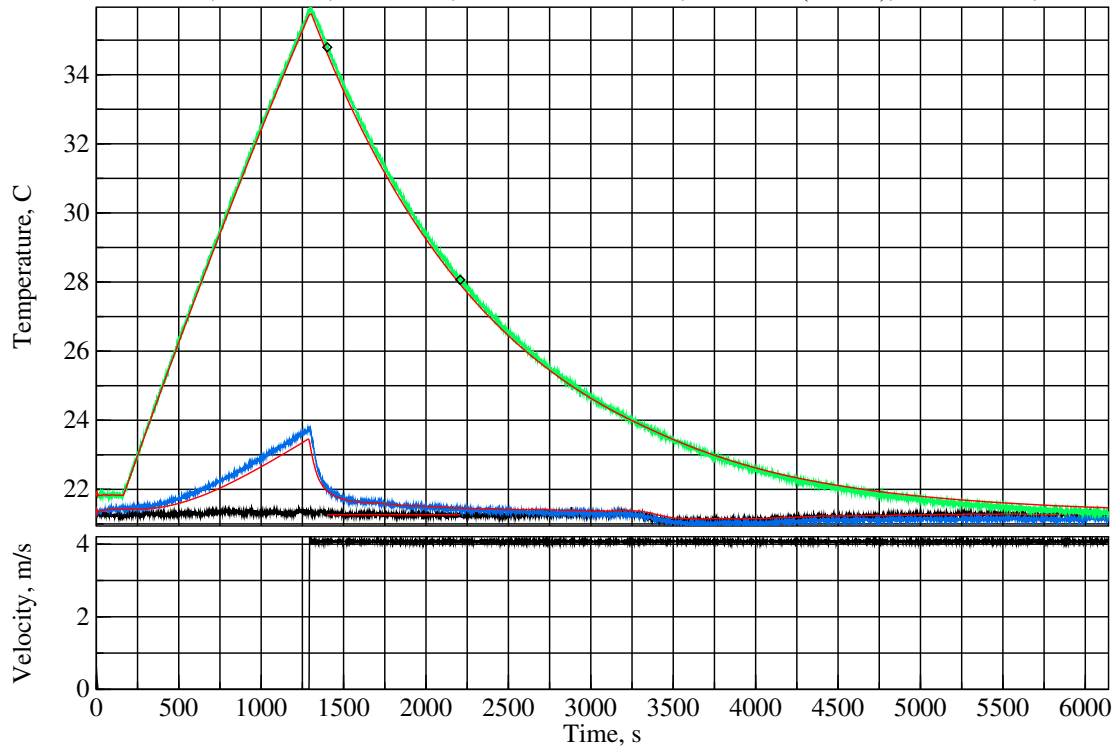


Estimated measurement uncertainties, bi-level 1mm roughness at  $Re = 44517$ .

| Symbol          | Nominal  | Sensitivity     | Bias        | Uncertainty | Component                 |
|-----------------|----------|-----------------|-------------|-------------|---------------------------|
| $\Delta T$      | 10.2K    | +10.9%/K        | 0.10K       | 1.09%       | LM35C differential        |
| $P$             | 100kPa   | +0.0008%/Pa     | 1.5kPa      | 1.22%       | MPXH6115A6U air pressure  |
| $C_{pt}$        | 4.24kJ/K | +0.026%/(J/K)   | 42J/K       | 1.09%       | plate thermal capacity    |
| $\eta$          | 0.408    | +183%           | 0.004       | 0.75%       | anemometer calibration    |
| $C_S$           | 1.000    | -8.03%          | 0.050       | 0.40%       | side reuptake             |
| $C_B$           | 1.000    | -3.25%          | 0.100       | 0.33%       | back reuptake             |
| $L_T$           | 8.34mm   | +9041%/m        | 100um       | 0.90%       | post length               |
| $\varsigma$     | 2.00mm   | -2853%/m        | 100um       | 0.29%       | post height               |
| $L_m$           | 3.57mm   | +467%/m         | 500um       | 0.23%       | side metal strip width    |
| $\epsilon_{rs}$ | 0.040    | +24.4%          | 0.010       | 0.24%       | test-surface emissivity   |
| $\epsilon_{wt}$ | 0.900    | +10.6%          | 0.025       | 0.27%       | wind-tunnel emissivity    |
|                 |          |                 |             | 2.42%       | combined bias uncertainty |
| Symbol          | Nominal  | Sensitivity     | Variability | Uncertainty | Component                 |
| $\omega$        | 640r/min | +0.117%/(r/min) | 4.3r/min    | 0.51%       | fan rotation rate         |
|                 |          |                 |             | 2.62%       | RSS combined uncertainty  |



20170701T231830Z – mixed Convection – Roughness=1.04mm; T=21.3+09.8°C; -90.00°  
 1280±6.3r/min, V=4.1m/s, Re=81697, Ra/L^3=0.941x10^9, h=36.2W/(K.m^2), U=3.37W/K, Nu=429.4



Estimated measurement uncertainties, bi-level 1mm roughness at  $Re = 81699$ .

| Symbol     | Nominal    | Sensitivity     | Bias        | Uncertainty | Component                    |
|------------|------------|-----------------|-------------|-------------|------------------------------|
| $\Delta T$ | 9.80K      | +10.9%/K        | 0.10K       | 1.09%       | LM35C differential           |
| $P$        | 100kPa     | +0.0008%/Pa     | 1.5kPa      | 1.18%       | MPXH6115A6U air pressure     |
| $C_{pt}$   | 4.24kJ/K   | +0.025%/(J/K)   | 42J/K       | 1.06%       | plate thermal capacity       |
| $\eta$     | 0.408      | +142%           | 0.004       | 0.58%       | anemometer calibration       |
| $u_u$      | 7.910      | +2.65%          | 0.100       | 0.26%       | diffuser airflow upper bound |
| $C_S$      | 1.000      | -4.93%          | 0.050       | 0.25%       | side reuptake                |
| $C_B$      | 1.000      | -2.04%          | 0.100       | 0.20%       | back reuptake                |
| $L_T$      | 8.34mm     | +9290%/m        | 100um       | 0.93%       | post length                  |
| $L_m$      | 3.57mm     | +438%/m         | 500um       | 0.22%       | side metal strip width       |
|            |            |                 |             | 2.28%       | combined bias uncertainty    |
| Symbol     | Nominal    | Sensitivity     | Variability | Uncertainty | Component                    |
| $\omega$   | 1.28kr/min | +0.053%/(r/min) | 6.3r/min    | 0.34%       | fan rotation rate            |
|            |            |                 |             | 2.38%       | RSS combined uncertainty     |