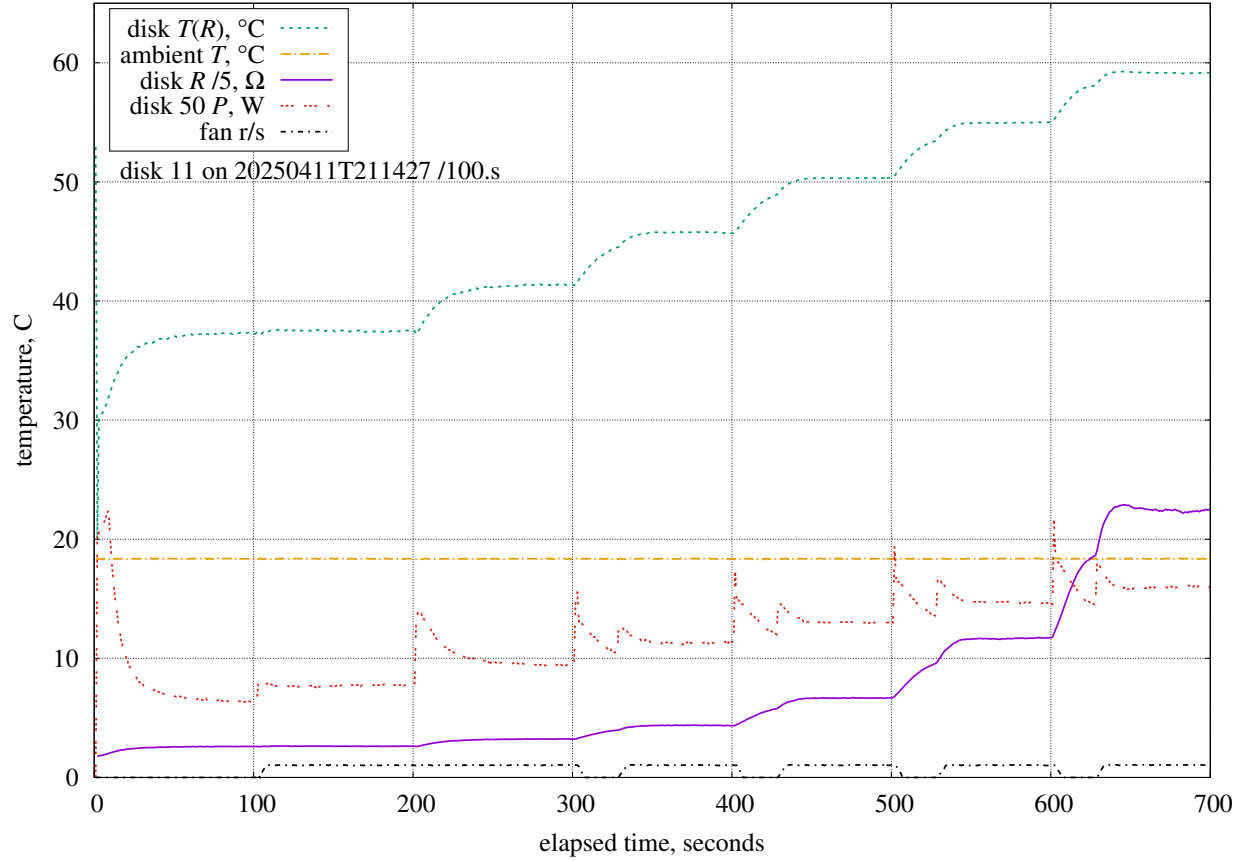


$\theta = 0.0^\circ$ ;  $\psi = 96.8^\circ$ ;  $V = 0.000 \text{ m/s}$  (0 r/min)

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

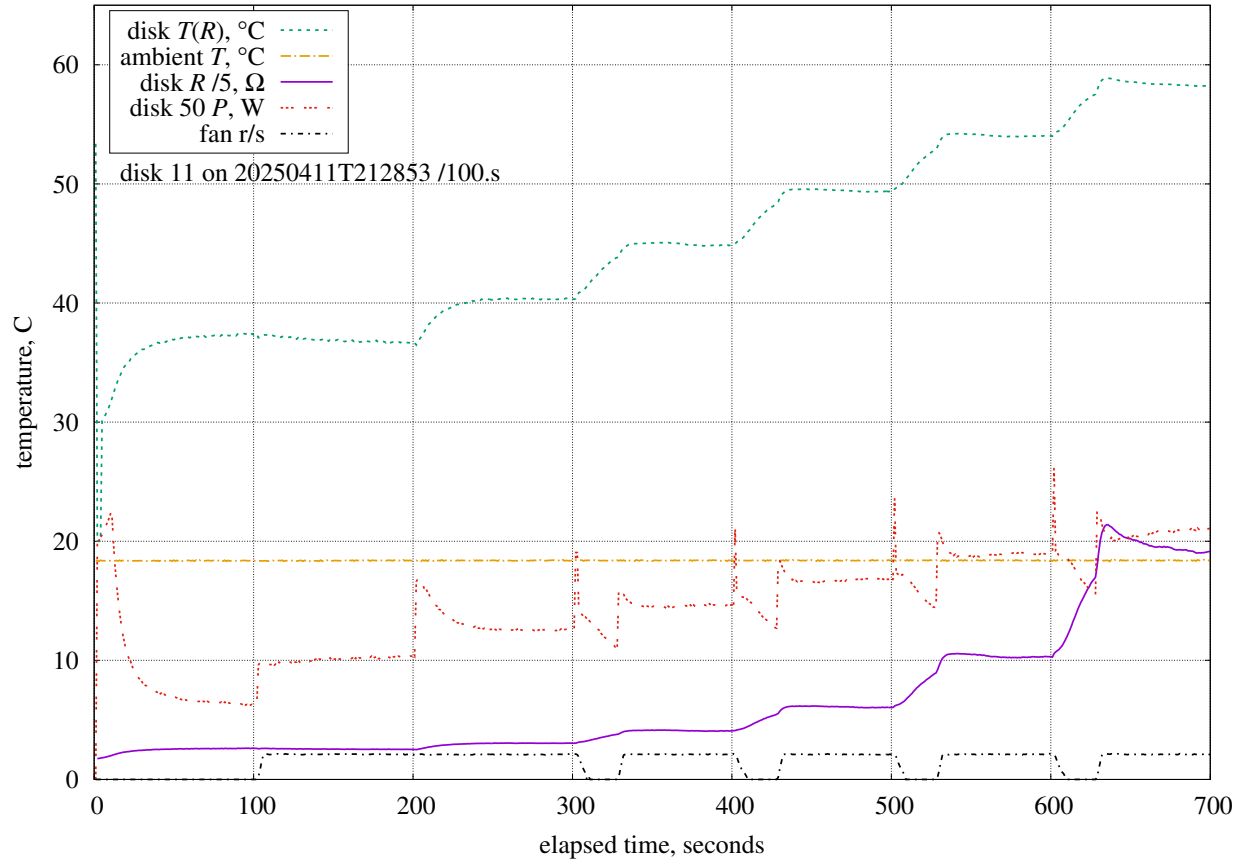
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
$\Delta T$	25.0.K	+4.34%/K	0.10.K	0.43%	LM35C differential
$P$	101.kPa	+0.0002%/Pa	1.5.kPa	0.29%	MPXH6115A6U air pressure
$D_o$	2.81.mm	+2834%/m	500.um	1.42%	tube outer diameter
$D_i$	1.11.mm	+4881%/m	200.um	0.98%	tube inner diameter
$L_{\text{wire}}$	38.0.mm	+979%/m	500.um	0.49%	wire length
$k_{\text{ABS}}$	179. $\frac{\text{mW}}{\text{K}\cdot\text{m}}$	+0.118%/ $\frac{\text{mW}}{\text{K}\cdot\text{m}}$	9.0. $\frac{\text{mW}}{\text{K}\cdot\text{m}}$	1.05%	ABS thermal conductivity
$d$	12.0.mm	+5220%/m	100.um	0.52%	disk diameter
$\theta$	50.0.m°	+21.6%/°	0.20.°	4.31%	plate angle
				4.85%	combined bias uncertainty



$\theta = 0.0^\circ$ ;  $\psi = 96.8^\circ$ ;  $V = 0.187 \text{ m/s}$  (62 r/min)

Estimated measurement uncertainties at  $Re = 139$ .

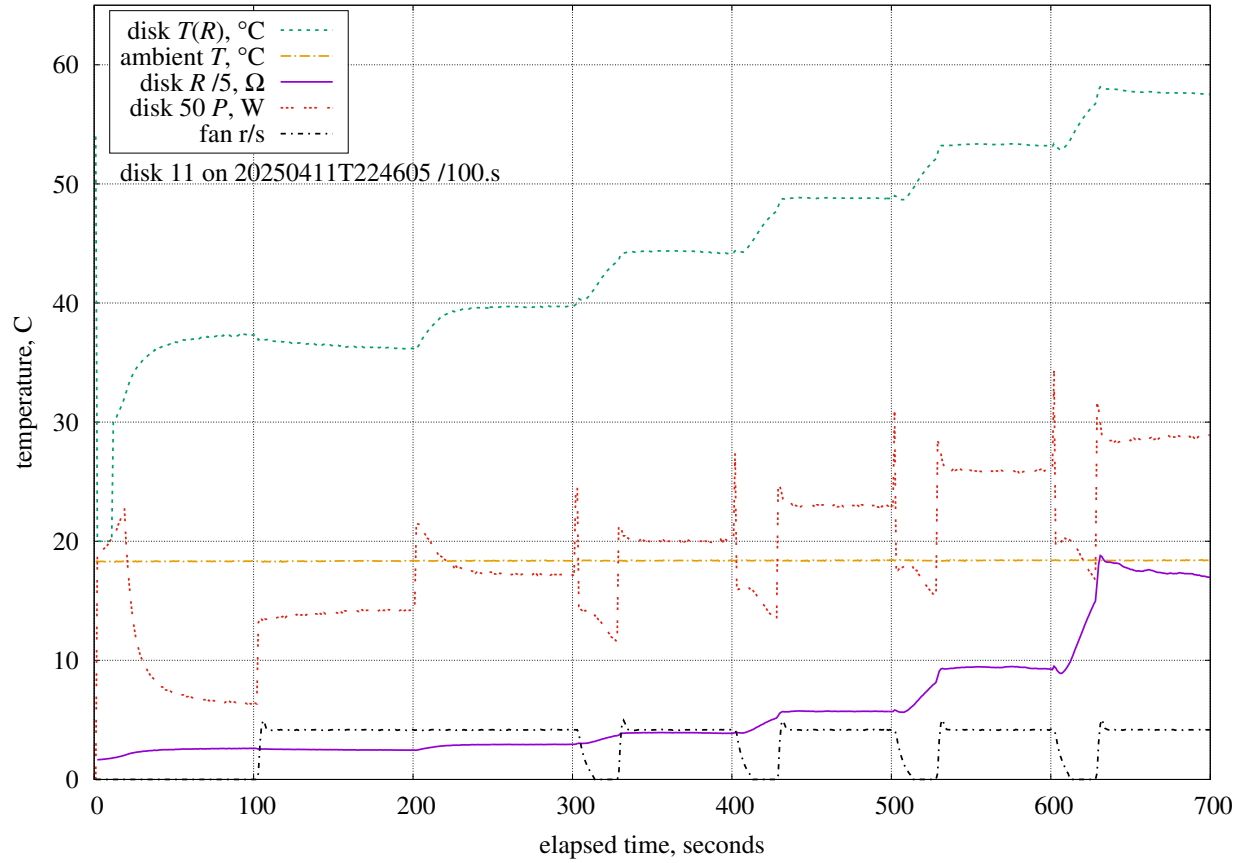
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
$T$	304.K	$-0.411\%/K$	0.50.K	0.21%	LM35C temperature sensor
$\Delta T$	25.0.K	$+4.11\%/K$	0.10.K	0.41%	LM35C differential
$P$	101.kPa	$+0.0005\%/Pa$	1.5.kPa	0.74%	MPXH6115A6U air pressure
$\eta$	0.340	$+116\%$	0.007	0.79%	anemometer calibration
$Re_0$	600	$-0.0051\%$	60	0.30%	integration lower-bound
$D_o$	2.81.mm	$-7239\%/m$	500.um	3.62%	tube outer diameter
$D_i$	1.11.mm	$+9378\%/m$	200.um	1.88%	tube inner diameter
$L_{\text{wire}}$	38.0.mm	$+1005\%/m$	500.um	0.50%	wire length
$k_{\text{ABS}}$	179. $\frac{\text{mW}}{\text{K}\cdot\text{m}}$	$+0.146\%/ \frac{\text{mW}}{\text{K}\cdot\text{m}}$	9.0. $\frac{\text{mW}}{\text{K}\cdot\text{m}}$	1.30%	ABS thermal conductivity
$d$	12.0.mm	$+5886\%/m$	100.um	0.59%	disk diameter
$\epsilon_{\text{ABS}}$	0.920	$-40.2\%$	0.010	0.40%	ABS emissivity
$\epsilon_{wt}$	0.900	$-40.5\%$	0.025	1.01%	wind-tunnel emissivity
$\theta$	50.0.m°	$-4.00\%/^\circ$	0.20.°	0.80%	plate angle
				4.72%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
$\omega$	62.0.r/min	$+0.635\%/(r/min)$	0.90.r/min	0.57%	fan rotation rate
				4.86%	RSS combined uncertainty



$\theta = 0.0^\circ$ ;  $\psi = 96.8^\circ$ ;  $V = 0.380$  m/s (126 r/min)

Estimated measurement uncertainties at  $Re = 284$ .

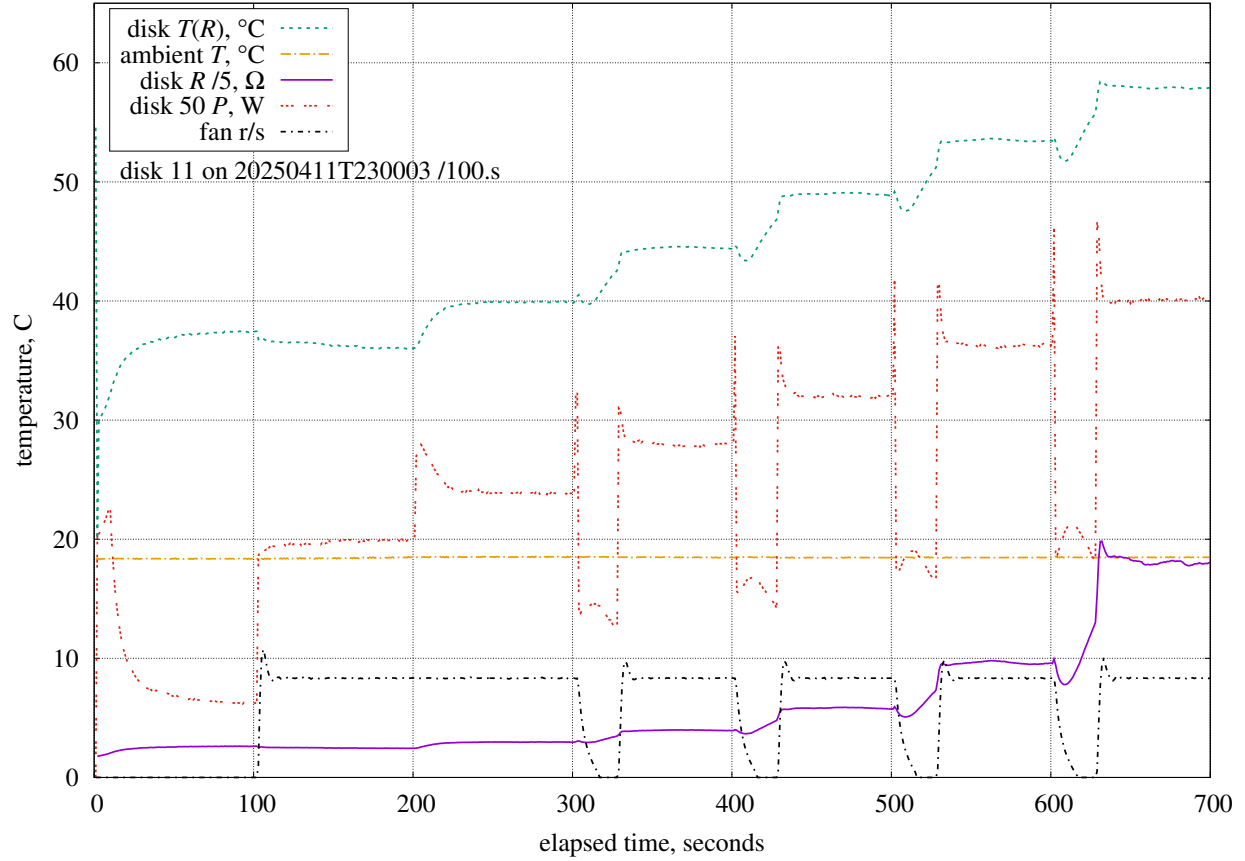
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
$T$	304.K	$-0.462\%/K$	0.50.K	0.23%	LM35C temperature sensor
$\Delta T$	25.0.K	$+3.97\%/K$	0.10.K	0.40%	LM35C differential
$P$	101.kPa	$+0.0005\%/Pa$	1.5.kPa	0.75%	MPXH6115A6U air pressure
$\eta$	0.340	$+128\%$	0.007	0.87%	anemometer calibration
$Re_0$	600	$-0.0071\%$	60	0.43%	integration lower-bound
$D_o$	2.81.mm	$-10538\%/m$	500.um	5.27%	tube outer diameter
$D_i$	1.11.mm	$+14104\%/m$	200.um	2.82%	tube inner diameter
$D_g$	166.um	$-369\%/m$	750.um	0.28%	tube air gap
$L_{wire}$	38.0.mm	$+1539\%/m$	500.um	0.77%	wire length
$k_{ABS}$	179. $\frac{mW}{K \cdot m}$	$+0.178\%/ \frac{mW}{K \cdot m}$	9.0. $\frac{mW}{K \cdot m}$	1.59%	ABS thermal conductivity
$d$	12.0.mm	$+5429\%/m$	100.um	0.54%	disk diameter
$\epsilon_{ABS}$	0.920	$-44.9\%$	0.010	0.45%	ABS emissivity
$\epsilon_{wt}$	0.900	$-45.4\%$	0.025	1.14%	wind-tunnel emissivity
$\theta$	50.0.m°	$-5.06\%/^\circ$	0.20.°	1.01%	plate angle
				6.59%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
$\omega$	126.r/min	$+0.345\%/(r/min)$	1.0.r/min	0.36%	fan rotation rate
				6.63%	RSS combined uncertainty



$\theta = 0.0^\circ$ ;  $\psi = 96.8^\circ$ ;  $V = 0.748$  m/s (250 r/min)

Estimated measurement uncertainties at  $Re = 558$ .

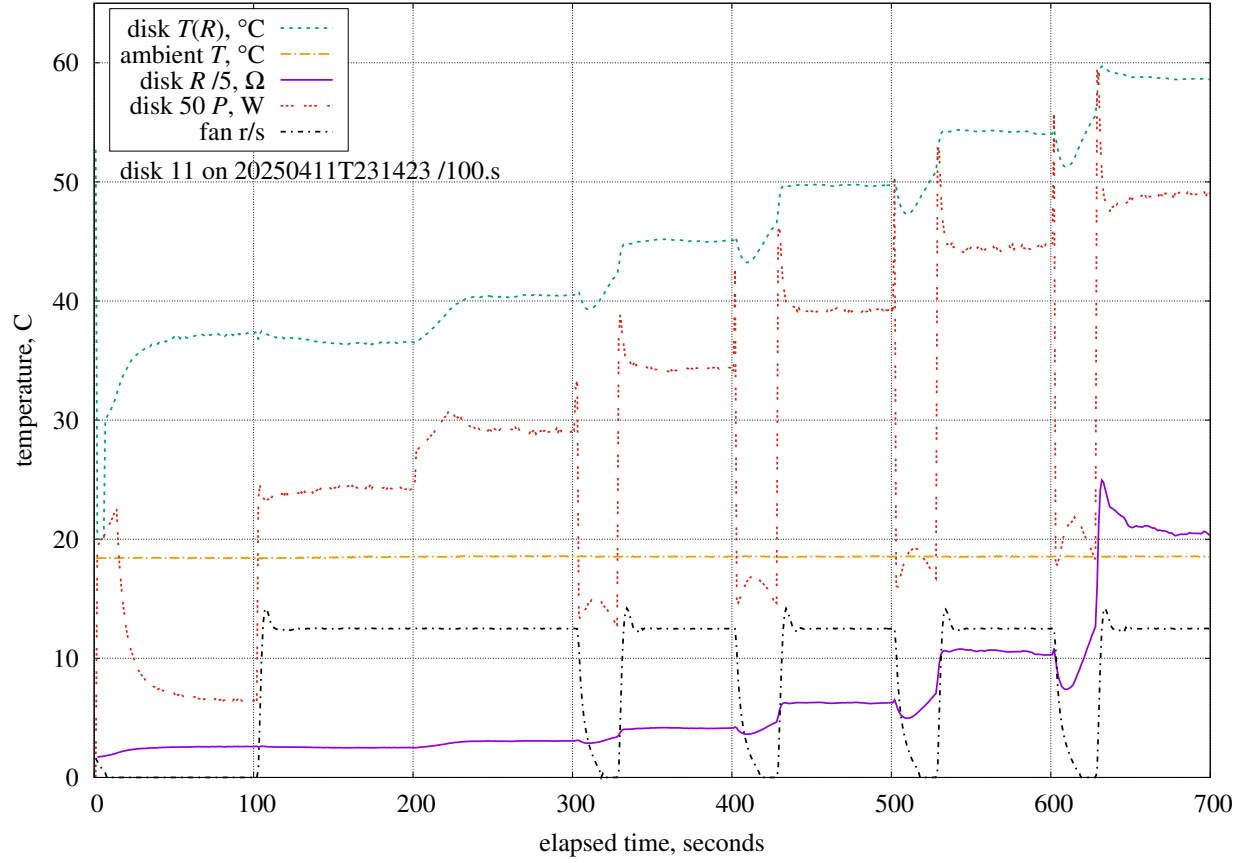
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
$T$	304.K	$-0.482\%/K$	0.50.K	0.24%	LM35C temperature sensor
$\Delta T$	25.0.K	$+3.82\%/K$	0.10.K	0.38%	LM35C differential
$P$	101.kPa	$+0.0005\%/Pa$	1.5.kPa	0.72%	MPXH6115A6U air pressure
$\eta$	0.340	$+129\%$	0.007	0.88%	anemometer calibration
$Re_0$	600	$-0.0087\%$	60	0.52%	integration lower-bound
$D_o$	2.81.mm	$-13641\%/m$	500.um	6.82%	tube outer diameter
$D_i$	1.11.mm	$+18456\%/m$	200.um	3.69%	tube inner diameter
$D_g$	166.um	$-517\%/m$	750.um	0.39%	tube air gap
$L_{wire}$	38.0.mm	$+2155\%/m$	500.um	1.08%	wire length
$k_{ABS}$	179. $\frac{mW}{K \cdot m}$	$+0.202\%/ \frac{mW}{K \cdot m}$	9.0. $\frac{mW}{K \cdot m}$	1.81%	ABS thermal conductivity
$d$	12.0.mm	$+5315\%/m$	100.um	0.53%	disk diameter
$\epsilon_{ABS}$	0.920	$-46.4\%$	0.010	0.46%	ABS emissivity
$\epsilon_{wt}$	0.900	$-47.2\%$	0.025	1.18%	wind-tunnel emissivity
$\theta$	50.0.m $^\circ$	$-4.42\%/^\circ$	0.20. $^\circ$	0.88%	plate angle
				8.32%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
$\omega$	250.r/min	$+0.176\%/(r/min)$	1.1.r/min	0.19%	fan rotation rate
				8.33%	RSS combined uncertainty



$\theta = 0.0^\circ$ ;  $\psi = 96.8^\circ$ ;  $V = 1.467 \text{ m/s}$  (500 r/min)

Estimated measurement uncertainties at  $Re = 1094$ .

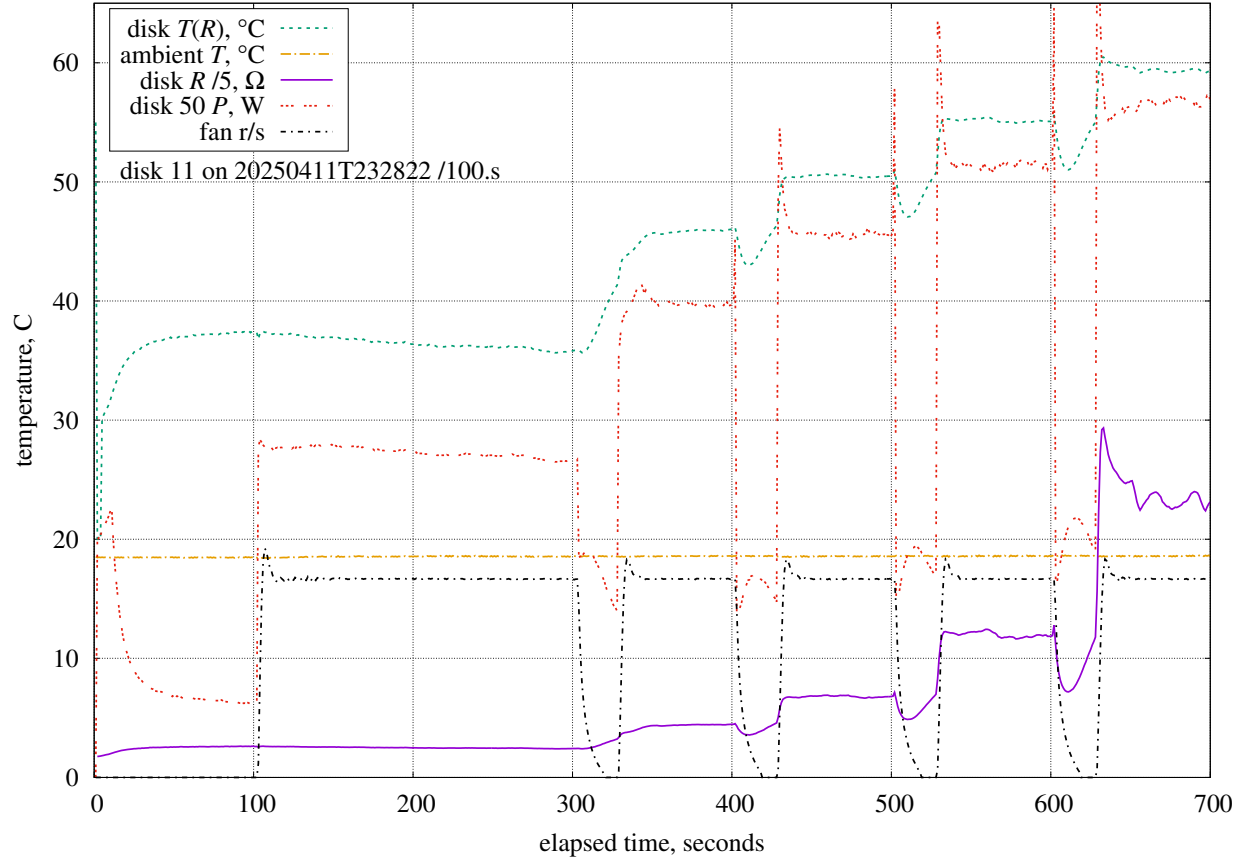
Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
$T$	304.K	$-0.496\%/K$	0.50.K	0.25%	LM35C temperature sensor
$\Delta T$	25.0.K	$+3.62\%/K$	0.10.K	0.36%	LM35C differential
$P$	101.kPa	$+0.0005\%/Pa$	1.5.kPa	0.69%	MPXH6115A6U air pressure
$\eta$	0.340	$+122\%$	0.007	0.83%	anemometer calibration
$Re_0$	600	$-0.0098\%$	60	0.59%	integration lower-bound
$D_o$	2.81.mm	$-16887\%/m$	500.um	8.44%	tube outer diameter
$D_i$	1.11.mm	$+22194\%/m$	200.um	4.44%	tube inner diameter
$D_g$	166.um	$-682\%/m$	750.um	0.51%	tube air gap
$L_{\text{wire}}$	38.0.mm	$+2842\%/m$	500.um	1.42%	wire length
$k_{\text{ABS}}$	$179. \frac{\text{mW}}{\text{K}\cdot\text{m}}$	$+0.220\%/ \frac{\text{mW}}{\text{K}\cdot\text{m}}$	$9.0. \frac{\text{mW}}{\text{K}\cdot\text{m}}$	1.97%	ABS thermal conductivity
$d$	12.0.mm	$+5459\%/m$	100.um	0.55%	disk diameter
$\epsilon_{\text{ABS}}$	0.920	$-47.8\%$	0.010	0.48%	ABS emissivity
$\epsilon_{wt}$	0.900	$-48.6\%$	0.025	1.21%	wind-tunnel emissivity
$\theta$	$50.0.m^\circ$	$-3.50\%/^\circ$	$0.20.^\circ$	0.70%	plate angle
				10.07%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
$\omega$	500.r/min	$+0.083\%/(r/min)$	1.5.r/min	0.13%	fan rotation rate
				10.07%	RSS combined uncertainty



$\theta = 0.0^\circ$ ;  $\psi = 96.8^\circ$ ;  $V = 2.130$  m/s (750 r/min)

Estimated measurement uncertainties at  $Re = 1588$ .

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
$T$	304.K	$-0.513\%/K$	0.50.K	0.26%	LM35C temperature sensor
$\Delta T$	25.0.K	$+3.47\%/K$	0.10.K	0.35%	LM35C differential
$P$	101.kPa	$+0.0004\%/Pa$	1.5.kPa	0.67%	MPXH6115A6U air pressure
$\eta$	0.340	$+112\%$	0.007	0.76%	anemometer calibration
$Re_0$	600	$-0.0100\%$	60	0.60%	integration lower-bound
$D_o$	2.81.mm	$-19006\%/m$	500.um	9.50%	tube outer diameter
$D_i$	1.11.mm	$+23904\%/m$	200.um	4.78%	tube inner diameter
$D_g$	166.um	$-785\%/m$	750.um	0.59%	tube air gap
$L_{wire}$	38.0.mm	$+3272\%/m$	500.um	1.64%	wire length
$k_{ABS}$	179. $\frac{mW}{K \cdot m}$	$+0.226\%/ \frac{mW}{K \cdot m}$	9.0. $\frac{mW}{K \cdot m}$	2.02%	ABS thermal conductivity
$d$	12.0.mm	$+5602\%/m$	100.um	0.56%	disk diameter
$\epsilon_{ABS}$	0.920	$-49.7\%$	0.010	0.50%	ABS emissivity
$\epsilon_{wt}$	0.900	$-50.6\%$	0.025	1.26%	wind-tunnel emissivity
$\theta$	50.0.m°	$-3.03\%/^\circ$	0.20.°	0.61%	plate angle
				11.15%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
$\omega$	750.r/min	$+0.051\%/(r/min)$	0.97.r/min	0.05%	fan rotation rate
				11.15%	RSS combined uncertainty



$\theta = 0.0^\circ$ ;  $\psi = 96.8^\circ$ ;  $V = 2.726$  m/s (1000 r/min)

Estimated measurement uncertainties at  $Re = 2031$ .

Symbol	Nominal	Sensitivity	Bias	Uncertainty	Component
$T$	304.K	$-0.550\%/K$	0.50.K	0.27%	LM35C temperature sensor
$\Delta T$	25.0.K	$+3.26\%/K$	0.10.K	0.33%	LM35C differential
$P$	101.kPa	$+0.0004\%/Pa$	1.5.kPa	0.65%	MPXH6115A6U air pressure
$\eta$	0.340	$+101\%$	0.007	0.69%	anemometer calibration
$Re_0$	600	$-0.0099\%$	60	0.59%	integration lower-bound
$D_o$	2.81.mm	$-21313\%/m$	500.um	10.66%	tube outer diameter
$D_i$	1.11.mm	$+24936\%/m$	200.um	4.99%	tube inner diameter
$D_g$	166.um	$-877\%/m$	750.um	0.66%	tube air gap
$L_{wire}$	38.0.mm	$+3656\%/m$	500.um	1.83%	wire length
$k_{ABS}$	179. $\frac{mW}{K \cdot m}$	$+0.230\%/ \frac{mW}{K \cdot m}$	9.0. $\frac{mW}{K \cdot m}$	2.06%	ABS thermal conductivity
$d$	12.0.mm	$+5670\%/m$	100.um	0.57%	disk diameter
$\epsilon_{ABS}$	0.920	$-53.9\%$	0.010	0.54%	ABS emissivity
$\epsilon_{wt}$	0.900	$-54.9\%$	0.025	1.37%	wind-tunnel emissivity
$\theta$	50.0.m°	$-2.77\%/^\circ$	0.20.°	0.55%	plate angle
				12.28%	combined bias uncertainty
Symbol	Nominal	Sensitivity	Variability	Uncertainty	Component
$\omega$	1.00.kr/min	$+0.034\%/(r/min)$	1.5.r/min	0.05%	fan rotation rate
				12.28%	RSS combined uncertainty