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pulse tube refrigerator

Inputs

NTnode	number time nodes	10
Lnorm	length scale (m)	1.000E-02
FreqNorm	frequency scale (Hz)	5.000E+01
Pnorm	pressure scale (Pa)	1.600E+06
Tnorm	temperature scale (K)	3.000E+02
Qnorm	heat flow scale (W)	1.000E+02
Freq	frequency (Hz)	5.000E+01
Gas	working gas	Ideal Helium

Outputs

Omega	angular frequency (rad/s)	3.142E+02
Objective Function (Pending)		
Minimize Tmin		
Value is 4.729E+01 (norm = 3.000E+02)		

1 pressure source

Inputs		
Pcharge	charge pressure (Pa)	1.600E+06
2 back volume		
Inputs		
NCell	number spatial cells	3
Length	mean-flow length (m)	1.000E-01
Twall	wall thickness (m)	1.000E-03
Tinit	initial temperature (NonDim, K)	unit spline... (0.000E+00, 3.000E+02) (1.000E+00, 3.000E+02)
Swet	wetted surface (m2)	2.000E-01
Volume	mean volume (m3)	1.139E-03
Outputs		
Aflow	mean flow area (m2)	1.139E-02
Asec	mean solid cross section (m2)	2.000E-03
Sratio	surface / min cyl surface	3.310E+00
2.1 cylinder-space gas		
Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Outputs		
PV	PV power output (W, rad)	-4.213E+01... (1.223, 0.018, 0.001, 0.000, 0.000)E+04 Amp (1.571, -1.337, 1.698, 1.390, 0.000)E+00 Arg
FQwNet	net surface heat inflow (W, rad)	-2.290E+02... (9.321, 2.138, 3.226, 2.323, 1.512)E+02 Amp (0.546, 0.209, 2.041, 0.346, 3.142)E+00 Arg
HNeg	net enthalpy neg bnd (W)	0.000E+00
HPos	net enthalpy pos bnd (W)	-1.867E+02
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	0.000E+00
AEQw	AE loss to surf heat flow (W)	2.009E+01
AEQx	AE loss to axial heat flow (W)	1.999E-01
AEdiscr	AE loss discrepancy (W)	1.199E+01
QwNeg	surf heat influx neg bnd (W/m)	7.018E+00
QwPos	surf heat influx pos bnd (W/m)	-9.803E+03
QxMean	mean axial heat flow (W)	-1.555E+00
TNeg	mean temperature neg bnd (K)	3.006E+02
TPos	mean temperature pos bnd (K)	3.115E+02
Vmean	mean volume (m3)	1.139E-03
FTmean	x-mean temperature (K, rad)	3.007E+02... (3.479, 0.169, 0.036, 0.022, 0.004)E+00 Amp (-2.833, -0.115, 0.502, -1.264, -3.142)E+00 Arg
FPmean	x-mean pressure (Pa, rad)	1.600E+06... (4.753, 0.198, 0.006, 0.016, 0.002)E+04 Amp (-2.908, 0.048, -0.314, -1.271, -3.142)E+00 Arg
FPNeg	pressure neg bnd (Pa, rad)	1.600E+06... (4.753, 0.198, 0.006, 0.016, 0.002)E+04 Amp (-2.908, 0.048, -0.318, -1.272, -3.142)E+00 Arg
FPPos	pressure pos bnd (Pa, rad)	1.600E+06... (4.753, 0.198, 0.006, 0.016, 0.002)E+04 Amp (-2.908, 0.047, -0.308, -1.271, -3.142)E+00 Arg
FV	volume (m3, rad)	1.139E-03... (2.434, 0.000, 0.000, 0.000, 0.000)E-05 Amp (0.000, -1.893, -1.893, -1.571, -2.046)E+00 Arg
FM	gas mass (kg, rad)	2.915E-03... (1.419, 0.115, 0.026, 0.008, 0.000)E-05 Amp (-0.767, 0.094, -2.265, -1.313, -3.142)E+00 Arg
FHmean	x-mean enthalpy flow (W, rad)	1.786E+01... (3.518, 0.590, 0.152, 0.077, 0.014)E+03 Amp (-2.333, -1.426, 2.373, -2.881, 0.000)E+00 Arg
FRhoUAmean	x-mean mass flow rate (kg/s, rad)	-4.579E-17... (2.255, 0.388, 0.095, 0.049, 0.009)E-03 Amp (-2.332, -1.445, 2.377, -2.892, 0.000)E+00 Arg
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	0.000E+00... (0.000, 0.000, 0.000, 0.000, 0.000)E+00 Amp (0.000, 0.000, 0.000, 0.000, 0.000)E+00 Arg
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	2.365E-18... (4.457, 0.722, 0.241, 0.103, 0.015)E-03 Amp (-2.337, -1.477, 2.447, -2.884, 0.000)E+00 Arg
MachMean	mean Mach number	4.955E-05
ReMean	mean turbulent Reynolds number	1.268E+04
VaMean	mean Valensi number	5.268E+03
TbMean	mean turbulence intensity (J/m3)	9.474E+01

Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

2.2 isothermal surface

Outputs		
QwNet	net surface heat outflow (W)	-2.290E+02

3 front volume

Inputs		
NCell	number spatial cells	3
Length	mean-flow length (m)	1.000E-01
Twall	wall thickness (m)	1.000E-03
Tinit	initial temperature (NonDim, K)	unit spline... (0.000E+00, 3.000E+02) (1.000E+00, 3.000E+02)
Swet	wetted surface (m2)	9.990E-03
Volume	mean volume (m3)	5.176E-05
Outputs		
Aflow	mean flow area (m2)	5.176E-04
Asec	mean solid cross section (m2)	9.990E-05
Sratio	surface / min cyl surface	1.298E+00

3.1 cylinder-space gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Outputs		
PV	PV power output (W, rad)	-1.382E+03... (1.217, 0.182, 0.026, 0.007, 0.001)E+04 Amp (-1.592, -0.749, -0.055, 0.740, 3.142)E+00 Arg
FQwNet	net surface heat inflow (W, rad)	-7.421E+02... (4.991, 2.507, 1.861, 3.474, 2.470)E+02 Amp (-0.822, 2.278, -0.331, -0.576, 0.000)E+00 Arg
HNeg	net enthalpy neg bnd (W)	-1.869E+02
HPos	net enthalpy pos bnd (W)	4.535E+02
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	0.000E+00
AEQw	AE loss to surf heat flow (W)	2.702E+01
AEQx	AE loss to axial heat flow (W)	8.920E-01
AEdiscr	AE loss discrepancy (W)	3.764E+01
QwNeg	surf heat influx neg bnd (W/m)	-1.001E+04
QwPos	surf heat influx pos bnd (W/m)	-2.000E+04
QxMean	mean axial heat flow (W)	-2.201E+00
TNeg	mean temperature neg bnd (K)	3.211E+02
TPos	mean temperature pos bnd (K)	3.246E+02
Vmean	mean volume (m3)	5.176E-05
FTmean	x-mean temperature (K, rad)	3.066E+02... (3.401, 0.462, 0.093, 0.088, 0.002)E+01 Amp (1.073, 1.405, 2.554, -2.281, -3.142)E+00 Arg
FPmean	x-mean pressure (Pa, rad)	1.589E+06... (4.753, 0.661, 0.203, 0.077, 0.011)E+05 Amp (0.864, 1.627, 2.392, -2.872, -3.142)E+00 Arg
FPNeg	pressure neg bnd (Pa, rad)	1.589E+06... (4.752, 0.661, 0.204, 0.078, 0.011)E+05 Amp (0.864, 1.628, 2.395, -2.870, -3.142)E+00 Arg
FPPos	pressure pos bnd (Pa, rad)	1.589E+06... (4.754, 0.662, 0.203, 0.077, 0.011)E+05 Amp (0.864, 1.625, 2.387, -2.873, -3.142)E+00 Arg
FV	volume (m3, rad)	5.176E-05... (2.434, 0.000, 0.000, 0.000, 0.000)E-05 Amp (-3.142, -1.633, -0.833, -2.034, -2.187)E+00 Arg
FM	gas mass (kg, rad)	1.236E-04... (4.502, 0.483, 0.055, 0.009, 0.000)E-05 Amp (2.773, -2.706, 2.784, -2.592, -3.142)E+00 Arg
FHmean	x-mean enthalpy flow (W, rad)	2.393E+02... (5.638, 1.635, 0.655, 0.271, 0.022)E+03 Amp (1.715, 2.344, 1.982, 3.017, 0.000)E+00 Arg
FRhoUAMean	x-mean mass flow rate (kg/s, rad)	8.359E-19... (3.498, 0.861, 0.387, 0.144, 0.017)E-03 Amp (1.732, 2.269, 1.796, 2.979, 0.000)E+00 Arg
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	2.953E-18... (4.456, 0.722, 0.241, 0.103, 0.015)E-03 Amp (-2.336, -1.476, 2.446, -2.888, 0.000)E+00 Arg
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	-5.659E-19... (1.018, 0.237, 0.064, 0.018, 0.002)E-02 Amp (1.372, 2.108, 1.578, 2.710, 0.000)E+00 Arg

MachMean	mean Mach number	2.581E-03
ReMean	mean turbulent Reynolds number	3.089E+04
VaMean	mean Valensi number	4.135E+03
TbMean	mean turbulence intensity (J/m3)	6.191E+02
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

3.2 isothermal surface

Outputs		
QwNet	net surface heat outflow (W)	-7.421E+02

4 constrained piston and cylinder

Inputs		
NCell	number spatial cells	3
Length	shell and liner length (m)	1.829E-02
Dshell	moving shell OD (m)	3.937E-02
Tinit	initial temperature (NonDim, K)	unit spline...
	(0.000E+00, 3.000E+02)	
	(1.000E+00, 3.000E+02)	
Outputs		
Dliner	cylinder liner OD (m)	4.137E-02

4.1 cylinder liner

Inputs		
Solid	canister material	SS304
Wcan	wall thickness (m)	1.000E-03
Outputs		
Din	canister ID (m)	3.937E-02
Avoid	void cross section (m2)	1.217E-03
Asolid	solid cross section (m2)	1.268E-04
Mass	canister mass (kg)	1.809E-02

4.2 piston shell

Inputs		
Solid	canister material	SS304
Wcan	wall thickness (m)	1.000E-03
Outputs		
Din	canister ID (m)	3.737E-02
Avoid	void cross section (m2)	1.097E-03
Asolid	solid cross section (m2)	1.205E-04
Mass	canister mass (kg)	1.720E-02

4.3 constrained piston

Inputs		
FX	displacement (m, rad)	0.000E+00...
	(10.00)E-03 Amp	
	(0.000)E+00 Arg	
Mass	reciprocating mass (kg)	7.760E-01
Outputs		
F	boundary force (N, rad)	1.323E+01...
	(1.168, 0.081, 0.025, 0.009, 0.001)E+03 Amp	
	(-2.425, -1.485, -0.749, 0.249, 0.000)E+00 Arg	
W	boundary power inflow (W, rad)	-1.206E+03...
	(0.130, 1.839, 0.130, 0.036, 0.004)E+03 Amp	
	(2.903, -0.875, -0.027, 0.743, 3.142)E+00 Arg	
FF	required forcing function (N, rad)	-1.323E+01...
	(7.761, 0.806, 0.248, 0.094, 0.013)E+02 Amp	
	(1.423, 1.657, 2.393, -2.892, 3.142)E+00 Arg	

4.3.3 neg-facing area

Inputs		
A	face area (m2)	1.217E-03

4.3.4 pos-facing area

Inputs		
A	face area (m2)	1.217E-03

4.4 spring (flexure bearing)

Inputs		
K	stiffness (N/m)	4.487E+04
Outputs		
F	boundary force (N, rad)	8.327E-18...
	(4.487, 0.000, 0.000, 0.000, 0.000)E+02 Amp	
	(0.000, 1.190, 2.944, -2.554, 0.000)E+00 Arg	
W	boundary power inflow (W, rad)	1.908E-16...

(0.000, 7.048, 0.000, 0.000, 0.000)E+02 Amp
(2.135, 1.571, 3.026, -0.281, 0.000)E+00 Arg

4.5 damper (flexure bearing)

Inputs
D damping coef ((N s)/m) 1.000E+02

Outputs
F boundary force (N, rad) 9.750E-18...
(3.142, 0.000, 0.000, 0.000, 0.000)E+02 Amp
(1.571, 3.019, -2.761, -0.571, 0.000)E+00 Arg
W boundary power inflow (W, rad) 4.935E+02...
(0.000, 4.935, 0.000, 0.000, 0.000)E+02 Amp
(1.245, 3.142, -1.927, -1.447, -0.355)E+00 Arg

4.6 annulus shuttle/seal/appendix (clearance)

Inputs
NCell number spatial cells 2
XNeg parent-relative neg bnd [0, 1] 0.000E+00
XPos parent-relative pos bnd [0, 1] 1.000E+00
Gap radial clearance gap (m) 2.500E-05
Roughness mean wall roughness / Dhyd (NonDim) 1.000E-03

Outputs
Aflow mean flow area (m2) 3.092E-06
Pwet wetted perimeter (m) 2.474E-01
Length annulus length (m) 1.829E-02
TsNeg temperature neg bnd (K) 3.000E+02
TsPos temperature pos bnd (K) 3.000E+02
QNeg shuttle heat flow neg bnd (W) 0.000E+00
QPos shuttle heat flow pos bnd (W) 0.000E+00
AEQ AE loss to shuttle heat flow (W) 0.000E+00

4.6.1 matrix gas

Inputs
Fmult flow friction multiplier 1.000E+00
Hmult heat transfer multiplier 1.000E+00
Kmult axial conduction multiplier interior 1.000E+00
KmultBnd axial conduction multiplier endpoints 0.000E+00
UpwindFrac upwind weight for density interpolation 1.000E-02

Outputs
FQwNet net surface heat inflow (W, rad) -1.402E-07...
(9.379, 2.356, 1.628, 1.125, 0.224)E+01 Amp
(-2.261, -1.302, -0.340, 0.383, 0.000)E+00 Arg
HNeg net enthalpy neg bnd (W) -4.078E+01
HPos net enthalpy pos bnd (W) -4.078E+01
QNeg net conduction neg bnd (W) 0.000E+00
QPos net conduction pos bnd (W) 0.000E+00
AEfric AE loss to flow friction (W) 5.349E+01
AEQw AE loss to surf heat flow (W) 1.226E-01
AEQx AE loss to axial heat flow (W) 3.755E-05
AEdiscr AE loss discrepancy (W) -3.107E-01
QwNeg surf heat influx neg bnd (W/m) -2.743E-06
QwPos surf heat influx pos bnd (W/m) -1.259E-05
QxMean mean axial heat flow (W) -3.909E-04
TNeg mean temperature neg bnd (K) 3.048E+02
TPos mean temperature pos bnd (K) 3.379E+02
Vmean mean volume (m3) 5.655E-08
FTmean x-mean temperature (K, rad) 3.230E+02...
(8.039, 2.005, 1.378, 0.954, 0.191)E-01 Amp
(0.880, 1.837, 2.803, -2.758, -3.142)E+00 Arg
FPmean x-mean pressure (Pa, rad) 1.591E+06...
(2.179, 0.297, 0.091, 0.035, 0.005)E+05 Amp
(0.929, 1.596, 2.383, -2.817, -3.142)E+00 Arg
FPNeg pressure neg bnd (Pa, rad) 1.597E+06...
(4.895, 0.377, 0.129, 0.051, 0.008)E+04 Amp
(-2.888, -0.983, -0.675, -0.332, 0.000)E+00 Arg
FPPos pressure pos bnd (Pa, rad) 1.586E+06...
(4.749, 0.627, 0.195, 0.075, 0.010)E+05 Amp
(0.864, 1.628, 2.389, -2.859, -3.142)E+00 Arg
FDP x-delta pressure (Pa, rad) -1.118E+04...
(5.158, 0.660, 0.208, 0.079, 0.011)E+05 Amp
(0.810, 1.657, 2.394, -2.896, 3.142)E+00 Arg
FM gas mass (kg, rad) 1.342E-07...
(1.778, 0.237, 0.070, 0.025, 0.003)E-08 Amp
(0.931, 1.584, 2.345, -2.821, -3.142)E+00 Arg
FHmean x-mean enthalpy flow (W, rad) -3.998E+01...
(8.771, 1.729, 0.503, 0.183, 0.028)E+02 Amp
(-2.333, -1.462, -0.717, 0.170, 0.000)E+00 Arg
FRhoUAm mean x-mean mass flow rate (kg/s, rad) -2.307E-05...
(5.222, 1.021, 0.294, 0.106, 0.016)E-04 Amp
(-2.333, -1.462, -0.719, 0.172, 0.000)E+00 Arg

FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	-2.307E-05...
	(5.226, 1.020, 0.294, 0.107, 0.015)E-04 Amp	
	(-2.337, -1.467, -0.727, 0.162, 0.000)E+00 Arg	
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	-2.307E-05...
	(5.219, 1.022, 0.294, 0.106, 0.017)E-04 Amp	
	(-2.327, -1.453, -0.705, 0.191, 0.000)E+00 Arg	
MachMean	mean Mach number	4.209E-02
TdMean	mean tidal amplitude / length	1.218E+01
ReMean	mean Reynolds number	2.548E+02
VaMean	mean Valensi number	2.239E-02
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

5 point heat source

Inputs		
T	source temperature (K)	3.000E+02
Outputs		
QNeg	net heat flow neg bnd (W)	0.000E+00
QPos	net heat flow pos bnd (W)	0.000E+00

6 connecting tube

Inputs		
NCell	number spatial cells	5
Length	duct length (m)	1.000E-01
Roughness	mean wall roughness / Dhyd (NonDim)	1.000E-03
Twall	wall thickness (m)	1.000E-03
Tinit	initial temperature (NonDim, K)	unit spline...
	(0.000E+00, 3.000E+02)	
	(1.000E+00, 3.000E+02)	
Dtube	tube internal diameter (m)	6.000E-03
Ntube	tube number	1.000E+00
Outputs		
Aflow	mean flow area (m2)	2.827E-05
Asec	mean solid cross section (m2)	2.199E-05
Pwet	wetted perimeter (m)	1.885E-02

6.1 duct gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Klocal	local-loss coefficient	1.500E+00
TbInNeg	incoming relative turbulence neg bnd	1.000E+00
TbInPos	incoming relative turbulence pos bnd	1.000E+00
Outputs		
FQwNet	net surface heat inflow (W, rad)	-8.508E-01...
	(1.921, 0.945, 0.353, 0.178, 0.005)E+02 Amp	
	(-1.723, -1.458, -0.556, 1.488, 3.142)E+00 Arg	
HNeg	net enthalpy neg bnd (W)	4.535E+02
HPos	net enthalpy pos bnd (W)	4.526E+02
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	8.780E+01
AEQw	AE loss to surf heat flow (W)	5.470E+00
AEQx	AE loss to axial heat flow (W)	2.520E-04
AEdiscr	AE loss discrepancy (W)	1.676E-01
QwNeg	surf heat influx neg bnd (W/m)	1.799E-01
QwPos	surf heat influx pos bnd (W/m)	-6.304E+01
QxMean	mean axial heat flow (W)	-1.707E-03
TNeg	mean temperature neg bnd (K)	3.234E+02
TPos	mean temperature pos bnd (K)	3.246E+02
Vmean	mean volume (m3)	2.827E-06
FTmean	x-mean temperature (K, rad)	3.243E+02...
	(1.610, 0.673, 0.355, 0.045, 0.042)E+01 Amp	
	(1.511, 1.639, 1.919, -1.111, 0.000)E+00 Arg	
FPmean	x-mean pressure (Pa, rad)	1.576E+06...
	(4.569, 0.578, 0.178, 0.059, 0.003)E+05 Amp	
	(0.834, 1.394, 1.990, -3.030, -3.142)E+00 Arg	
FPNeg	pressure neg bnd (Pa, rad)	1.575E+06...
	(4.734, 0.613, 0.184, 0.062, 0.007)E+05 Amp	
	(0.869, 1.450, 2.168, -2.793, -3.142)E+00 Arg	
FPPos	pressure pos bnd (Pa, rad)	1.577E+06...
	(4.411, 0.546, 0.176, 0.059, 0.003)E+05 Amp	
	(0.799, 1.329, 1.797, 3.001, -3.142)E+00 Arg	
FDP	x-delta pressure (Pa, rad)	2.361E+03...
	(4.550, 0.974, 0.669, 0.295, 0.039)E+04 Amp	
	(-1.527, -0.943, 0.284, 1.554, 0.000)E+00 Arg	
FM	gas mass (kg, rad)	6.584E-06...

	(1.658, 0.096, 0.015, 0.022, 0.011)E-06 Amp	
	(0.711, 0.687, -1.020, 3.114, -3.142)E+00 Arg	
FHmean	x-mean enthalpy flow (W, rad)	4.534E+02...
	(1.712, 0.426, 0.107, 0.043, 0.004)E+04 Amp	
	(1.336, 2.146, 1.850, 2.898, 0.000)E+00 Arg	
FRhoUAMean	x-mean mass flow rate (kg/s, rad)	-6.762E-19...
	(1.002, 0.234, 0.063, 0.019, 0.004)E-02 Amp	
	(1.351, 2.107, 1.581, 2.580, 0.000)E+00 Arg	
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	-5.659E-19...
	(1.018, 0.237, 0.064, 0.018, 0.002)E-02 Amp	
	(1.372, 2.108, 1.578, 2.710, 0.000)E+00 Arg	
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	-5.938E-19...
	(9.868, 2.308, 0.629, 0.190, 0.069)E-03 Amp	
	(1.330, 2.104, 1.598, 2.575, 0.000)E+00 Arg	
MachMean	mean Mach number	9.539E-02
TdMean	mean tidal amplitude / length	5.050E+00
ReMean	mean Reynolds number	6.649E+04
VaMean	mean Valensi number	3.147E+02
TbMean	mean relative turbulence	9.587E-01
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

6.2 thin surface

Inputs		
Kmult	axial conduction multiplier	1.000E+00
D	transverse conduction distance (m)	1.000E-02
Solid	solid material	SS304
Outputs		
Mass	solid mass (kg)	1.715E-02
Dskin	mean skin thickness (m)	1.167E-03
Lambda	mean thermal wavelength (m)	9.934E-04
Tortuosity	xt-mean conduction tortuosity factor	1.000E+00
QwNet	net surface heat outflow (W, rad)	-8.508E-01...
	(1.921, 0.945, 0.353, 0.178, 0.005)E+02 Amp	
	(-1.723, -1.458, -0.556, 1.488, 3.142)E+00 Arg	
QyNeg	y heat flow neg bnd (W)	0.000E+00
QyPos	y heat flow pos bnd (W)	0.000E+00
QxNeg	axial heat flow neg bnd (W)	0.000E+00
QxPos	axial heat flow pos bnd (W)	8.508E-01
AEQw	AE loss to surf heat flow (W)	0.000E+00
AEQy	AE loss to y heat flow (W)	0.000E+00
AEQx	AE loss to axial heat flow (W)	3.120E-02
AEdiscr	AE loss discrepancy (W)	3.537E-02
TsNeg	mean temperature neg bnd (K)	3.256E+02
TsPos	mean temperature pos bnd (K)	3.000E+02
TsMean	x-mean interior temperature (K, rad)	3.257E+02...
	(7.220, 1.776, 0.442, 0.168, 0.001)E-02 Amp	
	(-0.152, 0.112, 1.015, 3.059, 0.000)E+00 Arg	

7 constrained piston and cylinder

Inputs		
NCell	number spatial cells	3
Length	shell and liner length (m)	1.829E-03
Dshell	moving shell OD (m)	3.937E-02
Tinit	initial temperature (NonDim, K)	unit spline...
	(0.000E+00, 3.000E+02)	
	(1.000E+00, 3.000E+02)	
Outputs		
Dliner	cylinder liner OD (m)	4.137E-02

7.1 cylinder liner

Inputs		
Solid	canister material	SS304
Wcan	wall thickness (m)	1.000E-03
Outputs		
Din	canister ID (m)	3.937E-02
Avoid	void cross section (m2)	1.217E-03
Asolid	solid cross section (m2)	1.268E-04
Mass	canister mass (kg)	1.809E-03

7.2 piston shell

Inputs		
Solid	canister material	SS304
Wcan	wall thickness (m)	1.000E-03
Outputs		
Din	canister ID (m)	3.737E-02
Avoid	void cross section (m2)	1.097E-03
Asolid	solid cross section (m2)	1.205E-04
Mass	canister mass (kg)	1.720E-03

7.3 constrained piston

Inputs		
FX	displacement (m, rad)	0.000E+00...
(10.00)E-03 Amp		
(0.000)E+00 Arg		
Mass	reciprocating mass (kg)	7.760E-01
Outputs		
F	boundary force (N, rad)	1.323E+01...
(1.168, 0.081, 0.025, 0.009, 0.001)E+03 Amp		
(-2.425, -1.485, -0.749, 0.249, 0.000)E+00 Arg		
W	boundary power inflow (W, rad)	-1.206E+03...
(0.130, 1.839, 0.130, 0.036, 0.004)E+03 Amp		
(2.903, -0.875, -0.027, 0.743, 3.142)E+00 Arg		
FF	required forcing function (N, rad)	-1.323E+01...
(7.761, 0.806, 0.248, 0.094, 0.013)E+02 Amp		
(1.423, 1.657, 2.393, -2.892, 3.142)E+00 Arg		

7.3.3 neg-facing area

Inputs		
A	face area (m2)	1.217E-03

7.3.4 pos-facing area

Inputs		
A	face area (m2)	1.217E-03

7.4 spring (flexure bearing)

Inputs		
K	stiffness (N/m)	4.487E+04
Outputs		
F	boundary force (N, rad)	8.327E-18...
(4.487, 0.000, 0.000, 0.000, 0.000)E+02 Amp		
(0.000, 1.190, 2.944, -2.554, 0.000)E+00 Arg		
W	boundary power inflow (W, rad)	1.908E-16...
(0.000, 7.048, 0.000, 0.000, 0.000)E+02 Amp		
(2.135, 1.571, 3.026, -0.281, 0.000)E+00 Arg		

7.5 damper (flexure bearing)

Inputs		
D	damping coef ((N s)/m)	1.000E+02
Outputs		
F	boundary force (N, rad)	9.750E-18...
(3.142, 0.000, 0.000, 0.000, 0.000)E+02 Amp		
(1.571, 3.019, -2.761, -0.571, 0.000)E+00 Arg		
W	boundary power inflow (W, rad)	4.935E+02...
(0.000, 4.935, 0.000, 0.000, 0.000)E+02 Amp		
(1.245, 3.142, -1.927, -1.447, -0.355)E+00 Arg		

7.6 annulus shuttle/seal/appendix (clearance)

Inputs		
NCell	number spatial cells	2
XNeg	parent-relative neg bnd [0, 1]	0.000E+00
XPos	parent-relative pos bnd [0, 1]	1.000E+00
Gap	radial clearance gap (m)	2.500E-05
Roughness	mean wall roughness / Dhyd (NonDim)	1.000E-03
Outputs		
Aflow	mean flow area (m2)	3.092E-06
Pwet	wetted perimeter (m)	2.474E-01
Length	annulus length (m)	1.829E-03
TsNeg	temperature neg bnd (K)	3.000E+02
TsPos	temperature pos bnd (K)	3.000E+02
QNeg	shuttle heat flow neg bnd (W)	0.000E+00
QPos	shuttle heat flow pos bnd (W)	0.000E+00
AEQ	AE loss to shuttle heat flow (W)	0.000E+00

7.6.1 matrix gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Outputs		
FQwNet	net surface heat inflow (W, rad)	2.960E-09...
(1.655, 0.553, 0.143, 0.339, 0.044)E+02 Amp		
(-2.125, 1.162, 2.426, -3.030, -3.142)E+00 Arg		

HNeg	net enthalpy neg bnd (W)	-1.459E+02
HPos	net enthalpy pos bnd (W)	-1.461E+02
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	4.402E+02
AEQw	AE loss to surf heat flow (W)	6.119E+00
AEQx	AE loss to axial heat flow (W)	3.027E-04
AEdiscr	AE loss discrepancy (W)	-5.016E+01
QwNeg	surf heat influx neg bnd (W/m)	2.651E-06
QwPos	surf heat influx pos bnd (W/m)	5.851E-07
QxMean	mean axial heat flow (W)	-9.040E-04
TNeg	mean temperature neg bnd (K)	2.900E+02
TPos	mean temperature pos bnd (K)	2.954E+02
Vmean	mean volume (m3)	5.655E-09
FTmean	x-mean temperature (K, rad)	2.947E+02...
(1.496, 0.545, 0.120, 0.324, 0.044)E+01 Amp		
(1.013, -1.930, -0.727, 0.061, 0.000)E+00 Arg		
FPmean	x-mean pressure (Pa, rad)	1.360E+06...
(1.792, 1.956, 0.456, 0.173, 0.025)E+05 Amp		
(0.944, -1.557, -0.713, -0.876, -3.142)E+00 Arg		
FPNeg	pressure neg bnd (Pa, rad)	1.364E+06...
(1.925, 2.409, 1.100, 0.307, 0.105)E+05 Amp		
(-2.472, -1.549, -0.800, -0.473, 0.000)E+00 Arg		
FPPos	pressure pos bnd (Pa, rad)	1.356E+06...
(5.462, 1.503, 0.207, 0.136, 0.155)E+05 Amp		
(0.848, -1.570, 1.948, -1.965, -3.142)E+00 Arg		
FDP	x-delta pressure (Pa, rad)	-7.297E+03...
(7.364, 0.906, 1.294, 0.325, 0.260)E+05 Amp		
(0.802, 1.629, 2.280, 3.097, -3.142)E+00 Arg		
FM	gas mass (kg, rad)	1.250E-08...
(1.055, 1.646, 0.322, 0.153, 0.041)E-09 Amp		
(0.885, -1.502, -0.731, -1.687, -3.142)E+00 Arg		
FHmean	x-mean enthalpy flow (W, rad)	-1.440E+02...
(6.575, 1.180, 0.300, 0.145, 0.011)E+03 Amp		
(-2.335, -1.460, 2.407, -2.976, 0.000)E+00 Arg		
FRhoUAMean	x-mean mass flow rate (kg/s, rad)	2.307E-05...
(3.934, 0.620, 0.270, 0.113, 0.013)E-03 Amp		
(-2.338, -1.479, 2.444, -2.893, 0.000)E+00 Arg		
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	2.307E-05...
(3.934, 0.620, 0.270, 0.113, 0.013)E-03 Amp		
(-2.338, -1.478, 2.444, -2.893, 0.000)E+00 Arg		
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	2.307E-05...
(3.934, 0.620, 0.270, 0.113, 0.014)E-03 Amp		
(-2.337, -1.480, 2.445, -2.894, 0.000)E+00 Arg		
MachMean	mean Mach number	3.979E-01
TdMean	mean tidal amplitude / length	1.094E+03
ReMean	mean Reynolds number	2.142E+03
VaMean	mean Valensi number	2.218E-02
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

8 point heat source

Inputs		
T	source temperature (K)	3.000E+02
Outputs		
QNeg	net heat flow neg bnd (W)	4.414E+02
QPos	net heat flow pos bnd (W)	0.000E+00

9 aftercooler

Inputs		
NCell	number spatial cells	5
Length	duct length (m)	1.800E-02
Roughness	mean wall roughness / Dhyd (NonDim)	1.000E-03
Tinit	initial temperature (NonDim, K)	unit spline...
(0.000E+00, 3.000E+02)		
(1.000E+00, 3.000E+02)		
Wchan	channel width (m)	3.000E-04
Hchan	channel height (m)	6.000E-03
Nchan	channel number	8.000E+01
Tfin	fin thickness (m)	1.000E-03
Outputs		
Aflow	mean flow area (m2)	1.440E-04
Asec	mean solid cross section (m2)	4.800E-04
Pwet	wetted perimeter (m)	1.008E+00

9.1 duct gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00

KnultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Klocal	local-loss coefficient	1.500E+00
TbInNeg	incoming relative turbulence neg bnd	1.000E+00
TbInPos	incoming relative turbulence pos bnd	1.000E+00
Outputs		
FQwNet	net surface heat inflow (W, rad)	-4.228E+02...
	(3.679, 2.631, 1.263, 0.742, 0.095)E+02 Amp	
	(-1.606, -0.796, -0.322, -0.507, 0.000)E+00 Arg	
HNeg	net enthalpy neg bnd (W)	4.526E+02
HPos	net enthalpy pos bnd (W)	2.976E+01
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	5.352E+00
AEQw	AE loss to surf heat flow (W)	1.963E+01
AEQx	AE loss to axial heat flow (W)	9.051E-04
AEdiscr	AE loss discrepancy (W)	3.173E-01
QwNeg	surf heat influx neg bnd (W/m)	-2.977E+04
QwPos	surf heat influx pos bnd (W/m)	-2.655E+04
QxMean	mean axial heat flow (W)	7.648E-03
TNeg	mean temperature neg bnd (K)	3.257E+02
TPos	mean temperature pos bnd (K)	3.240E+02
Vmean	mean volume (m3)	2.592E-06
FTmean	x-mean temperature (K, rad)	3.235E+02...
	(8.076, 5.551, 2.328, 1.713, 0.249)E+00 Amp	
	(1.502, 2.208, 2.555, 2.224, -3.142)E+00 Arg	
FPmean	x-mean pressure (Pa, rad)	1.590E+06...
	(4.423, 0.586, 0.178, 0.072, 0.008)E+05 Amp	
	(0.794, 1.506, 2.034, 3.030, -3.142)E+00 Arg	
FPNeg	pressure neg bnd (Pa, rad)	1.590E+06...
	(4.434, 0.588, 0.178, 0.072, 0.008)E+05 Amp	
	(0.796, 1.509, 2.039, 3.037, -3.142)E+00 Arg	
FPPos	pressure pos bnd (Pa, rad)	1.590E+06...
	(4.413, 0.585, 0.177, 0.072, 0.008)E+05 Amp	
	(0.792, 1.503, 2.029, 3.023, -3.142)E+00 Arg	
FDP	x-delta pressure (Pa, rad)	2.049E+02...
	(2.684, 0.462, 0.230, 0.102, 0.043)E+03 Amp	
	(-1.657, -0.820, -0.232, 1.096, -3.142)E+00 Arg	
FM	gas mass (kg, rad)	6.117E-06...
	(1.582, 0.150, 0.036, 0.023, 0.006)E-06 Amp	
	(0.726, 0.926, 0.946, -1.556, 0.000)E+00 Arg	
FHmean	x-mean enthalpy flow (W, rad)	2.363E+02...
	(1.651, 0.399, 0.103, 0.040, 0.005)E+04 Amp	
	(1.303, 2.115, 1.730, 2.810, 0.000)E+00 Arg	
FRhoUAMean	x-mean mass flow rate (kg/s, rad)	-5.524E-19...
	(9.728, 2.267, 0.623, 0.206, 0.063)E-03 Amp	
	(1.310, 2.098, 1.586, 2.614, 0.000)E+00 Arg	
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	-5.938E-19...
	(9.868, 2.308, 0.629, 0.190, 0.069)E-03 Amp	
	(1.330, 2.104, 1.598, 2.575, 0.000)E+00 Arg	
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	-5.893E-19...
	(9.594, 2.221, 0.609, 0.214, 0.040)E-03 Amp	
	(1.287, 2.088, 1.554, 2.648, 0.000)E+00 Arg	
MachMean	mean Mach number	1.802E-02
TdMean	mean tidal amplitude / length	5.309E+00
ReMean	mean Reynolds number	1.211E+03
VaMean	mean Valensi number	2.901E+00
TbMean	mean relative turbulence	2.782E-01
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

9.2 distributed conductor

Inputs		
W	solid z-thickness (m)	9.202E-02
D	solid y-thickness (m)	1.300E-03
Solid	material	Copper
Outputs		
Mass	solid mass (kg)	1.916E-02
QyNeg	y heat flow neg bnd (W)	0.000E+00
QyPos	y heat flow pos bnd (W)	-4.238E+02
QxNeg	axial heat flow neg bnd (W)	-2.135E+02
QxPos	axial heat flow pos bnd (W)	2.103E+02
AEQy	AE loss to y heat flow (W)	8.308E-01
AEQx	AE loss to axial heat flow (W)	9.706E+00
AEdiscr	AE loss discrepancy (W)	3.495E+00
TsNeg	temperature neg bnd (K)	3.000E+02
TsPos	temperature pos bnd (K)	3.000E+02
TsMean	x-mean interior temperature (K)	3.113E+02

9.3 conductive surface

Inputs

D	fin conduction length (m)	6.000E-03
Solid	material	Copper
Outputs		
Mass	solid mass (kg)	7.690E-02
W	mean wall thickness (m)	4.762E-04
Tortuosity	x-mean conduction tortuosity factor	1.000E+00
QwNet	net surface heat outflow (W)	-4.228E+02
QyNeg	y heat flow neg bnd (W)	-4.238E+02
QyPos	y heat flow pos bnd (W)	0.000E+00
QxNeg	axial heat flow neg bnd (W)	0.000E+00
QxPos	axial heat flow pos bnd (W)	-9.462E-01
AEQw	AE loss to surf heat flow (W)	1.888E-02
AEQy	AE loss to y heat flow (W)	4.354E+00
AEQx	AE loss to axial heat flow (W)	3.025E-01
AEdiscr	AE loss discrepancy (W)	1.729E-01
TsNeg	temperature neg bnd (K)	3.134E+02
TsPos	temperature pos bnd (K)	3.132E+02
TsMean	x-mean interior temperature (K)	3.140E+02

10 regenerator

Inputs		
NCell	number spatial cells	15
Length	canister length (m)	5.400E-02
Din	canister ID (m)	2.800E-02
Solid	canister material	SS304
Tinit	initial temperature (NonDim, K)	unit spline... (0.000E+00, 3.000E+02) (1.000E+00, 3.000E+02)
Wcan	wall thickness (m)	1.500E-04
Outputs		
Avoid	void cross section (m2)	6.158E-04
Asolid	solid cross section (m2)	1.327E-05
Mass	canister mass (kg)	5.587E-03

10.1 woven screen matrix

Inputs		
Porosity	porosity (void/total)	5.870E-01
Dwire	wire diameter (m)	3.500E-05
Outputs		
Aflow	mean flow area (m2)	3.614E-04
Asec	mean solid cross section (m2)	2.543E-04
Pwet	wetted perimeter (m)	2.906E+01

10.1.1 matrix gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Outputs		
FQwNet	net surface heat inflow (W, rad)	-3.418E+00... (1.330, 0.304, 0.091, 0.028, 0.004)E+04 Amp (-1.947, -1.135, -1.672, -0.501, -3.142)E+00 Arg
HNeg	net enthalpy neg bnd (W)	2.976E+01
HPos	net enthalpy pos bnd (W)	2.634E+01
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	4.750E+02
AEQw	AE loss to surf heat flow (W)	1.258E+02
AEQx	AE loss to axial heat flow (W)	2.488E+01
AEdiscr	AE loss discrepancy (W)	1.752E+01
QwNeg	surf heat influx neg bnd (W/m)	-2.398E+03
QwPos	surf heat influx pos bnd (W/m)	4.680E+02
QxMean	mean axial heat flow (W)	4.872E+00
TNeg	mean temperature neg bnd (K)	3.241E+02
TPos	mean temperature pos bnd (K)	4.127E+01
Vmean	mean volume (m3)	1.952E-05
FTmean	x-mean temperature (K, rad)	1.902E+02... (7.966, 1.211, 1.452, 0.262, 0.394)E-01 Amp (1.261, 2.131, 0.646, 1.208, 0.000)E+00 Arg
FPmean	x-mean pressure (Pa, rad)	1.600E+06... (2.856, 0.366, 0.087, 0.029, 0.001)E+05 Amp (0.544, 1.068, 1.699, 2.260, 0.000)E+00 Arg
FPNeg	pressure neg bnd (Pa, rad)	1.591E+06... (4.414, 0.587, 0.177, 0.072, 0.008)E+05 Amp (0.792, 1.508, 2.036, 3.023, -3.142)E+00 Arg
FPPos	pressure pos bnd (Pa, rad)	1.603E+06... (2.184, 0.306, 0.037, 0.033, 0.005)E+05 Amp (0.344, 0.655, 0.850, 0.839, 0.000)E+00 Arg

FDP	x-delta pressure (Pa, rad)	1.214E+04...
	(2.621, 0.449, 0.167, 0.095, 0.014)E+05 Amp	
	(-1.981, -1.095, -0.898, 0.166, 0.000)E+00 Arg	
FM	gas mass (kg, rad)	1.053E-04...
	(1.610, 0.204, 0.039, 0.014, 0.001)E-05 Amp	
	(0.435, 0.825, 1.908, 2.486, -3.142)E+00 Arg	
FHmean	x-mean enthalpy flow (W, rad)	1.790E+01...
	(8.619, 1.925, 0.665, 0.226, 0.066)E+03 Amp	
	(1.155, 1.969, 1.352, 2.320, 0.000)E+00 Arg	
FRhoUamean	x-mean mass flow rate (kg/s, rad)	-7.446E-19...
	(8.368, 1.811, 0.696, 0.226, 0.075)E-03 Amp	
	(1.104, 1.930, 1.289, 2.229, 0.000)E+00 Arg	
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	-5.893E-19...
	(9.594, 2.221, 0.609, 0.214, 0.040)E-03 Amp	
	(1.287, 2.088, 1.554, 2.648, 0.000)E+00 Arg	
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	1.117E-18...
	(6.674, 1.074, 0.814, 0.258, 0.087)E-03 Amp	
	(0.765, 1.719, 1.114, 1.876, 0.000)E+00 Arg	
MachMean	mean Mach number	4.654E-03
TdMean	mean tidal amplitude / length	3.666E-01
ReMean	mean Reynolds number	5.813E+01
VaMean	mean Valensi number	1.042E-01
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

10.1.2 conductive surface

Inputs		
D	fin conduction length (m)	6.925E-04
Solid	material	SS304
Outputs		
Mass	solid mass (kg)	1.071E-01
W	mean wall thickness (m)	8.750E-06
Tortuosity	x-mean conduction tortuosity factor	1.164E-01
QwNet	net surface heat outflow (W)	-3.418E+00
QyNeg	y heat flow neg bnd (W)	-2.061E+00
QyPos	y heat flow pos bnd (W)	0.000E+00
QxNeg	axial heat flow neg bnd (W)	-9.462E-01
QxPos	axial heat flow pos bnd (W)	4.109E-01
AEQw	AE loss to surf heat flow (W)	1.591E-06
AEQy	AE loss to y heat flow (W)	1.235E-03
AEQx	AE loss to axial heat flow (W)	7.749E+00
AEdiscr	AE loss discrepancy (W)	1.202E-01
TsNeg	temperature neg bnd (K)	3.132E+02
TsPos	temperature pos bnd (K)	4.265E+01
TsMean	x-mean interior temperature (K)	1.902E+02

10.2 distributed conductor

Inputs		
D	solid y-thickness (m)	1.500E-04
Outputs		
W	solid z-thickness (m)	8.844E-02
Mass	solid mass (kg)	5.587E-03
QyNeg	y heat flow neg bnd (W)	0.000E+00
QyPos	y heat flow pos bnd (W)	-2.061E+00
QxNeg	axial heat flow neg bnd (W)	-1.844E+00
QxPos	axial heat flow pos bnd (W)	2.165E-01
AEQy	AE loss to y heat flow (W)	1.110E-03
AEQx	AE loss to axial heat flow (W)	3.723E+00
AEdiscr	AE loss discrepancy (W)	1.338E-01
TsNeg	temperature neg bnd (K)	3.000E+02
TsPos	temperature pos bnd (K)	4.267E+01
TsMean	x-mean interior temperature (K)	1.902E+02

11 CHX

Inputs		
NCell	number spatial cells	5
Length	duct length (m)	1.500E-02
Roughness	mean wall roughness / Dhyd (NonDim)	1.000E-03
Tinit	initial temperature (NonDim, K)	unit spline...
	(0.000E+00, 3.000E+02)	
	(1.000E+00, 3.000E+02)	
Wchan	channel width (m)	3.000E-04
Hchan	channel height (m)	2.000E-02
Nchan	channel number	1.200E+01
Tfin	fin thickness (m)	1.000E-03
Outputs		
Aflow	mean flow area (m2)	7.200E-05
Asec	mean solid cross section (m2)	2.400E-04
Pwet	wetted perimeter (m)	4.872E-01

11.1 duct gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Klocal	local-loss coefficient	1.500E+00
TbInNeg	incoming relative turbulence neg bnd	1.000E+00
TbInPos	incoming relative turbulence pos bnd	1.000E+00
Outputs		
FQwNet	net surface heat inflow (W, rad)	8.393E-01...
	(2.815, 1.423, 0.630, 0.173, 0.138)E+01 Amp	
	(-1.374, 1.844, -1.373, 2.089, 0.000)E+00 Arg	
HNeg	net enthalpy neg bnd (W)	2.634E+01
HPos	net enthalpy pos bnd (W)	2.718E+01
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	5.479E-01
AEQw	AE loss to surf heat flow (W)	1.660E+01
AEQx	AE loss to axial heat flow (W)	8.941E-03
AEdiscr	AE loss discrepancy (W)	8.044E-01
QwNeg	surf heat influx neg bnd (W/m)	7.855E+02
QwPos	surf heat influx pos bnd (W/m)	-1.302E+03
QxMean	mean axial heat flow (W)	-5.160E-03
TNeg	mean temperature neg bnd (K)	4.127E+01
TPos	mean temperature pos bnd (K)	4.729E+01
Vmean	mean volume (m3)	1.080E-06
FTmean	x-mean temperature (K, rad)	4.341E+01...
	(4.615, 2.109, 0.600, 0.096, 0.021)E+00 Amp	
	(1.826, -1.710, 0.667, -2.649, 0.000)E+00 Arg	
FPmean	x-mean pressure (Pa, rad)	1.603E+06...
	(2.183, 0.305, 0.037, 0.033, 0.005)E+05 Amp	
	(0.343, 0.651, 0.812, 0.821, 0.000)E+00 Arg	
FPNeg	pressure neg bnd (Pa, rad)	1.603E+06...
	(2.184, 0.305, 0.037, 0.032, 0.005)E+05 Amp	
	(0.344, 0.653, 0.842, 0.835, 0.000)E+00 Arg	
FPPos	pressure pos bnd (Pa, rad)	1.603E+06...
	(2.181, 0.305, 0.037, 0.033, 0.005)E+05 Amp	
	(0.342, 0.649, 0.783, 0.808, 0.000)E+00 Arg	
FDP	x-delta pressure (Pa, rad)	2.084E+01...
	(5.714, 1.238, 2.230, 1.084, 0.821)E+02 Amp	
	(-1.679, -0.348, -0.990, -0.093, -3.142)E+00 Arg	
FM	gas mass (kg, rad)	1.935E-05...
	(3.015, 1.002, 0.104, 0.058, 0.006)E-06 Amp	
	(-0.315, 1.173, -2.450, 1.295, 0.000)E+00 Arg	
FHmean	x-mean enthalpy flow (W, rad)	2.947E+01...
	(1.394, 0.250, 0.168, 0.059, 0.016)E+03 Amp	
	(0.722, 1.667, 1.086, 1.777, 0.000)E+00 Arg	
FRhoUamean	x-mean mass flow rate (kg/s, rad)	1.119E-18...
	(6.336, 0.954, 0.845, 0.234, 0.071)E-03 Amp	
	(0.727, 1.483, 1.192, 1.758, 0.000)E+00 Arg	
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	1.117E-18...
	(6.674, 1.074, 0.814, 0.258, 0.087)E-03 Amp	
	(0.765, 1.719, 1.114, 1.876, 0.000)E+00 Arg	
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	1.076E-18...
	(5.856, 0.921, 0.859, 0.226, 0.058)E-03 Amp	
	(0.689, 1.095, 1.218, 1.601, 0.000)E+00 Arg	
MachMean	mean Mach number	8.002E-03
TdMean	mean tidal amplitude / length	1.025E+00
ReMean	mean Reynolds number	5.789E+03
VaMean	mean Valensi number	8.601E+01
TbMean	mean relative turbulence	6.349E-01
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

11.2 distributed conductor

Inputs		
W	solid z-thickness (m)	1.294E-01
D	solid y-thickness (m)	1.000E-03
Solid	material	Copper
Outputs		
Mass	solid mass (kg)	1.727E-02
QyNeg	y heat flow neg bnd (W)	0.000E+00
QyPos	y heat flow pos bnd (W)	4.284E-01
QxNeg	axial heat flow neg bnd (W)	2.165E-01
QxPos	axial heat flow pos bnd (W)	-2.120E-01
AEQy	AE loss to y heat flow (W)	1.523E-04
AEQx	AE loss to axial heat flow (W)	6.438E-03
AEdiscr	AE loss discrepancy (W)	6.851E-04
TsNeg	temperature neg bnd (K)	4.267E+01
TsPos	temperature pos bnd (K)	4.273E+01

TsMean x-mean interior temperature (K) 4.270E+01

11.3 conductive surface

Inputs		
D	fin conduction length (m)	8.030E-03
Solid	material	Copper
Outputs		
Mass	solid mass (kg)	3.204E-02
W	mean wall thickness (m)	4.926E-04
Tortuosity	x-mean conduction tortuosity factor	1.000E+00
QwNet	net surface heat outflow (W)	8.393E-01
QyNeg	y heat flow neg bnd (W)	4.284E-01
QyPos	y heat flow pos bnd (W)	0.000E+00
QxNeg	axial heat flow neg bnd (W)	4.109E-01
QxPos	axial heat flow pos bnd (W)	0.000E+00
AEQw	AE loss to surf heat flow (W)	4.218E-04
AEQy	AE loss to y heat flow (W)	5.293E-03
AEQx	AE loss to axial heat flow (W)	3.543E-02
AEdiscr	AE loss discrepancy (W)	4.866E-03
TsNeg	temperature neg bnd (K)	4.265E+01
TsPos	temperature pos bnd (K)	4.275E+01
TsMean	x-mean interior temperature (K)	4.269E+01

12 pulse tube

Inputs		
NCell	number spatial cells	15
Length	duct length (m)	7.800E-02
Roughness	mean wall roughness / Dhyd (NonDim)	1.000E-03
Twall	wall thickness (m)	1.500E-04
Tinit	initial temperature (NonDim, K)	unit spline...
(0.000E+00, 3.000E+02)		
(1.000E+00, 3.000E+02)		
Dtube	tube internal diameter (m)	1.190E-02
Ntube	tube number	1.000E+00
Outputs		
Aflow	mean flow area (m2)	1.112E-04
Asec	mean solid cross section (m2)	5.678E-06
Pwet	wetted perimeter (m)	3.738E-02

12.1 compliance-duct gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Klocal	local-loss coefficient	0.000E+00
TbInNeg	incoming relative turbulence neg bnd	0.000E+00
TbInPos	incoming relative turbulence pos bnd	0.000E+00
Tmult	turbulent conduction multiplier	1.000E+00
Gmult	adverse g-field multiplier	0.000E+00
Bmult	boundary convection multiplier	1.000E+00
Smult	streaming convection multiplier	1.000E+00
Outputs		
FQwNet	net surface heat inflow (W, rad)	-4.173E-01...
(4.819, 0.444, 0.345, 0.073, 0.003)E+01 Amp		
(-0.937, -1.015, 1.240, 0.692, 3.142)E+00 Arg		
HNeg	net enthalpy neg bnd (W)	2.718E+01
HPos	net enthalpy pos bnd (W)	2.676E+01
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	3.177E-03
AEQw	AE loss to surf heat flow (W)	1.398E+01
AEQx	AE loss to axial heat flow (W)	1.148E+01
AEdiscr	AE loss discrepancy (W)	9.167E+00
QwNeg	surf heat influx neg bnd (W/m)	3.046E+01
QwPos	surf heat influx pos bnd (W/m)	-4.204E+01
QxMean	mean axial heat flow (W)	-3.222E+00
TNeg	mean temperature neg bnd (K)	4.729E+01
TPos	mean temperature pos bnd (K)	3.081E+02
Vmean	mean volume (m3)	8.675E-06
FTmean	x-mean temperature (K, rad)	1.897E+02...
(3.340, 0.085, 0.130, 0.021, 0.000)E+01 Amp		
(1.651, 2.050, 2.394, 2.148, 0.000)E+00 Arg		
FPmean	x-mean pressure (Pa, rad)	1.603E+06...
(2.182, 0.306, 0.037, 0.033, 0.004)E+05 Amp		
(0.340, 0.649, 0.758, 0.799, 0.000)E+00 Arg		
FPNeg	pressure neg bnd (Pa, rad)	1.603E+06...
(2.182, 0.306, 0.037, 0.033, 0.005)E+05 Amp		
(0.342, 0.650, 0.787, 0.811, 0.000)E+00 Arg		

FPPos	pressure pos bnd (Pa, rad)	1.603E+06...
	(2.182, 0.306, 0.037, 0.033, 0.004)E+05 Amp	
	(0.340, 0.648, 0.745, 0.794, 0.000)E+00 Arg	
FDP	x-delta pressure (Pa, rad)	7.052E+01...
	(4.138, 0.737, 1.541, 0.585, 0.786)E+02 Amp	
	(-1.107, -0.382, -0.637, -0.584, -3.142)E+00 Arg	
FM	gas mass (kg, rad)	5.068E-05...
	(1.666, 0.140, 0.082, 0.017, 0.001)E-05 Amp	
	(-0.773, -0.419, -0.307, 0.099, 0.000)E+00 Arg	
FHmean	x-mean enthalpy flow (W, rad)	3.129E+01...
	(1.319, 0.159, 0.162, 0.038, 0.003)E+03 Amp	
	(0.326, 1.217, 0.923, 1.360, 0.000)E+00 Arg	
FRhoUAm	x-mean mass flow rate (kg/s, rad)	1.326E-18...
	(1.887, 0.267, 0.260, 0.078, 0.021)E-03 Amp	
	(0.461, 0.434, 0.903, 0.885, 0.000)E+00 Arg	
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	1.076E-18...
	(5.856, 0.921, 0.859, 0.226, 0.058)E-03 Amp	
	(0.689, 1.095, 1.218, 1.601, 0.000)E+00 Arg	
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	1.338E-18...
	(8.641, 0.644, 0.895, 0.167, 0.056)E-04 Amp	
	(-0.027, 0.224, 0.813, 0.494, -3.142)E+00 Arg	
MachMean	mean Mach number	2.594E-03
TdMean	mean tidal amplitude / length	1.197E-01
ReMean	mean Reynolds number	1.370E+04
VaMean	mean Valensi number	7.115E+03
TbMean	mean relative turbulence	-7.782E-20
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00
QmolMean	mean molecular conduction (W)	-3.862E-02
QturbMean	mean turbulent conduction (W)	-3.714E-22
QfreeMean	mean free convection (W)	0.000E+00
QoscMean	mean boundary convection (W)	-9.305E-01
QstrMean	mean streaming convection (W)	-2.399E+00
Tmin		4.729E+01
TNeg		
	Export level: pulse tube refrigerator	

12.2 thin surface

Inputs		
Kmult	axial conduction multiplier	1.000E+00
D	transverse conduction distance (m)	1.500E-04
Solid	solid material	SS304
Outputs		
Mass	solid mass (kg)	3.455E-03
Dskin	mean skin thickness (m)	1.519E-04
Lambda	mean thermal wavelength (m)	9.605E-04
Tortuosity	xt-mean conduction tortuosity factor	1.000E+00
QwNet	net surface heat outflow (W, rad)	-4.173E-01...
	(4.819, 0.444, 0.345, 0.073, 0.003)E+01 Amp	
	(-0.937, -1.015, 1.240, 0.692, 3.142)E+00 Arg	
QyNeg	y heat flow neg bnd (W)	0.000E+00
QyPos	y heat flow pos bnd (W)	0.000E+00
QxNeg	axial heat flow neg bnd (W)	-2.120E-01
QxPos	axial heat flow pos bnd (W)	2.053E-01
AEQw	AE loss to surf heat flow (W)	0.000E+00
AEQy	AE loss to y heat flow (W)	0.000E+00
AEQx	AE loss to axial heat flow (W)	1.520E+00
AEdiscr	AE loss discrepancy (W)	7.984E-02
TsNeg	mean temperature neg bnd (K)	4.273E+01
TsPos	mean temperature pos bnd (K)	3.026E+02
TsMean	x-mean interior temperature (K, rad)	2.093E+02...
	(1.132, 0.021, 0.022, 0.003, 0.001)E-01 Amp	
	(0.719, 0.457, 2.915, 3.055, 0.000)E+00 Arg	

13 HHX

Inputs		
NCell	number spatial cells	5
Length	duct length (m)	1.920E-02
Roughness	mean wall roughness / Dhyd (NonDim)	1.000E-03
Tinit	initial temperature (NonDim, K)	unit spline...
	(0.000E+00, 3.000E+02)	
	(1.000E+00, 3.000E+02)	
Wchan	channel width (m)	2.000E-04
Hchan	channel height (m)	1.150E-03
Nchan	channel number	2.400E+01
Tfin	fin thickness (m)	1.000E-03
Outputs		
Aflow	mean flow area (m2)	5.520E-06
Asec	mean solid cross section (m2)	2.760E-05
Pwet	wetted perimeter (m)	6.480E-02

13.1 duct gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Klocal	local-loss coefficient	1.500E+00
TbInNeg	incoming relative turbulence neg bnd	1.000E+00
TbInPos	incoming relative turbulence pos bnd	1.000E+00
Outputs		
FQwNet	net surface heat inflow (W, rad)	-1.477E+01...
(4.697, 2.069, 1.886, 0.610, 0.038)E+01 Amp		
(-2.735, -2.878, -2.478, -2.603, 3.142)E+00 Arg		
HNeg	net enthalpy neg bnd (W)	2.676E+01
HPos	net enthalpy pos bnd (W)	1.199E+01
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	2.962E+00
AEQw	AE loss to surf heat flow (W)	1.003E+00
AEQx	AE loss to axial heat flow (W)	5.153E-05
AEdiscr	AE loss discrepancy (W)	2.461E-02
QwNeg	surf heat influx neg bnd (W/m)	-1.605E+03
QwPos	surf heat influx pos bnd (W/m)	-2.610E+02
QxMean	mean axial heat flow (W)	9.545E-04
TNeg	mean temperature neg bnd (K)	3.079E+02
TPos	mean temperature pos bnd (K)	3.010E+02
Vmean	mean volume (m3)	1.060E-07
FTmean	x-mean temperature (K, rad)	3.038E+02...
(8.536, 3.387, 2.161, 0.533, 0.399)E+00 Amp		
(0.544, 0.180, 0.663, 1.556, -3.142)E+00 Arg		
FPmean	x-mean pressure (Pa, rad)	1.601E+06...
(2.098, 0.279, 0.017, 0.026, 0.002)E+05 Amp		
(0.350, 0.705, 1.231, 0.868, 0.000)E+00 Arg		
FPNeg	pressure neg bnd (Pa, rad)	1.600E+06...
(2.181, 0.283, 0.034, 0.029, 0.003)E+05 Amp		
(0.339, 0.701, 0.793, 0.786, 0.000)E+00 Arg		
FPPos	pressure pos bnd (Pa, rad)	1.601E+06...
(2.016, 0.276, 0.015, 0.022, 0.001)E+05 Amp		
(0.362, 0.708, 2.590, 0.987, 0.000)E+00 Arg		
FDP	x-delta pressure (Pa, rad)	3.728E+02...
(1.722, 0.070, 0.402, 0.082, 0.019)E+04 Amp		
(-3.072, -2.720, -2.716, -2.937, -3.142)E+00 Arg		
FM	gas mass (kg, rad)	2.683E-07...
(2.773, 0.222, 0.185, 0.033, 0.040)E-08 Amp		
(0.300, 1.431, -2.560, -0.707, 0.000)E+00 Arg		
FHmean	x-mean enthalpy flow (W, rad)	1.714E+01...
(1.376, 0.127, 0.150, 0.031, 0.010)E+03 Amp		
(-0.030, 0.288, 0.793, 0.562, -3.142)E+00 Arg		
FRhoUAMean	x-mean mass flow rate (kg/s, rad)	1.337E-18...
(8.655, 0.649, 0.898, 0.166, 0.067)E-04 Amp		
(-0.032, 0.225, 0.823, 0.480, -3.142)E+00 Arg		
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	1.338E-18...
(8.641, 0.644, 0.895, 0.167, 0.056)E-04 Amp		
(-0.027, 0.224, 0.813, 0.494, -3.142)E+00 Arg		
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	1.338E-18...
(8.670, 0.658, 0.899, 0.163, 0.075)E-04 Amp		
(-0.037, 0.216, 0.831, 0.485, -3.142)E+00 Arg		
MachMean	mean Mach number	3.800E-02
TdMean	mean tidal amplitude / length	1.017E+01
ReMean	mean Reynolds number	1.676E+03
VaMean	mean Valensi number	1.157E+00
TbMean	mean relative turbulence	4.791E-01
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

13.2 distributed conductor

Inputs		
W	solid z-thickness (m)	8.170E-02
D	solid y-thickness (m)	2.000E-03
Solid	material	Copper
Outputs		
Mass	solid mass (kg)	2.792E-02
QyNeg	y heat flow neg bnd (W)	0.000E+00
QyPos	y heat flow pos bnd (W)	-1.477E+01
QxNeg	axial heat flow neg bnd (W)	2.053E-01
QxPos	axial heat flow pos bnd (W)	1.498E+01
AEQy	AE loss to y heat flow (W)	1.312E-03
AEQx	AE loss to axial heat flow (W)	8.594E-02
AEdiscr	AE loss discrepancy (W)	2.451E-03
TsNeg	temperature neg bnd (K)	3.026E+02
TsPos	temperature pos bnd (K)	3.000E+02

TsMean	x-mean interior temperature (K)	3.017E+02
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13.3 conductive surface

Inputs		
D	fin conduction length (m)	1.150E-03
Solid	material	Copper
Outputs		
Mass	solid mass (kg)	4.716E-03
W	mean wall thickness (m)	4.259E-04
Tortuosity	x-mean conduction tortuosity factor	1.000E+00
QwNet	net surface heat outflow (W)	-1.477E+01
QyNeg	y heat flow neg bnd (W)	-1.477E+01
QyPos	y heat flow pos bnd (W)	0.000E+00
QxNeg	axial heat flow neg bnd (W)	0.000E+00
QxPos	axial heat flow pos bnd (W)	0.000E+00
AEQw	AE loss to surf heat flow (W)	3.946E-04
AEQy	AE loss to y heat flow (W)	2.567E-03
AEQx	AE loss to axial heat flow (W)	9.709E-03
AEdiscr	AE loss discrepancy (W)	1.427E-03
TsNeg	temperature neg bnd (K)	3.027E+02
TsPos	temperature pos bnd (K)	3.005E+02
TsMean	x-mean interior temperature (K)	3.017E+02

14 inertance tube

Inputs		
NCell	number spatial cells	20
Length	duct length (m)	1.767E+00
Roughness	mean wall roughness / Dhyd (NonDim)	1.000E-03
Twall	wall thickness (m)	1.000E-03
Tinit	initial temperature (NonDim, K)	unit spline...
(0.000E+00, 3.000E+02)		
(1.000E+00, 3.000E+02)		
Dtube	tube internal diameter (m)	2.305E-03
Ntube	tube number	1.000E+00
Outputs		
Aflow	mean flow area (m2)	4.173E-06
Asec	mean solid cross section (m2)	1.038E-05
Pwet	wetted perimeter (m)	7.241E-03

14.1 duct gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Klocal	local-loss coefficient	1.500E+00
TbInNeg	incoming relative turbulence neg bnd	1.000E+00
TbInPos	incoming relative turbulence pos bnd	1.000E+00
Outputs		
FQwNet	net surface heat inflow (W, rad)	-1.080E+01...
(1.522, 0.265, 0.646, 0.128, 0.049)E+02 Amp		
(-2.342, -2.307, -2.608, -2.875, 0.000)E+00 Arg		
HNeg	net enthalpy neg bnd (W)	1.199E+01
HPos	net enthalpy pos bnd (W)	1.188E+00
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	2.925E+01
AEQw	AE loss to surf heat flow (W)	2.084E+00
AEQx	AE loss to axial heat flow (W)	2.498E-06
AEdiscr	AE loss discrepancy (W)	8.043E-02
QwNeg	surf heat influx neg bnd (W/m)	-2.735E+01
QwPos	surf heat influx pos bnd (W/m)	1.306E+00
QxMean	mean axial heat flow (W)	4.492E-06
TNeg	mean temperature neg bnd (K)	3.009E+02
TPos	mean temperature pos bnd (K)	2.999E+02
Vmean	mean volume (m3)	7.373E-06
FTmean	x-mean temperature (K, rad)	3.003E+02...
(6.324, 0.834, 0.910, 0.083, 0.001)E+00 Amp		
(0.992, 1.142, 2.704, 3.025, -3.142)E+00 Arg		
FPmean	x-mean pressure (Pa, rad)	1.597E+06...
(1.004, 0.149, 0.056, 0.011, 0.001)E+05 Amp		
(0.284, 0.784, -2.776, -2.665, -3.142)E+00 Arg		
FPNeg	pressure neg bnd (Pa, rad)	1.599E+06...
(2.016, 0.260, 0.017, 0.019, 0.000)E+05 Amp		
(0.362, 0.755, 2.679, 1.005, 0.000)E+00 Arg		
FPPos	pressure pos bnd (Pa, rad)	1.594E+06...
(6.570, 4.144, 0.960, 0.671, 0.165)E+03 Amp		
(-2.084, 2.649, 2.361, -2.074, -3.142)E+00 Arg		
FDP	x-delta pressure (Pa, rad)	-4.580E+03...

	(2.066, 0.276, 0.008, 0.026, 0.002)E+05 Amp	
	(-2.759, -2.530, -0.079, -2.121, 3.142)E+00 Arg	
FM	gas mass (kg, rad)	1.887E-05...
	(9.191, 1.183, 0.521, 0.087, 0.006)E-07 Amp	
	(-0.001, 0.584, -1.775, -2.198, -3.142)E+00 Arg	
FHmean	x-mean enthalpy flow (W, rad)	5.538E+00...
	(1.405, 0.152, 0.115, 0.022, 0.008)E+03 Amp	
	(-0.253, -0.237, 1.121, 0.681, -3.142)E+00 Arg	
FRhoUamean	x-mean mass flow rate (kg/s, rad)	1.328E-18...
	(8.999, 0.934, 0.717, 0.144, 0.053)E-04 Amp	
	(-0.254, -0.324, 1.136, 0.535, -3.142)E+00 Arg	
FRhoUANeg	mass flow rate neg bnd (kg/s, rad)	1.338E-18...
	(8.670, 0.658, 0.899, 0.163, 0.075)E-04 Amp	
	(-0.037, 0.216, 0.831, 0.485, -3.142)E+00 Arg	
FRhoUAPos	mass flow rate pos bnd (kg/s, rad)	1.328E-18...
	(9.235, 1.156, 0.774, 0.151, 0.047)E-04 Amp	
	(-0.354, -0.427, 1.409, 1.188, -3.142)E+00 Arg	
MachMean	mean Mach number	5.303E-02
TdMean	mean tidal amplitude / length	1.531E-01
ReMean	mean Reynolds number	1.614E+04
VaMean	mean Valensi number	5.397E+01
TbMean	mean relative turbulence	8.097E-01
Zmean	mean gas compressibility	1.000E+00
EOSErrMean	mean EOS relative error	0.000E+00

14.2 isothermal surface

Outputs		
QwNet	net surface heat outflow (W)	-1.080E+01

15 reservoir

Inputs		
NCell	number spatial cells	3
Length	mean-flow length (m)	1.500E-01
Twall	wall thickness (m)	3.000E-03
Tinit	initial temperature (NonDim, K)	unit spline...
	(0.000E+00, 3.000E+02)	
	(1.000E+00, 3.000E+02)	
Swet	wetted surface (m2)	3.740E-02
Volume	mean volume (m3)	5.000E-04
Outputs		
Aflow	mean flow area (m2)	3.333E-03
Asec	mean solid cross section (m2)	7.480E-04
Sratio	surface / min cyl surface	1.072E+00

15.1 cylinder-space gas

Inputs		
Fmult	flow friction multiplier	1.000E+00
Hmult	heat transfer multiplier	1.000E+00
Kmult	axial conduction multiplier interior	1.000E+00
KmultBnd	axial conduction multiplier endpoints	0.000E+00
UpwindFrac	upwind weight for density interpolation	1.000E-02
Outputs		
PV	PV power output (W, rad)	-3.192E-14...
	(1.211, 0.077, 0.034, 0.005, 0.000)E-16 Amp	
	(1.231, 1.152, 2.970, 2.719, 0.000)E+00 Arg	
FQwNet	net surface heat inflow (W, rad)	-1.188E+00...
	(2.471, 0.320, 0.121, 0.054, 0.037)E+01 Amp	
	(1.771, 0.774, -1.099, -0.692, 0.000)E+00 Arg	
HNeg	net enthalpy neg bnd (W)	1.188E+00
HPos	net enthalpy pos bnd (W)	0.000E+00
QNeg	net conduction neg bnd (W)	0.000E+00
QPos	net conduction pos bnd (W)	0.000E+00
AEfric	AE loss to flow friction (W)	0.000E+00
AEQw	AE loss to surf heat flow (W)	1.625E-02
AEQx	AE loss to axial heat flow (W)	3.467E-05
AEdiscr	AE loss discrepancy (W)	1.688E-03
QwNeg	surf heat influx neg bnd (W/m)	-3.270E+01
QwPos	surf heat influx pos bnd (W/m)	1.615E-01
QxMean	mean axial heat flow (W)	1.758E-02
TNeg	mean temperature neg bnd (K)	3.003E+02
TPos	mean temperature pos bnd (K)	3.000E+02
Vmean	mean volume (m3)	5.000E-04
FTmean	x-mean temperature (K, rad)	3.000E+02...
	(4.507, 0.298, 0.125, 0.018, 0.001)E-01 Amp	
	(-1.888, -1.959, -0.190, -0.467, -3.142)E+00 Arg	
FPmean	x-mean pressure (Pa, rad)	1.599E+06...
	(6.066, 0.387, 0.169, 0.025, 0.002)E+03 Amp	
	(-1.910, -1.989, -0.172, -0.422, -3.142)E+00 Arg	
FPNeg	pressure neg bnd (Pa, rad)	1.599E+06...
	(6.062, 0.386, 0.168, 0.024, 0.002)E+03 Amp	

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(-1.910, -1.989, -0.172, -0.422, -3.142)E+00 Arg
FPPos      pressure pos bnd (Pa, rad)      1.599E+06...
( 6.069, 0.388, 0.169, 0.025, 0.002)E+03 Amp
(-1.910, -1.989, -0.172, -0.422, -3.142)E+00 Arg
FV         volume (m3, rad)                5.000E-04...
( 3.348, 4.735, 2.647, 3.176, 3.789)E-23 Amp
(-1.893, -2.034, -1.571, -1.571, -2.344)E+00 Arg
FM         gas mass (kg, rad)              1.283E-03...
( 2.939, 0.184, 0.082, 0.012, 0.001)E-06 Amp
(-1.925, -1.998, -0.162, -0.383, -3.142)E+00 Arg
FHmean     x-mean enthalpy flow (W, rad)    2.034E-02...
( 7.196, 0.903, 0.602, 0.117, 0.035)E+02 Amp
(-0.354, -0.434, 1.407, 1.176, -3.142)E+00 Arg
FRhoUAmean x-mean mass flow rate (kg/s, rad) -2.131E-18...
( 4.622, 0.581, 0.387, 0.075, 0.022)E-04 Amp
(-0.354, -0.428, 1.406, 1.181, -3.142)E+00 Arg
FRhoUANeg  mass flow rate neg bnd (kg/s, rad) 1.328E-18...
( 9.235, 1.156, 0.774, 0.151, 0.047)E-04 Amp
(-0.354, -0.427, 1.409, 1.188, -3.142)E+00 Arg
FRhoUAPos  mass flow rate pos bnd (kg/s, rad) 0.000E+00...
( 0.000, 0.000, 0.000, 0.000, 0.000)E+00 Amp
( 0.000, 0.000, 0.000, 0.000, 0.000)E+00 Arg
MachMean   mean Mach number                3.450E-05
ReMean     mean turbulent Reynolds number    1.145E+04
VaMean     mean Valensi number              2.915E+04
TbMean     mean turbulence intensity (J/m3)  7.892E+00
Zmean      mean gas compressibility          1.000E+00
EOSErrMean mean EOS relative error           0.000E+00

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15.2 isothermal surface

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Outputs
QwNet      net surface heat outflow (W)      -1.188E+00

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