Ansys
2023 R1

Parametric Report

Analyst	NOTEBOOK
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Table of Contents

Design Points Table

	water_inlet_temp [K]	water_inlet_vel [m/s]	air_inlet_temp [K]	air_inlet_vel [m/s]	air_outlet_temp_avg-op [K]	water_outlet_temp_avg-op [K]	Write Data	Status
Base DP	500	10	300	5	357.20739	499.98242	True	Updated : Converged
DP1	525	10	300	5	364.35831	524.98023	False	Updated : Converged
DP2	550	10	300	5	371.50924	549.97803	False	Updated : Converged
DP3	575	10	300	5	378.66016	574.97583	False	Updated : Converged
DP4	600	10	300	5	385.81108	599.97364	False	Updated : Converged

Base Case Simulation Setup

Physics

Models

Model	Settings
Space	3D
Time	Steady
Viscous	SST k-omega turbulence model
Heat Transfer	Enabled

Material Properties

━ Fluid	
━ water-liquid	
Density	998.2 kg/m^3
Cp (Specific Heat)	4182 J/(kg K)
Thermal Conductivity	0.6 W/(m K)
Viscosity	0.001003 kg/(m s)
Molecular Weight	18.0152 kg/kmol
━ air	
Density	1.225 kg/m^3
Cp (Specific Heat)	1006.43 J/(kg K)
Thermal Conductivity	0.0242 W/(m K)
Viscosity	1.7894e-05 kg/(m s)
Molecular Weight	28.966 kg/kmol

Solid	
aluminum	
Density	2719 kg/m^3
Cp (Specific Heat)	871 J/(kg K)
Thermal Conductivity	202.4 W/(m K)

Cell Zone Conditions

Fluid	
fluid_outer-solid	
Material Name	air
Specify source terms?	no
Specify fixed values?	no
Frame Motion?	no
Laminar zone?	no
Porous zone?	no
3D Fan Zone?	no
fluid_inner	
Material Name	water liquid
Specify source terms?	no
Specify fixed values?	no
Frame Motion?	no
Laminar zone?	no
Porous zone?	no
3D Fan Zone?	no
Solid	
pipe-solid	
Material Name	aluminum
Specify source terms?	no
Specify fixed values?	no
Frame Motion?	no
Solid Motion?	no

Boundary Conditions

Inlet	
air_inlet	
Velocity Specification Method	Magnitude, Normal to Boundary
Reference Frame	Absolute
Velocity Magnitude	parameter
Supersonic/Initial Gauge Pressure [Pa]	0
Temperature	parameter
Turbulent Specification Method	Intensity and Viscosity Ratio
Turbulent Intensity [%]	5
Turbulent Viscosity Ratio	10
Note: Reinjected particles do not change their injection association	no
water_inlet	
Velocity Specification Method	Magnitude, Normal to Boundary
Reference Frame	Absolute
Velocity Magnitude	parameter
Supersonic/Initial Gauge Pressure [Pa]	0
Temperature	parameter
Turbulent Specification Method	Intensity and Viscosity Ratio
Turbulent Intensity [%]	5
Turbulent Viscosity Ratio	10
Note: Reinjected particles do not change their injection association	no
Outlet	
water_outlet	
Backflow Reference Frame	Absolute
Gauge Pressure [Pa]	0
Pressure Profile Multiplier	1
Backflow Total Temperature [K]	300
Backflow Direction Specification Method	Normal to Boundary
Turbulent Specification Method	Intensity and Viscosity Ratio
Backflow Turbulent Intensity [%]	5
Backflow Turbulent Viscosity Ratio	10

Note: Reinjected particles do not change their injection association	no	
Backflow Pressure Specification	Total Pressure	
Build artificial walls to prevent reverse flow?	no	
Radial Equilibrium Pressure Distribution	no	
Average Pressure Specification?	no	
Specify targeted mass flow rate	no	
─ air_outlet		
Backflow Reference Frame	Absolute	
Gauge Pressure [Pa]	0	
Pressure Profile Multiplier	1	
Backflow Total Temperature [K]	300	
Backflow Direction Specification Method	Normal to Boundary	
Turbulent Specification Method	Intensity and Viscosity Ratio	
Backflow Turbulent Intensity [%]	5	
Backflow Turbulent Viscosity Ratio	10	
Note: Reinjected particles do not change their injection association	no	
Backflow Pressure Specification	Total Pressure	
Build artificial walls to prevent reverse flow?	no	
Radial Equilibrium Pressure Distribution	no	
Average Pressure Specification?	no	
Specify targeted mass flow rate	no	
─ Wall		
─ pipe-solid:1		
Wall Thickness [mm]	0	
Heat Generation Rate [W/m^3]	0	
Material Name	aluminum	
Thermal BC Type	Heat Flux	
Heat Flux [W/m^2]	0	
Enable shell conduction?	no	
Convective Augmentation Factor	1	
─ fluid_outer-solid-pipe-solid		
Wall Thickness [mm]	0	
Heat Generation Rate [W/m^3]	0	
Material Name	aluminum	
Thermal BC Type	Coupled	
Enable shell conduction?	no	
Wall Motion	Stationary Wall	
Shear Boundary Condition	No Slip	
Wall Surface Roughness	0	
Wall Roughness Height [mm]	0	
Wall Roughness Constant	0.5	
Convective Augmentation Factor	1	
─ fluid_inner-pipe-solid		
Wall Thickness [mm]	0	
Heat Generation Rate [W/m^3]	0	
Material Name	aluminum	
Thermal BC Type	Coupled	
Enable shell conduction?	no	
Wall Motion	Stationary Wall	
Shear Boundary Condition	No Slip	
Wall Surface Roughness	0	
Wall Roughness Height [mm]	0	
Wall Roughness Constant	0.5	
Convective Augmentation Factor	1	
─ air_walls		
Wall Thickness [mm]	0	
Heat Generation Rate [W/m^3]	0	
Material Name	aluminum	
Thermal BC Type	Heat Flux	
Heat Flux [W/m^2]	0	
Enable shell conduction?	no	
Wall Motion	Stationary Wall	
Shear Boundary Condition	No Slip	
Wall Surface Roughness	0	

Wall Roughness Height [mm]		0
Wall Roughness Constant		0.5
Convective Augmentation Factor		1
─ fluid_outer-solid-pipe-solid-shadow		
Wall Thickness [mm]		0
Heat Generation Rate [W/m^3]		0
Material Name		aluminum
Thermal BC Type		Coupled
Enable shell conduction?		no
Convective Augmentation Factor		1
─ fluid_inner-pipe-solid-shadow		
Wall Thickness [mm]		0
Heat Generation Rate [W/m^3]		0
Material Name		aluminum
Thermal BC Type		Coupled
Enable shell conduction?		no
Convective Augmentation Factor		1

Reference Values

Area	1 m^2
Density	1.225 kg/m^3
Enthalpy	0 J/kg
Length	1 mm
Pressure	0 Pa
Temperature	288.16 K
Velocity	1 m/s
Viscosity	1.7894e-05 kg/(m s)
Ratio of Specific Heats	1.4
Yplus for Heat Tran. Coef.	300
Reference Zone	fluid_inner

Solver Settings

─ Equations	
Flow	True
Turbulence	True
Energy	True
─ Numerics	
Absolute Velocity Formulation	True
─ Pseudo Time Explicit Relaxation Factors	
Density	1
Body Forces	1
Turbulent Kinetic Energy	0.75
Specific Dissipation Rate	0.75
Turbulent Viscosity	1
Energy	0.75
Explicit Momentum	0.5
Explicit Pressure	0.5
─ Pressure-Velocity Coupling	
Type	Coupled
Pseudo Time Method (Global Time Step)	True
─ Discretization Scheme	
Pressure	Second Order
Momentum	Second Order Upwind
Turbulent Kinetic Energy	Second Order Upwind
Specific Dissipation Rate	Second Order Upwind
Energy	Second Order Upwind
─ Solution Limits	
Minimum Absolute Pressure [Pa]	1
Maximum Absolute Pressure [Pa]	5e+10
Minimum Temperature [K]	1
Maximum Temperature [K]	5000
Minimum Turb. Kinetic Energy [m^2/s^2]	1e-14

Minimum Spec. Dissipation Rate [s^-1]	1e-20
Maximum Turb. Viscosity Ratio	100000

Minimum Spec. Dissipation Rate [s^-1]	1e-20
Maximum Turb. Viscosity Ratio	100000