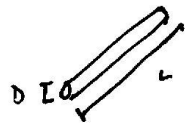
MICHAEL DELACRUZ
MET440
EXAM 3

PURPOSE : DETERMINE PLASTIC ROD DIAMETER FOR CENTER OF ROD IS 30°C AT 1338 s

DRAWINGS & DIAGRAMS



$T_\infty = 25°C$
$T_i = 70°C$

SOURCES : BAYAZITOGLU, Y. OSIZIK, N. "A TEXTBOOK FOR HEAT TRANSFER FUNDAMENTALS," BEGELL HOUSE INC, (2012)

DESIGN CONSIDERATIONS:
- TRANSIENT
- ONE DIMENSIONAL
- CONSTANT PROPERTIES

DATA & VARIABLES:

$T_i = 70°C$
$T_\infty = 25°C$
$h = 20.42\ W/m^2 \cdot K$
$t = 1338\ s$
$\rho = 1190\ kg/m^3$
$c_p = 1465\ J/kg \cdot K$
$k = 0.19\ W/m \cdot K$

PROCEDURE
1. ASSUME R RADIUS
2. SOLVE FOR BIOT NUMBER
3. USE TABLES TO FIND λ_1 & A_1
4. SOLVE FOR θ_0, θ & TEMPERATURE AT SPECIFIED LOCATIONS
5. ITERATE IF NECESSARY

ASSUME $r_o = 6mm$

$Bi = \frac{20.42 \times 0.006}{2(0.19} = 0.322\,421$

$\lambda_1 = .7701$

$C_1 = 1.0761$

$\alpha = 1.08986 \times 10^{-7}$

$\tau = 4.05065$

$\theta_0 = 1.0761\, e^{-(.7701^2 \times 4.05065)}$

$= 0.097402$

SURFACE

$\theta = 0.097402\, \underbrace{J_0(.7701)}_{0.8567}$

$= 0.08344$

$T_{(r,t)} = 0.08344\,(70-25) + 25$

$= 28.75\,^\circ C$

HALF RADIUS

$\theta = 0.097402\, \underbrace{J_0\left(\frac{.7701}{2}\right)}_{.963}$

$= 0.093798$

$T_{(r,t)} = 0.093798\,(70-25) + 25$

$= 29.2209\,^\circ C$

ASSUME $r_o = 9\ mm$

$$Bi = \frac{20.42 \times 0.009}{2(0.19)} = 0.483632$$

$A_1 = .9273$

$C_1 = 1.1117$

$\alpha = 1.089986 \times 10^{-7}$

$\tau = 1.800029$

$$\theta_0 = 1.1111\, e^{-(.9273^2 \times 1.800029)}$$

$$= 0.236291$$

SURFACE

$$\theta = 0.236291 \underbrace{J_0(.9273)}_{0.796}$$

$$= 0.188087$$

$$T(r,t) = 0.188087\,(70-25) + 25$$

$$= 33.4639\ ^\circ C \quad X \text{ TOO LARGE}$$

HALF RADIUS

$$\theta = 0.236291 \underbrace{J_0\left(\frac{.9273}{2}\right)}_{.9465}$$

$$= 0.223649$$

$$T(r,t) = 0.223649\,(70-25) + 25$$

$$= 35.0642\ ^\circ C \quad X \text{ TOO LARGE}$$

ASSUME $r_o = 7mm$

$Bi = \frac{20.42 \times 0.007}{2(0.19)} = 0.376158$

$\lambda_1 = .8265$

$A_1 = 1.088$

$\alpha = 1.08986 \times 10^{-7}$

$\tau = 2.97599$

$\theta_o = 1.088\, e^{-(.8265^2 \times 2.97599)}$

$= 0.142478$

~~$T_{(r,t)} = 0.142478 (70-25) + 25$ OUTSIDE SURFACE~~

~~$\theta = 0.142478$~~

$\theta = 0.142478 \frac{J_0(.8265)}{.836}$

$= 0.119112$

$T_{(r,t)} = 0.119112 (70-25) + 25$

$= 30.36°C$

$\theta = 0.142478 \frac{J_0(\frac{.8265}{2})}{.9575}$

$= .136423$

$T_{(r,t)} = .136423 (70-25) + 25$

$= 31.139°C$

SUMMARY:

IT WAS FOUND THAT AFTER A 7mm DIAMETER ROD REACHES A TEMPERATURE OF 31.14°C AT ITS CORE AFTER 1338s. THE SURFACE REACHES A TEMPERATURE OF 30.36°C AFTER 1338s

$$T_{(r=r_0,\ t=1338_s)} = 31.139\,^{\circ}C$$
$$T_{(r=\frac{r_0}{2},\ t=1338_s)} = 30.36\,^{\circ}C$$

MATERIALS

PLASTIC ROD W/ AN UNKNOWN DIAMETER & FLUID.

ANALYSIS:

THE TEMPERATURE AT THE CENTER CHANGES MUCH SLOWER THAN THAT OF THE SURFACE. THE SURFACE IS IN DIRECT CONTACT WITH THE COLDER UNKNOWN FLUID.

Michael Delacruz
MET 440

MET 440 EXAM 3

Report date	Nov 1, 2019 8:28:16 PM

Contents

Michael Delacruz
MET 440

Purpose: Verify calculated data from part 1 of the test in order to compare computed values from ComSol.

Drawings and Diagrams: See ComSol file

Sources: Bayazitoglu, Y. Osizik, N. “A textbook for Heat Transfer Fundamentals,” Begell House Inc,(2012)

Design Considerations:

- Transient
- One Dimensionaal
- Constant Properties

Procedure:

- Input Variables
- Build geometry
- Input Convective Heat flux
- Build Mesh
- Compute data
- Analyze cut point and point graph
- Evaluate and update as necessary

Analysis:

After analyzing my calculated value and my ComSol file, it is shown to have a slight difference in the radius size. The radius I calculated was 7mm while the ComSol file was at 10 mm. The solution given in ComSol is more correct as I had to do many more linear interpolations in order to achieve my desired value.

1 Global Definitions

Date	Nov 1, 2019 8:21:11 PM

Global settings

Name	Untitled.mph
Path	C:\Users\mdela002\Desktop\Untitled.mph
COMSOL version	COMSOL 5.1 (Build: 145)
Unit system	SI

Used products

COMSOL Multiphysics
CAD Import Module

1.1 Parameters 1

Parameters

Name	Expression	Value	Description
Ti	70[degC]	343.15 K	initial temp
Tinf	25[degC]	298.15 K	external temp
ho	20.42[W/m^2/K]	20.42 W/(m²·K)	heat transfer coefficient
t	1338[s]	1338 s	time
rho1	1190[kg/m^3]	1190 kg/m³	density
cp1	1465[J/kg/K]	1465 J/(kg·K)	specific heat
ko	0.19[W/m/K]	0.19 W/(m·K)	conductivity
Tc	30[degC]	303.15 K	target temp

2 Component 1

Date	Nov 1, 2019 7:15:05 PM

Component settings

Unit system	SI
Geometry shape order	automatic

2.1 Definitions

2.1.1 Coordinate Systems

Boundary System 1

Coordinate system type	Boundary system
Tag	sys1

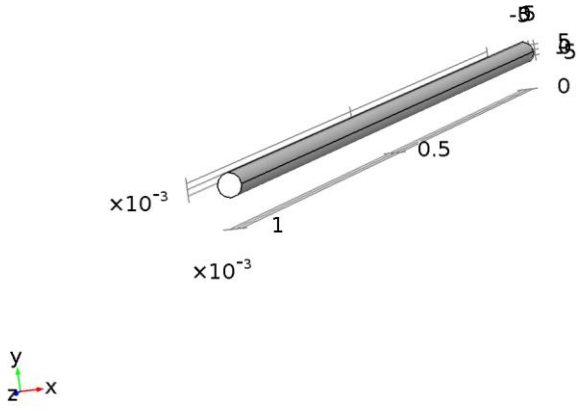
Coordinate names

First (t1)	Second (t2)	Third (n)
t1	t2	n

Settings

Description	Value
Create first tangent direction from	Global Cartesian

2.2 Geometry 1



Geometry 1

Units

Length unit	m
Angular unit	deg

Geometry statistics

Description	Value
Space dimension	3
Number of domains	1
Number of boundaries	6
Number of edges	12
Number of vertices	8

2.2.1 Cylinder 1 (cyl1)

Position

Description	Value
Position	{0, 0, 0}

Axis

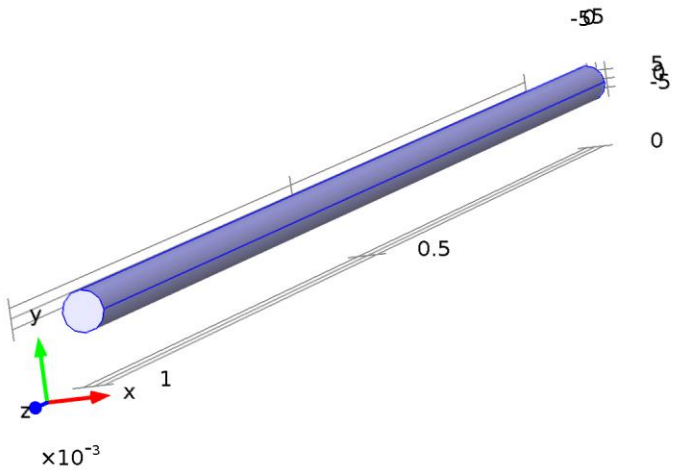
Description	Value
Axis type	z - axis
Layers	

Size and shape

Description	Value
Radius	10[mm]
Height	1

2.3 Materials

2.3.1 Material 1



Material 1

Selection

Geometric entity level	Domain
Selection	Domain 1

Material parameters

Name	Value	Unit
Thermal conductivity	ko	W/(m*K)
Density	rho1	kg/m^3
Heat capacity at constant pressure	cp1	J/(kg*K)

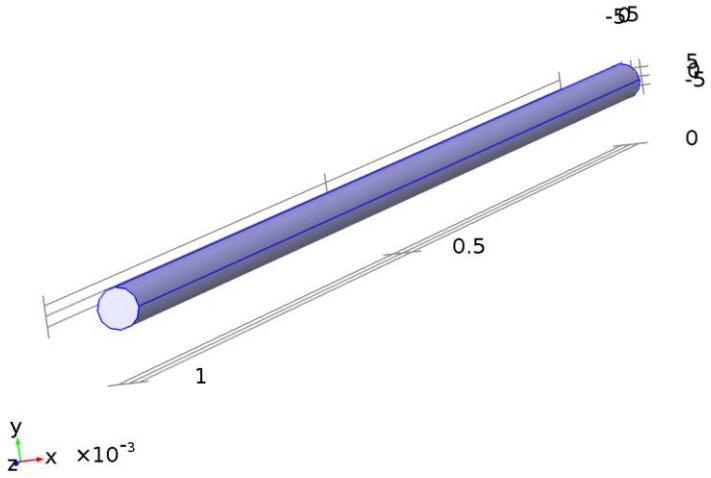
Basic Settings

Description	Value
Thermal conductivity	{{ko, 0, 0}, {0, ko, 0}, {0, 0, ko}}
Density	rho1
Heat capacity at constant pressure	cp1

2.4 Heat Transfer in Solids

Used products

COMSOL Multiphysics



Heat Transfer in Solids

Selection

Geometric entity level	Domain
Selection	Domain 1

Equations

$$\rho C_p \frac{\partial T}{\partial t} + \rho C_p \mathbf{u} \cdot \nabla T + \nabla \cdot \mathbf{q} = Q + Q_{ted}$$
$$\mathbf{q} = -k \nabla T$$

Settings

Description	Value
Temperature	Quadratic
Compute boundary fluxes	On
Apply smoothing to boundary fluxes	On
Value type when using splitting of complex variables	Real
Surface-to-surface radiation	Off
Radiation in participating media	Off
Heat transfer in biological tissue	Off
Isothermal domain	Off
Heat transfer in porous media	Off
Streamline diffusion	On
Crosswind diffusion	On

Description	Value
Isotropic diffusion	Off

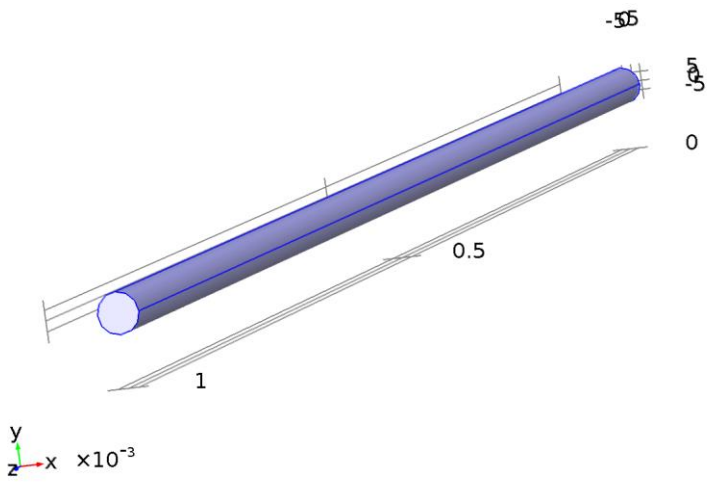
Variables

Name	Expression	Unit	Description	Selection
ht.q0	0	W/m^2	Inward heat flux	Boundaries 1–6
ht.Tu	T	K	Temperature	Boundaries 1–6
ht.Td	T	K	Temperature	Boundaries 1–6
ht.opaqueLayer	1		Thin layer opacity	Boundaries 1–6
ht.Tvar	T	K	Temperature	Domain 1
ht.Tvar	T	K	Temperature	Boundaries 1–6
ht.Tvar	T	K	Temperature	Edges 1–12
ht.Tvar	T	K	Temperature	Points 1–8
ht.addContinuityWeak	1		Boolean	Boundaries 1–6
ht.isConductiveLayer	1		Boolean	Domain 1
ht.d	1	1	Thickness	Domain 1
ht.nx	dnx	1	Normal vector, x component	Boundaries 1–6
ht.ny	dny	1	Normal vector, y component	Boundaries 1–6
ht.nz	dnz	1	Normal vector, z component	Boundaries 1–6
ht.nxmesh	root.dnxmesh	1	Normal vector (mesh), x component	Boundaries 1–6
ht.nymesh	root.dnymesh	1	Normal vector (mesh), y component	Boundaries 1–6

Name	Expression	Unit	Description	Selection
ht.nzmesh	root.dnzmesh	1	Normal vector (mesh), z component	Boundaries 1–6
ht.dnx	dnx	1	Normal vector down direction, x component	Boundaries 1–6
ht.dny	dny	1	Normal vector down direction, y component	Boundaries 1–6
ht.dnz	dnz	1	Normal vector down direction, z component	Boundaries 1–6
ht.unx	unx	1	Normal vector up direction, x component	Boundaries 1–6
ht.uny	uny	1	Normal vector up direction, y component	Boundaries 1–6
ht.unz	unz	1	Normal vector up direction, z component	Boundaries 1–6
ht.dEiInt	ht.intDom(d(ht.rho*ht.Ei,t)*ht.varIntSpa)	W	Total accumulated heat rate	Global
ht.dEi0Int	ht.intDom(d(ht.rho*ht.Ei0,t)*ht.varIntSpa)	W	Total accumulated energy rate	Global
ht.ntfluxInt	ht.intExtBnd(ht.ntflux*ht.varIntSpa)	W	Total net heat rate	Global
ht.ntefluxInt	ht.intExtBnd(ht.nteflux*ht.varIntSpa)	W	Total net energy rate	Global
ht.QInt	ht.intDom(ht.Qtot*ht.varIntSpa)-ht.intIntBnd((ht.ndflux_u+ht.ndflux_d)*ht.varIntSpa)	W	Total heat source	Global
ht.WnsInt	0	W	Total work source	Global

Name	Expression	Unit	Description	Selection
ht.WInt	0	W	Total work source	Global

2.4.1 Heat Transfer in Solids 1



Heat Transfer in Solids 1

Selection

Geometric entity level	Domain
Selection	Domain 1

Equations

$$\rho C_p \mathbf{u} \cdot \nabla T + \nabla \cdot \mathbf{q} = Q + Q_{ted}$$
$$\mathbf{q} = -k\nabla T$$

Settings

Description	Value
Thermal conductivity	From material
Density	From material
Heat capacity at constant pressure	From material

Properties from material

Property	Material	Property group
Thermal conductivity	Material 1	Basic
Density	Material 1	Basic

Property	Material	Property group
Heat capacity at constant pressure	Material 1	Basic

Variables

Name	Expression	Unit	Description	Selection
domflux.Tx	-ht.k_effxx*Tx-ht.k_effxy*Ty-ht.k_effxz*Tz	W/m^2	Domain flux, x component	Domain 1
domflux.Ty	-ht.k_effyx*Tx-ht.k_effyy*Ty-ht.k_effyz*Tz	W/m^2	Domain flux, y component	Domain 1
domflux.Tz	-ht.k_effzx*Tx-ht.k_effzy*Ty-ht.k_effzz*Tz	W/m^2	Domain flux, z component	Domain 1
ht.WnsInt	ht.solid1.intDom(ht.pA*(d(ht.ux,x)+d(ht.uy,y)+d(ht.uz,z))*ht.solid1.varIntSpa)	W	Total work source	Global
ht.kxx	material.k11	W/(m*K)	Thermal conductivity, xx component	Domain 1
ht.kyx	material.k21	W/(m*K)	Thermal conductivity, yx component	Domain 1
ht.kzx	material.k31	W/(m*K)	Thermal conductivity, zx component	Domain 1
ht.kxy	material.k12	W/(m*K)	Thermal conductivity, xy component	Domain 1
ht.kyy	material.k22	W/(m*K)	Thermal conductivity, yy component	Domain 1
ht.kzy	material.k32	W/(m*K)	Thermal conductivity, zy component	Domain 1
ht.kxz	material.k13	W/(m*K)	Thermal conductivity, xz component	Domain 1

Name	Expression	Unit	Description	Selection
ht.kyz	material.k23	W/(m*K)	Thermal conductivity, yz component	Domain 1
ht.kzz	material.k33	W/(m*K)	Thermal conductivity, zz component	Domain 1
ht.rho	material.rho	kg/m^3	Density	Domain 1
ht.Cp	material.Cp	J/(kg*K)	Heat capacity at constant pressure	Domain 1
ht.solid1.pRef	model.input.pRef	Pa	Reference pressure level	Domain 1
ht.alphap	-d(ht.rho,T)/(ht.rho+eps)	1/K	Isobaric compressibility coefficient	Domain 1
ht.pA	model.input.minput_pressure	Pa	Absolute pressure	Domain 1
ht.gradTmag	sqrt(ht.gradTx^2+ht.gradTy^2+ht.gradTz^2)	K/m	Temperature gradient magnitude	Domain 1
ht.kmean	(ht.k_effxx+ht.k_effyy+ht.k_effzz)/3	W/(m*K)	Mean effective thermal conductivity	Domain 1
ht.Q	0	W/m^3	Heat source	Domain 1
ht.qs	0	W/(m^3*K)	Production/absorption coefficient	Domain 1
ht.Qmet	0	W/m^3	Metabolic heat source	Domain 1
ht.Qtot	0	W/m^3	Total heat source	Domain 1
ht.rhoInt	subst(ht.rho,root.comp1.ht.solid1.minput_pressure,ht.pA)	kg/m^3	Density for integration	Domain 1
ht.CpInt	subst(ht.Cp,root.comp1.ht.solid1.minput_pressure,ht.pA)	J/(kg*K)	Specific heat capacity for integration	Domain 1
ht.gammaInt	subst(ht.gamma,root.comp1.ht.solid1.minput_pressure,ht.pA)	1	Ratio of specific heats for integration	Domain 1
ht.TRef	298.15[K]	K	Reference temperature	Domain 1

Name	Expression	Unit	Description	Selection
ht.pRef	ht.solid1.pRef	Pa	Reference pressure level	Domain 1
ht.HRef	0	J/kg	Reference enthalpy	Domain 1
ht.DeltaH	integrate(subst(ht.CpInt,ht.pA,ht.pRef),T,ht.TRef,T)	J/kg	Sensible enthalpy	Domain 1
ht.H	ht.HRef+ht.DeltaH	J/kg	Enthalpy	Domain 1
ht.H0	ht.H	J/kg	Total enthalpy	Domain 1
ht.Ei	ht.H	J/kg	Internal energy	Domain 1
ht.Ei0	ht.Ei	J/kg	Total internal energy	Domain 1
ht.Qbtot	0	W/m^2	Total boundary heat source	Boundaries 1–6
ht.k_effxx	ht.kxx	W/(m*K)	Effective thermal conductivity, xx component	Domain 1
ht.k_effyx	ht.kyx	W/(m*K)	Effective thermal conductivity, yx component	Domain 1
ht.k_effzx	ht.kzx	W/(m*K)	Effective thermal conductivity, zx component	Domain 1
ht.k_effxy	ht.kxy	W/(m*K)	Effective thermal conductivity, xy component	Domain 1
ht.k_effyy	ht.kyy	W/(m*K)	Effective thermal conductivity, yy component	Domain 1
ht.k_effzy	ht.kzy	W/(m*K)	Effective thermal conductivity, zy component	Domain 1
ht.k_effxz	ht.kxz	W/(m*K)	Effective thermal conductivity, xz component	Domain 1
ht.k_effyz	ht.kyz	W/(m*K)	Effective thermal conductivity, yz component	Domain 1
ht.k_effzz	ht.kzz	W/(m*K)	Effective thermal conductivity, zz component	Domain 1

Name	Expression	Unit	Description	Selection
ht.C_eff	ht.rho*ht.Cp	J/(m^3*K)	Effective volumetric heat capacity	Domain 1
ht.ux	0	m/s	Velocity field, x component	Domain 1
ht.uy	0	m/s	Velocity field, y component	Domain 1
ht.uz	0	m/s	Velocity field, z component	Domain 1
ht.gradTx	Tx	K/m	Temperature gradient, x component	Domain 1
ht.gradTy	Ty	K/m	Temperature gradient, y component	Domain 1
ht.gradTz	Tz	K/m	Temperature gradient, z component	Domain 1
ht.Qltot	0	W/m	Total line heat source	Edges 1–12
ht.Qptot	0	W	Total point heat source	Points 1–8
ht.alphaTdxx	ht.k_effxx/ht.C_eff	m^2/s	Thermal diffusivity, xx component	Domain 1
ht.alphaTdyx	ht.k_effyx/ht.C_eff	m^2/s	Thermal diffusivity, yx component	Domain 1
ht.alphaTdzx	ht.k_effzx/ht.C_eff	m^2/s	Thermal diffusivity, zx component	Domain 1
ht.alphaTdxy	ht.k_effxy/ht.C_eff	m^2/s	Thermal diffusivity, xy component	Domain 1
ht.alphaTdyy	ht.k_effyy/ht.C_eff	m^2/s	Thermal diffusivity, yy component	Domain 1
ht.alphaTdzy	ht.k_effzy/ht.C_eff	m^2/s	Thermal diffusivity, zy component	Domain 1
ht.alphaTdxz	ht.k_effxz/ht.C_eff	m^2/s	Thermal diffusivity, xz component	Domain 1
ht.alphaTdyz	ht.k_effyz/ht.C_eff	m^2/s	Thermal diffusivity, yz component	Domain 1

Name	Expression	Unit	Description	Selection
ht.alphaTdzz	ht.k_effzz/ht.C_eff	m^2/s	Thermal diffusivity, zz component	Domain 1
ht.alphaTdMean	ht.kmean/ht.C_eff	m^2/s	Mean thermal diffusivity	Domain 1
ht.dfluxx	-ht.k_effxx*Tx-ht.k_effxy*Ty-ht.k_effxz*Tz	W/m^2	Conductive heat flux, x component	Domain 1
ht.dfluxy	-ht.k_effyx*Tx-ht.k_effyy*Ty-ht.k_effyz*Tz	W/m^2	Conductive heat flux, y component	Domain 1
ht.dfluxz	-ht.k_effzx*Tx-ht.k_effzy*Ty-ht.k_effzz*Tz	W/m^2	Conductive heat flux, z component	Domain 1
ht.dfluxMag	sqrt(ht.dfluxx^2+ht.dfluxy^2+ht.dfluxz^2)	W/m^2	Conductive heat flux magnitude	Domain 1
ht.trlfluxx	0	W/m^2	Translational heat flux, x component	Domain 1
ht.trlfluxy	0	W/m^2	Translational heat flux, y component	Domain 1
ht.trlfluxz	0	W/m^2	Translational heat flux, z component	Domain 1
ht.trlfluxMag	sqrt(ht.trlfluxx^2+ht.trlfluxy^2+ht.trlfluxz^2)	W/m^2	Translational heat flux magnitude	Domain 1
ht.cfluxx	0	W/m^2	Convective heat flux, x component	Domain 1
ht.cfluxy	0	W/m^2	Convective heat flux, y component	Domain 1
ht.cfluxz	0	W/m^2	Convective heat flux, z component	Domain 1
ht.cfluxMag	sqrt(ht.cfluxx^2+ht.cfluxy^2+ht.cfluxz^2)	W/m^2	Convective heat flux magnitude	Domain 1
ht.tfluxx	ht.dfluxx+ht.trlfluxx+ht.cfluxx	W/m^2	Total heat flux, x component	Domain 1
ht.tfluxy	ht.dfluxy+ht.trlfluxy+ht.cfluxy	W/m^2	Total heat flux, y component	Domain 1
ht.tfluxz	ht.dfluxz+ht.trlfluxz+ht.cfluxz	W/m^2	Total heat flux, z component	Domain 1

Name	Expression	Unit	Description	Selection
ht.tfluxMag	sqrt(ht.tfluxx^2+ht.tfluxy^2+ht.tfluxz^2)	W/m^2	Total heat flux magnitude	Domain 1
ht.tefluxx	ht.dfluxx	W/m^2	Total energy flux, x component	Domain 1
ht.tefluxy	ht.dfluxy	W/m^2	Total energy flux, y component	Domain 1
ht.tefluxz	ht.dfluxz	W/m^2	Total energy flux, z component	Domain 1
ht.tefluxMag	sqrt(ht.tefluxx^2+ht.tefluxy^2+ht.tefluxz^2)	W/m^2	Total energy flux magnitude	Domain 1
ht.rflux	0	W/m^2	Radiative heat flux	Boundaries 1–6
ht.chflux	0	W/m^2	Boundary convective heat flux	Boundaries 1–6
ht.ntrlflux	mean(ht.trlfluxx)*ht.nx+mean(ht.trlfluxy)*ht.ny+mean(ht.trlfluxz)*ht.nz	W/m^2	Normal translational heat flux	Boundaries 1–6
ht.ncflux	mean(ht.cfluxx)*ht.nx+mean(ht.cfluxy)*ht.ny+mean(ht.cfluxz)*ht.nz	W/m^2	Normal convective heat flux	Boundaries 1–6
ht.ndflux	-dflux_spatial(T)/ht.d	W/m^2	Normal conductive heat flux	Boundaries 1–6
ht.ntflux	ht.ndflux+ht.ntrlflux+ht.ncflux	W/m^2	Normal total heat flux	Boundaries 1–6
ht.nteflux	mean(ht.tefluxx)*ht.nx+mean(ht.tefluxy)*ht.ny+mean(ht.tefluxz)*ht.nz-mean(ht.dfluxx)*ht.nx-mean(ht.dfluxy)*ht.ny-mean(ht.dfluxz)*ht.nz+ht.ndflux	W/m^2	Normal total energy flux	Boundaries 1–6
ht.solid1.dEiInt	ht.solid1.intDom(d(ht.rho*ht.Ei,t)*ht.solid1.varIntSpa)	W	Total accumulated heat rate	Global
ht.solid1.dEi0Int	ht.solid1.intDom(d(ht.rho*ht.Ei0,t)*ht.solid1.varIntSpa)	W	Total accumulated energy rate	Global
ht.solid1.ntfluxInt	ht.solid1.intExtBnd(ht.ntflux*ht.solid1.varIntSp	W	Total net heat rate	Global

Name	Expression	Unit	Description	Selection
	a)+ht.solid1.intExtBndUp(ht.ntflux_u*ht.solid1.varIntSpa)+ht.solid1.intExtBndDown(ht.ntflux_d*ht.solid1.varIntSpa)			
ht.solid1.ntefluxInt	ht.solid1.intExtBnd(ht.nteflux*ht.solid1.varIntSpa)+ht.solid1.intExtBndUp(ht.nteflux_u*ht.solid1.varIntSpa)+ht.solid1.intExtBndDown(ht.ntelflux_d*ht.solid1.varIntSpa)	W	Total net energy rate	Global
ht.solid1.QInt	ht.solid1.intDom(ht.Qtot*ht.solid1.varIntSpa)-ht.solid1.intIntBnd((ht.ndflux_u+ht.ndflux_d)*ht.solid1.varIntSpa)	W	Total heat source	Global
ht.solid1.WnsInt	ht.solid1.intDom(ht.pA*(d(ht.ux,x)+d(ht.uy,y)+d(ht.uz,z))*ht.solid1.varIntSpa)	W	Total work source	Global
ht.solid1.WInt	0	W	Total work source	Global
ht.gamma	1	1	Ratio of specific heats	Domain 1
ht.helem	h	m	Element size	Domain 1
ht.res_T	-ht.k_effxx*Txx-ht.k_effxy*Txy-ht.k_effxz*Txz-ht.k_effyx*Tyx-ht.k_effyy*Tyy-ht.k_effyz*Tyz-ht.k_effzx*Tzx-ht.k_effzy*Tzy-ht.k_effzz*Tzz-(ht.qs+ht.qs_oop)*T+ht.rho*ht.Cp*(ht.ux*Tx+ht.uy*Ty+ht.uz*Tz)-ht.Q-ht.Qoop	W/m^3	Equation residual	Domain 1

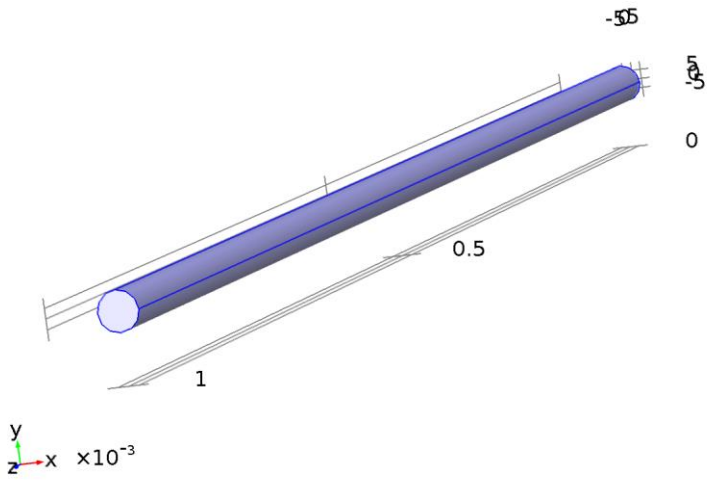
Shape functions

Name	Shape function	Unit	Description	Shape frame	Selection
T	Lagrange (Quadratic)	K	Temperature	Material	Domain 1

Weak expressions

Weak expression	Integration frame	Selection
(-(ht.k_effxx*Tx+ht.k_effxy*Ty+ht.k_effxz*Tz)*test(Tx)- (ht.k_effyx*Tx+ht.k_effyy*Ty+ht.k_effyz*Tz)*test(Ty)- (ht.k_effzx*Tx+ht.k_effzy*Ty+ht.k_effzz*Tz)*test(Tz))*ht.d	Material	Domain 1
-ht.rho*ht.Cp*(ht.ux*Tx+ht.uy*Ty+ht.uz*Tz)*test(T)*ht.d	Material	Domain 1
ht.streamline	Material	Domain 1

2.4.2 Initial Values 1



Initial Values 1

Selection

Geometric entity level	Domain
Selection	Domain 1

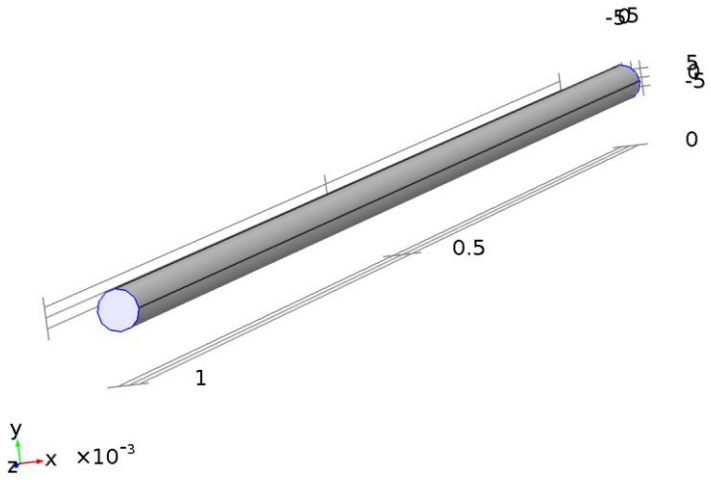
Settings

Description	Value
Temperature	Ti

Variables

Name	Expression	Unit	Description	Selection
ht.Tinit	Ti	K	Temperature	Domain 1

2.4.3 Thermal Insulation 1



Thermal Insulation 1

Selection

Geometric entity level	Boundary
Selection	Boundaries 3–4

Equations

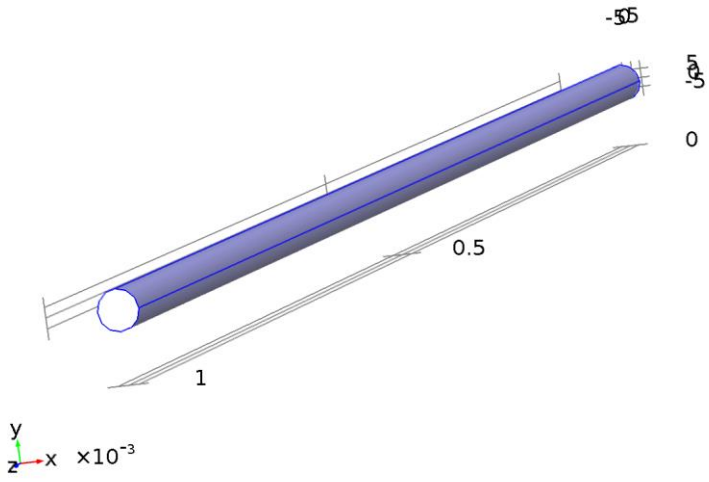
$$-\mathbf{n}\cdot\mathbf{q}=0$$

Variables

Name	Expression	Unit	Description	Selection
ht.ins1.ntfluxInt	ht.ins1.intExtBnd(ht.ntflux*ht.ins1.varIntSpa)	W	Total net heat rate	Global
ht.ins1.ntefluxInt	ht.ins1.intExtBnd(ht.nteflux*ht.ins1.varIntSpa)	W	Total net energy rate	Global
ht.ins1.ntfluxInt_u	ht.ins1.intIntBnd(ht.ntflux_u*ht.ins1.varIntSpa)	W	Total net heat rate, upside	Global
ht.ins1.ntefluxInt_u	ht.ins1.intIntBnd(ht.nteflux_u*ht.ins1.varIntSpa)	W	Total net energy rate, upside	Global

Name	Expression	Unit	Description	Selection
ht.ins1.ntfluxInt_d	ht.ins1.intIntBnd(ht.ntflux_d*ht.ins1.varIntSpa)	W	Total net heat rate, downside	Global
ht.ins1.ntefluxInt_d	ht.ins1.intIntBnd(ht.nteflux_d*ht.ins1.varIntSpa)	W	Total net energy rate, downside	Global
ht.ins1.Tave	if(ht.ins1.intBnd(ht.ins1.varIntSpa*ht.rho*ht.Cp*(ht.ux*ht.nx+ht.uy*ht.ny+ht.uz*ht.nz))==0,ht.ins1.intBnd(ht.ins1.varIntSpa*T)/ht.ins1.intBnd(ht.ins1.varIntSpa),ht.ins1.intBnd(ht.ins1.varIntSpa*ht.rho*ht.Cp*T*(ht.ux*ht.nx+ht.uy*ht.ny+ht.uz*ht.nz))/ht.ins1.intBnd(ht.ins1.varIntSpa*ht.rho*ht.Cp*(ht.ux*ht.nx+ht.uy*ht.ny+ht.uz*ht.nz)))	K	Weighted average temperature	Global

2.4.4 Heat Flux 1



Heat Flux 1

Selection

Geometric entity level	Boundary
Selection	Boundaries 1–2, 5–6

Equations

$$-\mathbf{n}\cdot\mathbf{q} = q_0$$

Settings

Description	Value
Heat flux	Convective heat flux
Heat transfer coefficient	User defined
Heat transfer coefficient	ho
External temperature	Tinf

Variables

Name	Expression	Unit	Description	Selection
ht.q0	ht.hf1.q0	W/m^2	Inward heat flux	Boundaries 1–2, 5–6
ht.hf1.h	ho	W/(m^2*K)	Heat transfer coefficient	Boundaries 1–2, 5–6
ht.hf1.Text	Tinf	K	External temperature	Boundaries 1–2, 5–6
ht.hf1.q0	ht.hf1.h*(ht.hf1.Text-ht.hf1.Tvar)	W/m^2	Boundary convective heat flux	Boundaries 1–2, 5–6
ht.hf1.Tvar	ht.Tu	K	Temperature	Boundaries 1–2, 5–6
ht.hf1.ntfluxInt	ht.hf1.intExtBnd(ht.ntflux*ht.hf1.varIntSpa)	W	Total net heat rate	Global
ht.hf1.ntefluxInt	ht.hf1.intExtBnd(ht.nteflux*ht.hf1.varIntSpa)	W	Total net energy rate	Global
ht.hf1.ntfluxInt_u	ht.hf1.intIntBnd(ht.ntflux_u*ht.hf1.varIntSpa)	W	Total net heat rate, upside	Global
ht.hf1.ntefluxInt_u	ht.hf1.intIntBnd(ht.nteflux_u*ht.hf1.varIntSpa)	W	Total net energy rate, upside	Global
ht.hf1.ntfluxInt_d	ht.hf1.intIntBnd(ht.ntflux_d*ht.hf1.varIntSpa)	W	Total net heat rate, downside	Global
ht.hf1.ntefluxInt_d	ht.hf1.intIntBnd(ht.nteflux_d*ht.hf1.varIntSpa)	W	Total net energy rate, downside	Global
ht.hf1.Tave	if(ht.hf1.intBnd(ht.hf1.varIntSpa*ht.rho*ht.Cp*(ht.ux*ht.nx+ht.uy*ht.ny+ht.uz*ht.nz))==0,ht.hf1.intBnd(ht.hf1.varIntSpa*T)/ht.hf1.intBnd(ht.hf1.va	K	Weighted average temperature	Global

Name	Expression	Unit	Description	Selection
	rIntSpa),ht.hf1.intBnd(ht.hf1.varIntSpa*ht.rho*ht.Cp*T*(ht.ux*ht.nx+ht.uy*ht.ny+ht.uz*ht.nz))/ht.hf1.intBnd(ht.hf1.varIntSpa*ht.rho*ht.Cp*(ht.ux*ht.nx+ht.uy*ht.ny+ht.uz*ht.nz)))			

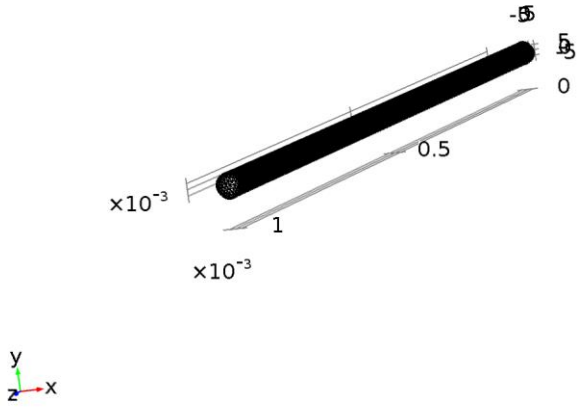
Weak expressions

Weak expression	Integration frame	Selection
ht.hf1.q0*test(ht.hf1.Tvar)*ht.d	Material	Boundaries 1–2, 5–6

2.5 Mesh 1

Mesh statistics

Description	Value
Minimum element quality	0.1681
Average element quality	0.7617
Tetrahedral elements	239458
Triangular elements	36376
Edge elements	2064
Vertex elements	8



Mesh 1

2.5.1 Size (size)

Settings

Description	Value
Maximum element size	0.02
Minimum element size	2.0E-4
Curvature factor	0.2
Maximum element growth rate	1.3
Predefined size	Extremely fine

2.5.2 Free Tetrahedral 1 (ftet1)

Selection

Geometric entity level	Remaining

3 Study 1

Computation information

Computation time	4 min 6 s
CPU	Intel(R) Xeon(R) CPU E5-2680 v4 @ 2.40GHz, 2 cores
Operating system	Windows 8

3.1 Time Dependent

Study settings

Description	Value
Include geometric nonlinearity	Off

Times	Unit
range(0,6,t)	s

Physics and variables selection

Physics interface	Discretization
Heat Transfer in Solids (ht)	physics

Mesh selection

Geometry	Mesh
Geometry 1 (geom1)	mesh1

3.2 Solver Configurations

3.2.1 Solution 1

Compile Equations: Time Dependent (st1)

Study and step

Description	Value
Use study	Study 1
Use study step	Time Dependent

Dependent Variables 1 (v1)

General

Description	Value
Defined by study step	Time Dependent

Initial values of variables solved for

Description	Value
Solution	Zero

Values of variables not solved for

Description	Value
Solution	Zero

Temperature (comp1.T) (comp1_T)

General

Description	Value
Field components	comp1.T

Time-Dependent Solver 1 (t1)

General

Description	Value
Defined by study step	Time Dependent
Time	{0, 6, 12, 18, 24, 30, 36, 42, 48, 54, 60, 66, 72, 78, 84, 90, 96, 102, 108, 114, 120, 126, 132, 138, 144, 150, 156, 162, 168, 174, 180, 186, 192, 198, 204, 210, 216, 222, 228, 234, 240, 246, 252, 258, 264, 270, 276, 282, 288, 294, 300, 306, 312, 318, 324, 330, 336, 342, 348, 354, 360, 366, 372, 378, 384, 390, 396, 402, 408, 414, 420, 426, 432, 438, 444, 450, 456, 462, 468, 474, 480, 486, 492, 498, 504, 510, 516, 522, 528, 534, 540, 546, 552, 558, 564, 570, 576, 582, 588, 594, 600, 606, 612, 618, 624, 630, 636, 642, 648, 654, 660, 666, 672, 678, 684, 690, 696, 702, 708, 714, 720, 726, 732, 738, 744, 750, 756, 762, 768, 774, 780, 786, 792, 798, 804, 810, 816, 822, 828, 834, 840, 846, 852, 858, 864, 870, 876, 882, 888, 894, 900, 906, 912, 918, 924, 930, 936, 942, 948, 954, 960, 966, 972, 978, 984, 990, 996, 1002, 1008, 1014, 1020, 1026, 1032, 1038, 1044, 1050, 1056, 1062, 1068, 1074, 1080, 1086, 1092, 1098, 1104, 1110, 1116, 1122, 1128, 1134, 1140, 1146, 1152, 1158, 1164, 1170, 1176, 1182, 1188, 1194, 1200, 1206, 1212, 1218, 1224, 1230, 1236, 1242, 1248, 1254, 1260, 1266, 1272, 1278, 1284, 1290, 1296, 1302, 1308, 1314, 1320, 1326, 1332, 1338}

Time stepping

Description	Value
Maximum BDF order	2
Error estimation	Exclude algebraic

Log

```
Time-Dependent Solver 1 in Solution 1 started at 1-Nov-2019 19:37:51.
Time-dependent solver (BDF)
Number of degrees of freedom solved for: 357101 (plus 76886 internal DOFs).
Symmetric matrices found.
Scales for dependent variables:
Temperature (comp1.T): 3.4e+002
Step        Time    Stepsize      Res  Jac  Sol Order Tfail NLfail LinIt   LinErr
LinRes
   0           0           - out    2    3    2                 0     4    0.001 2.
4e-005
   1       1.338       1.338        4    4    4     1     0      0     6   3e-
005 4.4e-007
   2       2.676       1.338        6    5    6     1     0      0     8 8.4e-
006 1.4e-007
   3       5.352       2.676        8    6    8     2     0      0    10 2.1e-
005 3.3e-007
   -           6           - out
   4      10.704       5.352       10    7   10     1     0      0    12 1.5e-
005 2.2e-007
   -          12           - out
   -          18           - out
   5      21.408      10.704       12    8   12     1     0      0    14 1.5e-
005 1.4e-007
   -          24           - out
   -          30           - out
   -          36           - out
   -          42           - out
   6      42.816      21.408       14    9   14     1     0      0    16 2.5e-
005 1.6e-007
   -          48           - out
   -          54           - out
   -          60           - out
   7      64.224      21.408       16   10   16     1     0      0    18 1.1e-
005 6.9e-008
   -          66           - out
   -          72           - out
   -          78           - out
   -          84           - out
   -          90           - out
   -          96           - out
   -         102           - out
   8      107.04      42.816       18   11   18     1     0      0    20 1.5e-
005 7.7e-008
   -         108           - out
   -         114           - out
   -         120           - out
   -         126           - out
   -         132           - out
   -         138           - out
   -         144           - out
   9      149.86      42.816       20   12   20     1     0      0    22 6.2e-
006 3.5e-008
   -         150           - out
   -         156           - out
   -         162           - out
   -         168           - out
```

```
    -         174           - out
    -         180           - out
    -         186           - out
    -         192           - out
    -         198           - out
    -         204           - out
    -         210           - out
    -         216           - out
    -         222           - out
    -         228           - out
    -         234           - out
   10      235.49      85.632       22   13   22     1     0      0    24 9.5e-
006 4.4e-008
    -         240           - out
    -         246           - out
    -         252           - out
    -         258           - out
    -         264           - out
    -         270           - out
    -         276           - out
    -         282           - out
    -         288           - out
    -         294           - out
    -         300           - out
    -         306           - out
    -         312           - out
    -         318           - out
   11      321.12      85.632       24   14   24     1     0      0    26 4.2e-
006 2.2e-008
    -         324           - out
    -         330           - out
    -         336           - out
    -         342           - out
    -         348           - out
    -         354           - out
    -         360           - out
    -         366           - out
    -         372           - out
    -         378           - out
    -         384           - out
    -         390           - out
    -         396           - out
    -         402           - out
    -         408           - out
    -         414           - out
    -         420           - out
    -         426           - out
    -         432           - out
    -         438           - out
    -         444           - out
    -         450           - out
   12      454.92       133.8       26   15   26     1     0      0    28 3.8e-
006 2.2e-008
    -         456           - out
    -         462           - out
    -         468           - out
```

```
    -         474           - out
    -         480           - out
    -         486           - out
    -         492           - out
    -         498           - out
    -         504           - out
    -         510           - out
    -         516           - out
    -         522           - out
    -         528           - out
    -         534           - out
    -         540           - out
    -         546           - out
    -         552           - out
    -         558           - out
    -         564           - out
    -         570           - out
    -         576           - out
    -         582           - out
    -         588           - out
   13      588.72       133.8       28   16   28     1     0      0    30 2.5e-
006 1.6e-008
    -         594           - out
    -         600           - out
    -         606           - out
    -         612           - out
    -         618           - out
    -         624           - out
    -         630           - out
    -         636           - out
    -         642           - out
    -         648           - out
    -         654           - out
    -         660           - out
    -         666           - out
    -         672           - out
    -         678           - out
    -         684           - out
    -         690           - out
    -         696           - out
    -         702           - out
    -         708           - out
    -         714           - out
    -         720           - out
   14      722.52       133.8       30   17   30     1     0      0    32 2.2e-
006 1.3e-008
    -         726           - out
    -         732           - out
    -         738           - out
    -         744           - out
    -         750           - out
    -         756           - out
    -         762           - out
    -         768           - out
    -         774           - out
    -         780           - out
```

```
    -         786           - out
    -         792           - out
    -         798           - out
    -         804           - out
    -         810           - out
    -         816           - out
    -         822           - out
    -         828           - out
    -         834           - out
    -         840           - out
    -         846           - out
    -         852           - out
   15      856.32       133.8       32   18   32     2     0      0    34 1.4e-
006 8.2e-009
    -         858           - out
    -         864           - out
    -         870           - out
    -         876           - out
    -         882           - out
    -         888           - out
    -         894           - out
    -         900           - out
    -         906           - out
    -         912           - out
    -         918           - out
    -         924           - out
    -         930           - out
    -         936           - out
    -         942           - out
    -         948           - out
    -         954           - out
    -         960           - out
    -         966           - out
    -         972           - out
    -         978           - out
    -         984           - out
    -         990           - out
   16      990.12       133.8       33   19   33     2     0      0    35 2.4e-
006 1.3e-008
    -         996           - out
    -        1002           - out
    -        1008           - out
    -        1014           - out
    -        1020           - out
    -        1026           - out
    -        1032           - out
    -        1038           - out
    -        1044           - out
    -        1050           - out
    -        1056           - out
    -        1062           - out
    -        1068           - out
    -        1074           - out
    -        1080           - out
    -        1086           - out
    -        1092           - out
```

```
    -        1098           - out
    -        1104           - out
    -        1110           - out
    -        1116           - out
    -        1122           - out
   17      1123.9       133.8       34   20   34     2     0      0    36 1.6e-
006 9.8e-009
    -        1128           - out
    -        1134           - out
    -        1140           - out
    -        1146           - out
    -        1152           - out
    -        1158           - out
    -        1164           - out
    -        1170           - out
    -        1176           - out
    -        1182           - out
    -        1188           - out
    -        1194           - out
    -        1200           - out
    -        1206           - out
    -        1212           - out
    -        1218           - out
    -        1224           - out
    -        1230           - out
    -        1236           - out
    -        1242           - out
    -        1248           - out
    -        1254           - out
   18      1257.7       133.8       36   21   36     2     0      0    38 4.1e-
007 2.3e-009
    -        1260           - out
    -        1266           - out
    -        1272           - out
    -        1278           - out
    -        1284           - out
    -        1290           - out
    -        1296           - out
    -        1302           - out
    -        1308           - out
    -        1314           - out
    -        1320           - out
    -        1326           - out
    -        1332           - out
    -        1338           - out
   19      1391.5       133.8       38   22   38     2     0      0    40 3.5e-
007   2e-009
Time-stepping completed.
Time-Dependent Solver 1 in Solution 1: Solution time: 239 s (3 minutes, 59 seconds)
                                       Physical memory: 2.39 GB
                                       Virtual memory: 2.55 GB
```

Fully Coupled 1 (fc1)

General

Description	Value
Linear solver	Iterative 1

Method and termination

Description	Value
Damping factor	0.9
Jacobian update	Once per time step
Maximum number of iterations	5

Iterative 1 (i1)

General

Description	Value
Factor in error estimate	20

Multigrid 1 (mg1)

General

Description	Value
Use hierarchy in geometries	Geometry 1

Presmoother (pr)

SOR Line 1 (sl1)

Main

Description	Value
Relaxation factor	0.2

Secondary

Description	Value
Number of secondary iterations	2
Relaxation factor	0.5

Postsmoother (po)

SOR Line 1 (sl1)

Main

Description	Value
Relaxation factor	0.2

Secondary

Description	Value
Number of secondary iterations	2
Relaxation factor	0.5

Coarse Solver (cs)

Direct 1 (d1)

General

Description	Value
Solver	PARDISO

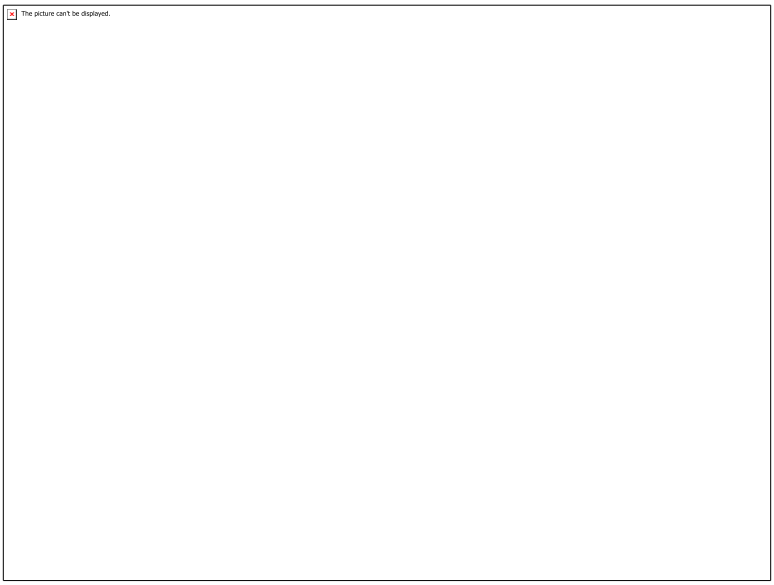
4 Results

4.1 Data Sets

4.1.1 Study 1/Solution 1

Solution

Description	Value
Solution	Solution 1
Component	Save Point Geometry 1



Data set: Study 1/Solution 1

4.1.2 Cut Point 3D 1

Data

Description	Value
Data set	Study 1/Solution 1

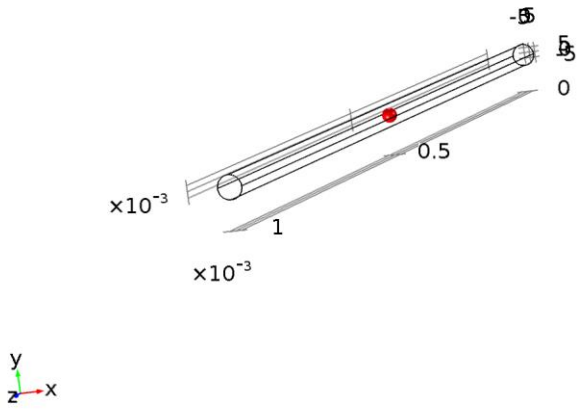
Point data

Description	Value
Entry method	Coordinates

Settings

Description	Value
x	0
y	0

Description	Value
z	0.5



Data set: Cut Point 3D 1

4.1.3 Cut Point 3D 2

Data

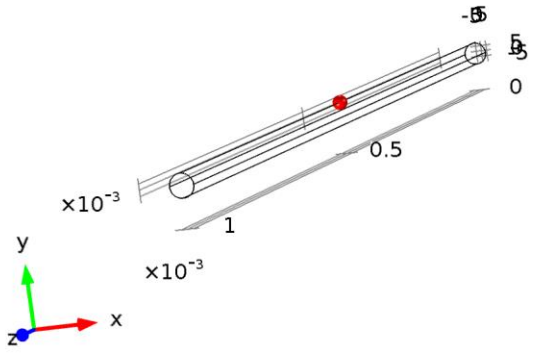
Description	Value
Data set	Study 1/Solution 1

Point data

Description	Value
Entry method	Coordinates

Settings

Description	Value
x	0
y	0.01
z	0.5

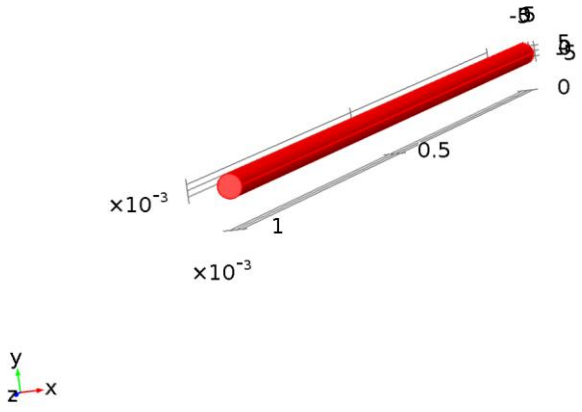


Data set: Cut Point 3D 2

4.1.4 Study 1/Solution 1

Solution

Description	Value
Solution	Solution 1
Component	Save Point Geometry 1



Data set: Study 1/Solution 1

4.2 Derived Values

4.2.1 Point Evaluation 1

Data

Description	Value
Data set	Cut Point 3D 1

Expression

Description	Value
Expression	T
Unit	degC
Description	Temperature

4.2.2 Point Evaluation 2

Data

Description	Value
Data set	Cut Point 3D 2

Expression

Description	Value
Expression	T
Unit	degC
Description	Temperature

4.3 Tables

4.3.1 Table 1

Point Evaluation 1 (T)

Table 1

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
0.0000	70.000
6.0000	70.000
12.000	69.998
18.000	69.991
24.000	69.965
30.000	69.913
36.000	69.861

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
42.000	69.809
48.000	69.701
54.000	69.584
60.000	69.468
66.000	69.318
72.000	69.088
78.000	68.858
84.000	68.629
90.000	68.399
96.000	68.169
102.00	67.940
108.00	67.699
114.00	67.398
120.00	67.098
126.00	66.797
132.00	66.496
138.00	66.196
144.00	65.895
150.00	65.593
156.00	65.260
162.00	64.927
168.00	64.594
174.00	64.260
180.00	63.927
186.00	63.594
192.00	63.261
198.00	62.927
204.00	62.594
210.00	62.261
216.00	61.927
222.00	61.594

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
228.00	61.261
234.00	60.928
240.00	60.605
246.00	60.286
252.00	59.967
258.00	59.648
264.00	59.329
270.00	59.009
276.00	58.690
282.00	58.371
288.00	58.052
294.00	57.733
300.00	57.414
306.00	57.095
312.00	56.776
318.00	56.456
324.00	56.161
330.00	55.891
336.00	55.621
342.00	55.352
348.00	55.082
354.00	54.812
360.00	54.542
366.00	54.272
372.00	54.002
378.00	53.733
384.00	53.463
390.00	53.193
396.00	52.923
402.00	52.653
408.00	52.384

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
414.00	52.114
420.00	51.844
426.00	51.574
432.00	51.304
438.00	51.035
444.00	50.765
450.00	50.495
456.00	50.234
462.00	50.013
468.00	49.792
474.00	49.572
480.00	49.351
486.00	49.130
492.00	48.909
498.00	48.689
504.00	48.468
510.00	48.247
516.00	48.027
522.00	47.806
528.00	47.585
534.00	47.364
540.00	47.144
546.00	46.923
552.00	46.702
558.00	46.481
564.00	46.261
570.00	46.040
576.00	45.819
582.00	45.598
588.00	45.378
594.00	45.194

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
600.00	45.016
606.00	44.837
612.00	44.659
618.00	44.480
624.00	44.302
630.00	44.123
636.00	43.945
642.00	43.766
648.00	43.588
654.00	43.409
660.00	43.231
666.00	43.052
672.00	42.874
678.00	42.695
684.00	42.517
690.00	42.338
696.00	42.159
702.00	41.981
708.00	41.802
714.00	41.624
720.00	41.445
726.00	41.274
732.00	41.110
738.00	40.946
744.00	40.784
750.00	40.622
756.00	40.462
762.00	40.303
768.00	40.145
774.00	39.988
780.00	39.832

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
786.00	39.678
792.00	39.524
798.00	39.372
804.00	39.221
810.00	39.071
816.00	38.922
822.00	38.774
828.00	38.627
834.00	38.482
840.00	38.337
846.00	38.194
852.00	38.052
858.00	37.911
864.00	37.773
870.00	37.635
876.00	37.500
882.00	37.365
888.00	37.232
894.00	37.100
900.00	36.969
906.00	36.839
912.00	36.711
918.00	36.584
924.00	36.458
930.00	36.333
936.00	36.210
942.00	36.088
948.00	35.967
954.00	35.848
960.00	35.730
966.00	35.613

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
972.00	35.497
978.00	35.382
984.00	35.269
990.00	35.157
996.00	35.046
1002.0	34.935
1008.0	34.826
1014.0	34.717
1020.0	34.610
1026.0	34.505
1032.0	34.400
1038.0	34.296
1044.0	34.194
1050.0	34.093
1056.0	33.993
1062.0	33.894
1068.0	33.796
1074.0	33.700
1080.0	33.604
1086.0	33.510
1092.0	33.417
1098.0	33.325
1104.0	33.235
1110.0	33.145
1116.0	33.057
1122.0	32.970
1128.0	32.882
1134.0	32.795
1140.0	32.708
1146.0	32.622
1152.0	32.538

Time (s)	Temperature (degC), Point: (0, 0, 0.5)
1158.0	32.454
1164.0	32.371
1170.0	32.289
1176.0	32.208
1182.0	32.129
1188.0	32.050
1194.0	31.971
1200.0	31.894
1206.0	31.818
1212.0	31.743
1218.0	31.669
1224.0	31.595
1230.0	31.523
1236.0	31.452
1242.0	31.381
1248.0	31.312
1254.0	31.243
1260.0	31.175
1266.0	31.106
1272.0	31.038
1278.0	30.970
1284.0	30.904
1290.0	30.838
1296.0	30.773
1302.0	30.708
1308.0	30.645
1314.0	30.582
1320.0	30.520
1326.0	30.458
1332.0	30.398
1338.0	30.338

4.3.2 Table 2

Point Evaluation 2 (T)

Table 2

Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
0.0000	69.993
6.0000	65.836
12.000	64.323
18.000	63.182
24.000	62.196
30.000	61.416
36.000	60.636
42.000	59.856
48.000	59.232
54.000	58.633
60.000	58.033
66.000	57.480
72.000	57.038
78.000	56.595
84.000	56.152
90.000	55.709
96.000	55.266
102.00	54.823
108.00	54.394
114.00	54.037
120.00	53.680
126.00	53.323
132.00	52.965
138.00	52.608
144.00	52.251
150.00	51.896
156.00	51.621
162.00	51.346
168.00	51.071

Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
174.00	50.797
180.00	50.522
186.00	50.247
192.00	49.972
198.00	49.697
204.00	49.422
210.00	49.147
216.00	48.872
222.00	48.597
228.00	48.322
234.00	48.047
240.00	47.810
246.00	47.585
252.00	47.360
258.00	47.135
264.00	46.910
270.00	46.686
276.00	46.461
282.00	46.236
288.00	46.011
294.00	45.786
300.00	45.561
306.00	45.336
312.00	45.112
318.00	44.887
324.00	44.685
330.00	44.510
336.00	44.334
342.00	44.158
348.00	43.982
354.00	43.806

Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
360.00	43.630
366.00	43.455
372.00	43.279
378.00	43.103
384.00	42.927
390.00	42.751
396.00	42.575
402.00	42.400
408.00	42.224
414.00	42.048
420.00	41.872
426.00	41.696
432.00	41.520
438.00	41.345
444.00	41.169
450.00	40.993
456.00	40.824
462.00	40.684
468.00	40.544
474.00	40.404
480.00	40.264
486.00	40.124
492.00	39.984
498.00	39.845
504.00	39.705
510.00	39.565
516.00	39.425
522.00	39.285
528.00	39.145
534.00	39.005
540.00	38.865

Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
546.00	38.726
552.00	38.586
558.00	38.446
564.00	38.306
570.00	38.166
576.00	38.026
582.00	37.886
588.00	37.746
594.00	37.631
600.00	37.519
606.00	37.407
612.00	37.295
618.00	37.183
624.00	37.071
630.00	36.959
636.00	36.847
642.00	36.735
648.00	36.623
654.00	36.511
660.00	36.399
666.00	36.287
672.00	36.174
678.00	36.062
684.00	35.950
690.00	35.838
696.00	35.726
702.00	35.614
708.00	35.502
714.00	35.390
720.00	35.278
726.00	35.171

Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
732.00	35.068
738.00	34.965
744.00	34.863
750.00	34.762
756.00	34.662
762.00	34.562
768.00	34.463
774.00	34.365
780.00	34.268
786.00	34.171
792.00	34.075
798.00	33.979
804.00	33.885
810.00	33.791
816.00	33.698
822.00	33.605
828.00	33.513
834.00	33.422
840.00	33.332
846.00	33.243
852.00	33.154
858.00	33.066
864.00	32.979
870.00	32.894
876.00	32.809
882.00	32.724
888.00	32.641
894.00	32.559
900.00	32.477
906.00	32.396
912.00	32.316

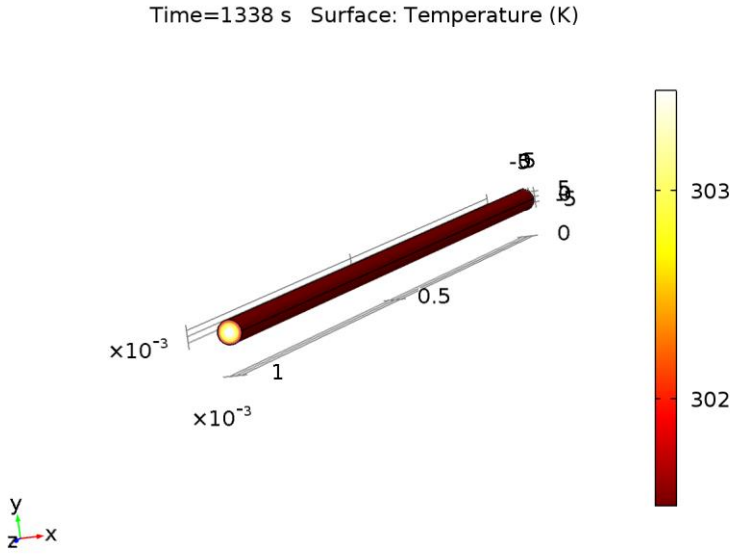
Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
918.00	32.236
924.00	32.158
930.00	32.080
936.00	32.003
942.00	31.927
948.00	31.851
954.00	31.776
960.00	31.703
966.00	31.630
972.00	31.557
978.00	31.486
984.00	31.415
990.00	31.345
996.00	31.276
1002.0	31.207
1008.0	31.138
1014.0	31.071
1020.0	31.004
1026.0	30.938
1032.0	30.872
1038.0	30.808
1044.0	30.744
1050.0	30.680
1056.0	30.618
1062.0	30.556
1068.0	30.495
1074.0	30.435
1080.0	30.375
1086.0	30.317
1092.0	30.259
1098.0	30.201

Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
1104.0	30.145
1110.0	30.089
1116.0	30.034
1122.0	29.979
1128.0	29.924
1134.0	29.870
1140.0	29.816
1146.0	29.762
1152.0	29.709
1158.0	29.657
1164.0	29.605
1170.0	29.554
1176.0	29.503
1182.0	29.453
1188.0	29.404
1194.0	29.355
1200.0	29.307
1206.0	29.260
1212.0	29.213
1218.0	29.166
1224.0	29.120
1230.0	29.075
1236.0	29.031
1242.0	28.987
1248.0	28.943
1254.0	28.900
1260.0	28.858
1266.0	28.815
1272.0	28.772
1278.0	28.730
1284.0	28.688

Time (s)	Temperature (degC), Point: (0, 0.01, 0.5)
1290.0	28.647
1296.0	28.606
1302.0	28.566
1308.0	28.526
1314.0	28.487
1320.0	28.448
1326.0	28.410
1332.0	28.372
1338.0	28.335

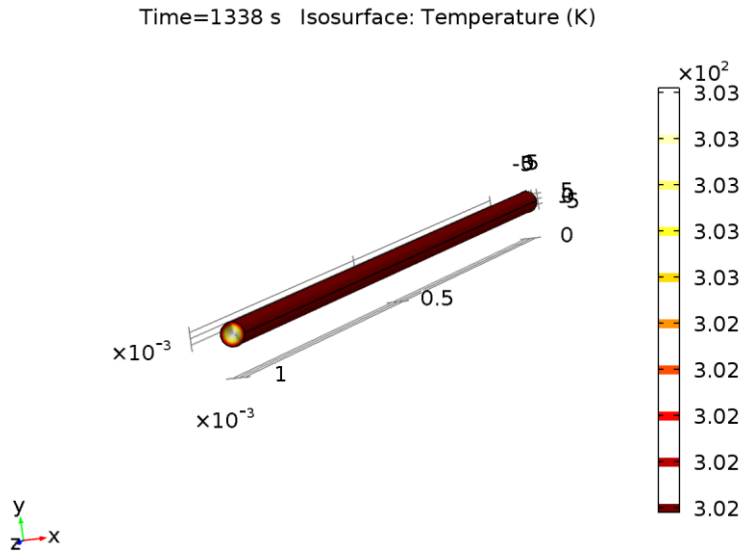
4.4 Plot Groups

4.4.1 Temperature (ht)



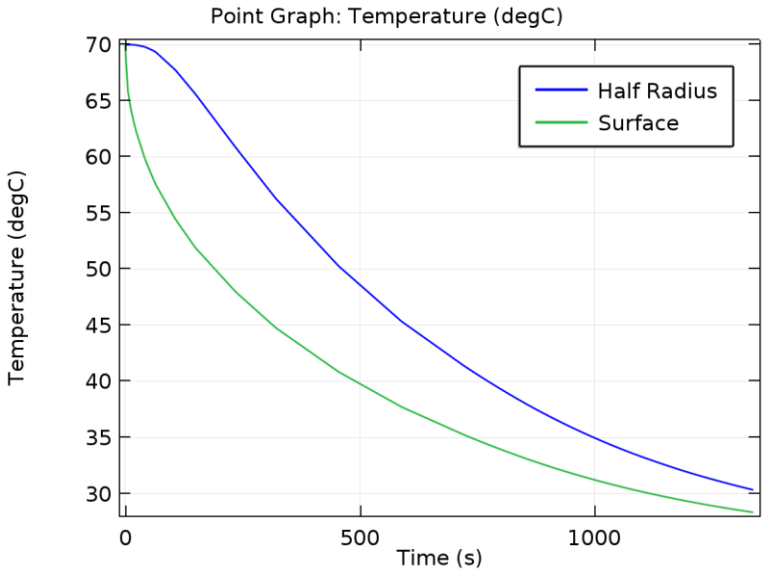
Time=1338 s Surface: Temperature (K)

4.4.2 Isothermal Contours (ht)



Time=1338 s Isosurface: Temperature (K)

4.4.3 1D Plot Group 3



Point Graph: Temperature (degC)