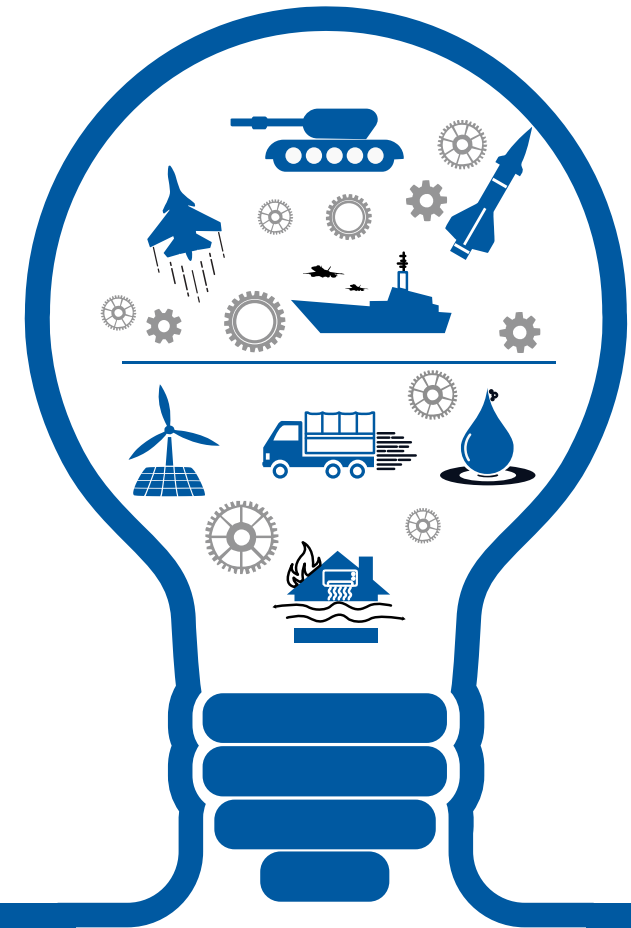


Electric Heater Design

REFERENCE MANUAL

<http://labs.zeusnumerix.com/electric-heater-design>



Contents

- Introduction & Approach
- Web App - Usage
- Input Description
- Output Description
- References





Introduction & Approach

- This application calculates heat transfer coefficients, skin temperature, coil temperature and pressure drop of an electric coil heater design.
- Calculation of output for two type of heater i.e. (i) shell and coil circular heater and rectangular duct air heater are done.
- inLine or staggered element packing arrangement are considered for calculation.
- Set of empirical & analytical calculations are conducted based on the references cited in the last slide of this manual.



Web App - Usage

- User needs to upload a control file containing details of heater design. The control file could be of circular heater design or for rectangular heater design.
- Next upload is fluid database i.e. thermo-physical properties of fluid to be heated
- Final upload is material database i.e. thermo-physical properties of coil material

- Upon execution, following output is generated:
 1. Common Output: Estimate of pressure drop & power required for the design
 2. Full Load Output: Estimates of temperatures for important components

- User can download the output data (textual format) for future reference



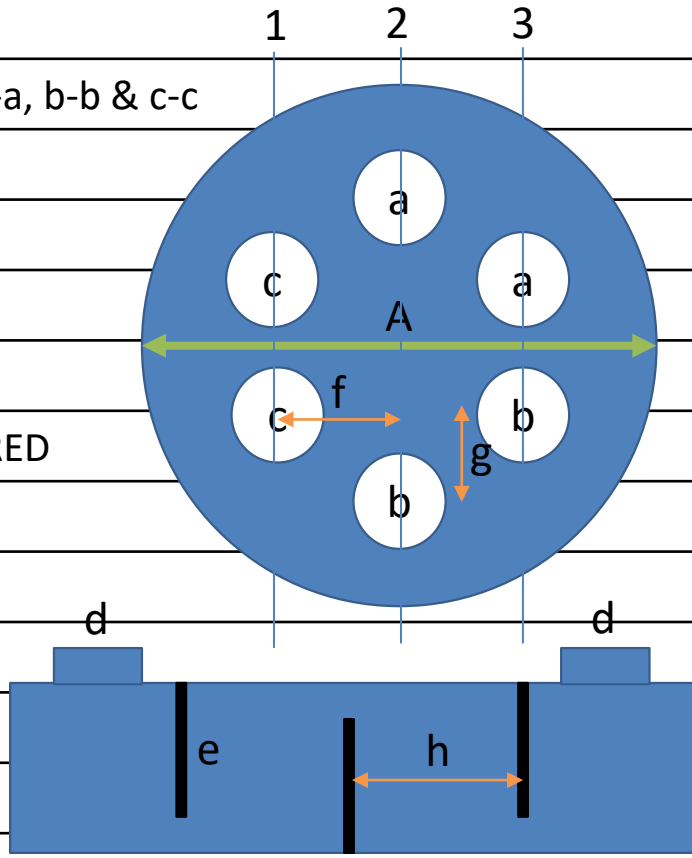
Control File Description – Common

Major Parameters	Default Value	Unit	Description
medium_to_be_heated	“WATER@1Bar” or “DRY AIR”	-	Choice of fluid based on available properties in the fluid database
thermal_efficiency	0.9557	-	Assumed efficiency after accounting for loss of heat through wall
inlet_temperature	15.0	°C	Inlet temperature of working fluid
outlet_temperature	35.0	°C	Desired outlet temperature of working fluid
flow_rate	100.0	Kg/hr	Flow rate for the working fluid
leakage_allowance	0.7	-	leakage of fluid between the junction of the baffle and the element
working_pressure	0.0	BarG	Applicable for gaseous state, where compressibility is important
allowable_pressure_drop	0.5	BarG	For check, if calculated pressure drop exceeds allowable
coil_diameter	4.0	mm	Diameter of the heating coil through which current passes
allowed_coil_surface_temperature	1000	°C	For check, if calculated coil temperature exceeds allowable
heater_element_thickness	1.0	mm	Thickness of outer sheath of heater element
heater_element_diameter	10.0	Mm	Cumulative outer diameter of the heater element



Control File Description – Circular

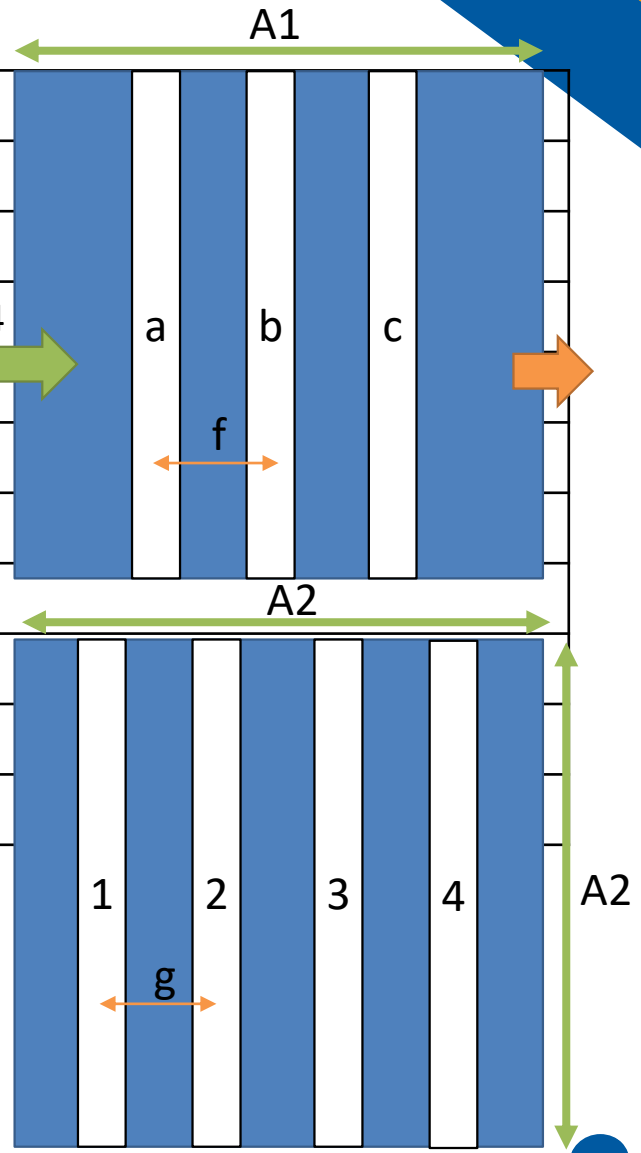
Major Parameters	Default Value	Unit	Description
material	SS304	-	Material of electric element clad
no_of_heating_elements	3	-	Example in default (a, b & c)
no_of_bends_per_element	1	-	Element repeats after bend a-a, b-b & c-c
cross_section_of_heater	CIRCULAR	-	-
internal_diameter_of_heater_vessel	100	mm	Dimension 'A'
outlet_nozzle_diameter	25	mm	Dimension 'd'
number_rows	3		Rows 1-2-3
element_packing_configuration	STAGGERED	-	Option of IN-LINE or STAGGERED
baffle_diameter	90	mm	Dimension 'e'
element_spacing_pitch_horizontal	20	mm	Dimension 'f'
element_spacing_pitch_vertical	20	mm	Dimension 'g'
no_of_baffles	3	-	As per the image
baffle_cut	25	%	% opening at baffle after 'e'
baffle_pitch	45	mm	Dimension 'h'





Control File Description – Rectangular

Major Parameters	Default Value	Unit	Description
material	SS304	-	Material of electric element clad
no_of_heating_elements	3	-	Example in default (a, b & c)
no_of_bends_per_element	4	-	Element repeats after bend 1-2-3-4
cross_section_of_heater	RECTANGULAR	-	-
length_of_heater_box	150	mm	Dimension 'A1'
width_of_heater_box	150	mm	Dimension 'A2'
number_rows	3		Rows a-b-c
element_packing_configuration	IN-LINE	-	Option of IN-LINE or STAGGERED
element_spacing_pitch_horizontal	30	mm	Dimension 'f'
element_spacing_pitch_vertical	25	mm	Dimension 'g'





Output Description

- For Circular Heater:
 - Pressure drop for fluid through heater
 - Power required to produce desired heating
 - Temperatures for element surface & coil surface (maximum & average)

- For Rectangular Heater:
 - Pressure drop for fluid through heater (Row Wise)
 - Power required to produce desired heating (Row Wise)
 - Temperatures for element surface & coil surface (maximum & average)



References

- ANONYMOUS, (2010), VDI Heat Atlas. Second ed. Germany: Springer
- ANONYMOUS, (2007), Standard of the Tubular Exchanger Manufacturers Association, Ninth ed. USA: TEMA
- GANAPATHY, V. (1991), Waste Heat Boiler Deskbook. USA: Fairmont Press, Inc.
- THULUKKANAM, K. (2013), Heat Exchanger Design Handbook, Second ed. Florida CRC Press

WebApp is restricted;

For educational use with less than 15 elements in a cross-section

Thank You !



Abhishek Jain



+91 72760 31511



abhishek@zeusnumerix.com



www.zeusnumerix.com

