Release Notes

INSTED CLOUD Ver. 8.2

TTC TECHNOLOGIES, INC.

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Release Features

INSTED CLOUD Ver. 8.2

INSTED is your one-stop software suite for empirical thermal and hydraulic analysis of engineering systems and components, with a focus on finned and un-finned heat exchangers, flow over tube banks, performance of isolated fins and fin arrays, analysis of heat conduction in composite solids, internal and external flow and heat transfer, performance analysis of flows in piping systems, design analysis of pipe flows, and power calculations for pump selection. INSTED calculations are very fast, leading to fast turnaround in the analysis cycle. The interface is easy and fun to use. With the CLOUD deployment of INSTED, you can carry out your thermal-hydraulic analysis of heat exchangers and other engineering systems/components anytime, anywhere, and even on your smartphones or tablets.

The most recent version of INSTED (Ver. 8.2) includes significant enhancements, changes, and bug fixes, to further improve your experience on INSTED CLOUD. The new features include the following:

Improved Plate-Fin Solver

- Advanced "Genetic Algorithm" (GA) has been implemented for the sizing and optimization modules, which greatly improves the calculation speed and provides more accurate results.
- Instead of returning only one design realization as in the previous version of INSTED, the plate-fin sizing calculation now provides you with a list of feasible design realizations.
- The Optimization solver now allows the fin geometries (shape, profile, fin height, and fin pitch) to be design variables when searching for optimum design.
- More objective functions and design constraints are now available for the Plate-Fin optimization task.
- Additional inputs (end plate thickness, side bar width, and height) are now allowed as part of the Plate-Fin HEX geometry.
- Additional outputs (coefficient of performance, mean stream temperature, mean fluid density, mean fluid specific heat, etc.) are now provided during Plate-Fin Rating, Multiple-Rating, Sizing, and Optimization analyses.

New Features in Plate-Fin

- In "Preference", you can now "Turn Off" and "Turn On" the automatic unit conversion feature for all the input textboxes.
- In the previous version of INSTED, you could choose the default unit system in "Preference" to either "SI" or "British." In this new version, an option "Custom" has been added to allow you to specify the default units for each kind of variable (temperature, length, power, etc.)
- In addition to the "ALPEMA sheet", a new downloadable Excel file is now available for you to export more output data from Plate-Fin Rating, Multiple-Rating, and Sizing and Optimization realizations.
- Both the ALPEMA sheet and the downloadable Excel file can be generated for different unit systems (SI/British/Custom).
- You now have the option of showing the data for only one stream or for both streams when plotting the rating results.

- You now have the option of reversing the plotting direction for the data in one stream when plotting the rating results. This is especially useful for the parallel counter-flow case, where you may want to compare the hot/cold flow curves point-by–point.
- In “Preference,” you now have the option of specifying the precision and format of the output.

More details on the release features can be found in the following sections.

New Features

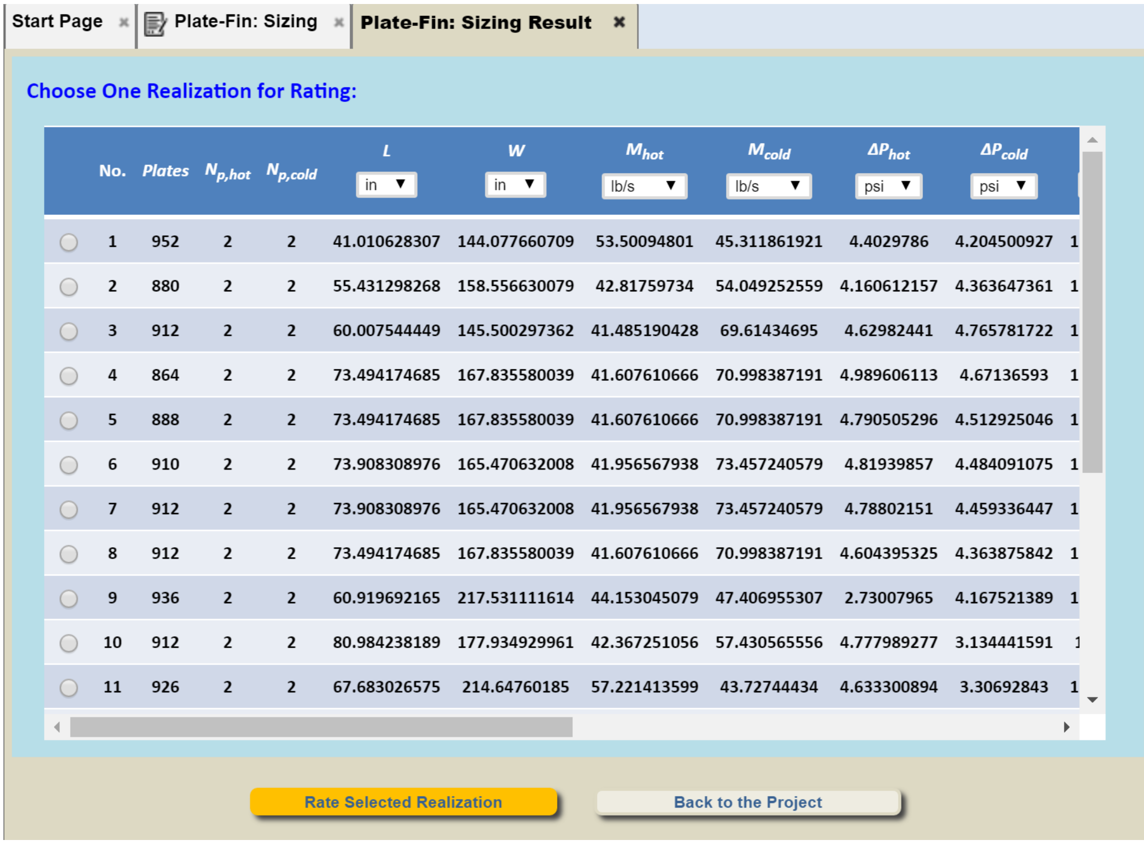
Many new features have been added to INSTED in this new version.

#1. New Plate-Fin Sizing Solver and Re-Designed Interface

(1) A new, more powerful Plate-Fin Sizing solver based on the Genetic Algorithm (GA) has been deployed. The new solver comes with a huge performance boost (faster calculation) and is more stable and robust compared with the previous version.

(2) The following new Plate-Fin “Sizing Criteria” have been added:
   a. Fix or unfix the total number of plates
   b. Fix or unfix the fin height/pitch
   c. Fix the overall effectiveness to a value
   d. Fix the overall coefficient of performance (COP) to a value

(3) In the previous version of INSTED, sizing results only showed one design realization. Similar to optimization, sizing results now display a list of feasible design realizations. Some of the parameters from the results of sizing are shown for each realization.



Note that you can click the link-buttons in the "Fin_{hot}" and "Fin_{cold}" columns to view the details of the fin geometry in a realization.

(4) You can choose one realization and click the "Rate Selected Realization" button to view the details of this realization.

Sizing Result:

Plate Length:	86.390634016	in
Plate Width:	267.10869122	in
Hot Flow Rate:	42.524334845	lb/s
Cold Flow Rate:	56.637630763	lb/s
Total No. of Plates:	778	
No. of Hot Passes:	2	
No. of Cold Passes:	2	
Hot Fin Shape:	rectangular	
Hot Fin Profile:	herringbone	
Hot Fin Efficiency:	0.673977058	
Hot Fin Height:	0.224409449	in
Hot Fin Pitch:	0.078740157	in
Hot Fin Thickness:	0.005905512	in
Hot Fin Wavelength:	0.1	in
Hot Fin Wave Amplitude	0.02	in
Cold Fin Shape:	rectangular	
Cold Fin Profile:	offset-strip	
Cold Fin Efficiency:	0.633649816	
Cold Fin Height:	0.224409449	in
Cold Fin Pitch:	0.078740157	in
Cold Fin Thickness:	0.005905512	in
Cold Fin Offset Pitch:	0.03	in
Heat Transfer Rate:	1.091279e+7	Btu/h
Heat Transfer Area:	8.953367e+6	in²
Hot Pressure Loss:	3.56482239	psi
Cold Pressure Loss:	5.220433667	psi
Operating Weight:	14987.884011391	lb
Effectiveness:	0.977641181	
COP:	2.994004898	

Save to a Regular Rating Project

Detail Result:

Hot Flow | Cold Flow | Overall

Inlet Temperature:	860.017999931	°F
Outlet Temperature:	576.302956537	°F
Pressure Loss:	1.279794668	psi
Mass Flow Rate:	47.432502282	lb/s
Mass Flux:	0.583164922	lb/(s·ft²)
Flow Velocity:	17.298900066	ft/s
Fouling Resistance:	0.	ft²·s·°F/btu
Equivalent Diameter:	0.109251969	in
Reynolds Number:	246.910876643	
Heat Coefficient:	39.009512094	btu/(h·ft²·°F)
Effective hA:	7398.971823643	btu/(h·°F)
Colburn Factor j:	0.056665018	
Friction Factor f:	0.305221458	
Fin Shape:	rectangular	
Fin Profile:	herringbone	
Fin Efficiency:	0.673977058	
Fin Height:	0.0057	m
Fin Pitch:	0.078740157	in
Fin Thickness:	0.005905512	in
Fin Wavelength:	0.1	in
Fin Wave Amplitude:	0.02	in
Flow Length:	86.390634016	in
Flow Width:	133.554345591	in
Power:	1.075464e+6	Btu/h
Mean Temperature:	718.160478233	°F
Mean Density:	0.033711099	lb/ft³
Mean Specific Heat:	0.25317665	Btu/(lb·°F)
Mean Viscosity:	2.150301e-5	lb/(ft·s)
Mean Conductivity:	0.028889466	btu/(h·ft·°F)
Mean Heat Capacity:	43231.687401343	btu/(h·°F)
Mean Prandtl Number:	0.6784	
Mean Nusselt Number:	12.293894548	
Free Flow Area:	10500.467239134	in²

Download Realization Data

#2. New Plate-Fin Optimization Solver and Re-Designed Interface

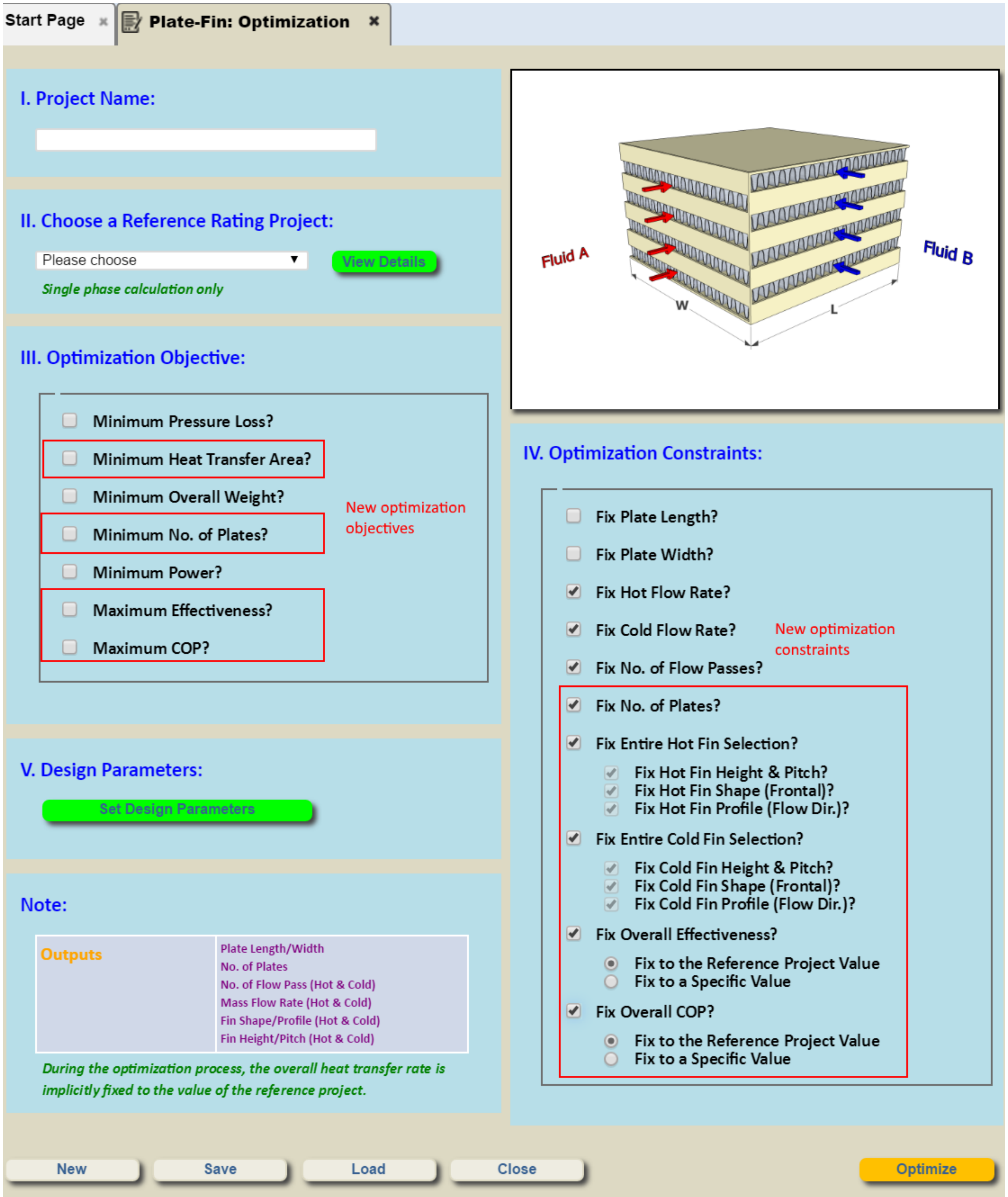
(1) The new GA- based optimization module in INSTED shows a huge performance boost (faster calculation); it is more stable and robust compared to the previous version of the solver.

(2) New "Objective Functions" have been added:
   a. Minimum heat transfer area
   b. Minimum number of plates
   c. Maximum effectiveness
   d. Maximum COP

(3) Fin geometry/size is now allowed to be a design variable of the optimization task. The following are design variables in the search for an optimum solution:
   a. Plate height
   b. Plate width
   c. Total number of plates
   d. Number of flow passes (hot & cold)
   e. Mass flow rate (hot & cold)
   f. Fin shape (frontal) (hot & cold)
   g. Fin profile (flow direction) (hot & cold)
   h. Fin height/pitch (hot & cold)

(4) The following new Plate-Fin "Optimization Constraints" have been added:
   a. Fix or unfix the total number of plates
   b. Fix or unfix the fin height/pitch
   c. Fix or unfix the fin shape
   d. Fix or unfix the fin profile
   e. Fix the overall effectiveness to a value
   f. Fix the overall coefficient of performance (COP) to a value

Note that, during the optimization process, the overall heat transfer rate is implicitly fixed to the value of the reference project.


Start Page
Plate-Fin: Optimization
I. Project Name:
II. Choose a Reference Rating Project:
Please choose
View Details
Single phase calculation only
III. Optimization Objective:
Minimum Pressure Loss?
Minimum Heat Transfer Area?
Minimum Overall Weight?
Minimum No. of Plates?
Minimum Power?
Maximum Effectiveness?
Maximum COP?
New optimization objectives
Fluid A
Fluid B
W
L
IV. Optimization Constraints:
Fix Plate Length?
Fix Plate Width?
Fix Hot Flow Rate?
Fix Cold Flow Rate?
Fix No. of Flow Passes?
New optimization constraints
Fix No. of Plates?
Fix Entire Hot Fin Selection?
Fix Hot Fin Height & Pitch?
Fix Hot Fin Shape (Frontal)?
Fix Hot Fin Profile (Flow Dir.)?
Fix Entire Cold Fin Selection?
Fix Cold Fin Height & Pitch?
Fix Cold Fin Shape (Frontal)?
Fix Cold Fin Profile (Flow Dir.)?
Fix Overall Effectiveness?
Fix to the Reference Project Value
Fix to a Specific Value
Fix Overall COP?
Fix to the Reference Project Value
Fix to a Specific Value
V. Design Parameters:
Set Design Parameters
Note:
Outputs
Plate Length/Width
No. of Plates
No. of Flow Pass (Hot & Cold)
Mass Flow Rate (Hot & Cold)
Fin Shape/Profile (Hot & Cold)
Fin Height/Pitch (Hot & Cold)
During the optimization process, the overall heat transfer rate is implicitly fixed to the value of the reference project.
New
Save
Load
Close
Optimize

(5) When the calculations have been completed, a list of feasible design realizations is displayed. Note that the list is sorted consistent with the objective functions, with the "best" being on top of the list.

Choose One Realization for Rating:

		Plates	$N_{p,hot}$	$N_{p,cold}$	L (in)	W (in)	M_{hot} (lb/s)	M_{cold} (lb/s)	ΔP_{hot} (psi)	ΔP_{cold} (psi)
○	1 best	300	1	1	35.433070866	70.866141732	55.997414595	55.115565546	4.947965659	2.928374806
○	2	300	1	1	35.433070866	70.866141732	44.745083108	117.795160556	1.230086033	2.239712926
○	3	300	1	1	35.433070866	70.866141732	134.841759406	44.920528161	5.04324024	0.454661314
○	4	300	1	1	35.433070866	70.866141732	56.530033294	62.748596201	0.64162514	1.003774558
○	5	300	1	1	35.433070866	70.866141732	48.248281566	94.583077482	0.610361269	1.692361464
○	6	300	1	1	35.433070866	70.866141732	116.245603536	44.890449013	4.166432636	0.454183812
○	7	300	1	1	35.433070866	70.866141732	79.648883097	48.285119719	1.759718556	0.719716006
○	8	300	1	1	35.433070866	70.866141732	106.706440415	46.701473347	2.792845367	0.4832574
○	9	300	1	1	35.433070866	70.866141732	48.650016624	87.726135512	0.612668187	1.300464599
○	10	300	1	1	35.433070866	70.866141732	110.411047752	46.434287684	2.94765836	0.478926869
○	11	300	1	1	35.433070866	70.866141732	78.812274935	50.085327542	1.73063635	0.753928192

Rate Selected Realization   Back to the Project

(5) You can choose one realization and click the "Rate Selected Realization" button to view details of this design realization and carry out a rating analysis on it.

Optimization Result:

Plate Length:	35.433070866	in
Plate Width:	70.866141732	in
Hot Flow Rate:	55.997414595	lb/s
Cold Flow Rate:	55.115565546	lb/s
Total No. of Plates:	300	
No. of Hot Passes:	1	
No. of Cold Passes:	1	
Hot Fin Shape:	wavy	
Hot Fin Profile:	herringbone	
Hot Fin Height:	0.224409449	in
Hot Fin Pitch:	0.078740157	in
Hot Fin Thickness:	0.005905512	in
Hot Fin Wavelength:	0.393700787	in
Hot Fin Wave Amplitude	0.118110236	in
Cold Fin Shape:	rectangular	
Cold Fin Profile:	herringbone	
Cold Fin Height:	0.224409449	in
Cold Fin Pitch:	0.078740157	in
Cold Fin Thickness:	0.005905512	in
Cold Fin Wavelength:	0.393700787	in
Cold Fin Wave Amplitude:	0.118110236	in
Heat Transfer Rate:	1.138654e+7	Btu/h
Heat Transfer Area:	7.533015e+5	in²
Hot Pressure Loss:	4.947965659	psi
Cold Pressure Loss:	2.928374806	psi
Operating Weight:	2522.04452149	lb
Effectiveness:	0.787043952	
COP:	1.953180058	

Save to a Regular Rating Project

Detail Result:

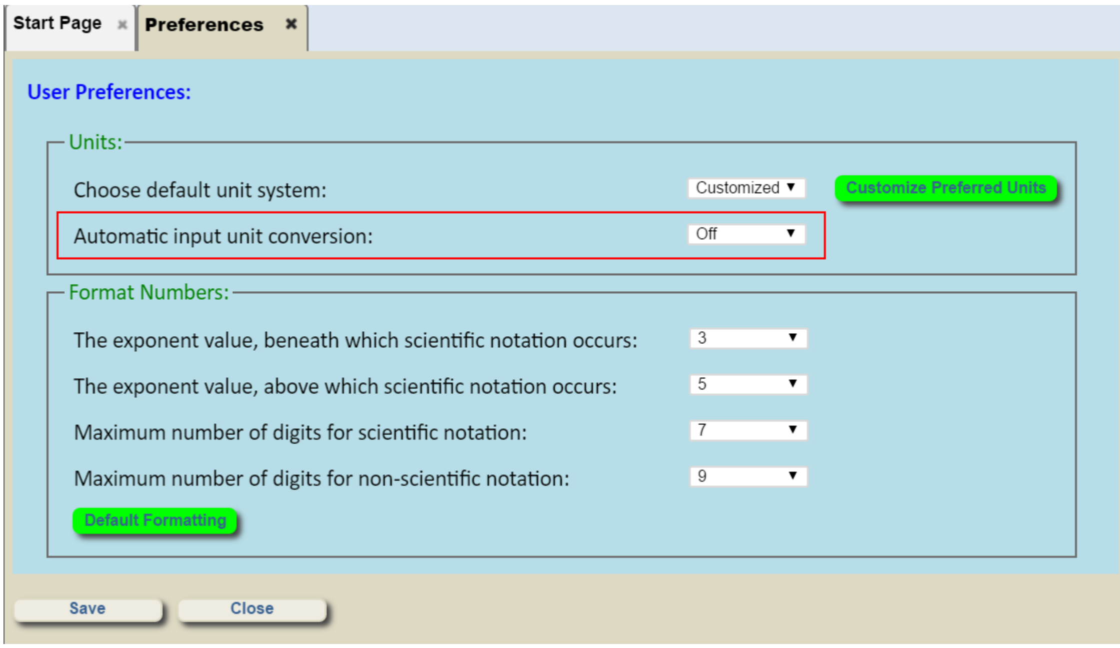
Hot Flow | Cold Flow | Overall

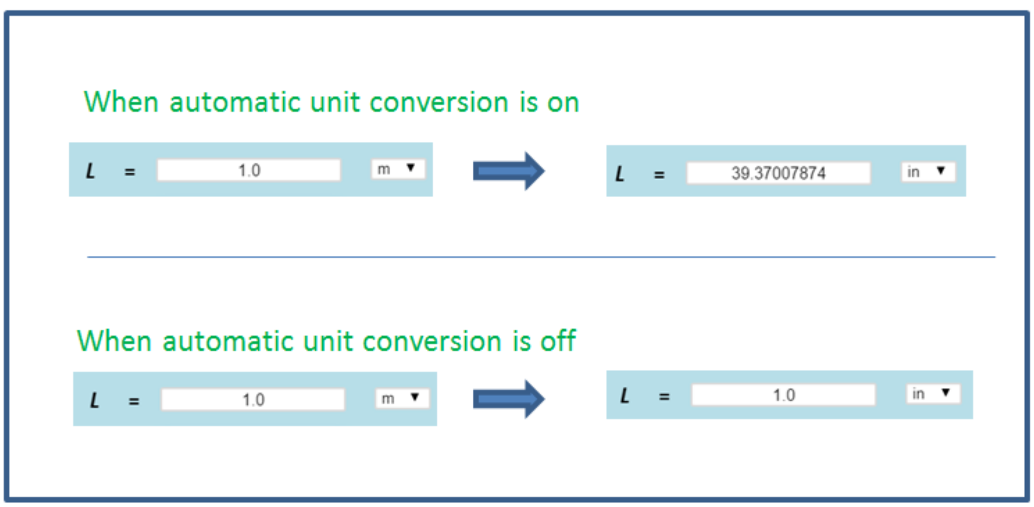
Inlet Temperature:	860.017999931	°F
Outlet Temperature:	636.918926878	°F
Pressure Loss:	4.947965659	psi
Mass Flow Rate:	55.997414595	lb/s
Mass Flux:	3.753180203	lb/(s·ft²)
Flow Velocity:	111.333666158	ft/s
Fouling Resistance:	0.	ft²·s·°F/btu
Equivalent Diameter:	0.108133307	in
Reynolds Number:	1572.817586642	
Heat Coefficient:	44.628140027	btu/(h·ft²·°F)
Effective hA:	300.32110984	btu/(h·°F)
Colburn Factor j:	0.010072686	
Friction Factor f:	0.054714403	
Fin Shape:	wavy	
Fin Profile:	herringbone	
Fin Efficiency:	0.651966141	
Fin Height:	0.224409449	in
Fin Pitch:	0.078740157	in
Fin Thickness:	0.005905512	in
Fin Wavelength:	0.393700787	in
Fin Wave Amplitude:	0.118110236	in
Flow Length:	35.433070866	in
Flow Width:	70.866141732	in
Power:	5.475361e+6	Btu/h
Mean Temperature:	748.468463405	°F
Mean Density:	0.033711099	lb/ft³
Mean Specific Heat:	0.25317665	Btu/(lb·°F)
Mean Viscosity:	2.150301e-5	lb/(ft·s)
Mean Conductivity:	0.028889466	btu/(h·ft·°F)
Mean Heat Capacity:	51038.056238956	btu/(h·°F)
Mean Prandtl Number:	0.678400083	
Mean Nusselt Number:	13.920598805	
Free Flow Area:	2148.478671957	in²

Download Realization Data

#3. Turn On/Off Automatic Unit Conversion

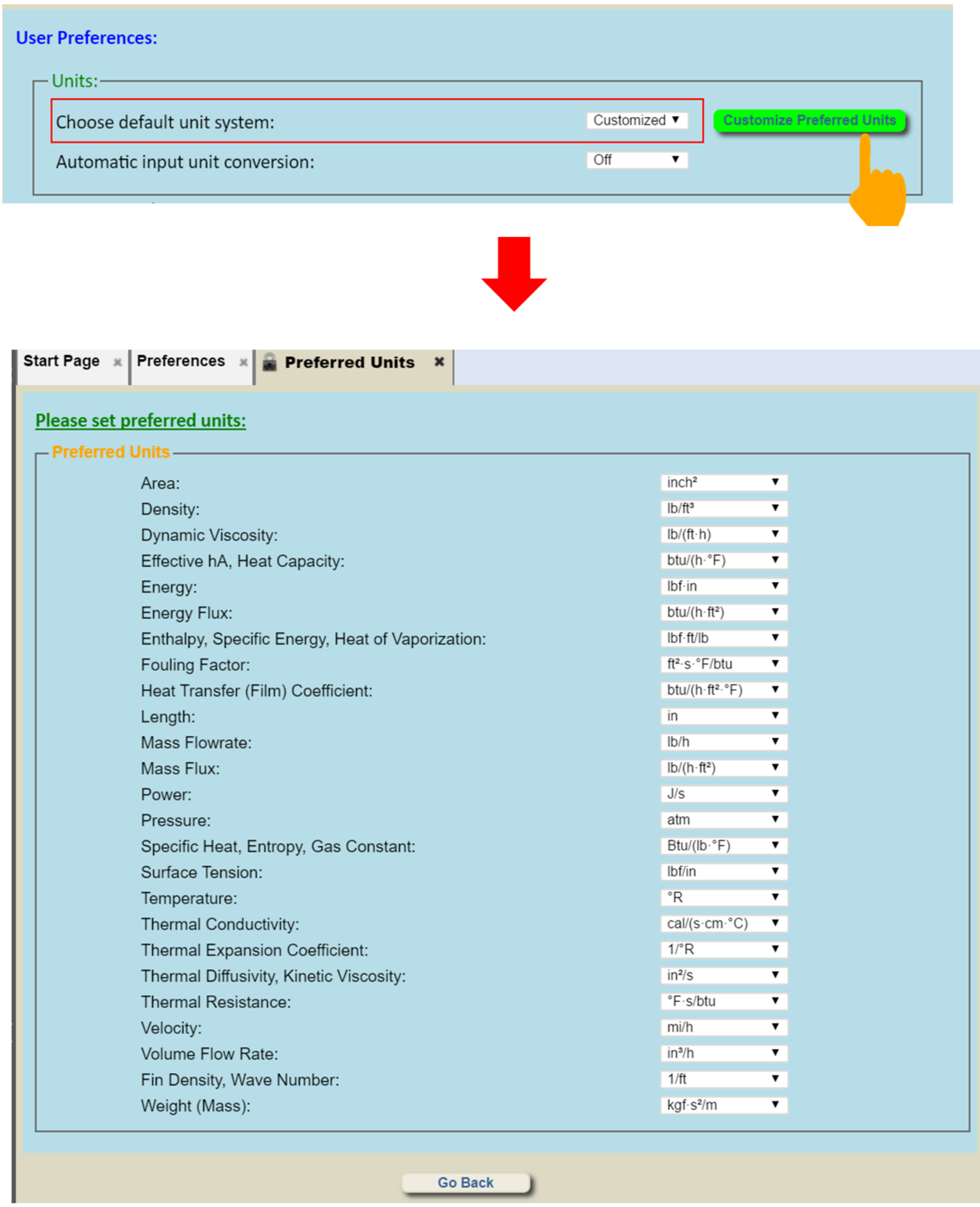
In the “Preference” tab, you now have the option of turning On/Off the Automatic Unit Conversion feature when entering values in INSTED.





#4. Customizable Preferred Units

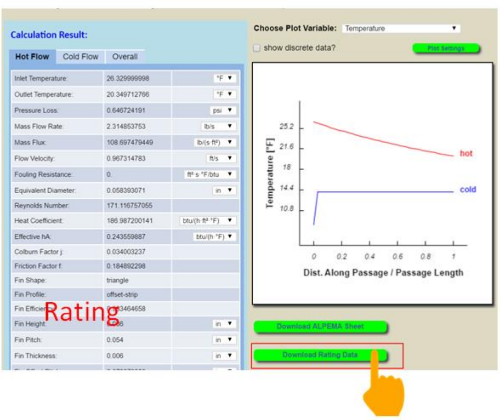
In the "Preference" tab, in addition to allowing the use of "SI" or "British" as the default unit system, you can now choose "Customized" as a new option. Click "Customize Preferred Units" to specify the preferred units for each type of variable.

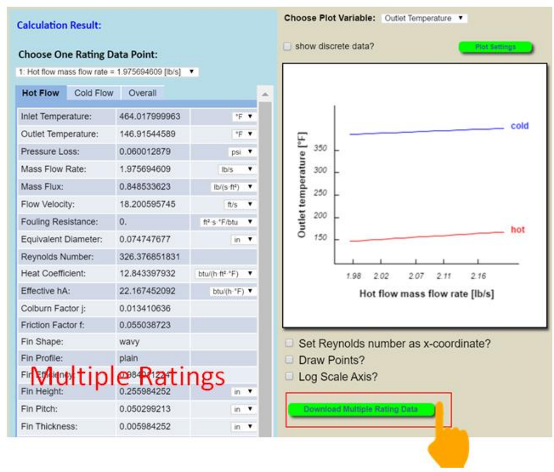


#5. Export Rating/Multiple-Rating/Sizing/Optimization Data into Excel

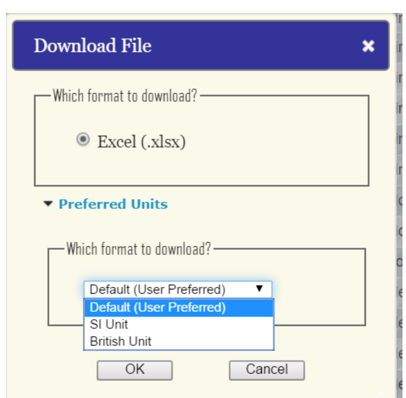
Selected Plate-Fin Rating, Multiple-Rating, and Sizing and Optimization realization data can now be exported into an Excel file by clicking

- “Download Rating Data” in Plate-Fin rating
- “Download Multiple Rating Data” in Plate-Fin multiple-ratings
- “Download Realization Data” in Plate-Fin sizing and optimization





After these buttons have been clicked, a new window will pop-up in which you can choose the units you prefer when exporting data to Excel.



Excel file for plate-fin rating:

INSTED Output for HX Sizing and Rating Simulations- Last Rev. [08/29/2016]

		HX problem statement											
		Performance Requirement			Operating conditions -Hot				Operating conditions -Cold				
Design #	Description (for example, flow arrangement, multipassing, single/two phase flow etc.)	Q	Δp-hot	Δp-cold	Fluid type	Flow rate	Tin	Pin	Fluid type	Flow rate	Tin	Pin	t-sp
		[kW]	[kPa]	[kPa]	[-]	[lb/s]	[°F]	[psi]	[-]	[lb/s]	[°F]	[psi]	[in]
1	cross-flow/counter-current, single banking, 2 hot flow passes, , 4 cold flow passes, , Boiling					2.31485	26.33	14.5038	(Sample) R1	0.04409	8.33	29.008	0.016

	HX core design input						HX core dimensions						Hot side										
Pin	t-sp	t-ep	w-sb-hot	h-sb-hot	w-sb-cold	h-sb-cold	P-L	P-W	L-NF/S	Np-h	Np-c	W	Type	N-fin or channel	H	t-fin	l or λ	2a	dh	Ac	A	Type
[psi]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[in]	[-]	[-]	[lb]	[-]	[1/in]	[in]	[in]	[in]	[in]	[in]	[in²]	[in²]	[-]
29.008	0.016	0.016	0.125	0.125	0.086	0.086	2.25	9	2.056	11	10	0.4028	triangle/offset-strip	18.519	0.086	0.006	0.0781		0.0584	3.0667	194.06	triangle/offset-

HX Size, Weight and Performance- Output																						
	Cold side									Hot Side												
A	Type	N-fin or channel	H	t	l or λ	2a	dh	Ac	A	Tout	Tmean	Δp	σΔP	ρ_{mean}	μ_{mean}	$c_{p\text{-}mean}$	$k_{\text{-}mean}$	Re	Pr	Nu	ηhA	P	Tou
[in²]	[-]	[1/in]	[in]	[in]	[in]	[in]	[in]	[in²]	[in²]	[°F]	[°F]	[psi]	[kPa]	[lb/ft³]	[lb/(ft*s)]	Btu/(lb*°F	tu/(h*ft*°	[-]	[-]	[-]	btu/(h*°F]	[Btu/h]	[°F]
194.06	triangle/offset-strip	18.519	0.086	0.006	0.0781		0.0584	0.2889	146.25	20.35	23.074	0.6467		112.37	0.0031	0.2102	0.0404	171.12	57.829	22.498	0.2436	8.8753	14.0

HX Size, Weight and Performance- Output																								
	Hot Side													Cold Side										
A	Tout	Tmean	Δp	σΔP	ρ_{mean}	μ_{mean}	$c_{p\text{-}mean}$	$k_{\text{-}mean}$	Re	Pr	Nu	ηhA	P	Tout	Tmean	Δp	σΔP	ρ_{mean}	μ_{mean}	$c_{p\text{-}mean}$	$k_{\text{-}mean}$	Re	Pr	Nu
[in²]	[°F]	[°F]	[psi]	[kPa]	[lb/ft³]	[lb/(ft*s)]	Btu/(lb*°F	tu/(h*ft*°	[-]	[-]	[-]	btu/(h*°F]	[Btu/h]	[°F]	[°F]	[psi]	[kPa]	[lb/ft³]	[lb/(ft*s)]	Btu/(lb*°F	tu/(h*ft*°	[-]	[-]	[-]
146.25	20.35	23.074	0.6467		112.37	0.0031	0.2102	0.0404	171.12	57.829	22.498	0.2436	8.8753	14.018	13.901	5.1807		14.52308	0.0001	0.2629	0.0327	556.37	3.2571	384.5

			Overall HX core performance						
Nu	ηhA	P	EB	C*	ε	Q	NTU	UA	COP
[-]	btu/(h*°F]	[Btu/h]	[%]	[-]	[-]	[Btu/h]	[-]	btu/(h*°F]	[-]
384.51	0.2441	550.1		0.0238	0.7126	10469	33.849	1196.7	18.7288

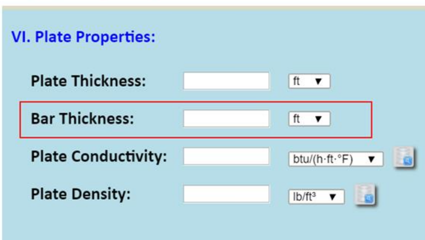
Excel file for plate-fin Multiple-Rating:

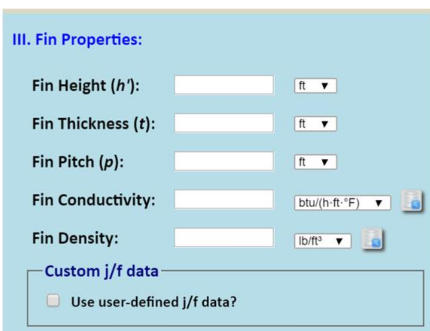
Design #	Description (for example, flow arrangement, multipassing, single/two	Performance Requiremen Q	Δp-hot	Δp-cold	Operating conditions -Hot Fluid type	Flow rate	Tin	Pin	Operating conditions -Cold Fluid type	Flow rate	Tin	Pin	HX core design input t-sp	t-ep	w-sb-hot	h-sb-hot	w-sb-cold
		[kW]	[kPa]	[kPa]	[-]	[lb/s]	[°F]	[psi]	[-]	[lb/s]	[°F]	[psi]	[in]	[in]	[in]	[in]	[in]
#1: Hot flow mass flow rate = 1.975694609 [lb/s]	cross-flow, single banking					1.97569	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#2: Hot flow mass flow rate = 1.9867177221 [lb/s]	cross-flow, single banking					1.98672	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#3: Hot flow mass flow rate = 1.9977408352 [lb/s]	cross-flow, single banking					1.99774	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#4: Hot flow mass flow rate = 2.0087639483 [lb/s]	cross-flow, single banking					2.00876	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#5: Hot flow mass flow rate = 2.0197870614 [lb/s]	cross-flow, single banking					2.01979	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#6: Hot flow mass flow rate = 2.0308101745 [lb/s]	cross-flow, single banking					2.03081	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#7: Hot flow mass flow rate = 2.0418332876 [lb/s]	cross-flow, single banking					2.04183	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#8: Hot flow mass flow rate = 2.0528564007 [lb/s]	cross-flow, single banking					2.05286	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#9: Hot flow mass flow rate = 2.0638795138 [lb/s]	cross-flow, single banking					2.06388	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#10: Hot flow mass flow rate = 2.0749026269 [lb/s]	cross-flow, single banking					2.0749	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#11: Hot flow mass flow rate = 2.08592574 [lb/s]	cross-flow, single banking					2.08593	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#12: Hot flow mass flow rate = 2.0969488531 [lb/s]	cross-flow, single banking					2.09695	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#13: Hot flow mass flow rate = 2.1079719662 [lb/s]	cross-flow, single banking					2.10797	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#14: Hot flow mass flow rate = 2.1189950793 [lb/s]	cross-flow, single banking					2.119	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#15: Hot flow mass flow rate = 2.1300181924 [lb/s]	cross-flow, single banking					2.13002	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#16: Hot flow mass flow rate = 2.1410413055 [lb/s]	cross-flow, single banking					2.14104	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#17: Hot flow mass flow rate = 2.1520644186 [lb/s]	cross-flow, single banking					2.15206	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#18: Hot flow mass flow rate = 2.1630875317 [lb/s]	cross-flow, single banking					2.16309	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#19: Hot flow mass flow rate = 2.1741106448 [lb/s]	cross-flow, single banking					2.17411	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#20: Hot flow mass flow rate = 2.1851337579 [lb/s]	cross-flow, single banking					2.18513	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25
#21: Hot flow mass flow rate = 2.196156871 [lb/s]	cross-flow, single banking					2.19616	464.02	14.6959		1.829	39.218	14.696	0.0157	0.0157	0.1	0.1	0.25

#6. New Inputs for Plate-Fin Geometry

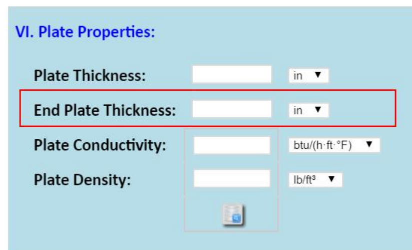
- The "Bar Thickness" in the old version has been removed
- "End Plate Thickness" has been added. This value will affect the stack height and weight of the HEX
- "Bar Width" and "Bar Height" have been added into "Fin Properties", this allows you to set different values of side/separator bar width and height for different streams
- The value of "Bar Height" is allowed to be slightly different from the value of "Fin Height." If zero is input for "Bar Height," its value will automatically be set to be equal to "Fin Height."
- The value of "Bar Width' can be set to zero if the width of the side/separator bar is negligible.

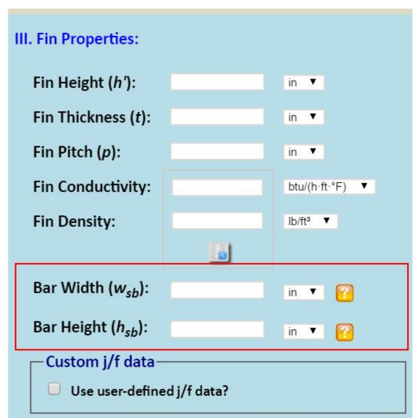
Old version



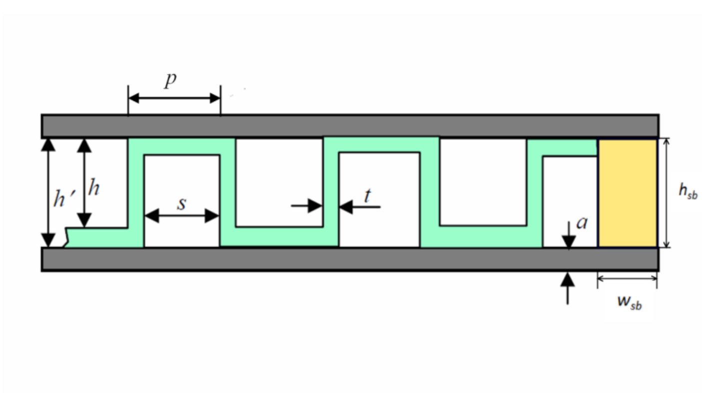


New version





The dimensions of bar width (w_{sb}) and bar height (h_{sb}) are shown in the illustration of a fin below.



#7. Additional Outputs for Plate-Fin Calculations

The following data have been added to the Plate-Fin rating output results:

- Mean temperature (hot/cold)
- Mean density (hot/cold)
- Mean viscosity (hot/cold)
- Mean specific heat (hot/cold)
- Mean thermal conductivity (hot/cold)
- Mean Prandtl number (hot/cold)
- Mean Nusselt number (hot/cold)
- Heat transfer surface area (hot/cold)
- Free flow area (hot/cold)
- Coefficient of performance (COP)

Note that COP is defined as $COP = \frac{Overall\ Heat\ Transfer\ Rate}{Power_{hot}+Power_{cold}}$

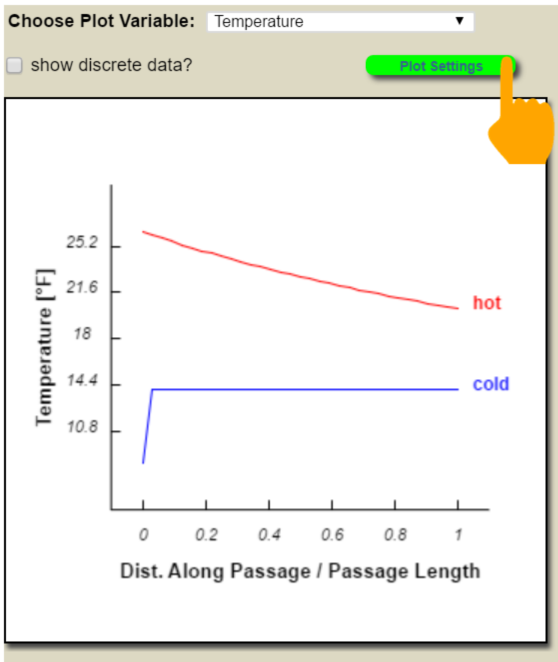
Fin Height:	0.086	in
Fin Pitch:	0.054	in
Fin Thickness:	0.006	in
Fin Offset Pitch:	0.078070866	in
Flow Length:	2.25	in
Flow Width:	4.3125	in
Power:	8.875277345	Btu/h
Mean Temperature:	23.074265811	°F
Mean Density:	112.370329037	lb/ft³
Mean Specific Heat:	0.210184389	Btu/(lb·°F)
Mean Viscosity:	0.003091057	lb/(ft·s)
Mean Conductivity:	0.040445252	btu/(h·ft·°F)
Mean Heat Capacity:	1751.566039145	btu/(h·°F)
Mean Prandtl Number:	57.828566331	
Mean Nusselt Number:	22.497531161	
Free Flow Area:	3.066667183	in²
Heat Transfer Area:	194.062500775	in²

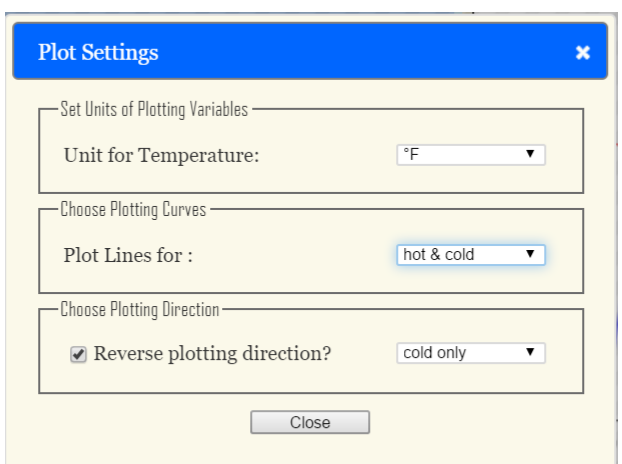
Heat Transfer Area:	405.0	in
U:	425.473316688	btu/(h·ft²·°F)
UA:	1196.672503537	btu/(h·°F)
Heat Flow Rate:	10468.929550324	Btu/h
Ratio of Heat Capacity:	0.023829074	
Effectiveness:	0.712632467	
NTU:	33.848869	
COP:	18.728760058	
Empty Weight:	0.40281829	lb
Operating Weight:	0.873371113	lb

#8. More Controls on Plotting the Curves of Rating Results

By clicking the "Plot Setting" button, you can

- Set units of the variables to be plotted
- Indicate whether to plot the graph for one or two streams
- Indicate the plotting direction for the streams





Note that, by default, the curves are plotted along the respective flow directions. "Reversing" the plotting direction is especially useful for parallel counter-flow HEX. By reversing the plotting direction of one stream, you can compare the data for the two streams point-by-point.

#9. Set the Precision and Formats of the Outputs

You can specify the precision and formats of the outputs in “Preference.” The meaning of the settings is self-explanatory.