UNILAB

HEAT TRANSFER SOFTWARE

Made in Italy

UNILAB Coils User Manual

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Introduction

UNILAB Coils User Manual

Software for the design and rating of finned heat exchangers

aligned with version 8.0

MAIN FEATURES

COILS is a tool for the design and rating of finned pack heat exchangers in the following calculation modalities:

- **Heating** and **Cooling** of the air without any change of phase of the liquid, gas or refrigerant in the tubes
- **Condensing** and **Direct Expansion** of refrigerants with change of phase
- **Steam**
- **Pump evaporators with R717**

Compressors and axial fans

In the Professional edition, **COILS** has an extensible archives of usable axial fans and compressors in the **Condensing** and **Direct Expansion** calculation options. In this way it's very easy to carry out the design of remote condensers and unit coolers.

Geometries

COILS has an extensible archive with more than 50 geometries, the most used in the air conditioning and refrigeration industry.
It's possible to insert a new geometry with the following characteristics:

- **Staggered** and **aligned** tube
- **Spiroidal** or **integral** fins
- Tubes with different types of corrugation
- Fins with different types of corrugation

Moreover, changing the correction factors of the geometry it's possible to obtain calculation results adherent to the experimental data gained from a laboratory of measures.

UNILAB is the only software house in Europe able to help an heat exchangers manufacturer in the obtaining of the Eurovent certification for water coils with the aid of our software (HECOILS norm EN 1216 - see the Eurovent website for more information). The adjustment of the correction factors has allowed a maximum deviation of the values calculates from the experimental data of 5% for the thermal power and of 10% for the pressure drop air side and tubes side, for the same geometry in different configurations and multiple conditions.

Calculation modalities

- In the **Verify** modality the user can rate the power and the pressure drops knowing all the geometrical parameters of the exchanger and the working conditions changing one or more input variables at the same time (for example: geometry, inlet air temperature and humidity, fluid, fin thickness, fin type, tube type, fluid temperatures etc.)

- In the **Design** modality it is possible to insert the working conditions and the power required without knowing all the geometrical parameters, obtaining a list of exchangers compatible with the initial conditions imposed

SYSTEM REQUIREMENTS

Suggested System Requirements

- Operating System Microsoft® Windows® 7 with Service Pack 1, 8.1 or 10, 32 or 64 bits
- Intel® Core 2 or AMD Athlon®; 1.5 GHz or faster processor
- 4 GB or more of RAM
- 2 GB or more of available hard-disk space for 32-bit operative system; 4 GB or more of available hard-disk space for 64-bit operative system
- Screen resolution **1366x768** pixel recommended with 24-bit color, small characters and 512 MB or more of dedicated VRAM
- Internet connection and registration are necessary for required software activation, validation of subscriptions.

Getting Started

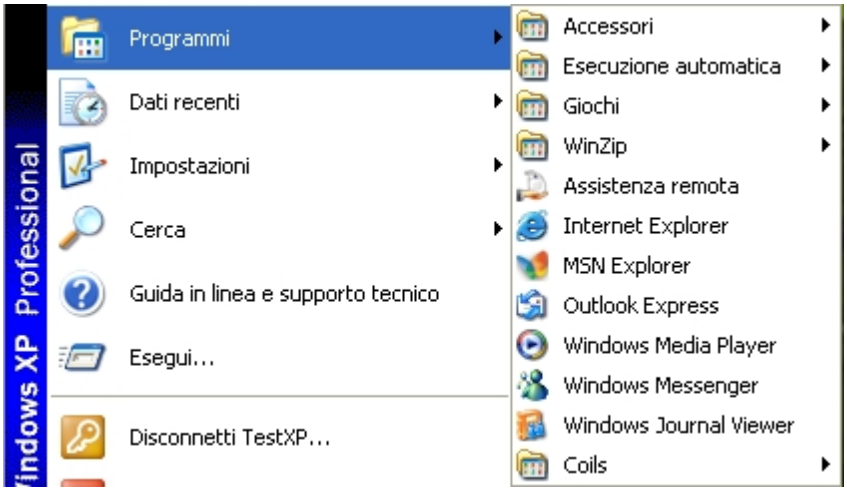
Program Opening

Program Opening

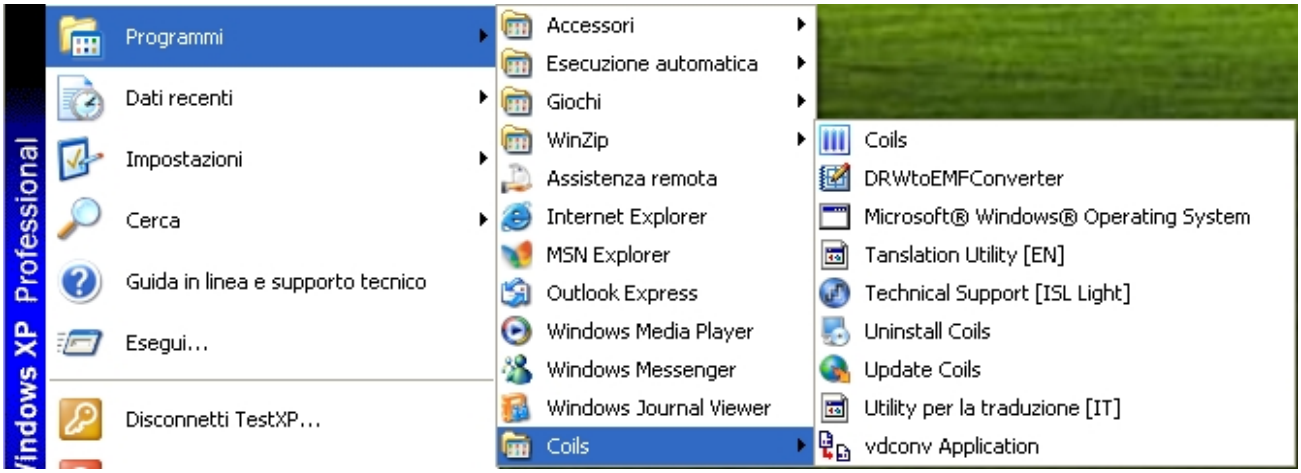
To open the program

- Click on start button 

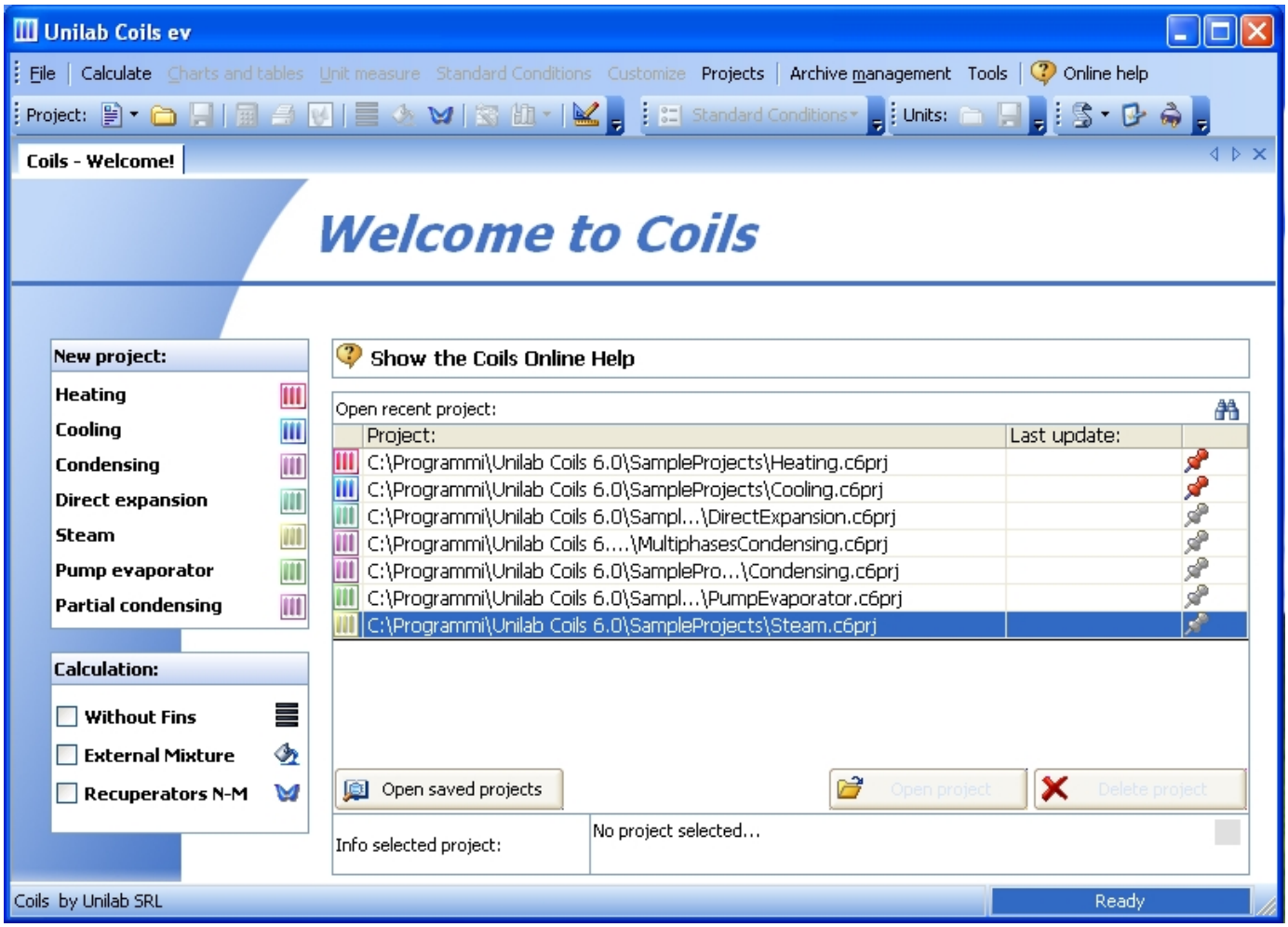
- Then click on the “Program” voice of the menu



- Then click on “Unilab Coils” voice of the menu



Here is the first screen of the program



Under the New Project , We have the possible calculation modes the battery.

- Under the “Open recent project: ”, We can see the projects We have recently opened plus projects examples that We will see in detail in the next section.
-

Project Examples

Project Examples

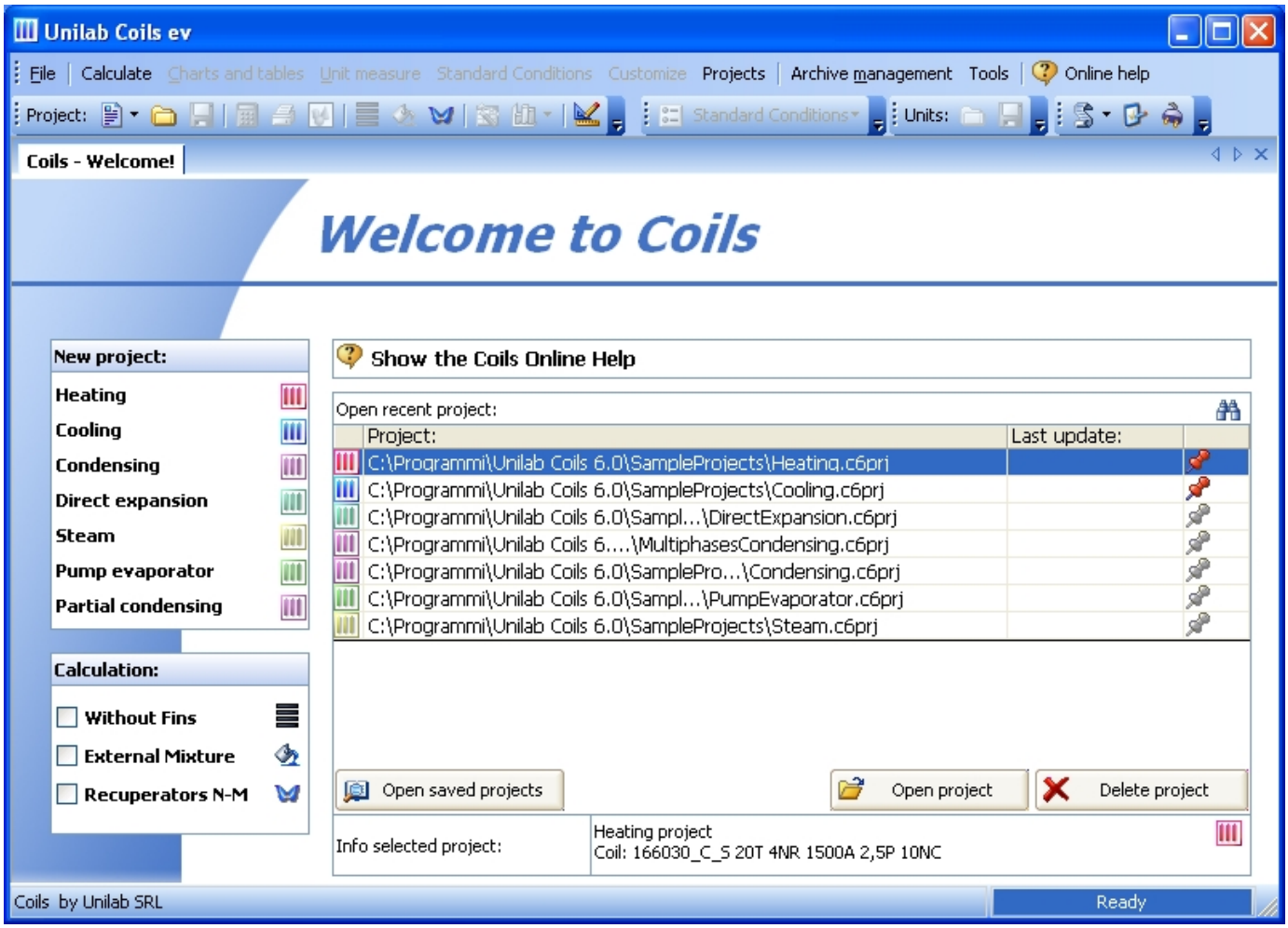
In this section We will see the different calculation modalities in already prepared examples.

Heating example

Heating example

To open an example of Heating calculation modality:

- Click on “Heating.c6prj” file under the “Open recent project” area

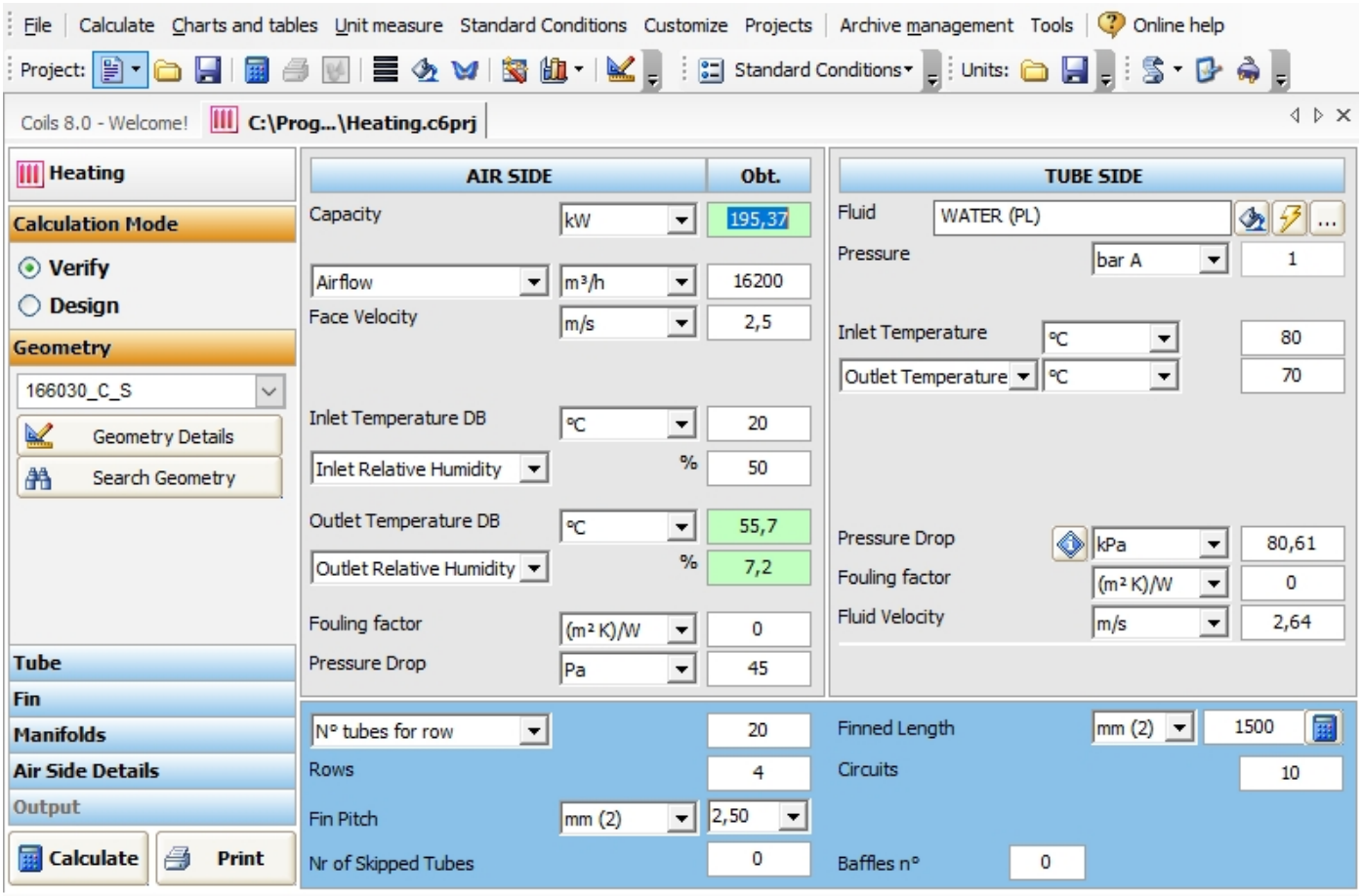


the name of the file is highlighted in blue

under the selected project area we can see the file’s data

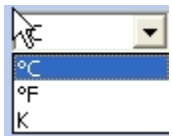
- Double click on the

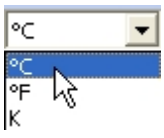
file



Where we can see four main areas.

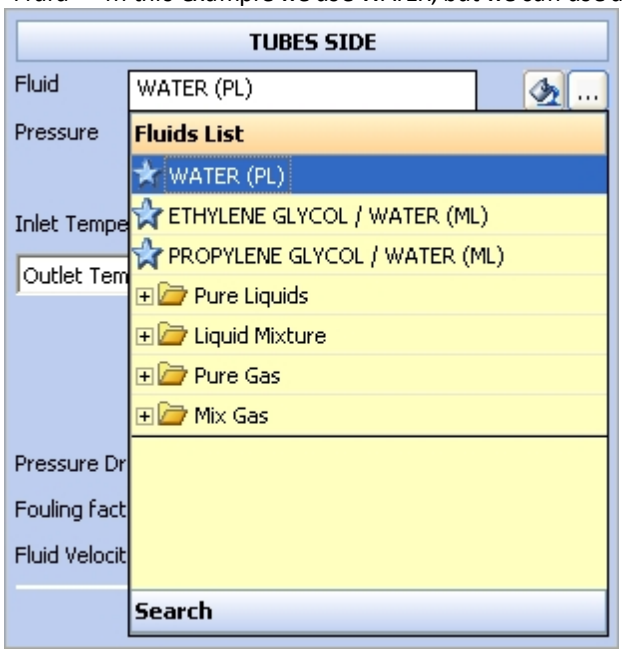
- Calculation type and relative Geometry, Tube data, Fin data, Manifolds Data, and Air Side details
- Air Side data with relative parameters.
  - "Capacity" measured in W or in can be measured in  for example
  - "AirFlow" measured in m^3/h but can also be set in 
  - "Face Velocity" measured in m/s but can also be changed in 

- o "Inlet Temperature DB" measured in C but can be changed into 

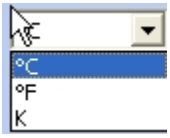
- o "Outlet Temperature DB" measured in C but can be changed into 

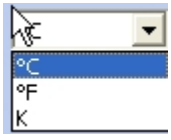
- o "Pressure Drop" measured in Pa or in 

- Tubes Side data
  - o "Fluid" - in this example we use WATER, but we can use a wide range of fluids



  - o "Pressure" measured in bar A or in 

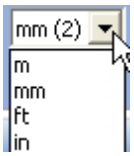
  - o "Inlet Temperature" measured in C or in 

- o "Outlet Temperature" measured in C or in 

- o "Pressure Drop" measured in kPa or in 

- o "Fluid Velocity" measured in m/s or in 

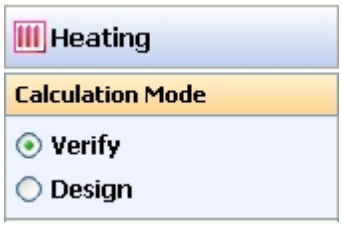
- Coil Data
  - o "N tubes for row" or it can be expressed in 

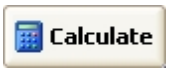
  - o Rows
  - o "Fin Pitch" measured in mm or in 

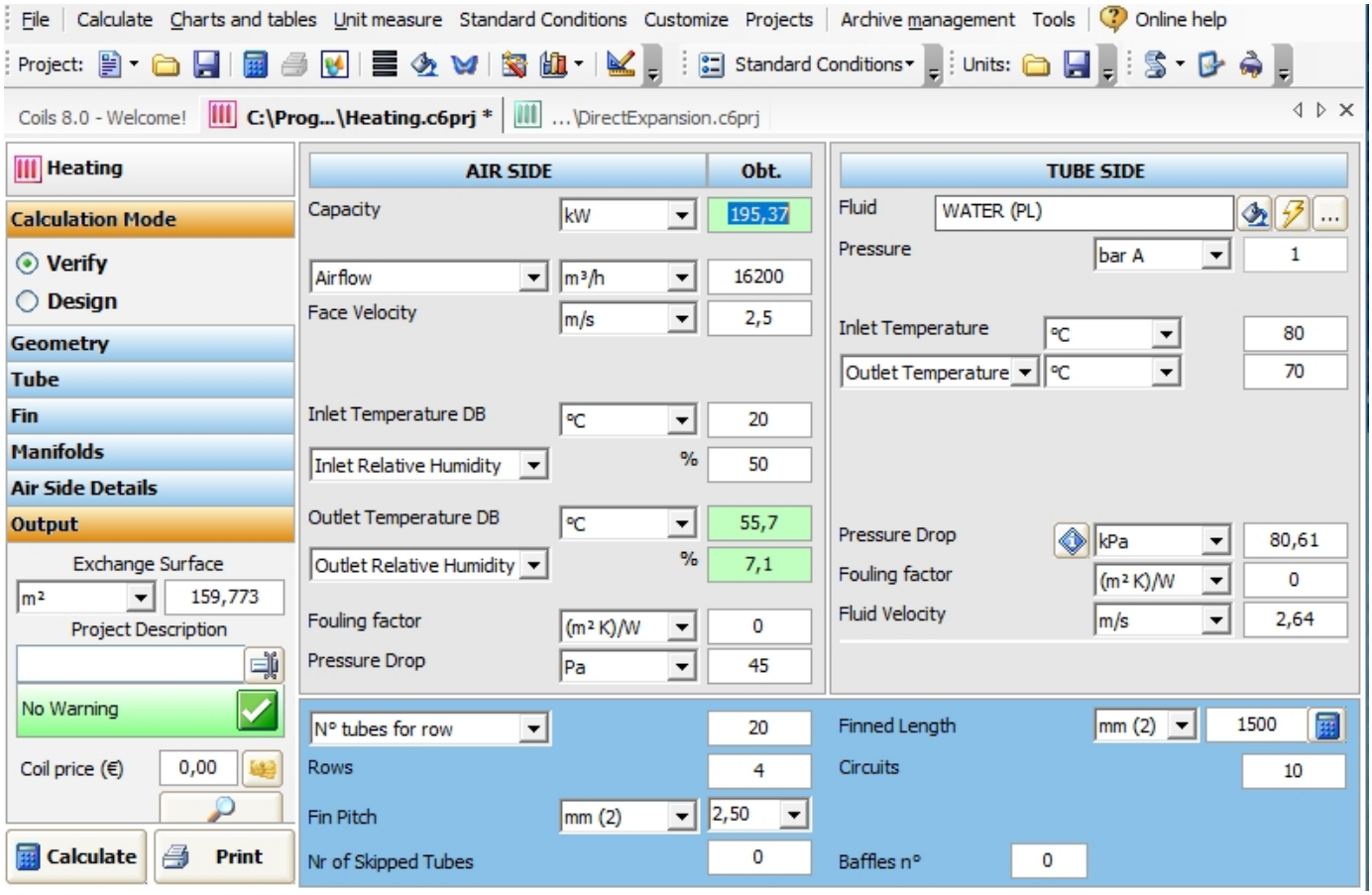
  - o "Nr of skipped Tubes" which is the number of not alimented circuits
  - o "Finned Length" measured in mm or in 

  - o "Circuits" which indicates the number of circuits
  - o "Baffles n°" which indicates the number of the baffles.

As we stated in the introduction our program is able to perform two types of calculation "Verify" and "Design".
Since in this example we have all the working conditions, we work in Verify mode, in which the user can rate the power and the pressure drop knowing all the geometrical parameters of the exchanger and the working conditions, changing one or more input variables at the same time (for example: geometry, inlet air temperature and humidity, fluid, fin thickness, fin type, tube type, fluid temperatures etc.)
In Calculation area we can see that we are working in the "Verify modality", which is selected .

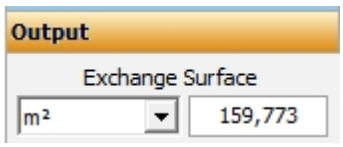


Now simply press the “Calculate” button 



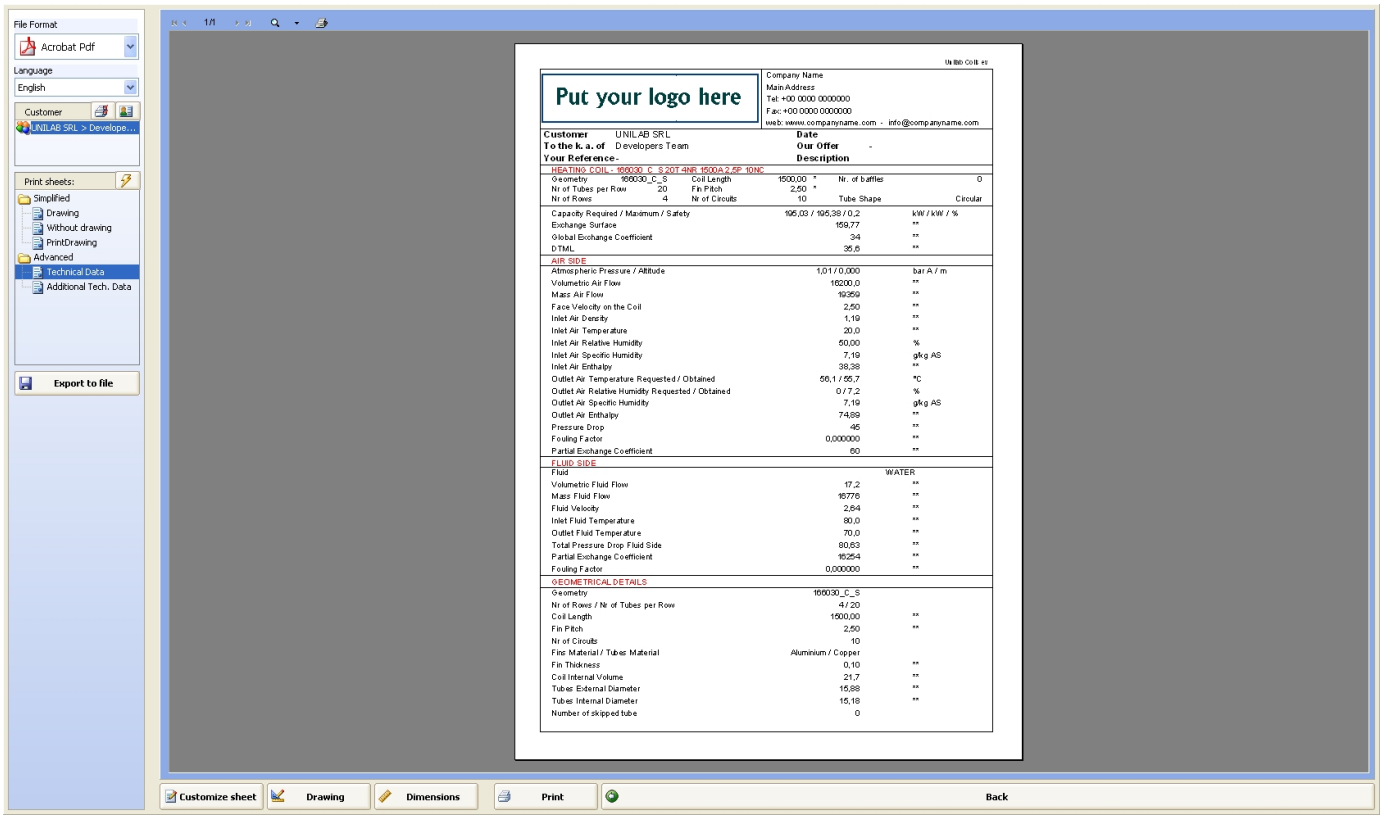
where the “Capacity air Side” is calculated

in the “Output” area the exchange surface is calculated



In addition the “No Warning ” message indicates that the working conditions were correct.

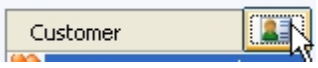
- Now to see the output results of our calculation, press the "Print" button 



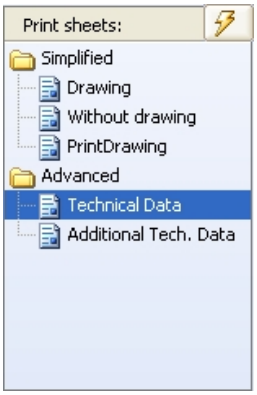
Where we have:

- "File Format" where by clicking on its menu, we can choose between Pdf-format or Word-format

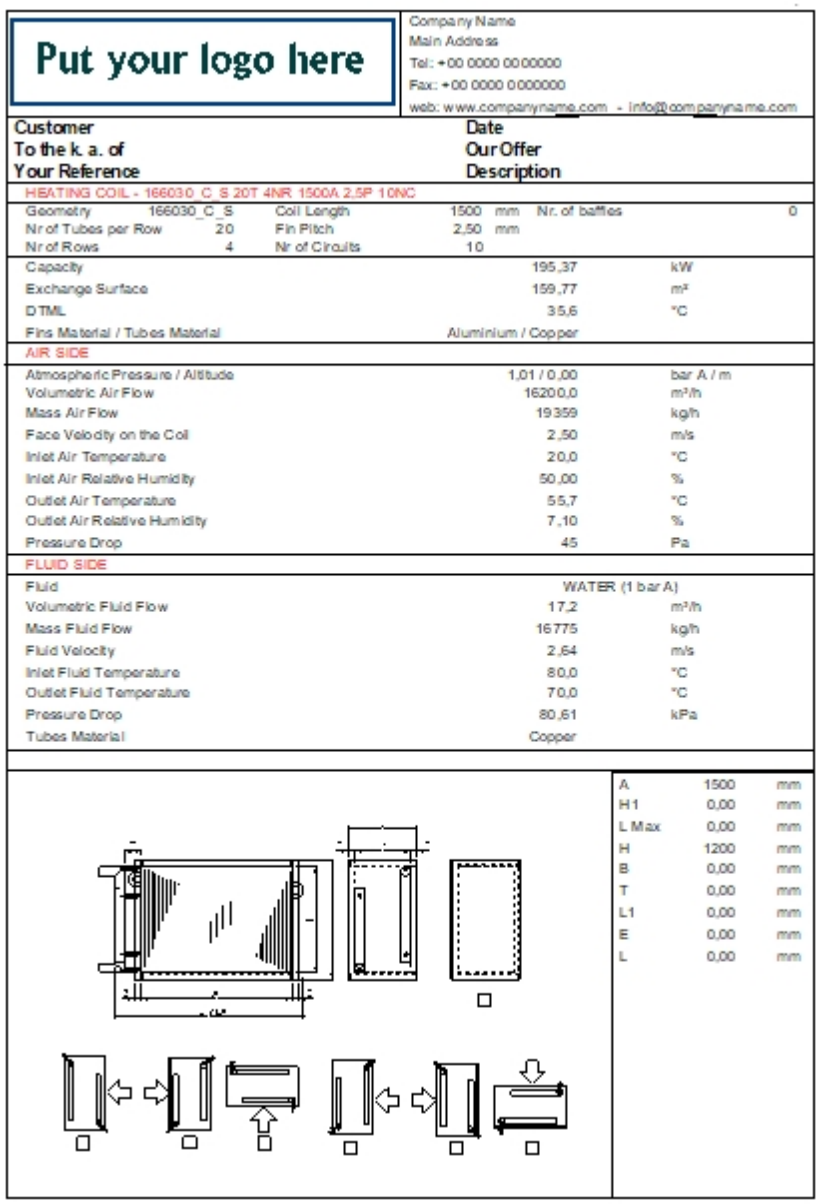
- "Customer" where we can add the customer data, that will show the printouts by clicking the "customer" button



- "Print Sheets:" which allows us to see detailed printout pages.

For example, if we choose the Simplified Drawing 

, will obtain



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web: www.companyname.com - info@companyname.com

Customer		Date	
To the k. a. of		Our Offer	
Your Reference		Description	
HEATING COIL - 166030_C_S 20T 4NR 1500A 2,5P 10NC			
Geometry	166030_C_S	Coil Length	1500 mm
Nr of Tubes per Row	20	Fin Pitch	2,50 mm
Nr of Rows	4	Nr of Circuits	10
Nr. of baffles	0		
Capacity	195,37	kW	
Exchange Surface	159,77	m²	
DTML	35,6	°C	
Fins Material / Tubes Material	Aluminium / Copper		
AIR SIDE			
Atmospheric Pressure / Altitude	1,01 / 0,00	bar A / m	
Volumetric Air Flow	16200,0	m³/h	
Mass Air Flow	19359	kg/h	
Face Velocity on the Coil	2,50	m/s	
Inlet Air Temperature	20,0	°C	
Inlet Air Relative Humidity	50,00	%	
Outlet Air Temperature	55,7	°C	
Outlet Air Relative Humidity	7,10	%	
Pressure Drop	45	Pa	
FLUID SIDE			
Fluid	WATER (1 bar A)		
Volumetric Fluid Flow	17,2	m³/h	
Mass Fluid Flow	16775	kg/h	
Fluid Velocity	2,64	m/s	
Inlet Fluid Temperature	80,0	°C	
Outlet Fluid Temperature	70,0	°C	
Pressure Drop	80,61	kPa	
Tubes Material	Copper		

A	1500	mm
H1	0,00	mm
L Max	0,00	mm
H	1200	mm
B	0,00	mm
T	0,00	mm
L1	0,00	mm
E	0,00	mm
L	0,00	mm

- by choosing the “Without Drawing” option:

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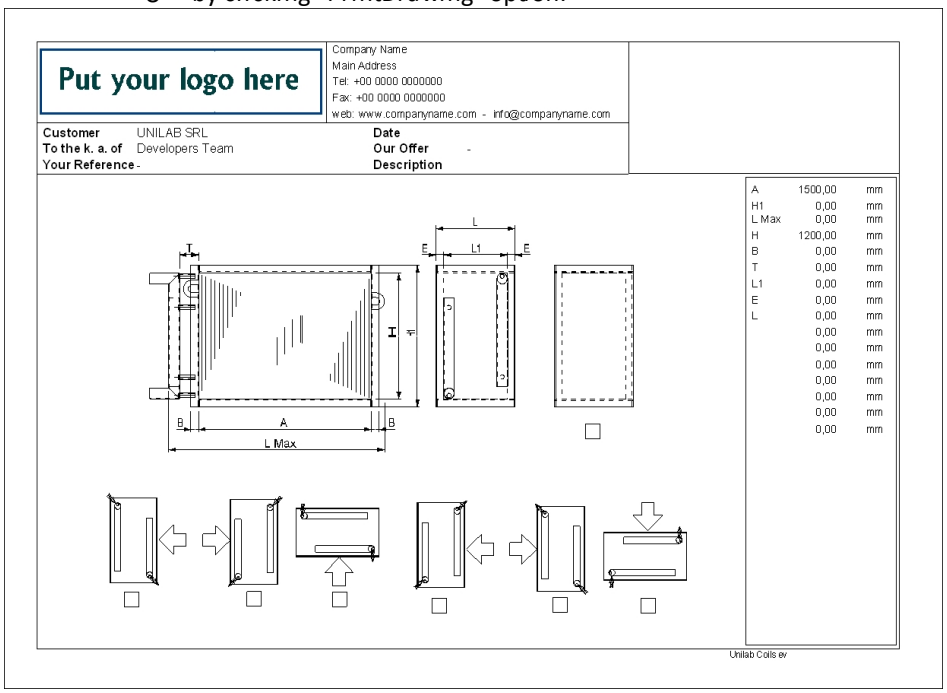
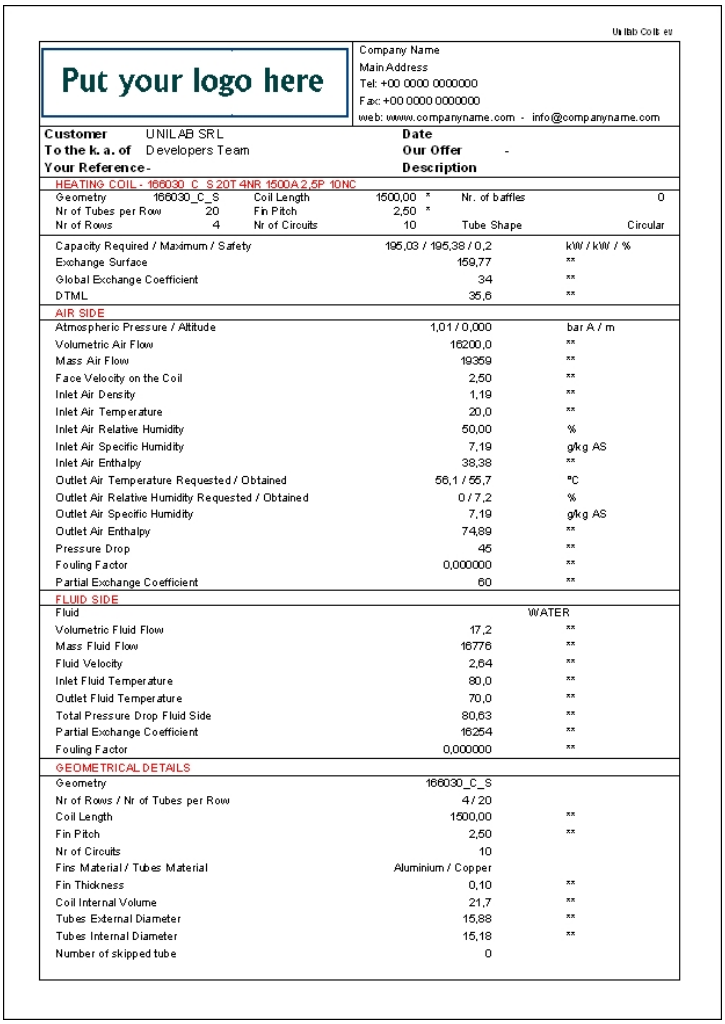
To the k. a. of		Our Offer	
Your Reference		Description	
HEATING COIL - 166030_C_S 20T 4NR 1500A 2,5P 10NC			
Geometry	166030_C_S	Coil Length	1500 mm
Nr of Tubes per Row	20	Fin Pitch	2,50 mm
Nr of Rows	4	Nr of Circuits	10
Nr. of baffles	0		
Capacity	195,37	kW	
Exchange Surface	159,77	m²	
DTML	35,6	°C	
Fins Material / Tubes Material	Aluminium / Copper		
AIR SIDE			
Atmospheric Pressure / Altitude	1,01 / 0,00	bar A / m	
Volumetric Air Flow	16200,0	m³/h	
Mass Air Flow	19359	kg/h	
Face Velocity on the Coil	2,50	m/s	
Inlet Air Temperature	20,0	°C	
Inlet Air Relative Humidity	50,00	%	
Outlet Air Temperature	55,7	°C	
Outlet Air Relative Humidity	7,10	%	
Pressure Drop	45	Pa	
FLUID SIDE			
Fluid	WATER (1 bar A)		
Volumetric Fluid Flow	17,2	m³/h	
Mass Fluid Flow	16775	kg/h	
Fluid Velocity	2,64	m/s	
Inlet Fluid Temperature	80,0	°C	
Outlet Fluid Temperature	70,0	°C	
Pressure Drop	80,61	kPa	
Tubes Material	Copper		

- by clicking “PrintDrawing” option:



- the “Advanced Technical Data” :



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Description

HEATING COIL - 166030_C_S 20T 4NR 1500A 2,5P 10NC

Geometry	166030_C_S	Coil Length	1500,00 *	Nr. of baffles	0
Nr of Tubes per Row	20	Fin Pitch	2,50 *		
Nr of Rows	4	Nr of Circuits	10	Tube Shape	Circular

Capacity Required / Maximum / Safety	195,03 / 195,38 / 0,2	kW / kW / %
Exchange Surface	159,77	**
Global Exchange Coefficient	34	**
DTML	35,6	**

AIR SIDE

Atmospheric Pressure / Altitude	1,01 / 0,000	bar A / m
Volumetric Air Flow	16200,0	**
Mass Air Flow	19359	**
Face Velocity on the Coil	2,50	**
Inlet Air Density	1,19	**
Inlet Air Temperature	20,0	**
Inlet Air Relative Humidity	50,00	%
Inlet Air Specific Humidity	7,19	g/kg AS
Inlet Air Enthalpy	38,38	**
Outlet Air Temperature Requested / Obtained	56,1 / 55,7	°C
Outlet Air Relative Humidity Requested / Obtained	0 / 7,2	%
Outlet Air Specific Humidity	7,19	g/kg AS
Outlet Air Enthalpy	74,89	**
Pressure Drop	45	**
Fouling Factor	0,000000	**
Partial Exchange Coefficient	60	**

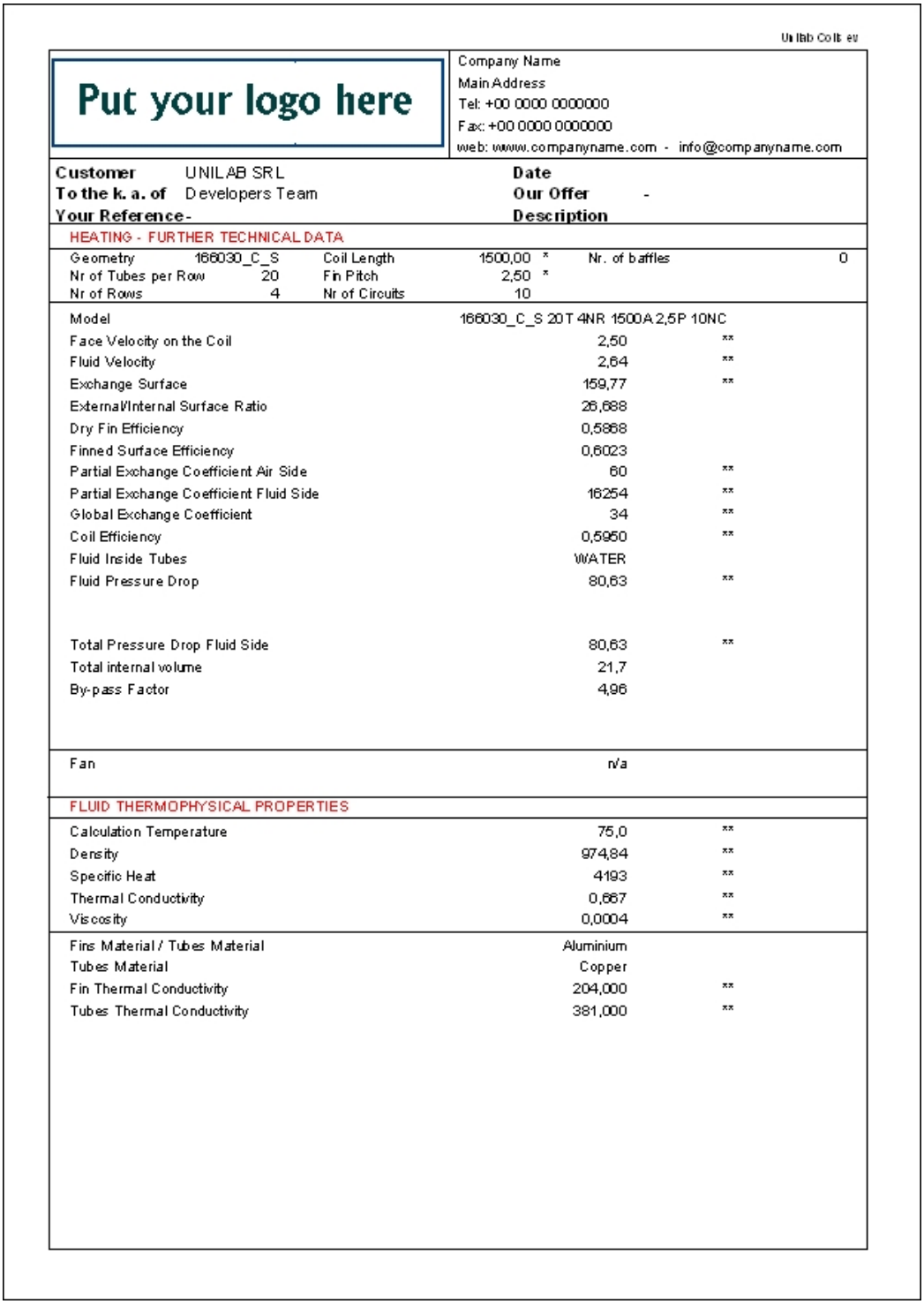
FLUID SIDE

Fluid		WATER
Volumetric Fluid Flow	17,2	**
Mass Fluid Flow	16776	**
Fluid Velocity	2,64	**
Inlet Fluid Temperature	80,0	**
Outlet Fluid Temperature	70,0	**
Total Pressure Drop Fluid Side	80,63	**
Partial Exchange Coefficient	16254	**
Fouling Factor	0,000000	**

GEOMETRICAL DETAILS

Geometry	166030_C_S	
Nr of Rows / Nr of Tubes per Row	4 / 20	
Coil Length	1500,00	**
Fin Pitch	2,50	**
Nr of Circuits	10	
Fins Material / Tubes Material	Aluminium / Copper	
Fin Thickness	0,10	**
Coil Internal Volume	21,7	**
Tubes External Diameter	15,88	**
Tubes Internal Diameter	15,18	**
Number of skipped tube	0	

- the “Advanced Additional Technical Data”:



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Customer UNILAB SRL **Date**
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Your Reference - **Description**

HEATING - FURTHER TECHNICAL DATA

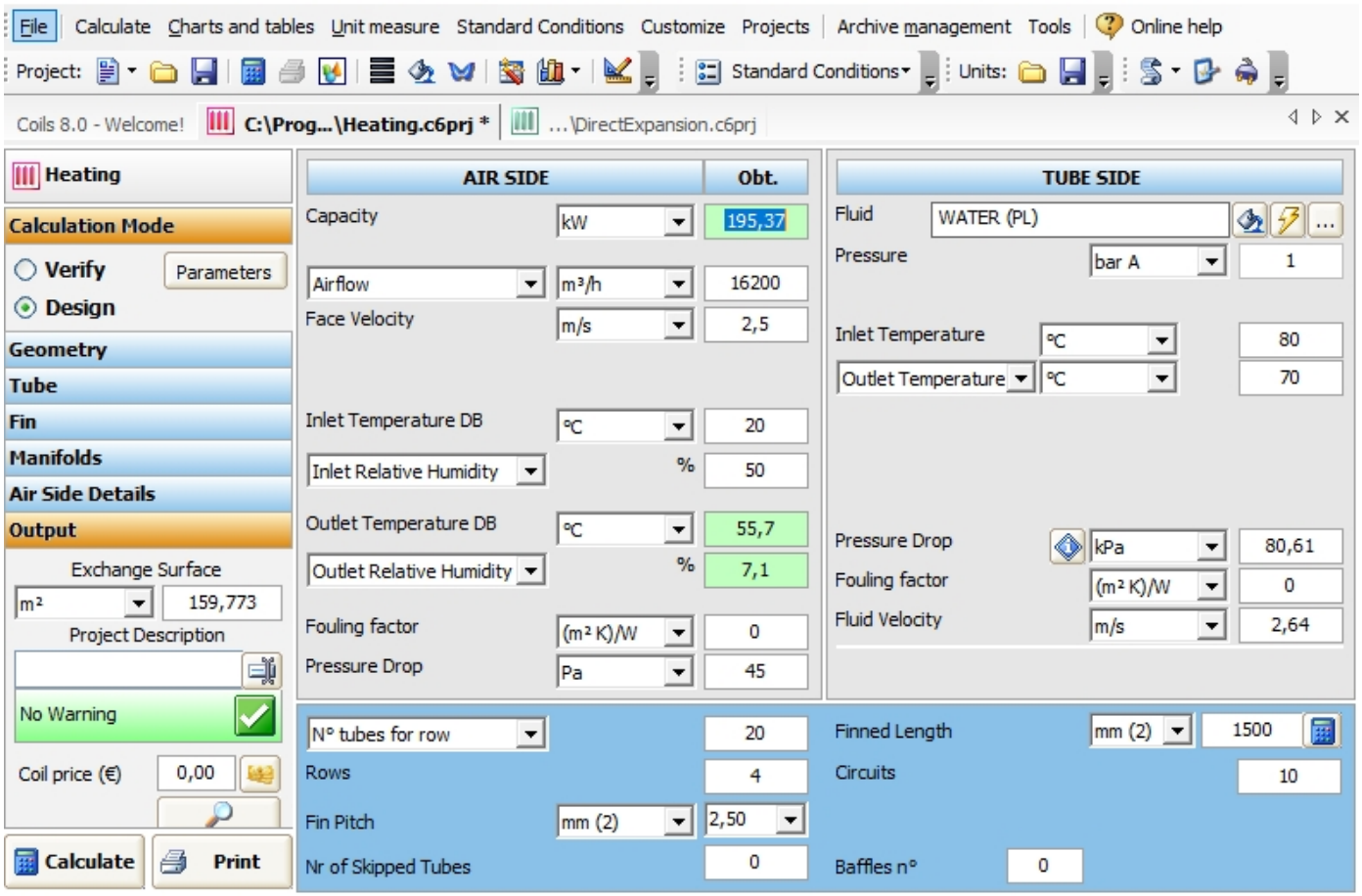
Geometry	166030_C_S	Coil Length	1500,00 *	Nr. of baffles	0
Nr of Tubes per Row	20	Fin Pitch	2,50 *		
Nr of Rows	4	Nr of Circuits	10		

Model	166030_C_S 20T 4NR 1500A 2,5P 10NC	
Face Velocity on the Coil	2,50	**
Fluid Velocity	2,64	**
Exchange Surface	159,77	**
External/Internal Surface Ratio	26,688	
Dry Fin Efficiency	0,5868	
Finned Surface Efficiency	0,6023	
Partial Exchange Coefficient Air Side	60	**
Partial Exchange Coefficient Fluid Side	16254	**
Global Exchange Coefficient	34	**
Coil Efficiency	0,5950	**
Fluid Inside Tubes	WATER	
Fluid Pressure Drop	80,63	**
Total Pressure Drop Fluid Side	80,63	**
Total internal volume	21,7	
By-pass Factor	4,96	
Fan	n/a	

FLUID THERMOPHYSICAL PROPERTIES

Calculation Temperature	75,0	**
Density	974,84	**
Specific Heat	4193	**
Thermal Conductivity	0,667	**
Viscosity	0,0004	**
Fins Material / Tubes Material	Aluminium	
Tubes Material	Copper	
Fin Thermal Conductivity	204,000	**
Tubes Thermal Conductivity	381,000	**

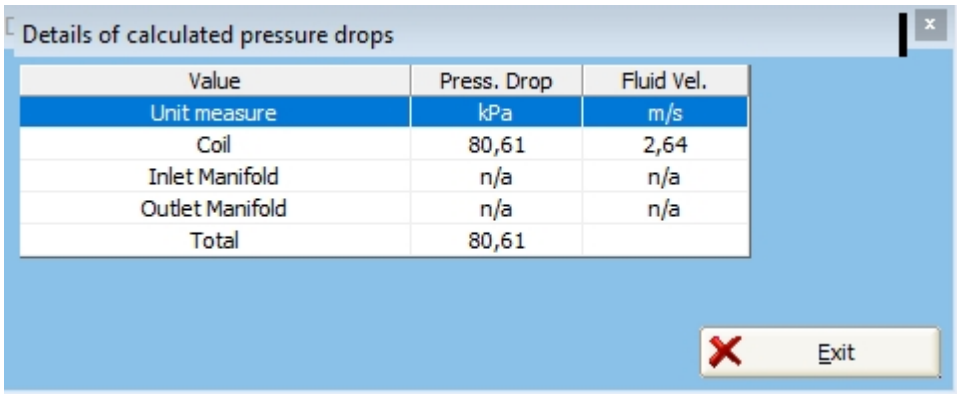
Let’s see, how the Design modality operates.



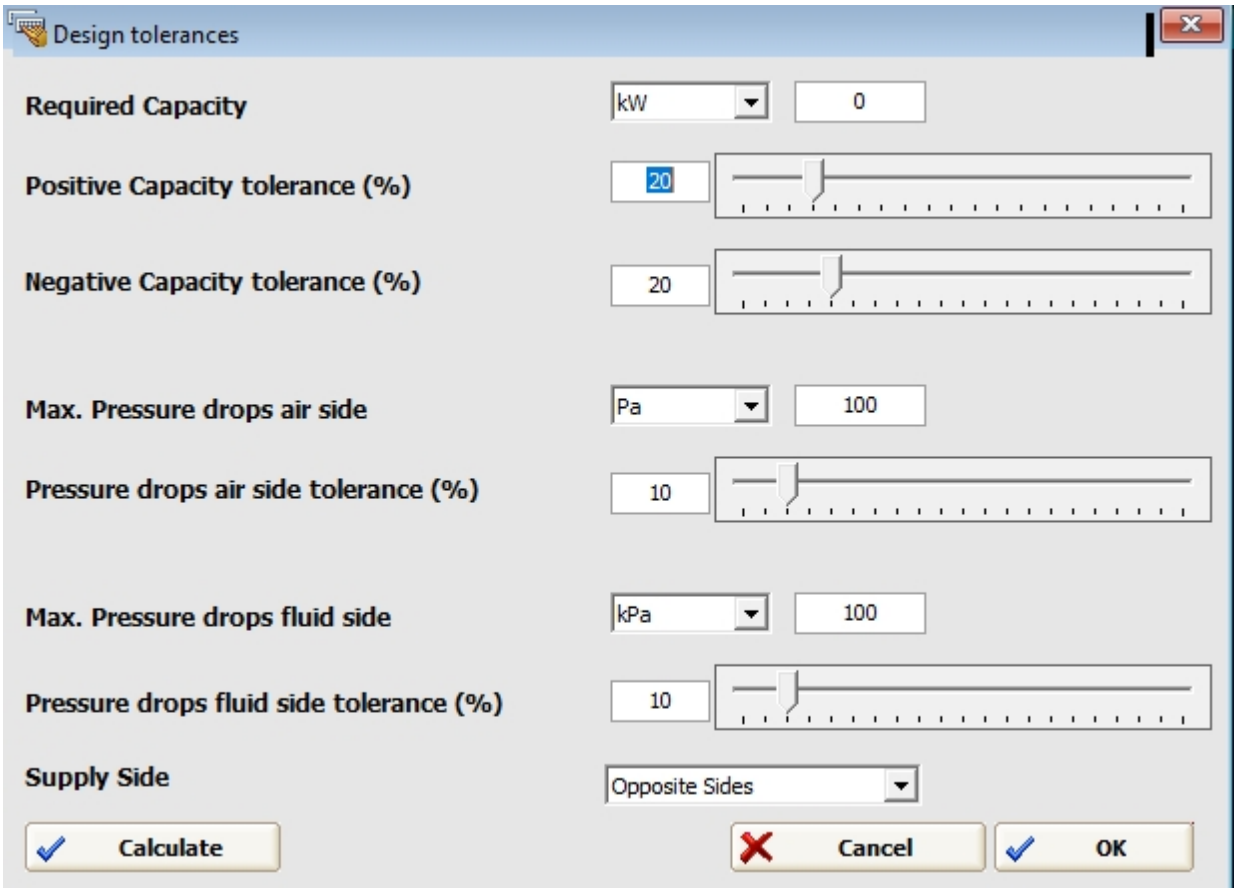
where on “Air Side” we can see “Pressure Drop ” measured in Pa, as calculation’s result.

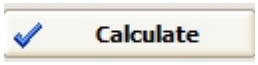
in the “Tubes Side” We can see “Pressure Drop” measured in kPa, as calculation’s result.

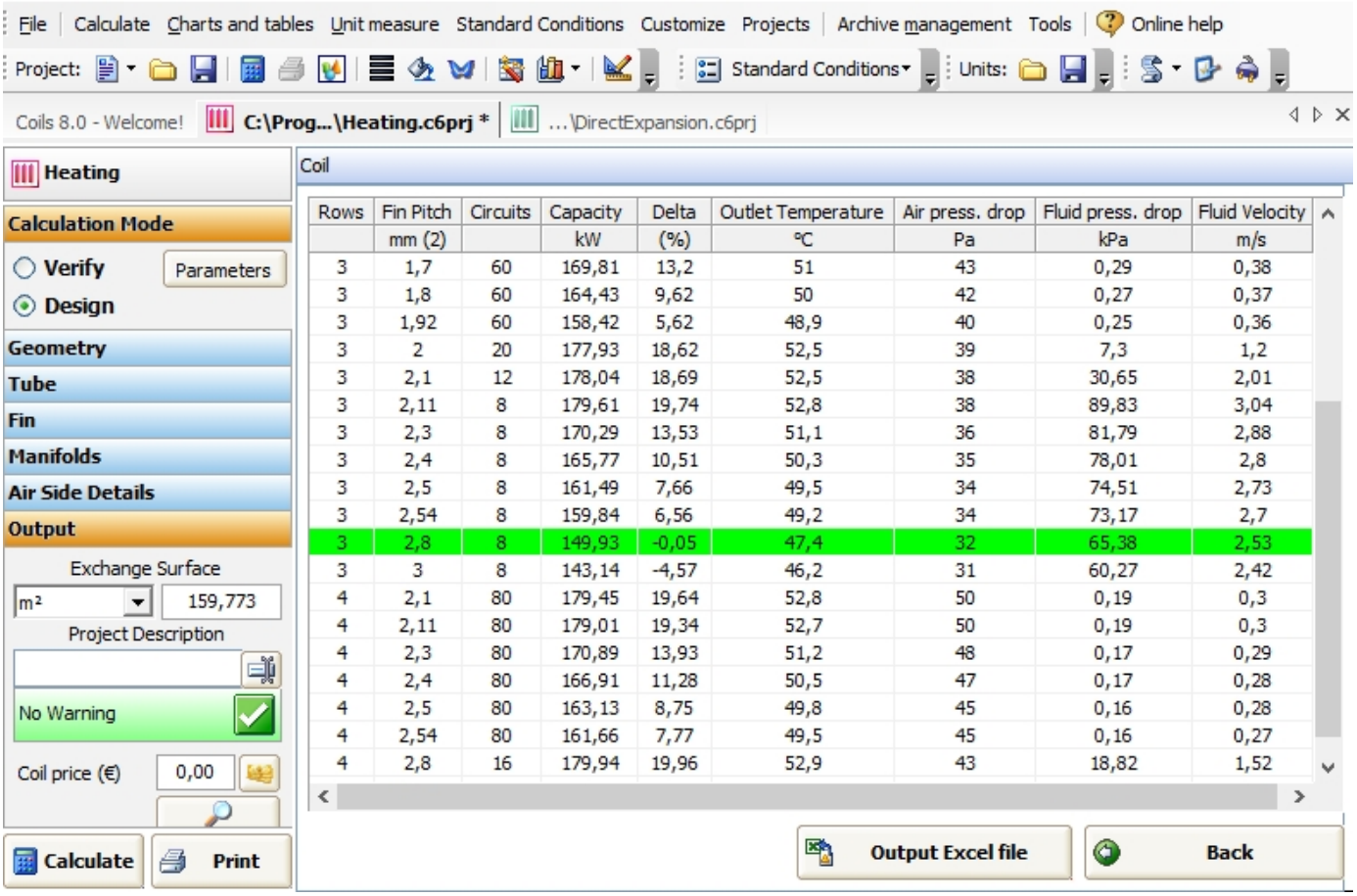
Clicking on “i” we can see an information about calculated pressure drop



- We hit the “Design” button and obtain the following, where you should set the tolerances and the required capacity



- We click on "Calculate" button 



Rows	Fin Pitch	Circuits	Capacity	Delta	Outlet Temperature	Air press. drop	Fluid press. drop	Fluid Velocity
	mm (2)		kW	(%)	°C	Pa	kPa	m/s
3	1,7	60	169,81	13,2	51	43	0,29	0,38
3	1,8	60	164,43	9,62	50	42	0,27	0,37
3	1,92	60	158,42	5,62	48,9	40	0,25	0,36
3	2	20	177,93	18,62	52,5	39	7,3	1,2
3	2,1	12	178,04	18,69	52,5	38	30,65	2,01
3	2,11	8	179,61	19,74	52,8	38	89,83	3,04
3	2,3	8	170,29	13,53	51,1	36	81,79	2,88
3	2,4	8	165,77	10,51	50,3	35	78,01	2,8
3	2,5	8	161,49	7,66	49,5	34	74,51	2,73
3	2,54	8	159,84	6,56	49,2	34	73,17	2,7
3	2,8	8	149,93	-0,05	47,4	32	65,38	2,53
3	3	8	143,14	-4,57	46,2	31	60,27	2,42
4	2,1	80	179,45	19,64	52,8	50	0,19	0,3
4	2,11	80	179,01	19,34	52,7	50	0,19	0,3
4	2,3	80	170,89	13,93	51,2	48	0,17	0,29
4	2,4	80	166,91	11,28	50,5	47	0,17	0,28
4	2,5	80	163,13	8,75	49,8	45	0,16	0,28
4	2,54	80	161,66	7,77	49,5	45	0,16	0,27
4	2,8	16	179,94	19,96	52,9	43	18,82	1,52

where we can see a list of all possible coils chosen by software and based on the inserted Capacity value:

Rows	Fin Pitch	Circuits	Capacity	Delta	Outlet Temperature	Air press. drop	Fluid press. drop	Fluid Velocity
	mm (2)		kW	(%)	°C	Pa	kPa	m/s
3	1,7	60	169,81	13,2	51	43	0,29	0,38
3	1,8	60	164,43	9,62	50	42	0,27	0,37
3	1,92	60	158,42	5,62	48,9	40	0,25	0,36
3	2	20	177,93	18,62	52,5	39	7,3	1,2
3	2,1	12	178,04	18,69	52,5	38	30,65	2,01
3	2,11	8	179,61	19,74	52,8	38	89,83	3,04
3	2,3	8	170,29	13,53	51,1	36	81,79	2,88
3	2,4	8	165,77	10,51	50,3	35	78,01	2,8
3	2,5	8	161,49	7,66	49,5	34	74,51	2,73
3	2,54	8	159,84	6,56	49,2	34	73,17	2,7
3	2,8	8	149,93	-0,05	47,4	32	65,38	2,53
3	3	8	143,14	-4,57	46,2	31	60,27	2,42
4	2,1	80	179,45	19,64	52,8	50	0,19	0,3
4	2,11	80	179,01	19,34	52,7	50	0,19	0,3
4	2,3	80	170,89	13,93	51,2	48	0,17	0,29
4	2,4	80		11,28	50,5	47	0,17	0,28
4	2,5	80	163,13	8,75	49,8	45	0,16	0,28
4	2,54	80	161,66	7,77	49,5	45	0,16	0,27
4	2,8	16	179,94	19,96	52,9	43	18,82	1,52

- In this table we can see some fields relative to the coils geometries

Rows	Fin Pitch	Circuits	Capacity
	mm (2)		kW
3	2,3	8	170,29
3	1,7	60	169,81
4	2,4	80	166,91
3	2,4	8	165,77
3	1,8	60	164,43
4	2,5	80	163,13
2	1,6	8	161,96
4	2,54	80	161,66
3	2,5	8	161,49
3	2,54	8	159,84
3	1,92	60	158,42
2	1,7	8	155,59
3	2,8	8	149,93
2	1,8	8	149,71
2	1,92	8	143,23

- Delta stands for the percentage difference from the capacity we are seeking.

Delta
(%)
13,53
13,2
11,28
10,51
9,62
8,75
7,97
7,77
7,66
6,56
5,62
3,73
-0,05
-0,2
-4,52

- the remaining fields are about the air and fluid side variables

Outlet Temperature	Air press. drop	Fluid press. drop	Fluid Velocity
°C	Pa	kPa	m/s
51,1	36	81,79	2,88
51	43	0,29	0,38
50,5	47	0,17	0,28
50,3	35	78,01	2,8
50	42	0,27	0,37
49,8	45	0,16	0,28
49,6	30	52,98	2,74
49,5	45	0,16	0,27
49,5	34	74,51	2,73
49,2	34	73,17	2,7
48,9	40	0,25	0,36
48,4	29	49,37	2,63
47,4	32	65,38	2,53
47,4	28	46,1	2,53
46,2	27	42,65	2,42

- The highlighted row shows chosen coil, that fits best the capacity sought.

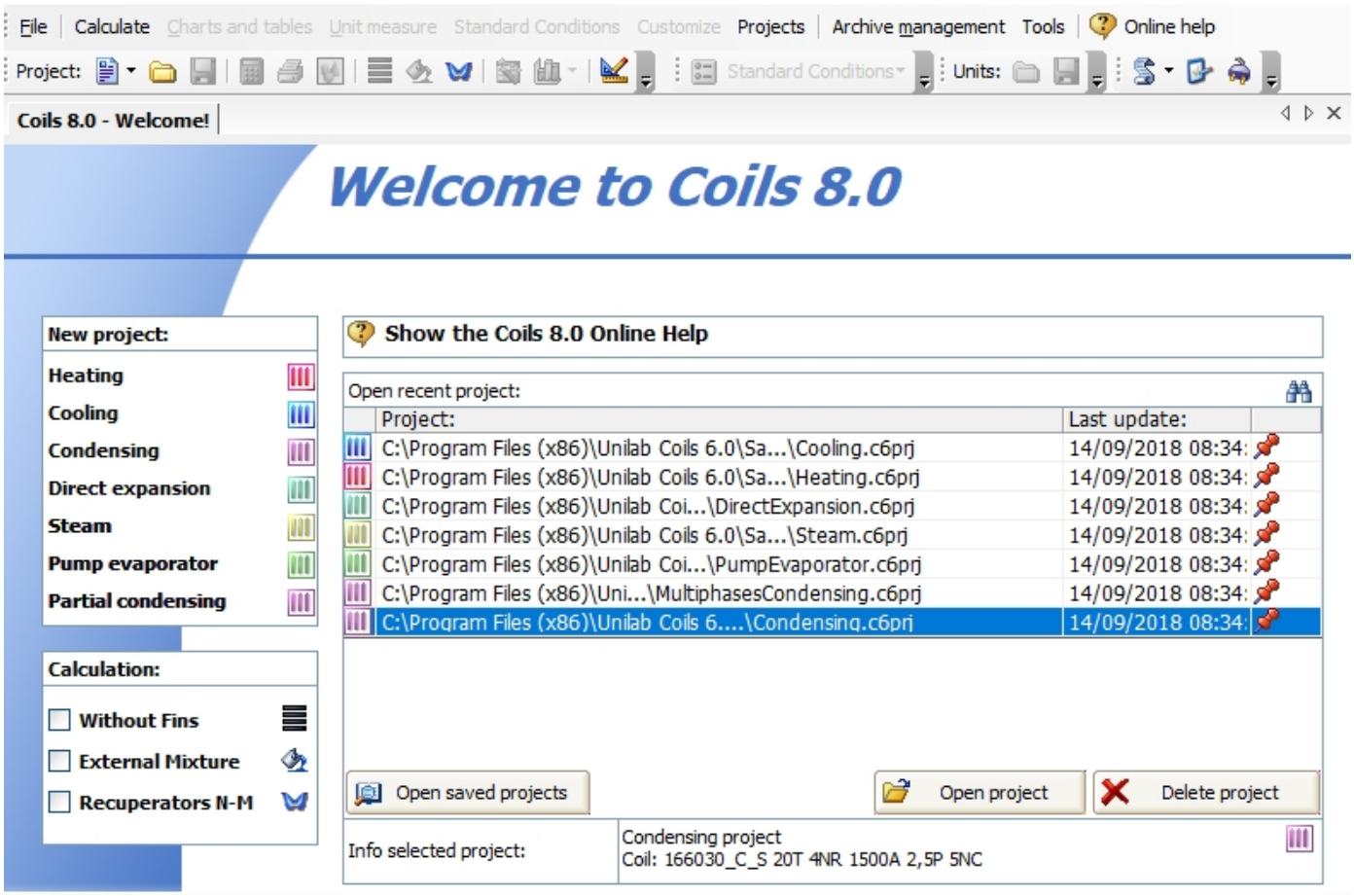
3	2,8	8	149,93	-0,05	47,4	32	65,38	2,53

Condensing Example

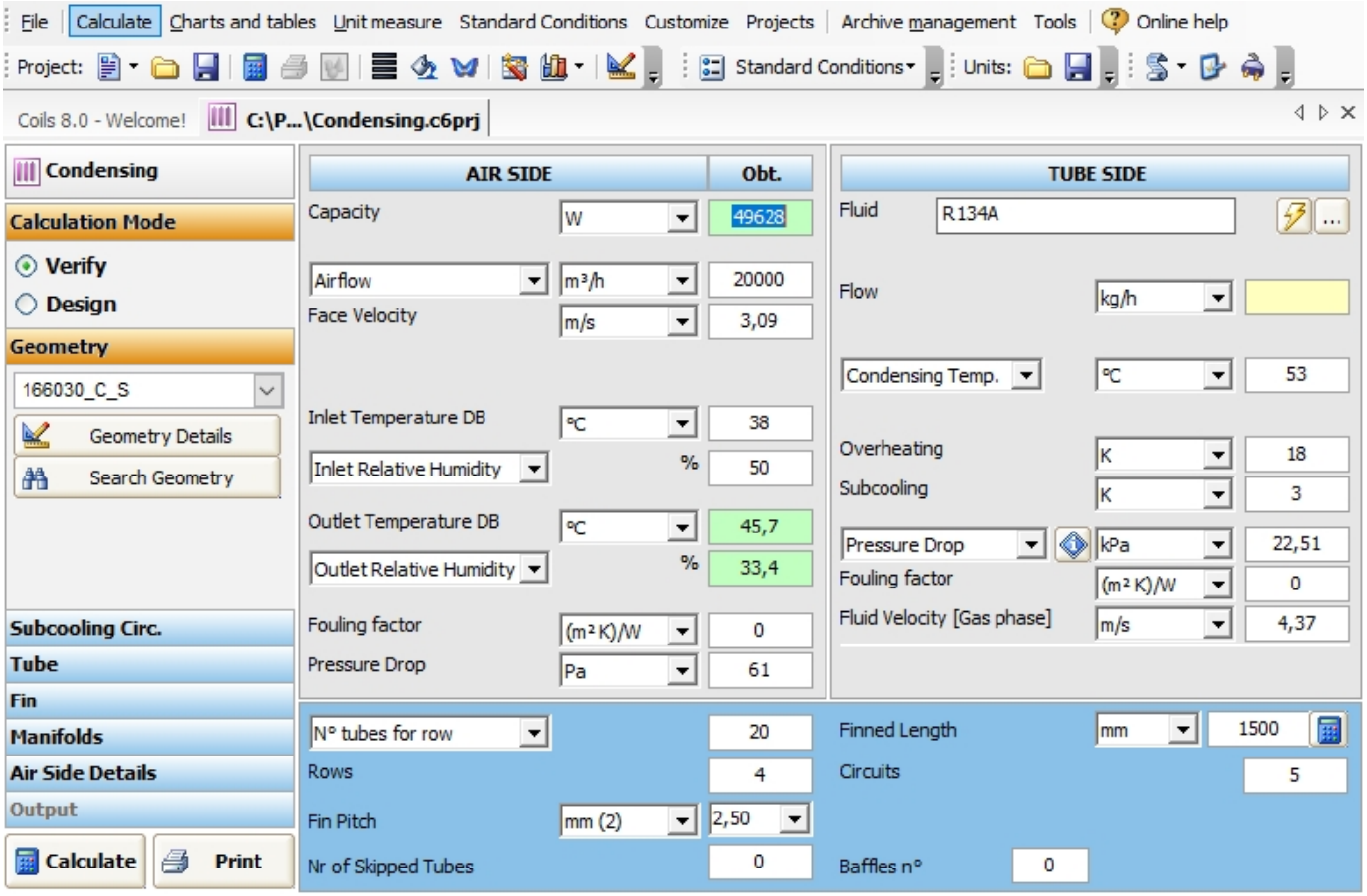
Condensing Example

To open the Condensing calculation example

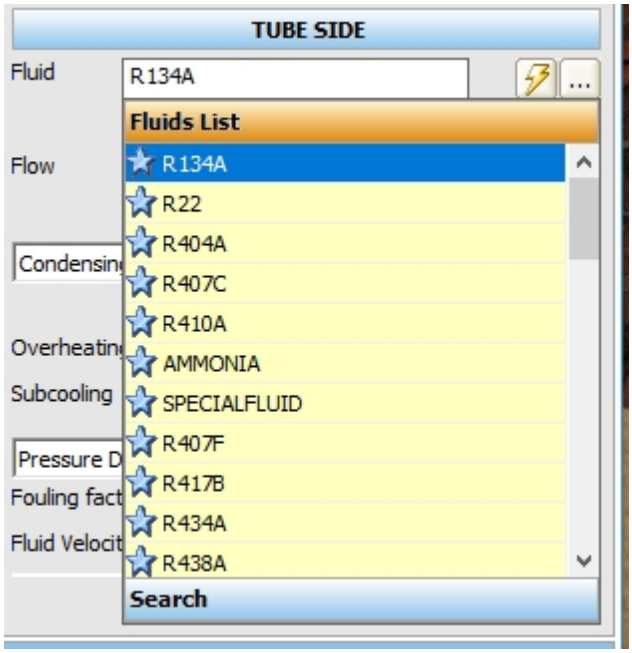
- Click on “Condensing.c6prj” file under the “Open recent project” area



- Double click on the file 



"Fluid" in this example is R134a, but there is a wide range of fluids



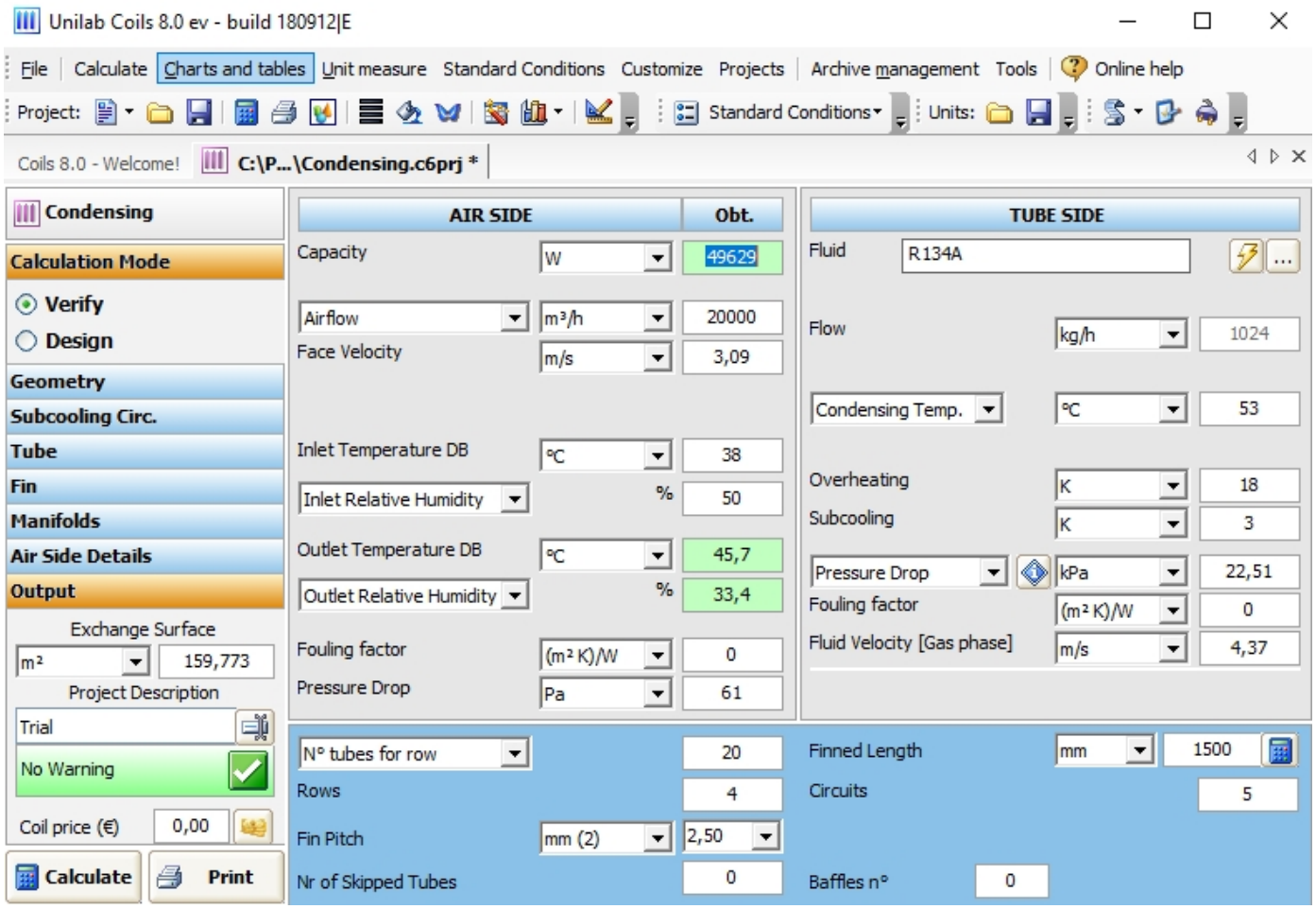
- "Flow"

As we stated in the introduction, our program is able to perform two types of calculation "Verify" and "Design"

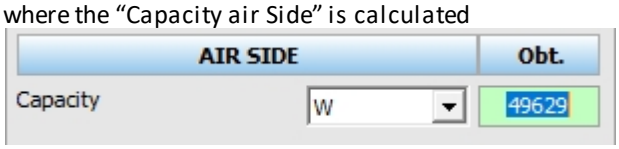
Since in this example we have all the working conditions, we work in Verify mode, in which the user can rate the power and the pressure drop, knowing all the geometrical parameters of the exchanger and the working

conditions, changing one or more input variables at the same time (for example: geometry, inlet air temperature and humidity, fluid, fin thickness, fin type, tube type, fluid temperatures etc.)

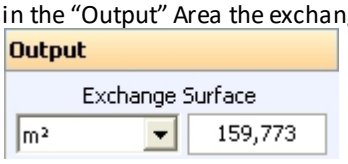
- Now we simply click on "Calculate" button 



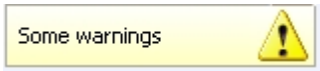
where the "Capacity air Side" is calculated



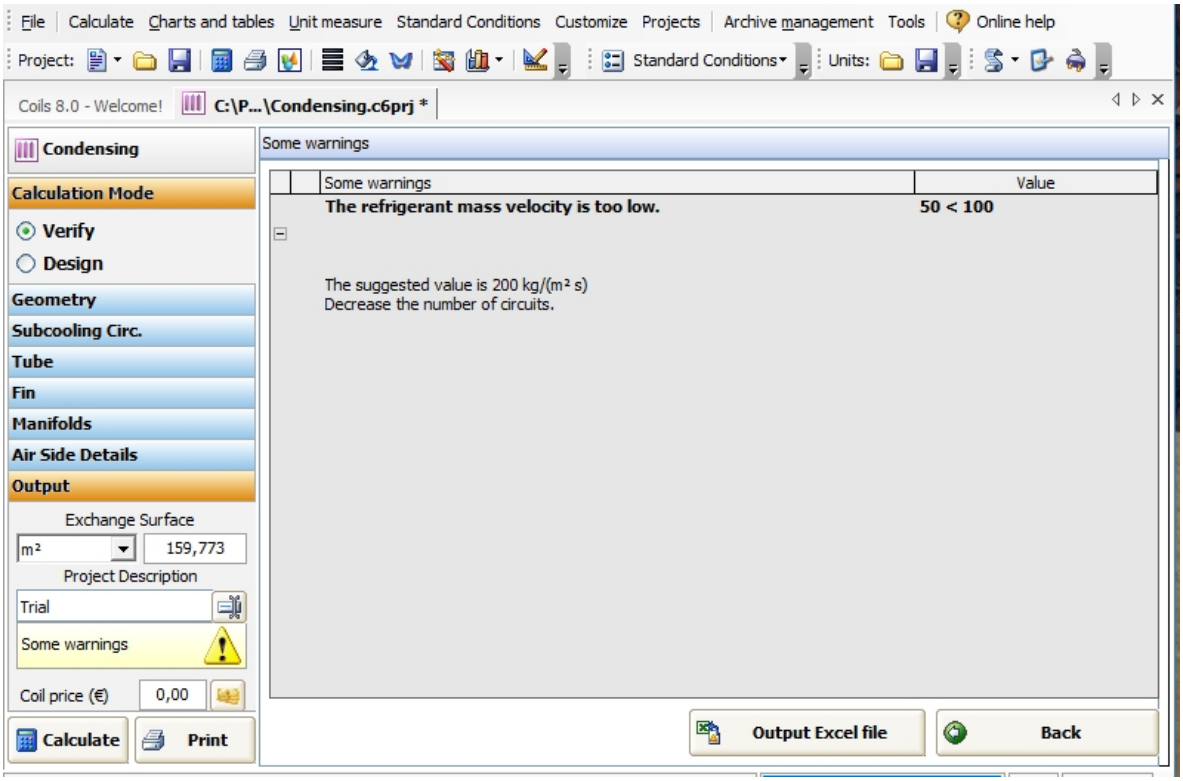
in the "Output" Area the exchange surface is calculated



In this case, we see some warnings.

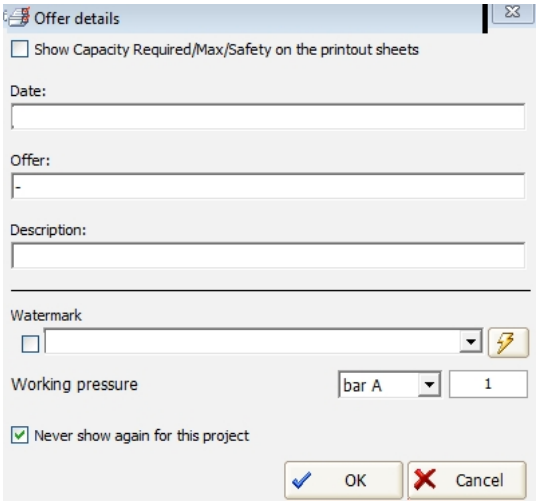


- By clicking on the warning message, in the previous version the messages were based on the fluid velocity, we have added as variable refrigerant mass velocity.



- Now to see the output results of our calculation, let's click on 

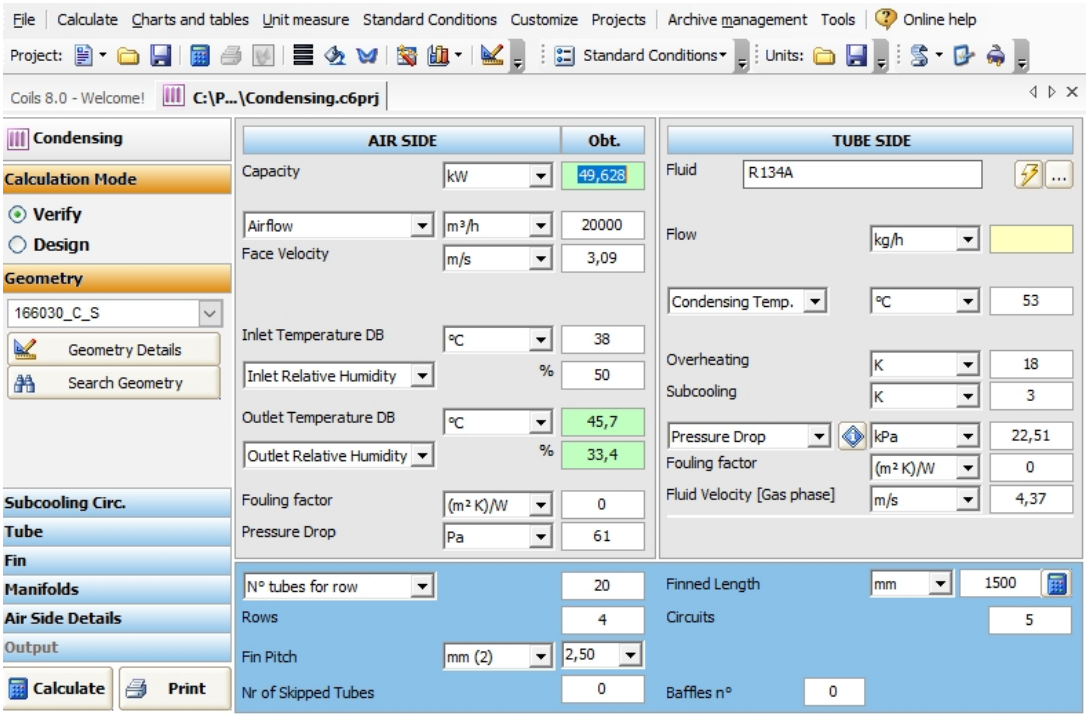
button



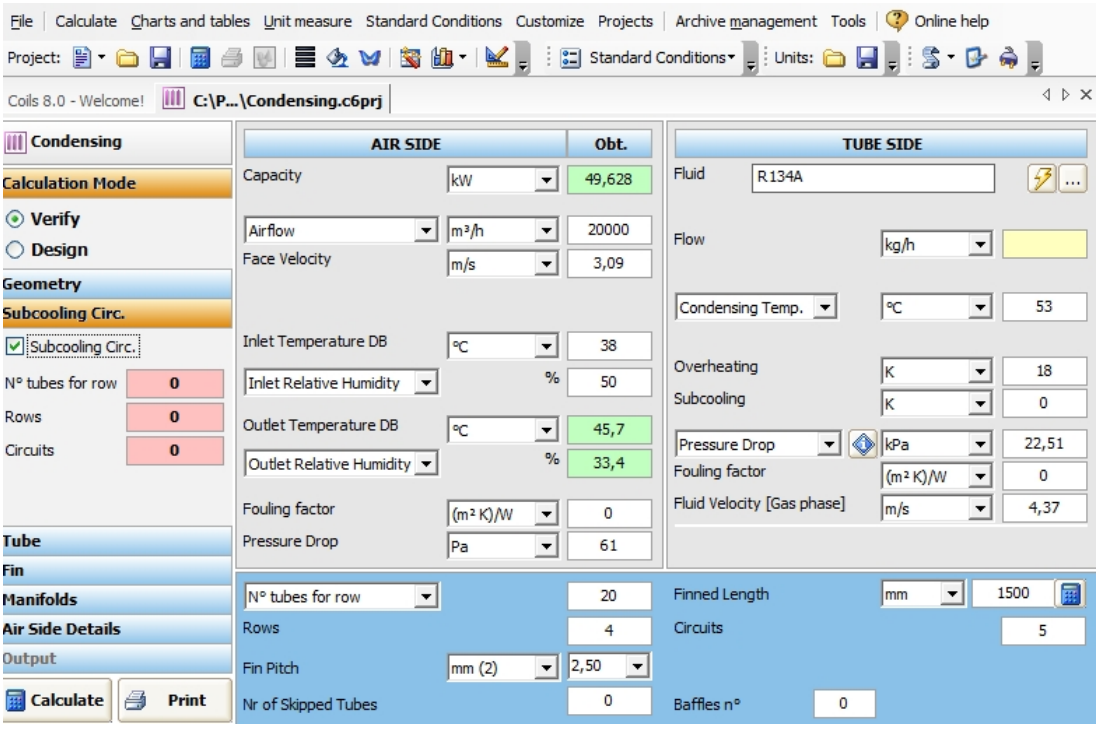
SUBCOOLING CIRCUIT IN CONDENSING MODALITY EXAMPLE

SUBCOOLING CIRCUIT IN CONDENSING MODALITY EXAMPLE

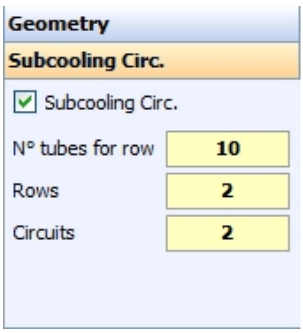
In Coils, in the Condensing modality, it is possible to calculate the subcooling circuit.
To do so, let's see this example.
Let's open the existing project in condensing modality in Coils



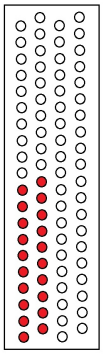
This refers to a coils without subcooling circuit. To do its calculation, we can click on the "Subcooling Circ."



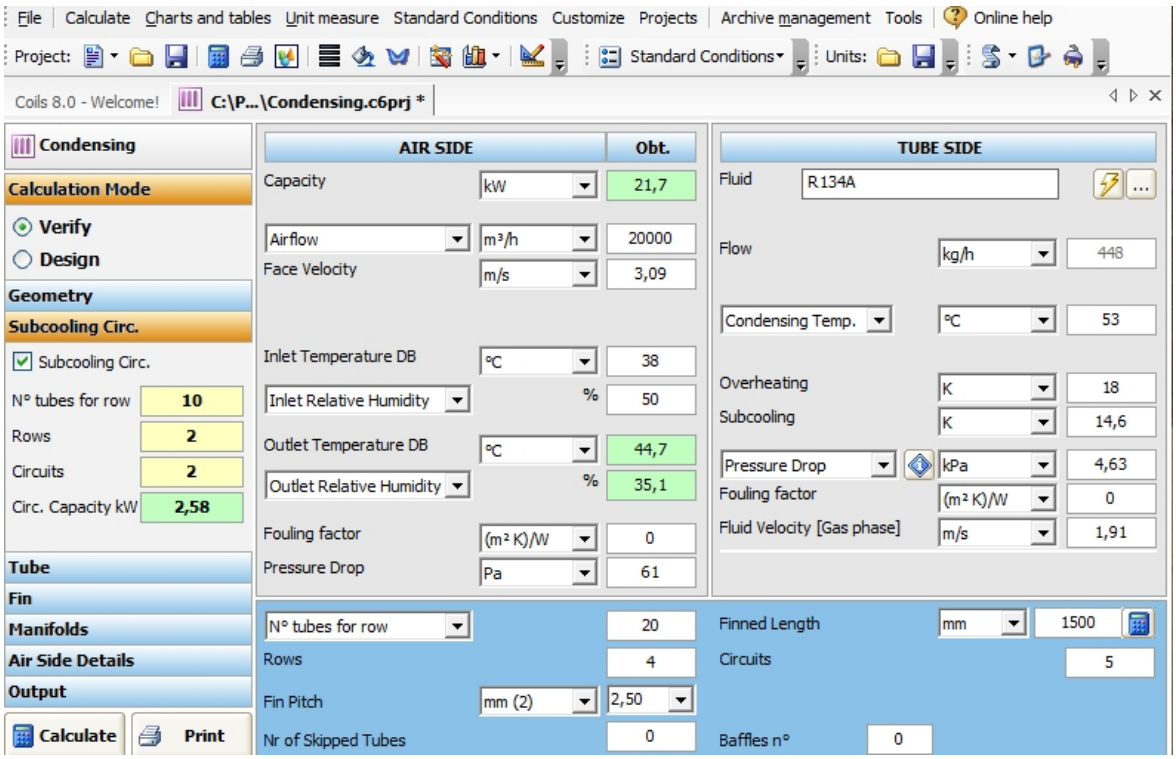
Then we can insert the data relative to the subcooling part, which are: "*N° tubes for row*", "*Rows*" and the "*Circuits*", which are the input values, as we can see in the following screen.



In that example, configuration of the coil could be the following:



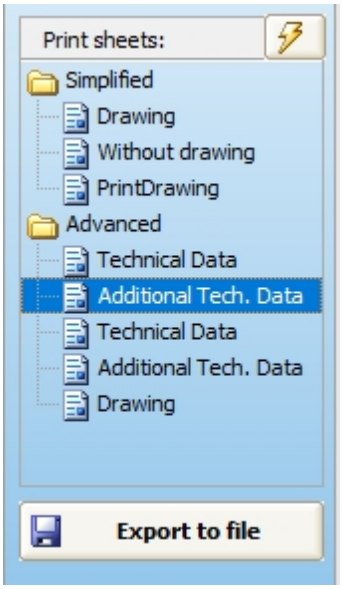
Where the subcooling circuit is composed by the red coloured tubes.
Then we click on “calculate” to obtain the capacity of the subcooling circuit.



We can see our results in

Then we can go to print to see the printout templates.

To see the data relative to the subcooling part please refer to the Advanced Print Sheets, then to the first Technical Data and Additional Tech. Data.



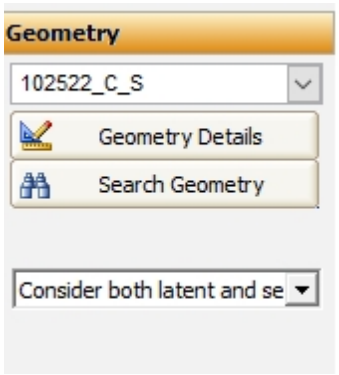
REFRIGERANT SIDE		
Fluid		R134A
Mass Fluid Flow	448	kg/h
Fluid Velocity (Gaseous Phase)	1,91	m/s
Fluid Velocity (Liquid Phase)	0,13	m/s
Mass velocity	137	kg/(m² s)
SubCooling	3,0	K
Desuperheating	18,0	K
Condensing Temperature	53,0	°C
Fluid Pressure Drop	2,60916	kPa
Manifold Pressure Drop	0	kPa
Total Pressure Drop Fluid Side	2,60916	kPa
Partial Exchange Coefficient	1513	W/(m² K)
Fouling Factor	0,000000	(m² K)/W

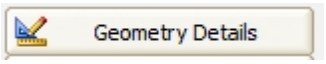
Geometry Section

Geometries Details

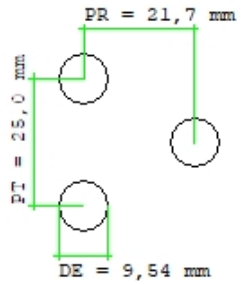
Geometry Details

In the Geometry section of the left part of the mask



push the button  to see the details of the selected geometry (in this example the 102522_C_S):

Where we can see the Geometry Drawing



Where

- "DE" stands for "External Diameter" of the coil
- "PT" stands for "Rows Spacing" of the coil
- "PR" stands for "Tubes Spacing" of the coil

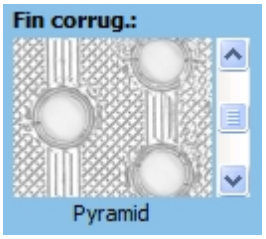
we can also see Fin corrugation type in images:

- “Smooth” Fin corrugation

by scrolling down with the arrows, we can see the other corrugation types:

- “Corrugated” Fin corrugation

- “Pyramid” Fin corrugation



- “Windowed” Fin corrugation

- “Louvered” Fin corrugation

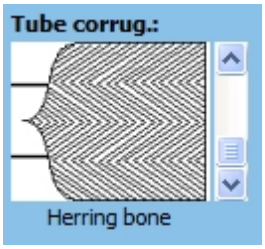
We can also see Tube corrugation type in images:

- “Smooth” Tube Corrugation

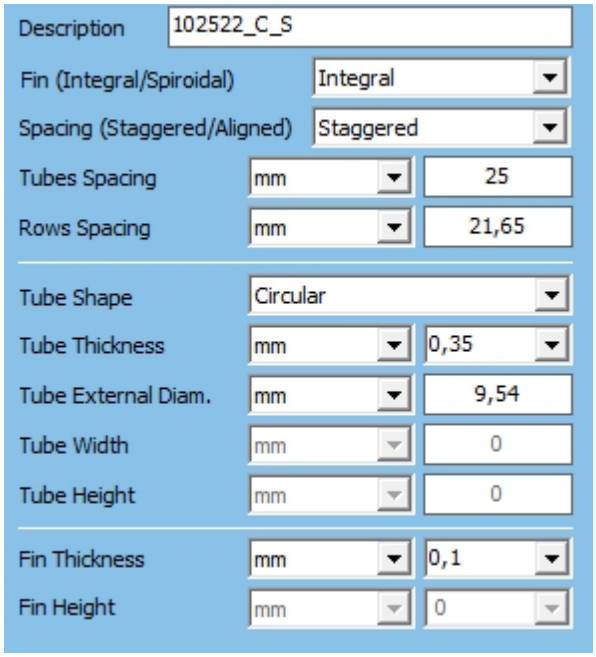
- “Microfin” Tube Corrugation

- “Gross Grooved” Tube Corrugation

- “Hearing Bone” Tube Corrugation

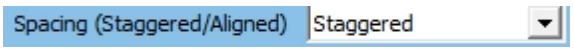


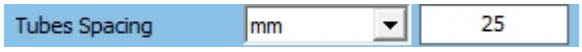
We can also see the Description and other geometry detailes:

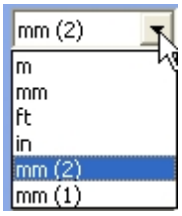


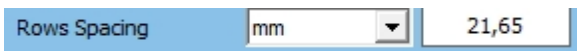
where

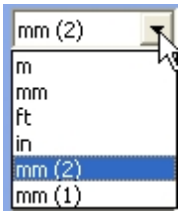
- "Description" is a string that identifies a geometry
  - the first two digits "10" stand the tube external diameter rounded
  - the third and fourth digits "25" stand for the Tubes Spacing
  - the fifth and the sixth digits "22" stand for the Rows Spacing rounded
  - the last two characters stand for the initial of Fin and Tube corrugation Type
- "Fin" can be Integral or Spiroidal 

- "Spacing" can be Staggered or Aligned 

- "Tube Spacing" 

can be entered in 

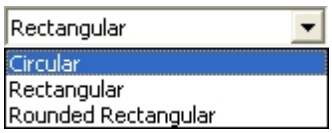
or even when We have entered a measure in one unit measure We can always transform it just by clicking on the unit We desire.
- "Fin Spacing" 

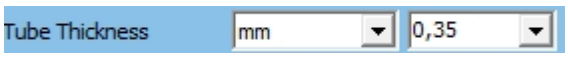
can be entered in 

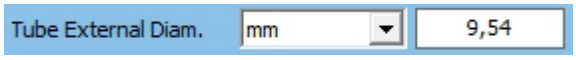
.

The other factors that we can set or see in Geometry Detail are:

- Tube Shape 

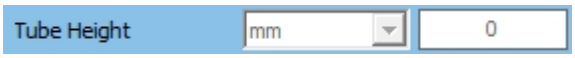
which can be 

- Tubes Thickness 

- Tube External Diameter 

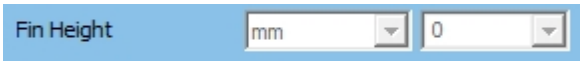
if the tubes are circular

- Tube Width 

and Tube Height 

if the tubes are rectangular

- Fin Thickness 

- Fin Height 

There is another area we can see:

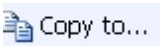
This allows us to copy the geometry in other calculation modality, if we need it, after hitting the "Copy to..." button.

We have a place where we can select possible Coil operation mode to copy the geometry to.

permits to add a new geometry.

permits only saving by default

permits to give a file name while saving the geometry



permits to copy a geometry from one treatment to the other

** For further information about the geometries factors and theirs possible values, please see section "Geometry management" **

New Geometry

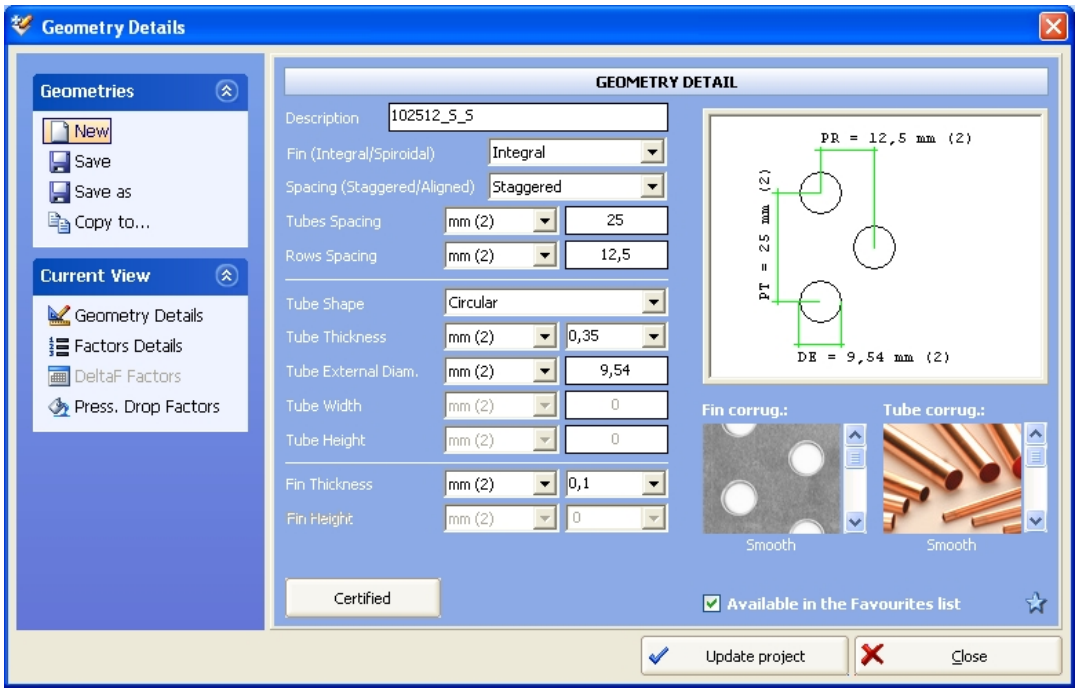
New Geometry

Let's do an example of inserting a new geometry for DX-Coil

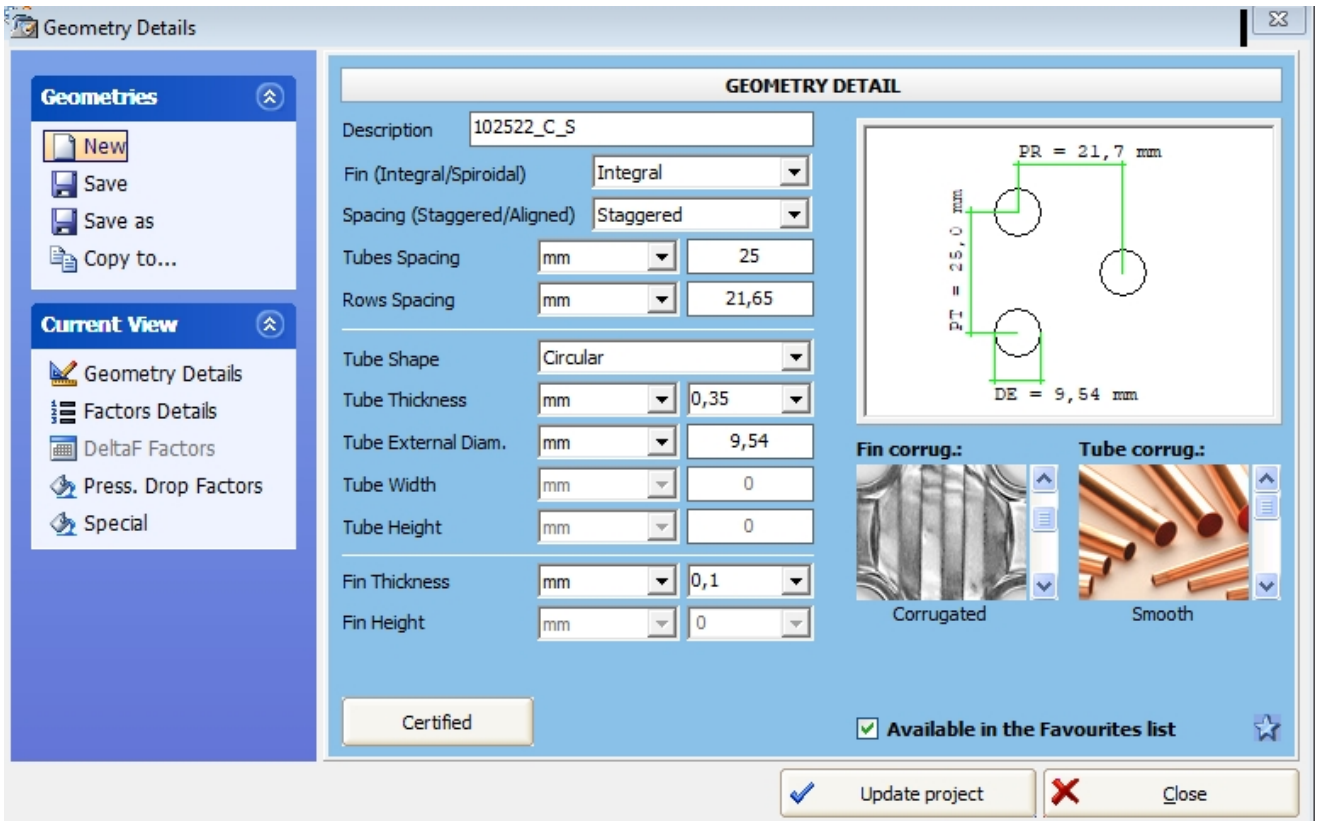
With :

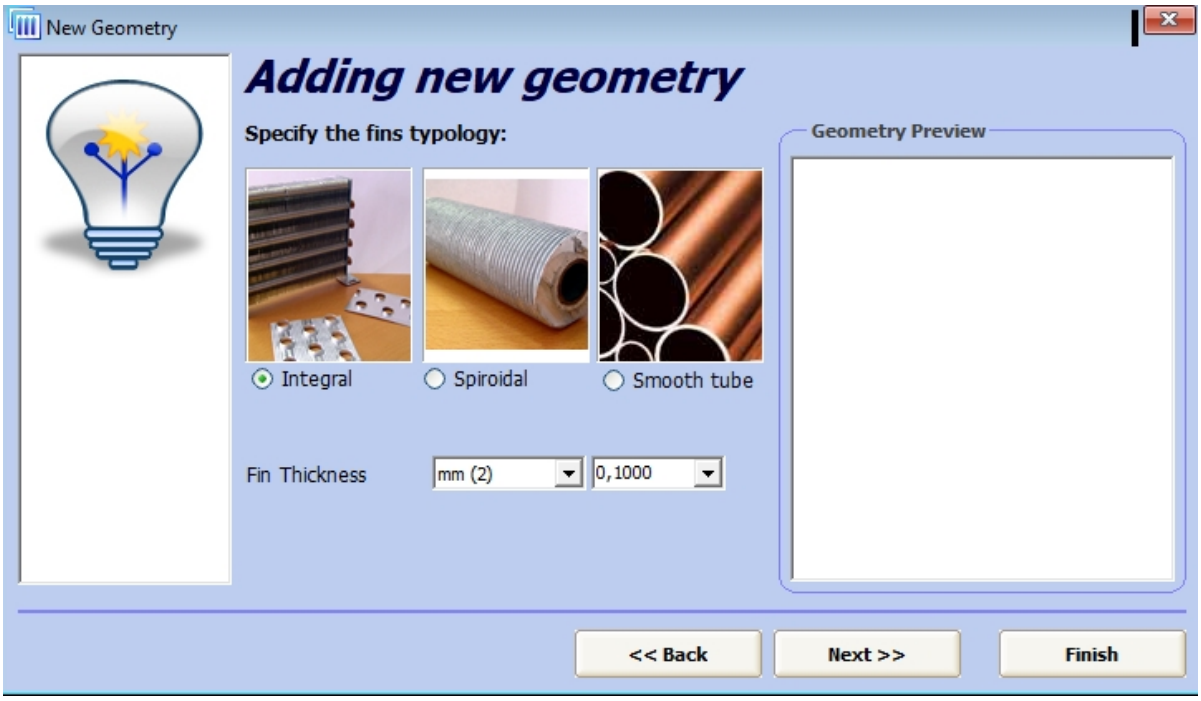
External diameter	*0.7 mm*
Tube spacing	*19.05 mm*
Rows Spacing	*16.5*

- At following screen let's click on the "New" button

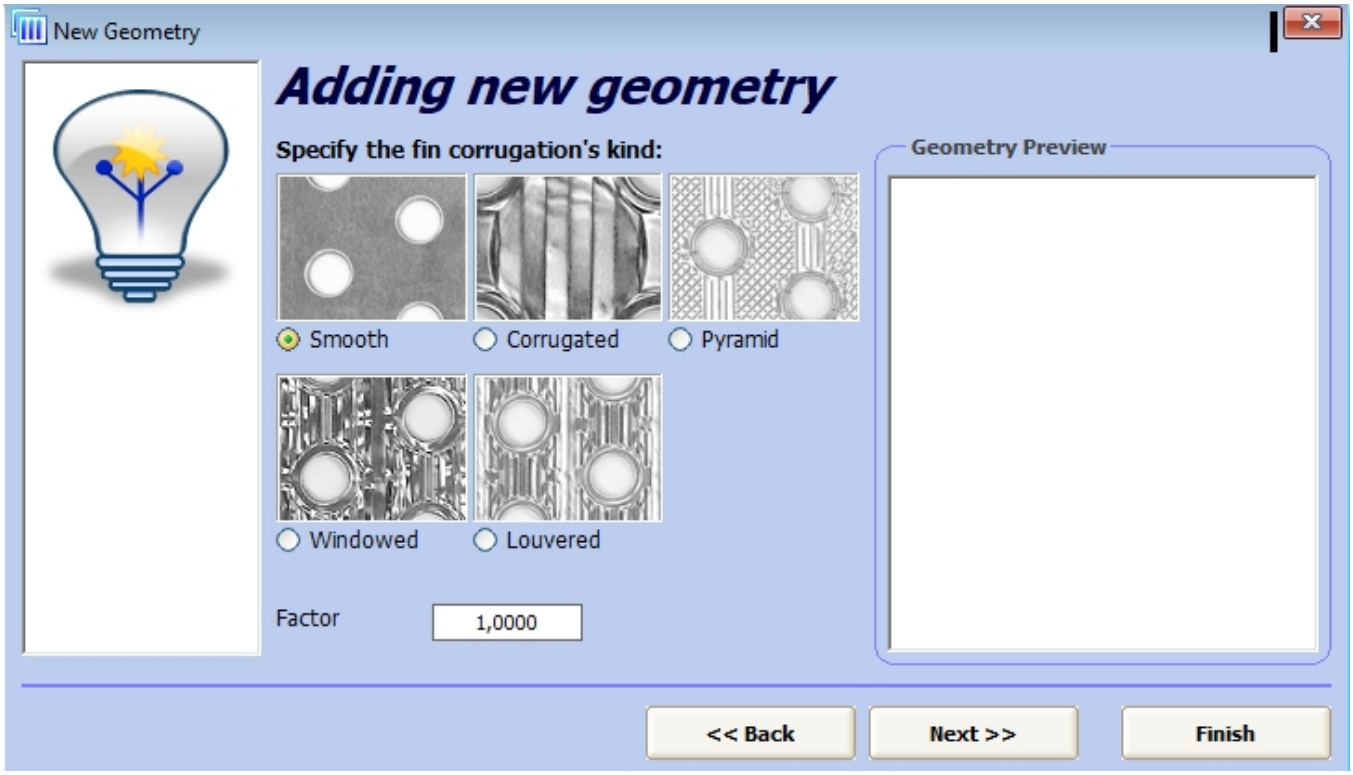


In the next screen we have two types of Coils, spiroidal and integral. We choose the integral one

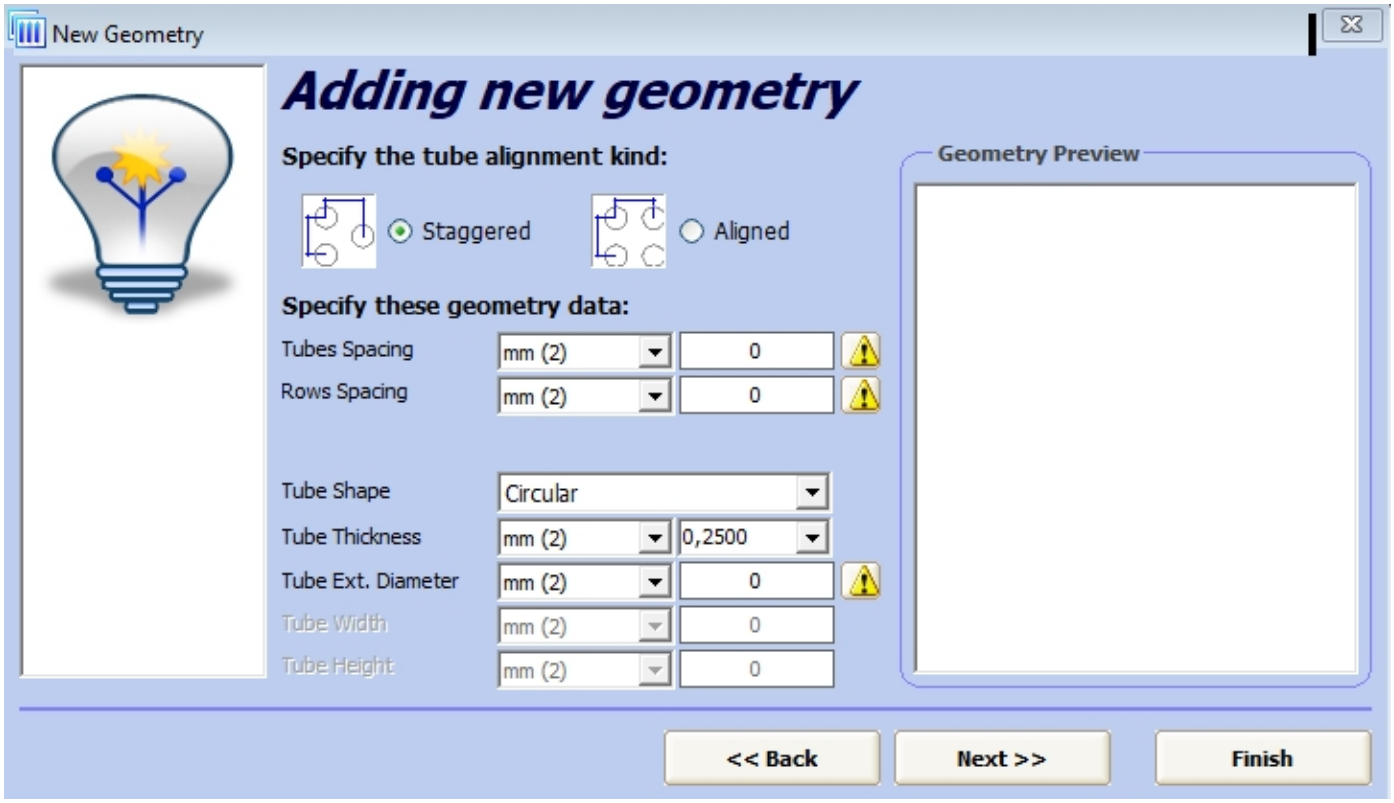




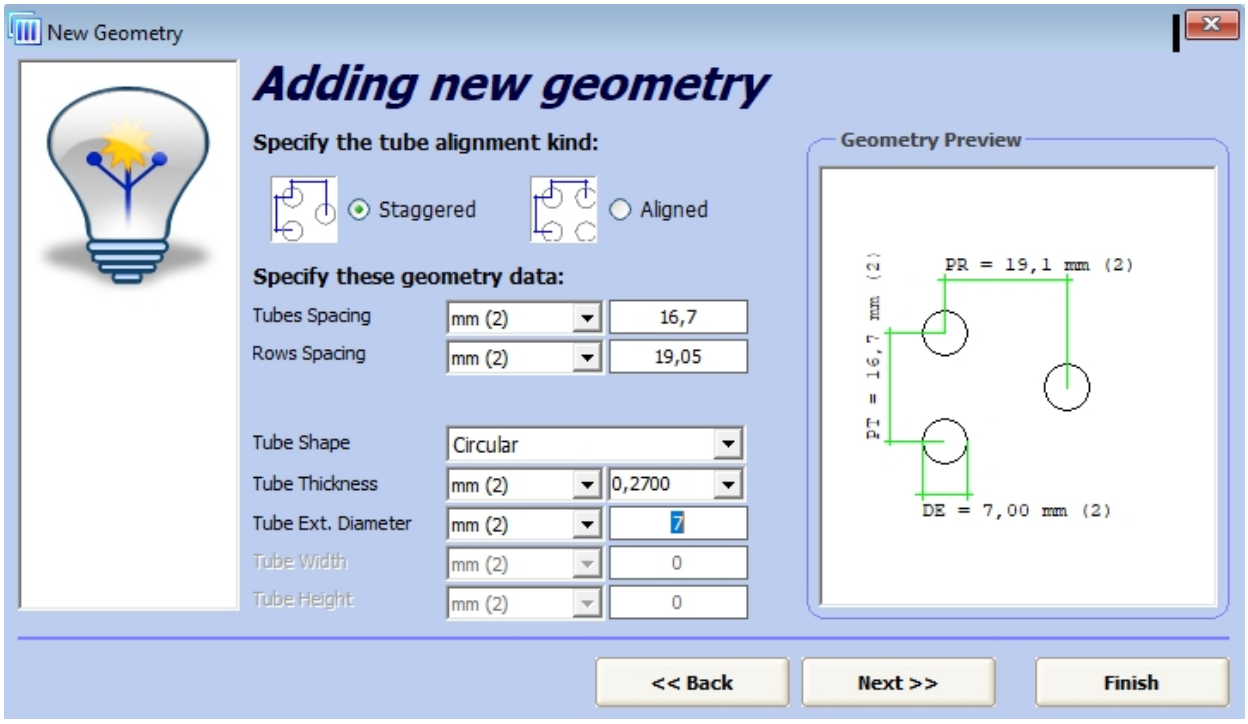
- Let's insert Fin Thickness at 0.1000
- Let's click on the "Next" button 



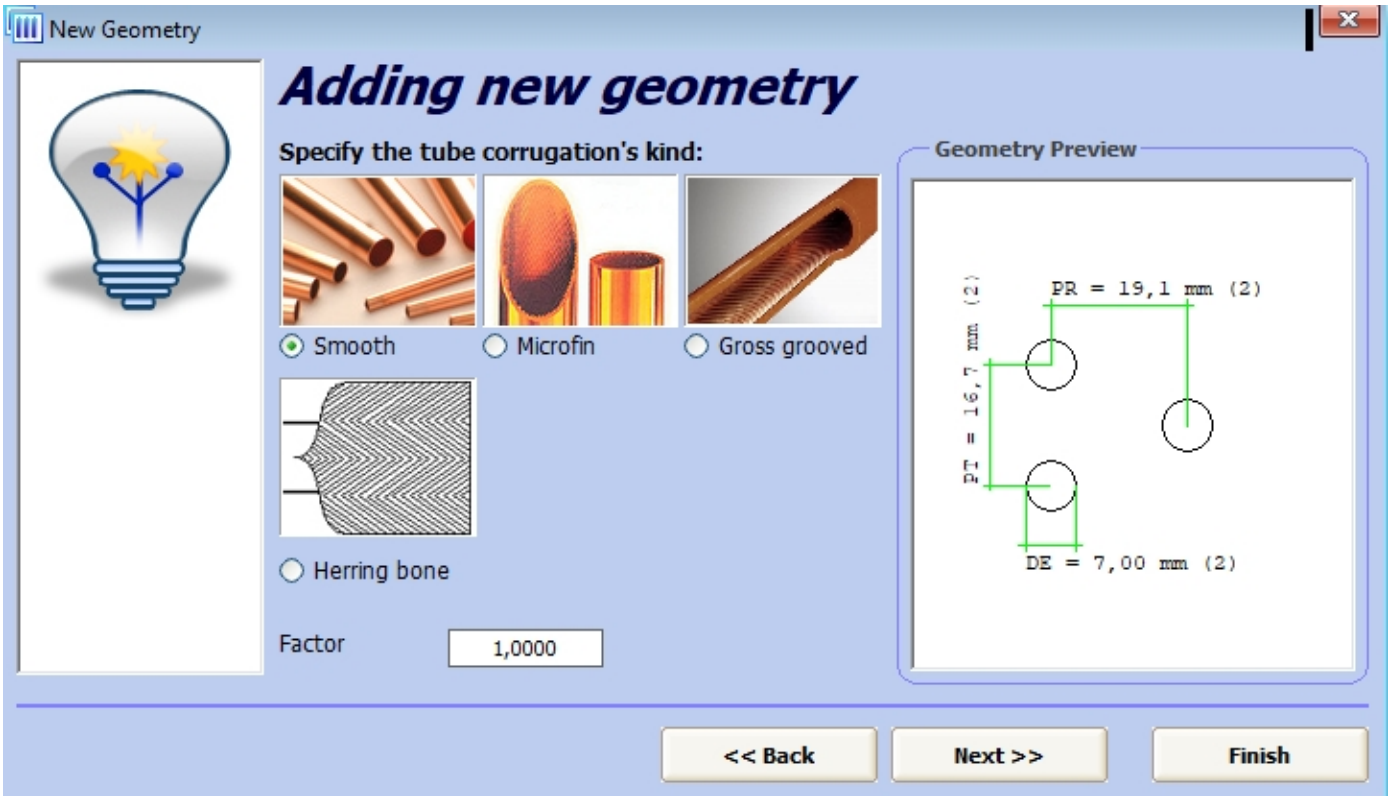
- Let's choose the fin corrugation as "Smooth" and click on the "Next" button

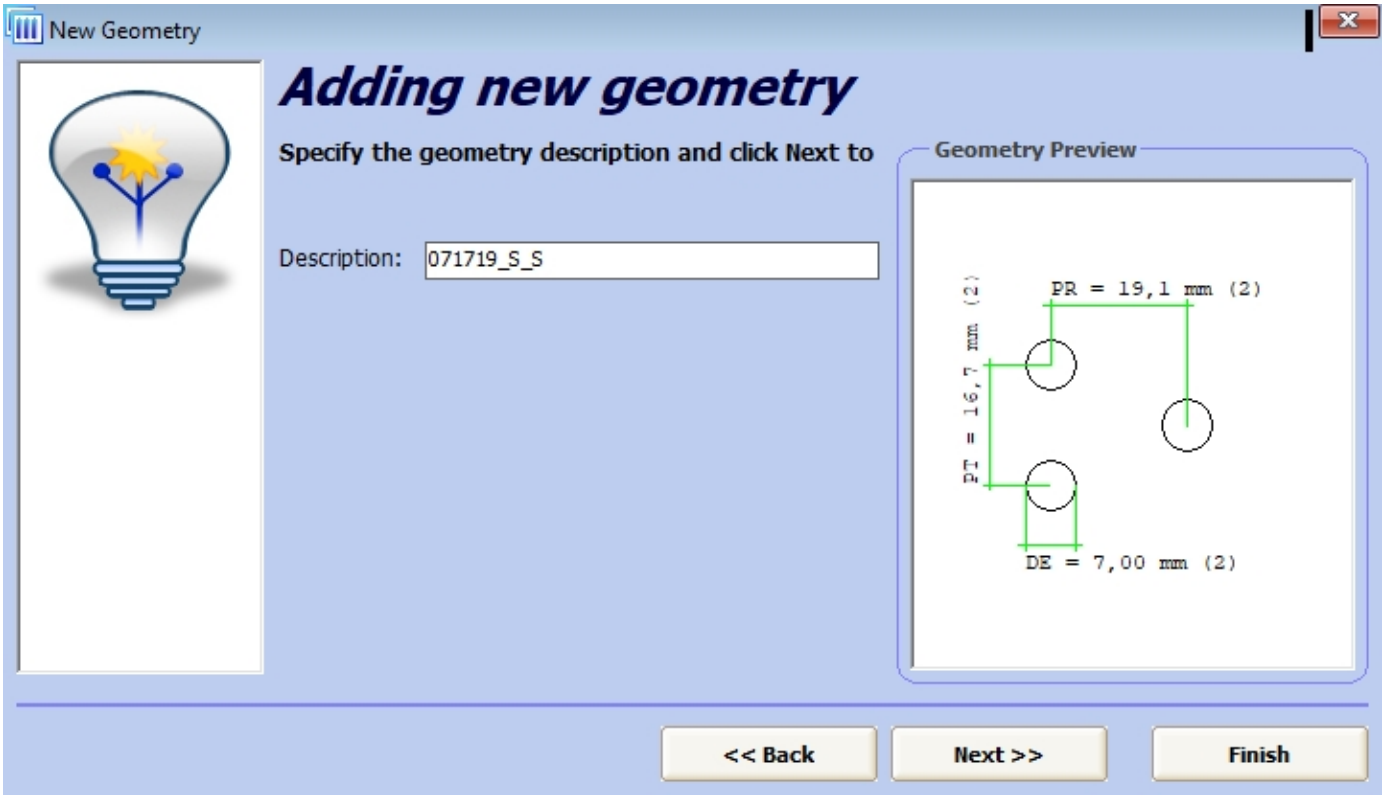


- Let's leave the tube alignment "Staggered" and click on the "Next" button after enter 7 mm as external diameter, 19,05 mm as tube thickness, 16,5 mm as rows spacing,



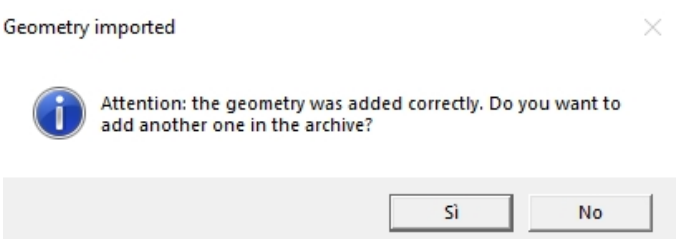
- After clicking on the "Next button", we specify the tube corrugation type at "Smooth" and then click to the "next" button again



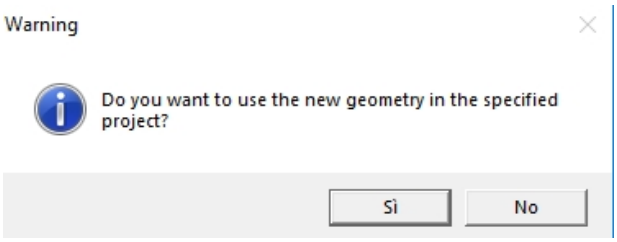


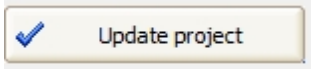
Here we can see the description name given as explained in the previous paragraph.

- Clicking “Next” button again yields the following message



- In this case, we do not want to add another geometry, so we reply "No"

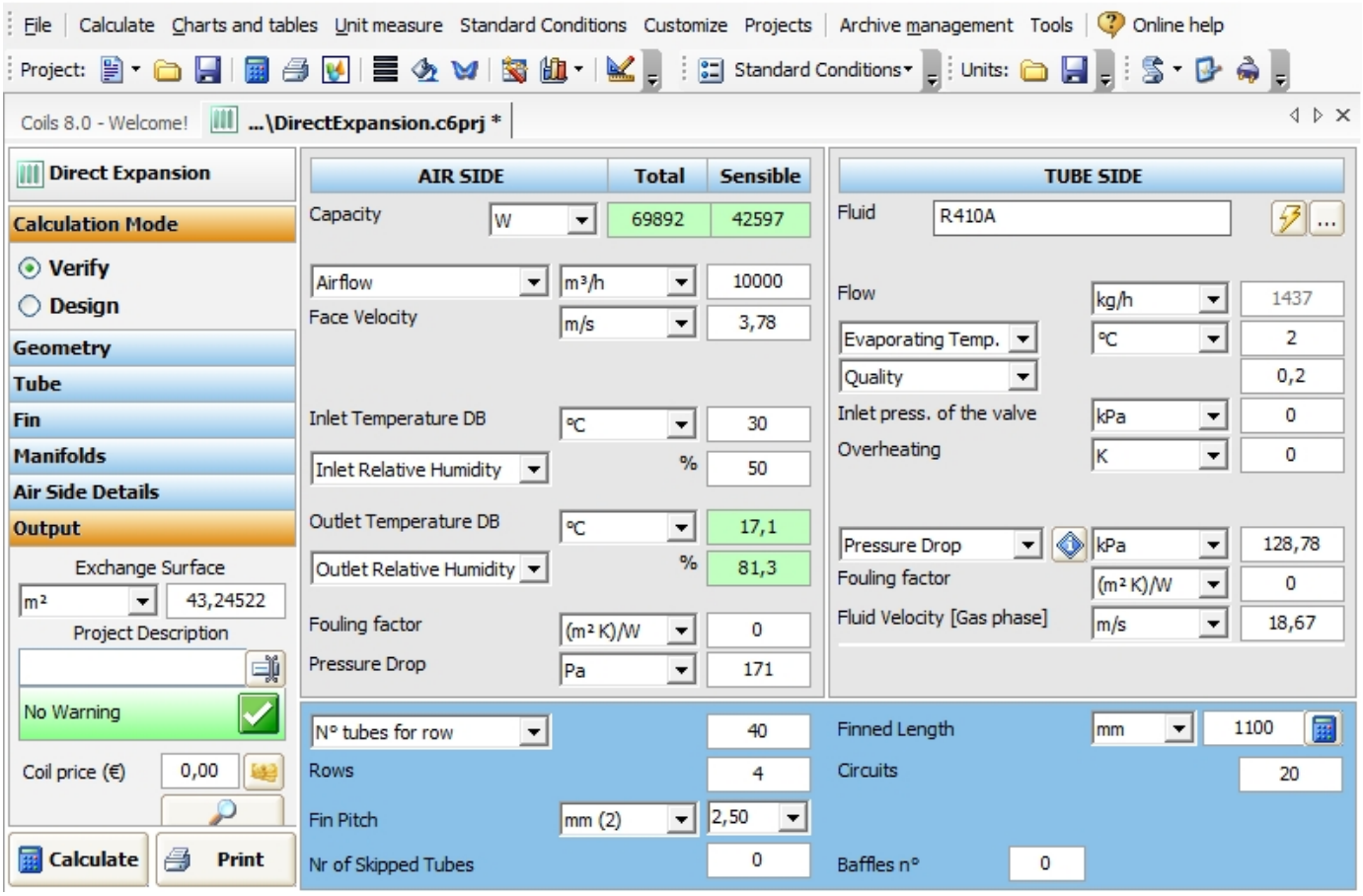


- Then we choose "Yes", click on 

and geometry will be used in this project

As we can see, we have added a new Geometry. Now we can proceed with a Calculation.

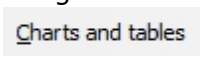
- We then hit the calculate button and get the result



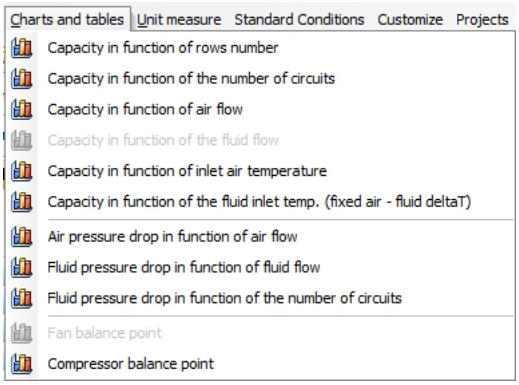
CHARTS AND TABLES

CHARTS AND TABLES

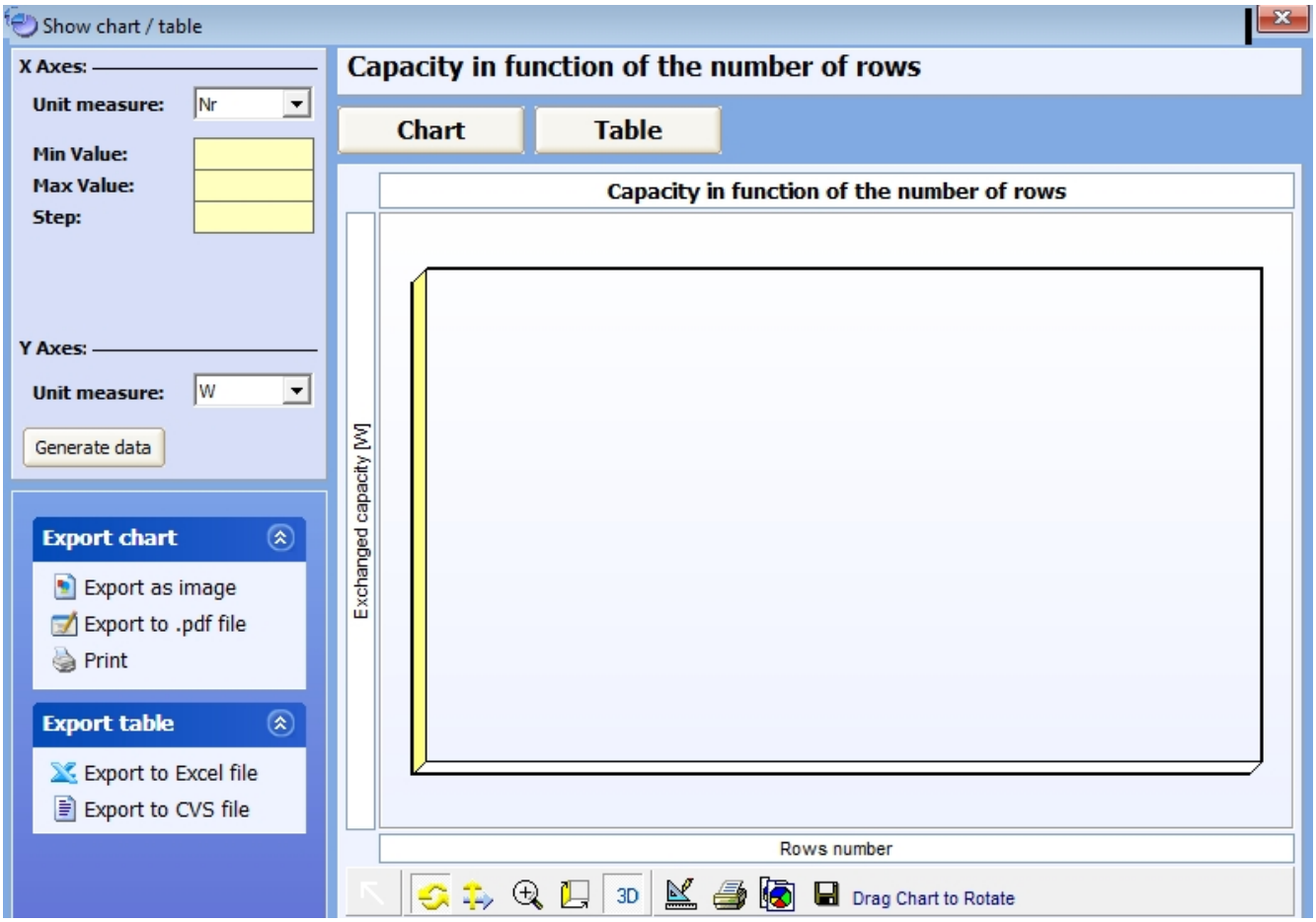
In this part, we will describe the part regarding charts and tables with examples.

- Let's Click on "Charts and Tables" menu 

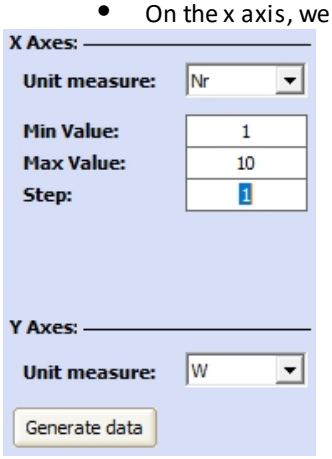
on the menu bar
- Let's click on "Capacity in function of rows number"

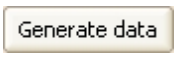


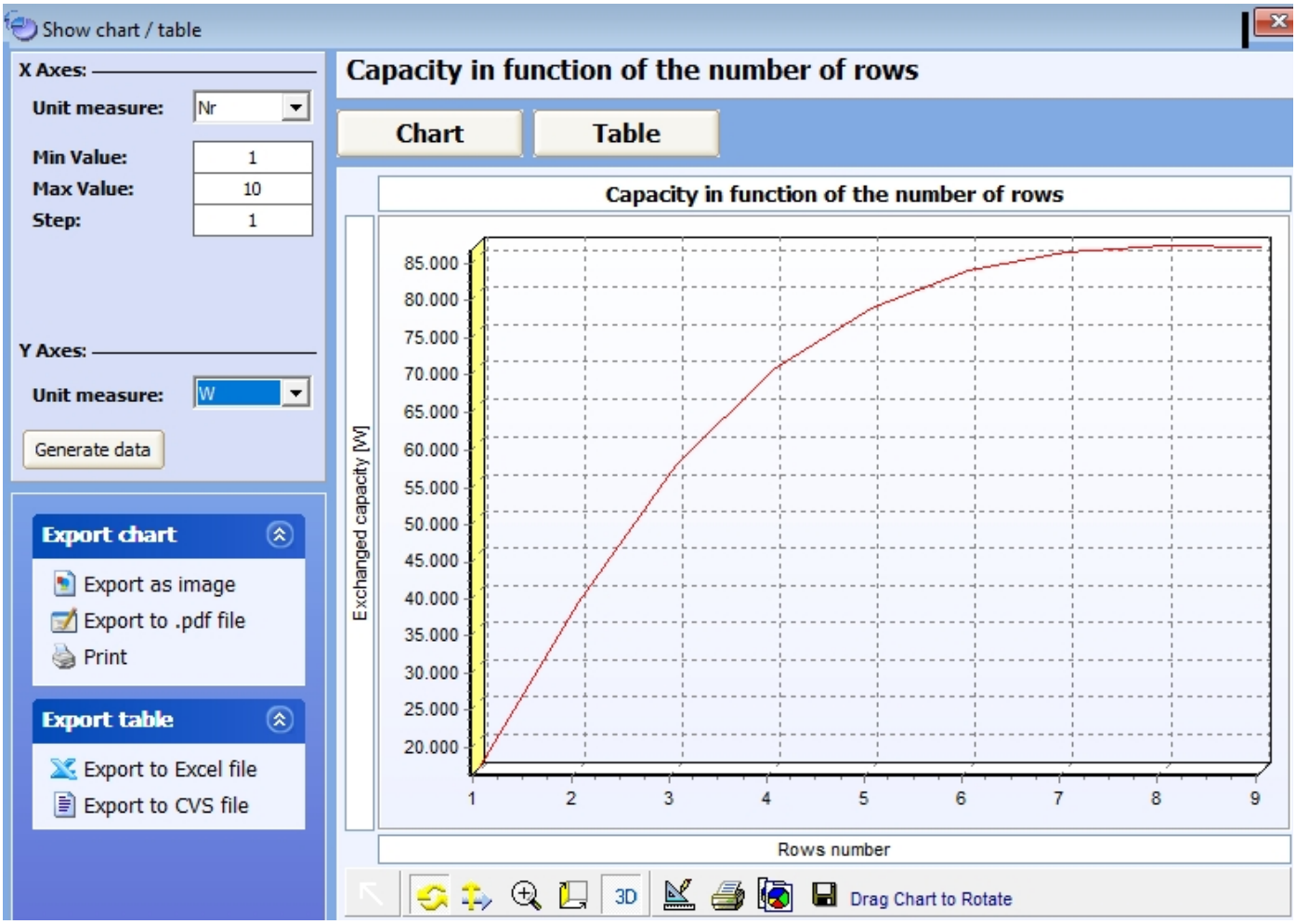
- A chart page opens

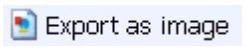
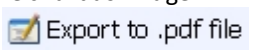
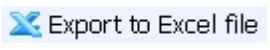
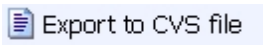


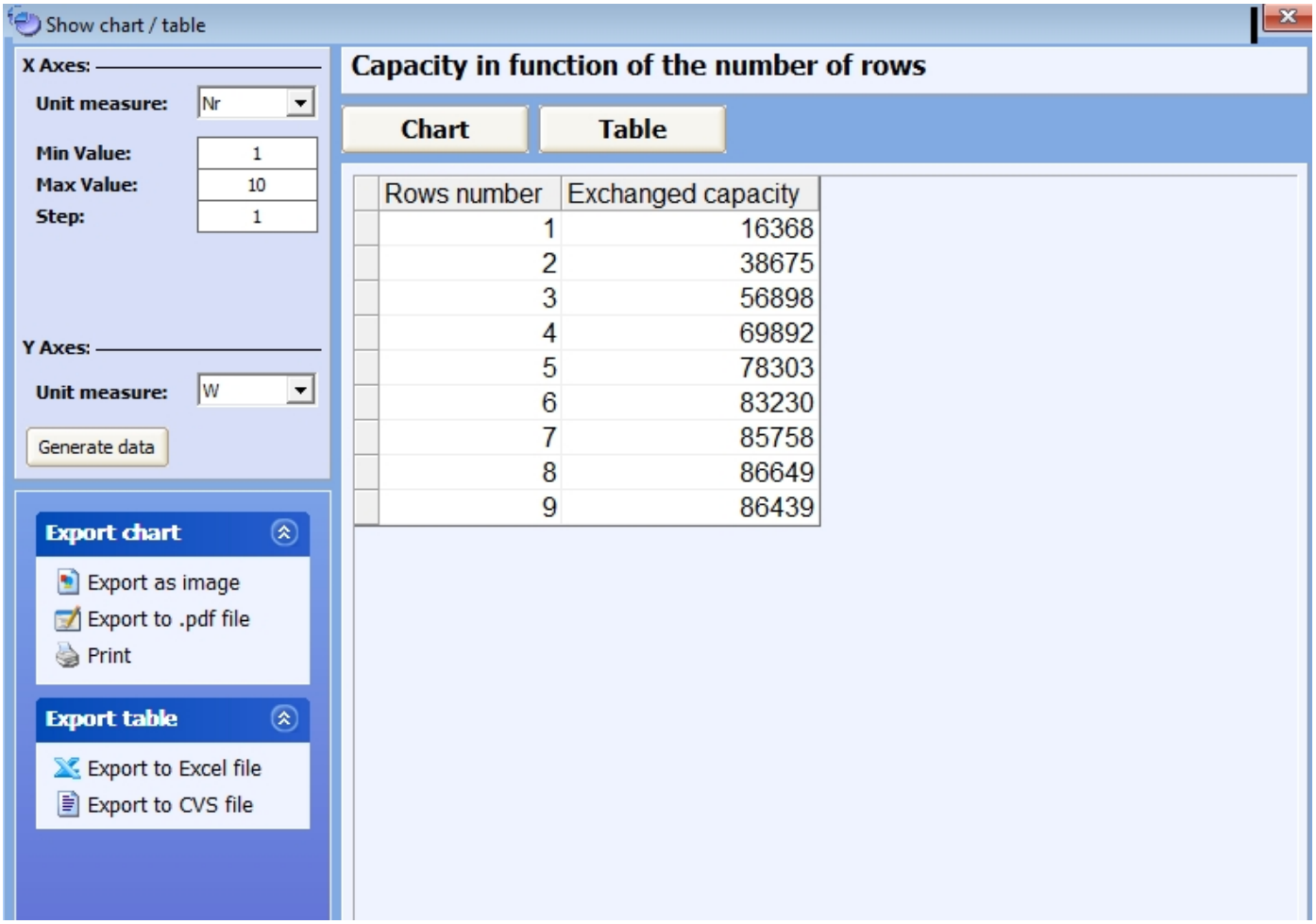
- On the x axis, we can set the number of Rows. In this example, we put the Min value 1, Max Value 10 and Step: 1



- Then we hit the "Generate data" button 



- From the above image we see, that it's possible to:
  - Export and Save the chart as Image 
  - Export to .pdf file 
  - Print the chart 
  - Export the table to file excel  or to cvs file 
- Let's click on the "Table" button 



- To view another graph. Click on ” Charts and Tables”.

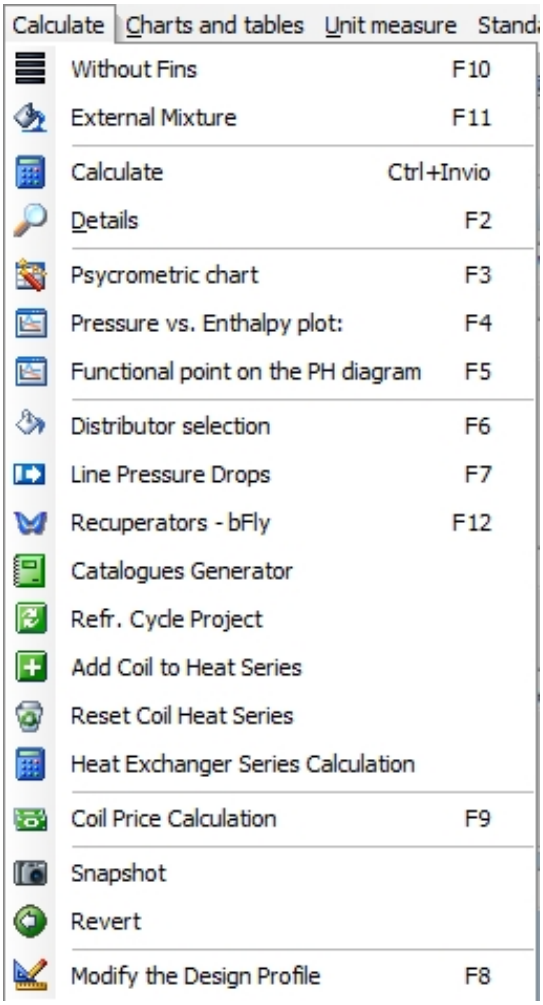
We can follow the same procedures as above to get the other Graphs. The graphs balance point will be examined in a separate section.

CALCULATE MENU

MENU “CALCULATE”

Let’s examine the Calculate Menu.

- Let’s click on the “Calculate” Menu

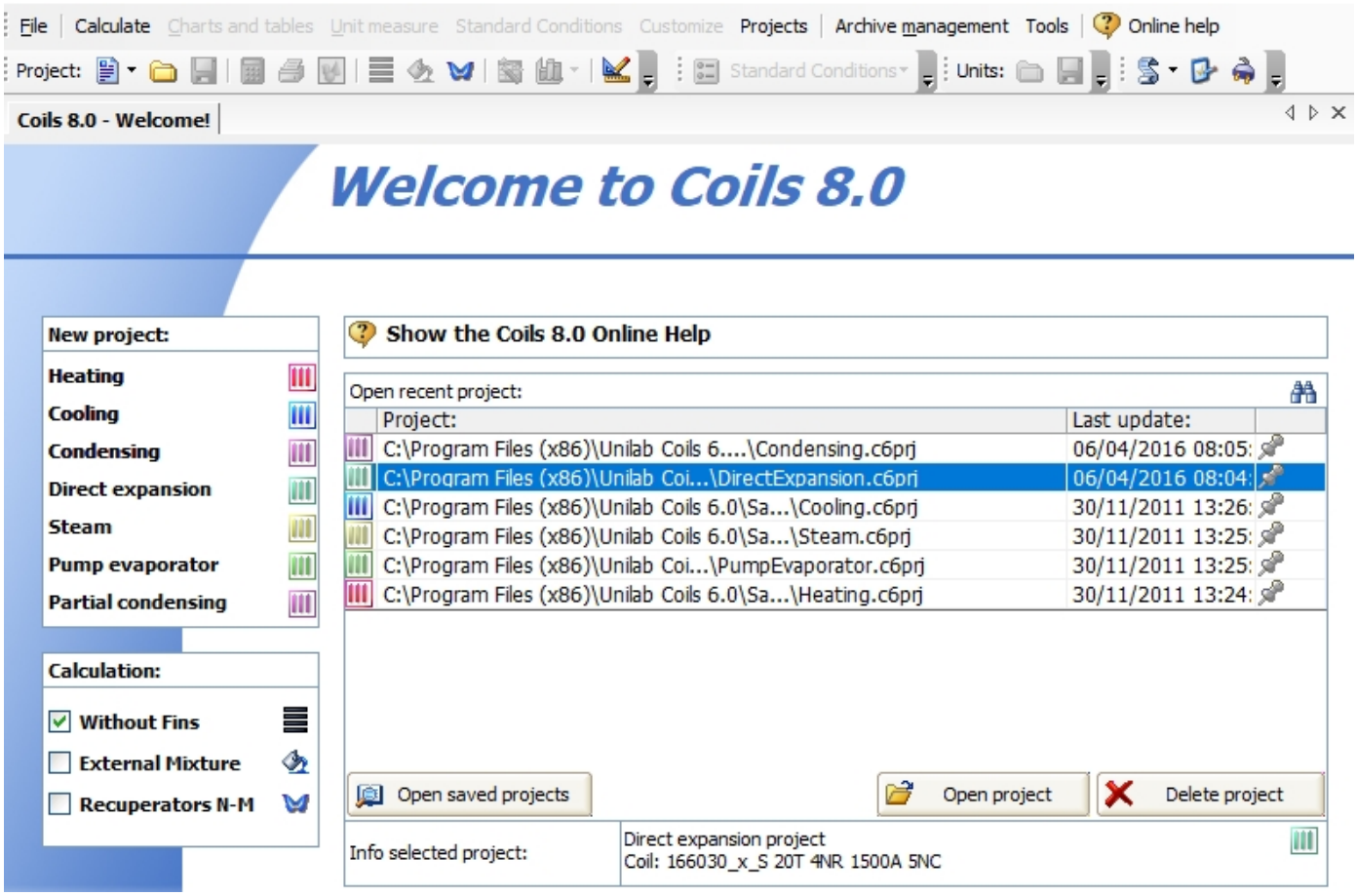

Calculate
Charts and tables
Unit measure
Stand
Without Fins F10
External Mixture F11
Calculate Ctrl+Invio
Details F2
Psycrometric chart F3
Pressure vs. Enthalpy plot: F4
Functional point on the PH diagram F5
Distributor selection F6
Line Pressure Drops F7
Recuperators - bFly F12
Catalogues Generator
Refr. Cycle Project
Add Coil to Heat Series
Reset Coil Heat Series
Heat Exchanger Series Calculation
Coil Price Calculation F9
Snapshot
Revert
Modify the Design Profile F8

Without Fins

Without Fins

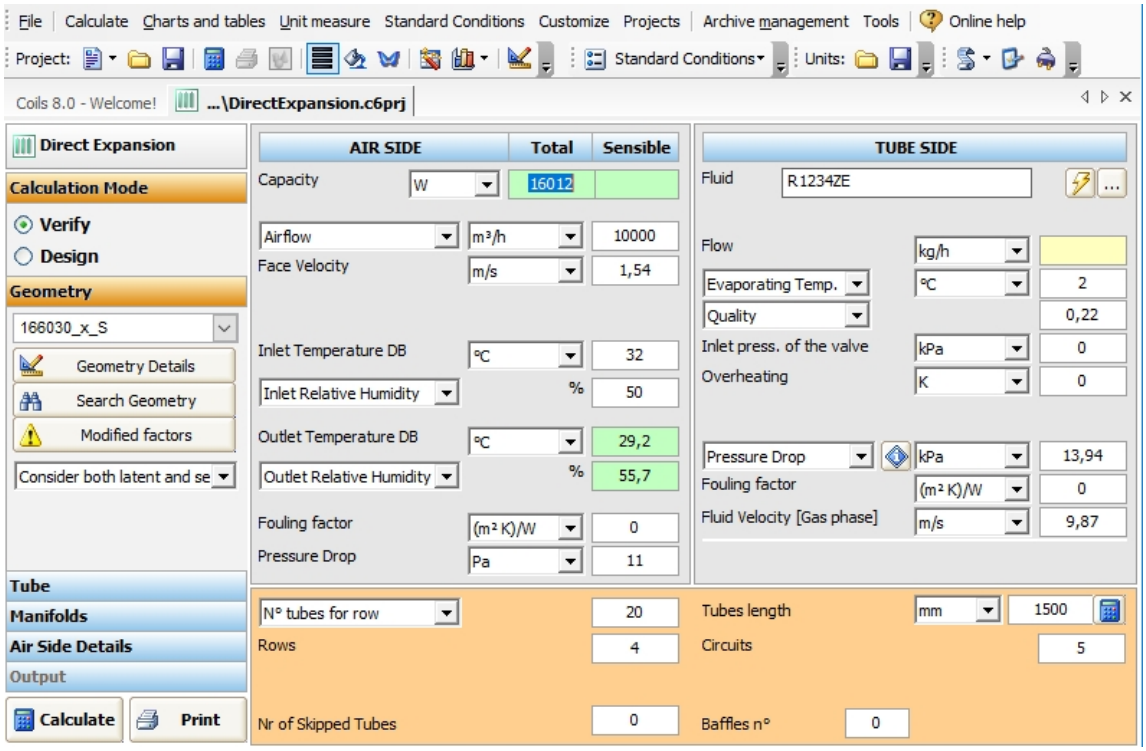
We have added (only in the Enterprise Edition) a possibility to calculate coils without fins, available in all the calculation modalities. The applications of this typology of coils are a lot, both on low and high temperatures (recuperator gas-gas both mono and multi crossing, painting rooms, coils for fluids with considerable filth, or with transportation of dust and strips of paper, fabric, etc.). With this system you can simulate the shell and tubes with non circular plate, but rather rectangular or quadrangular.

when we click on the without fins option, we start the calculation of such fins.

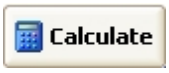


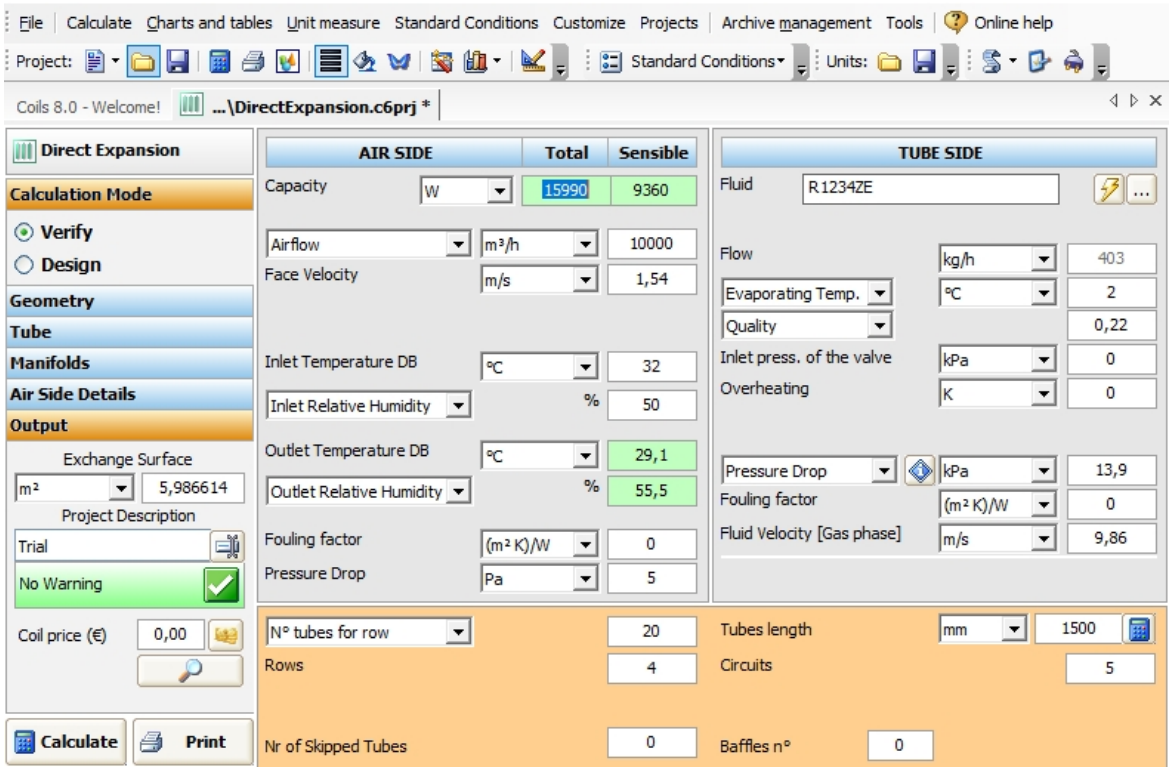
We can open new project by clicking on the left part like Heating, Cooling, Condensing, Direct expansion, Steam, Pump Evaporator and Partial condensing.

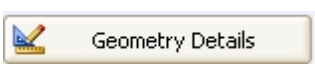
Let's open an example of heating calculation.

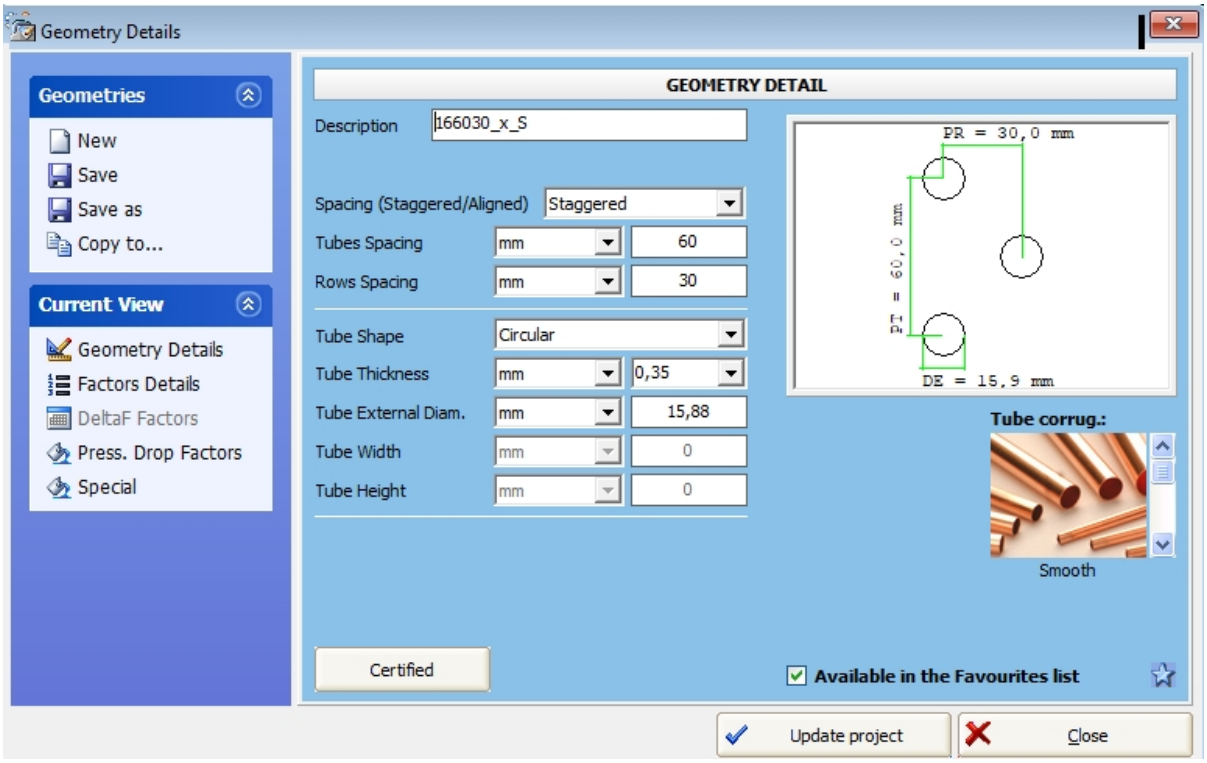


We can see, that in the bottom part of the calculation form we do not mention the fin, because the tube is smooth or bare

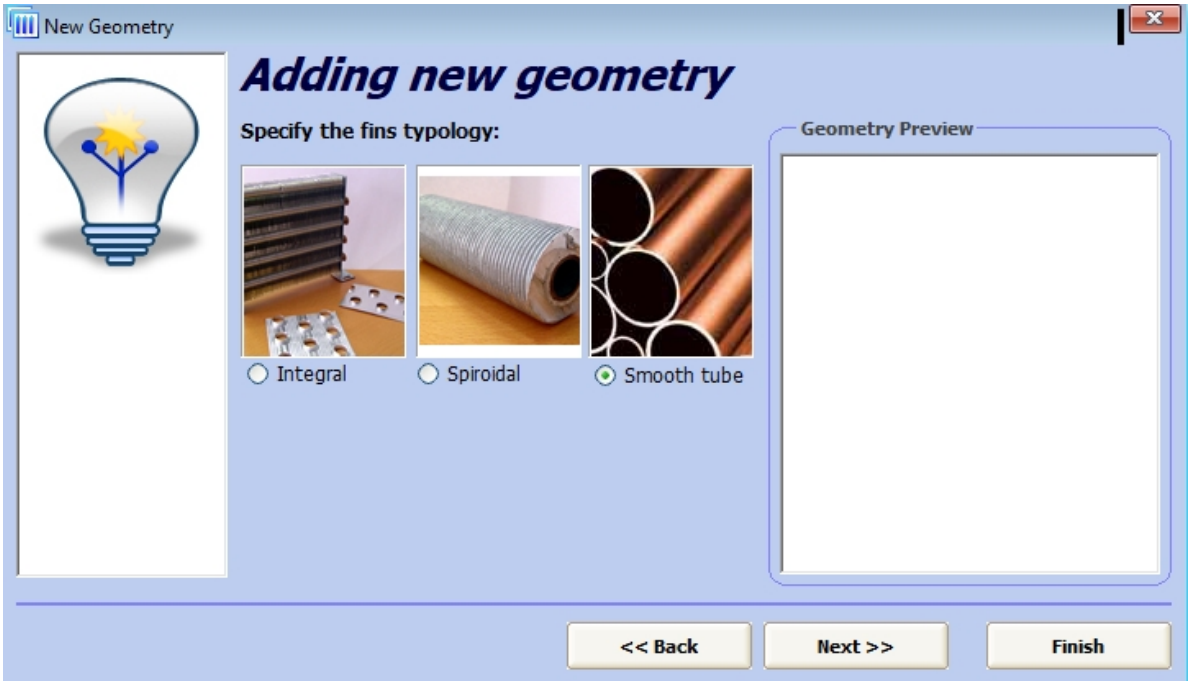
After the input of data, we can click on the “Calculate” button 



If we click on the geometry details 



We click on “New” 



We can see the smooth tube.

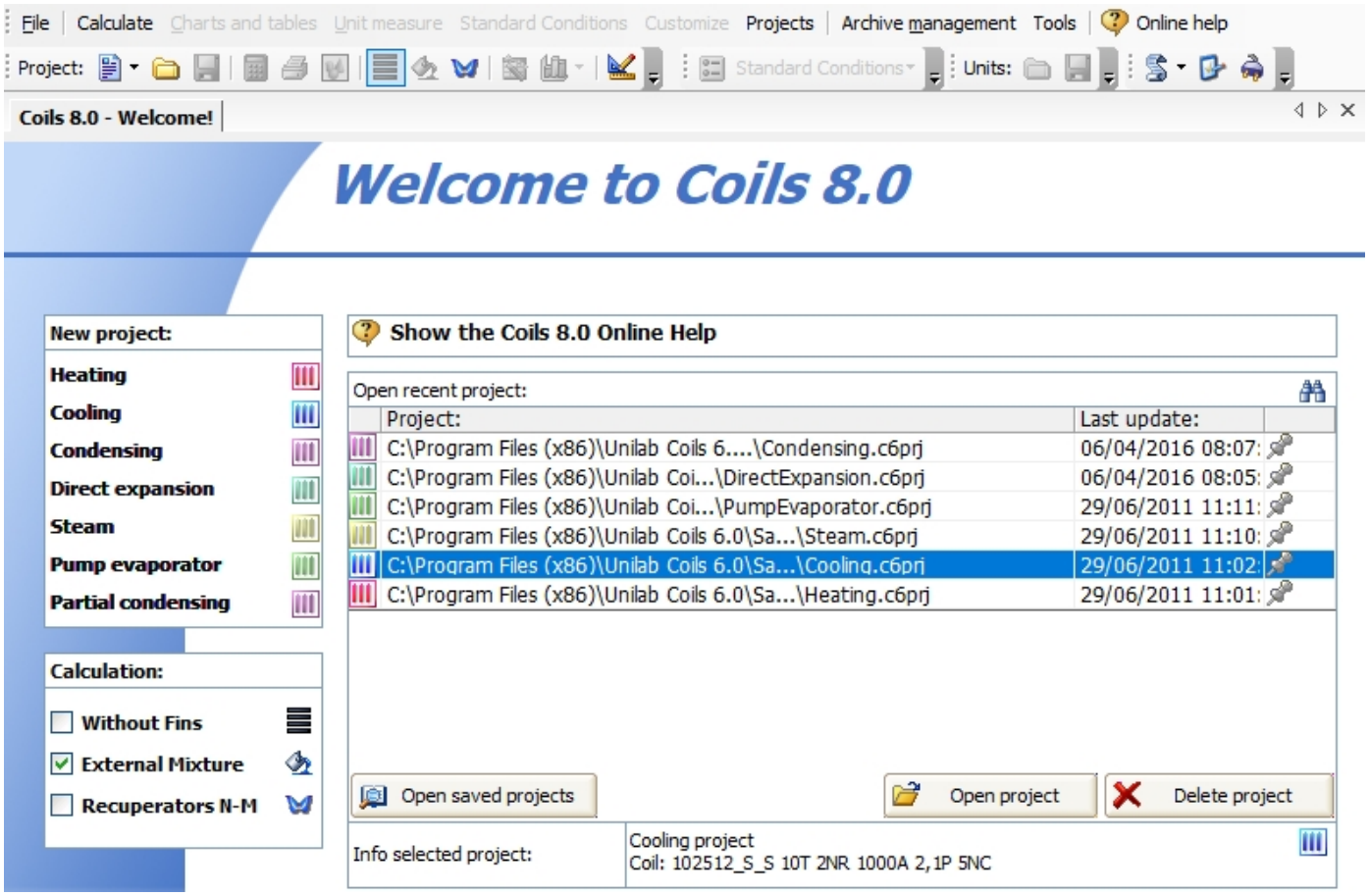
External Mixture

External Mixture

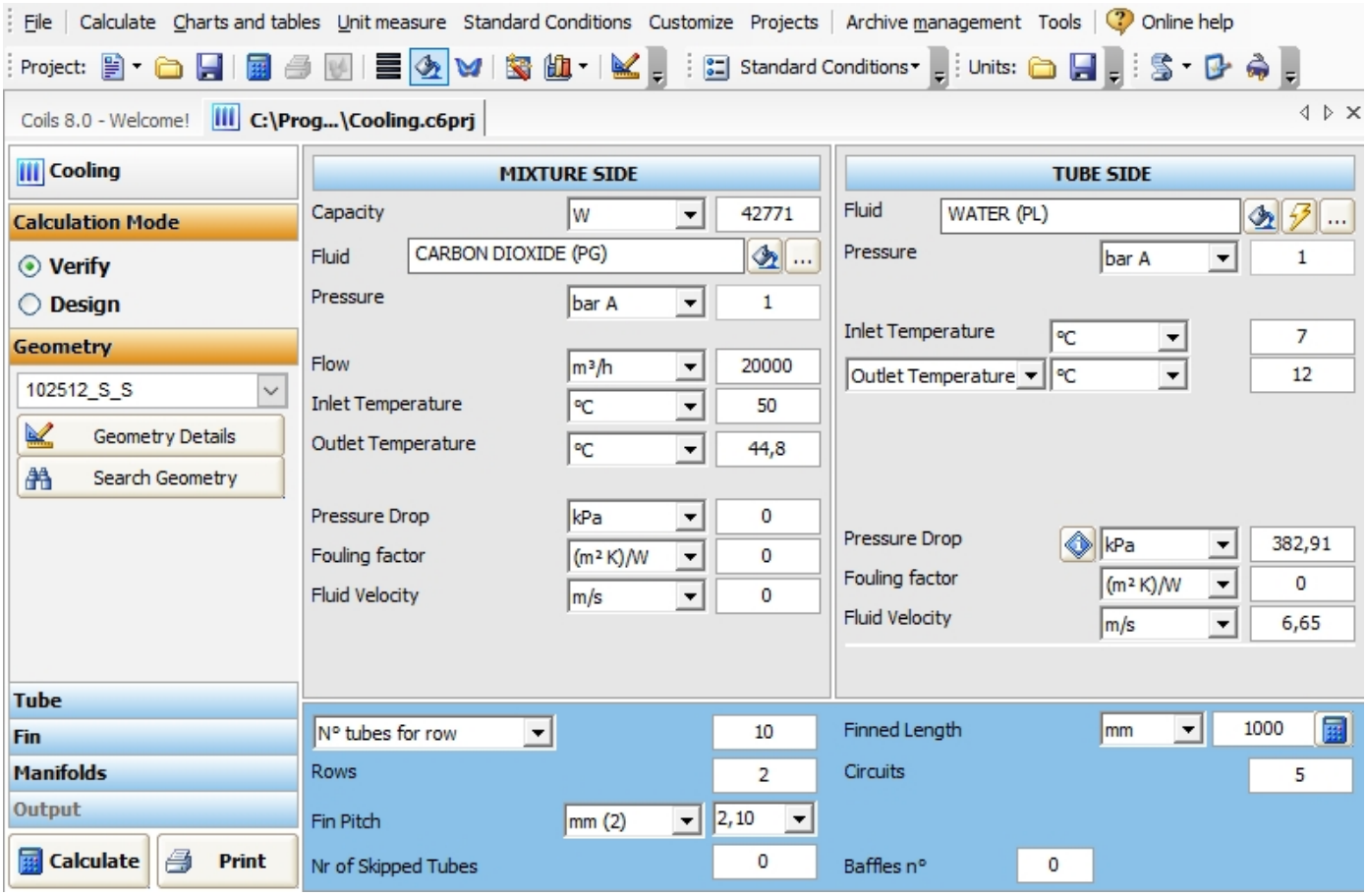
We have added (only in Enterprise edition) in all the modalities the possibility of choosing on the external tubes side whichever fluid either in gaseous phase or in liquid phase, both pure and mixture. The only actual limitation is, that in this case the calculation is performed only without the condensation of some condensing fluid, so only

the calculation of the sensible capacity will be given. Also in this case, the applications are many, if we were to think only at the possibility to analyzing the combustion gas, or the coils immersed in water tubs, or inside shell and tubes, etc…

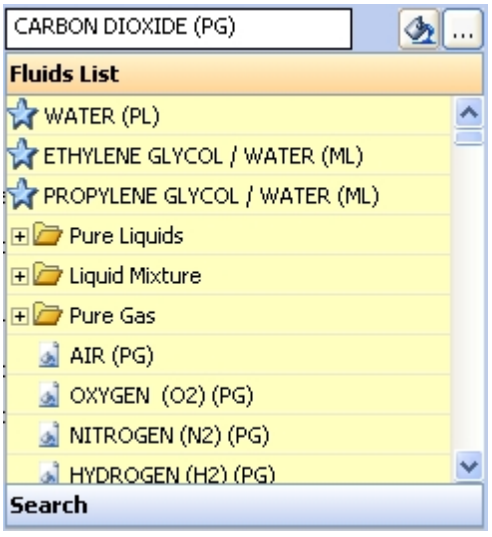
From the main form of Coils, if we click on external mixture



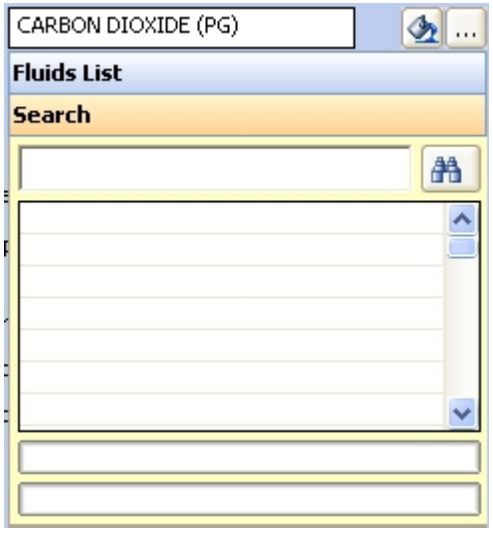
We obtain



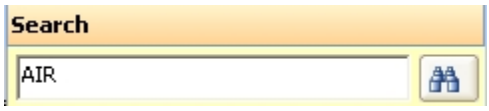
Where we can see that on the mixture side we can choose our fluid by clicking on the ... , next to the "Fluid" field:



The fluids list, where we can click on the Search voice and get

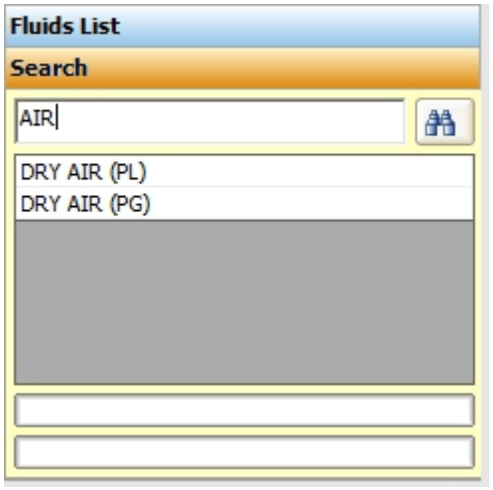


For example, let's search the fluid "AIR" . we input "AIR" in the search box

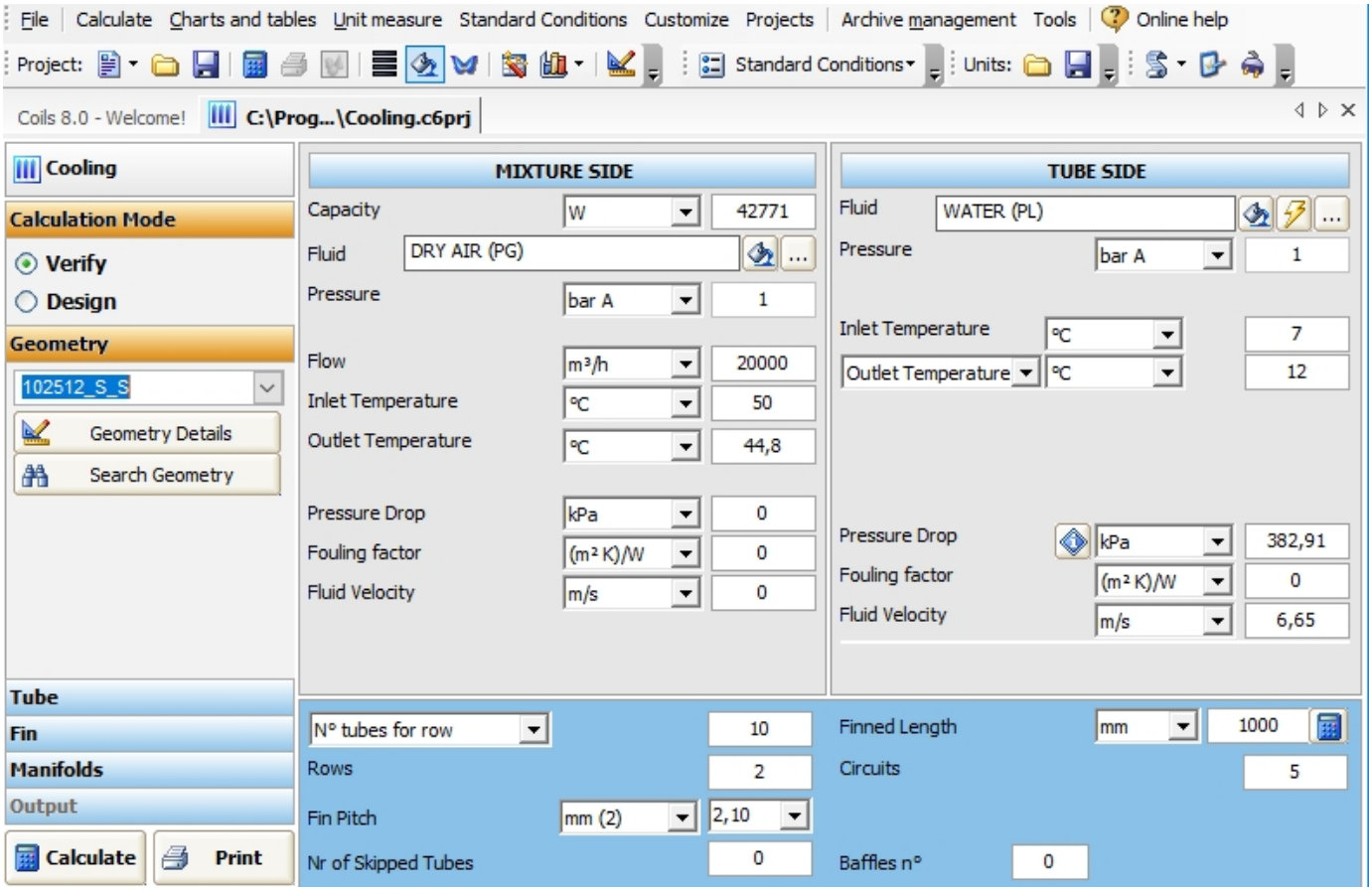


We click on the search button 

We have found our fluid



To select the fluid we click on "DRY AIR (PG)"



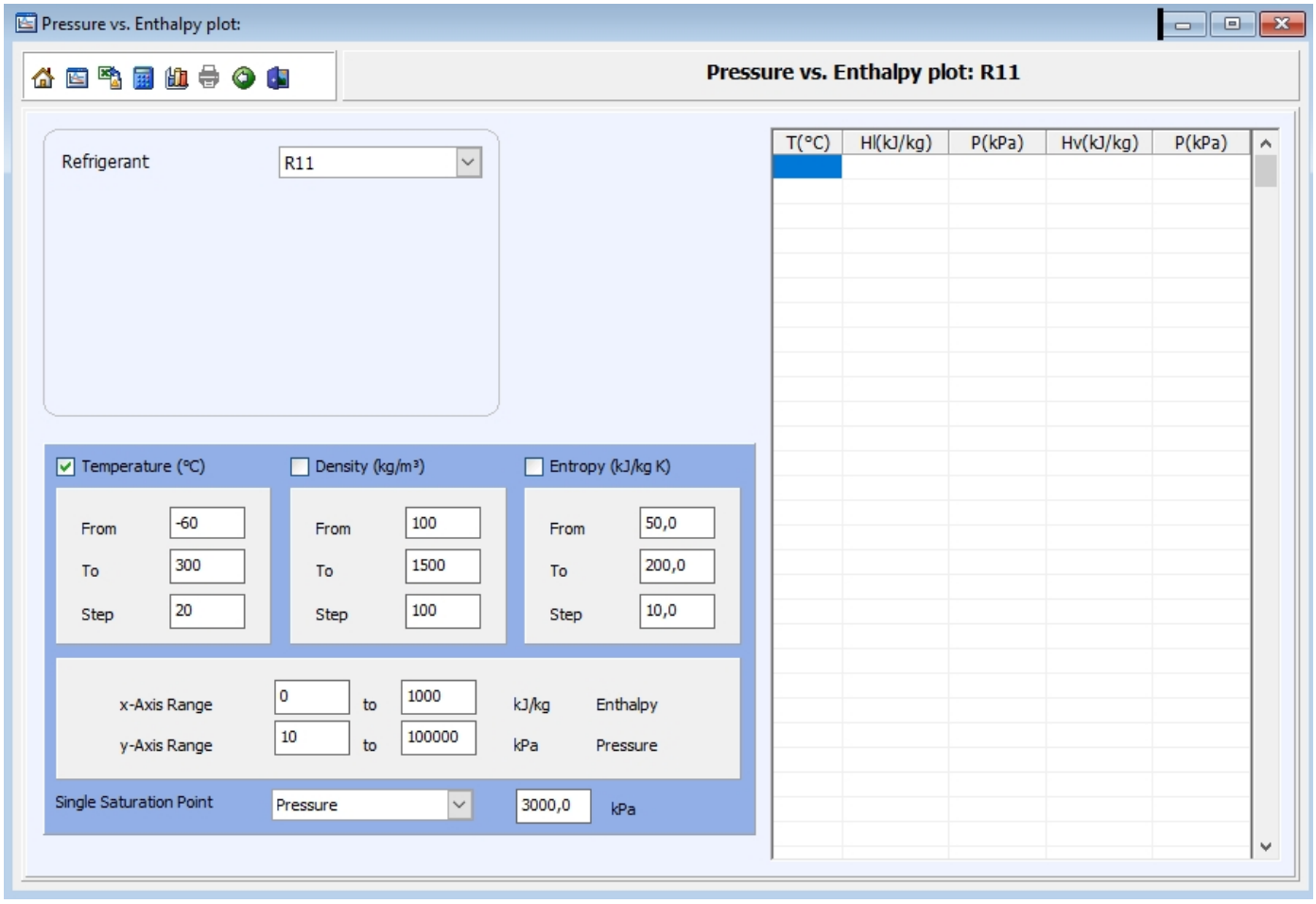
Then we can perform our calculation and proceed to the printouts.

Pressure vs. Enthalpy plot

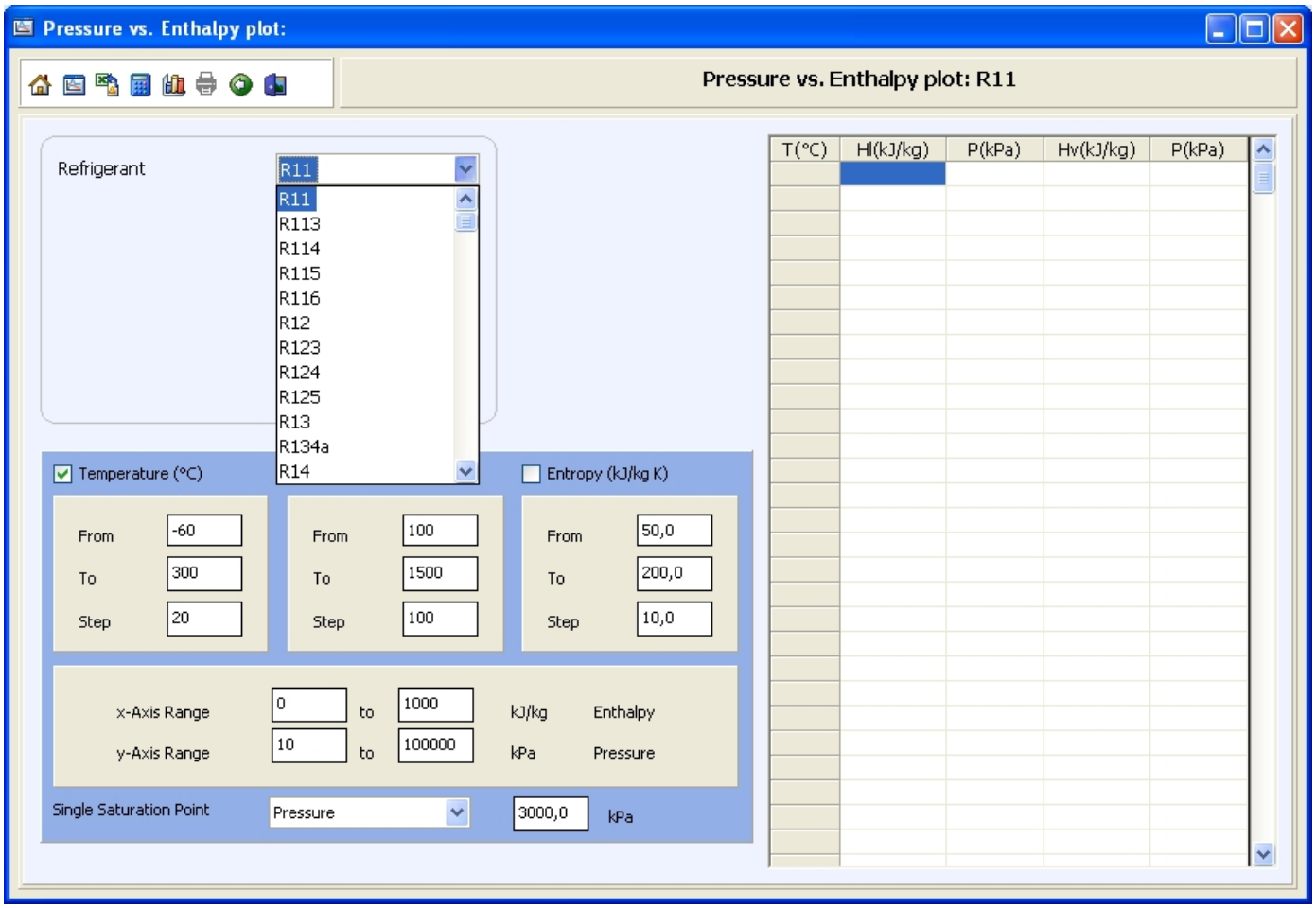
Pressure vs. Enthalpy plot

When we click the “Pressure vs. Enthalpy” voice 

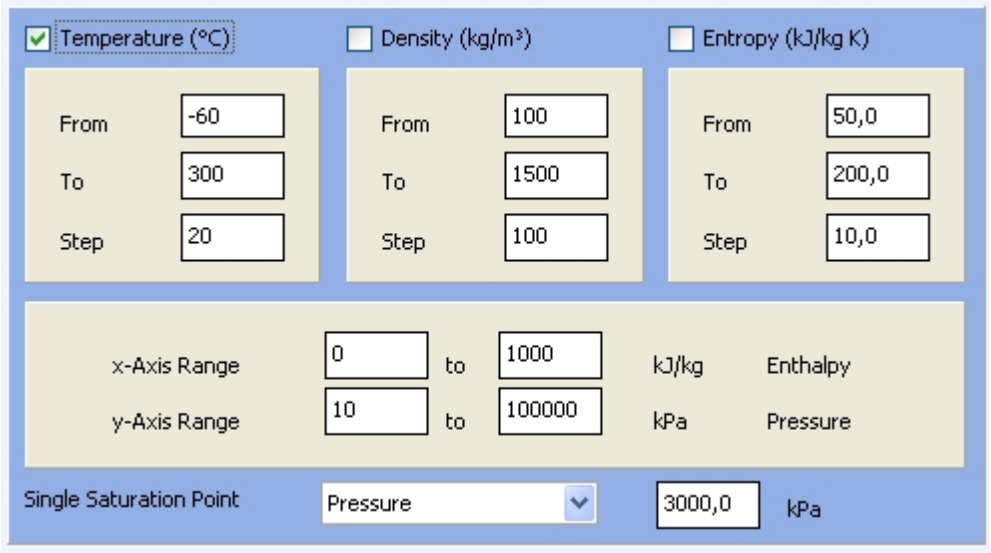
we get



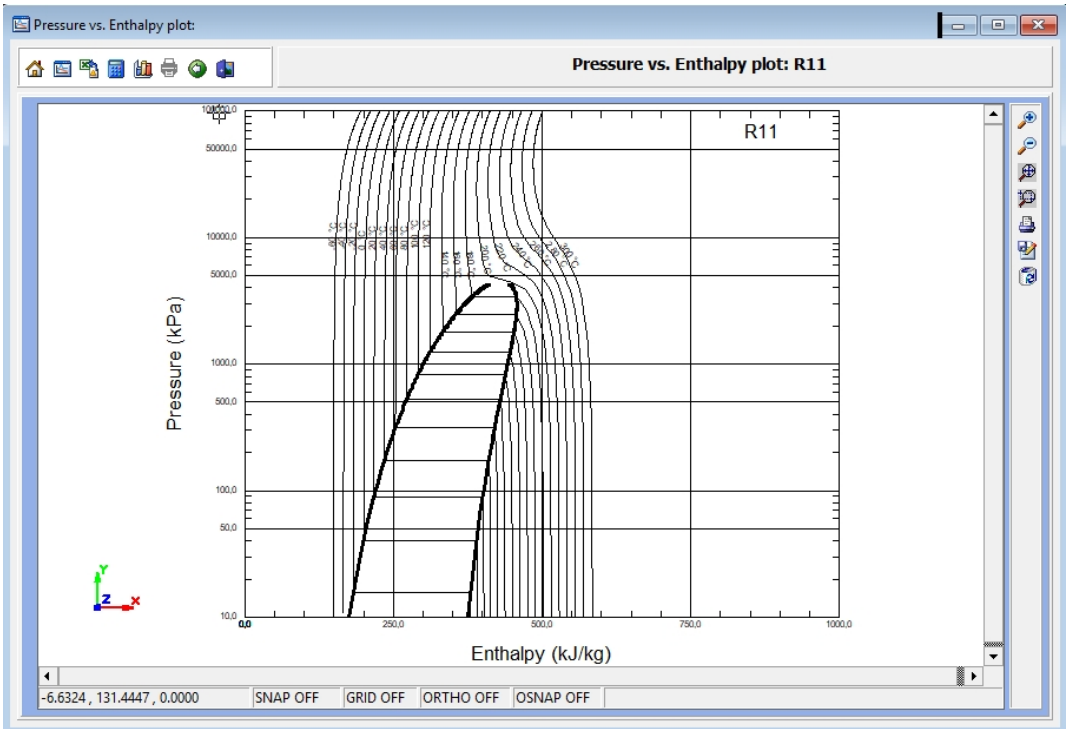
We can choose the refrigerant of which we want to build the chart



We can set and modify the chart data



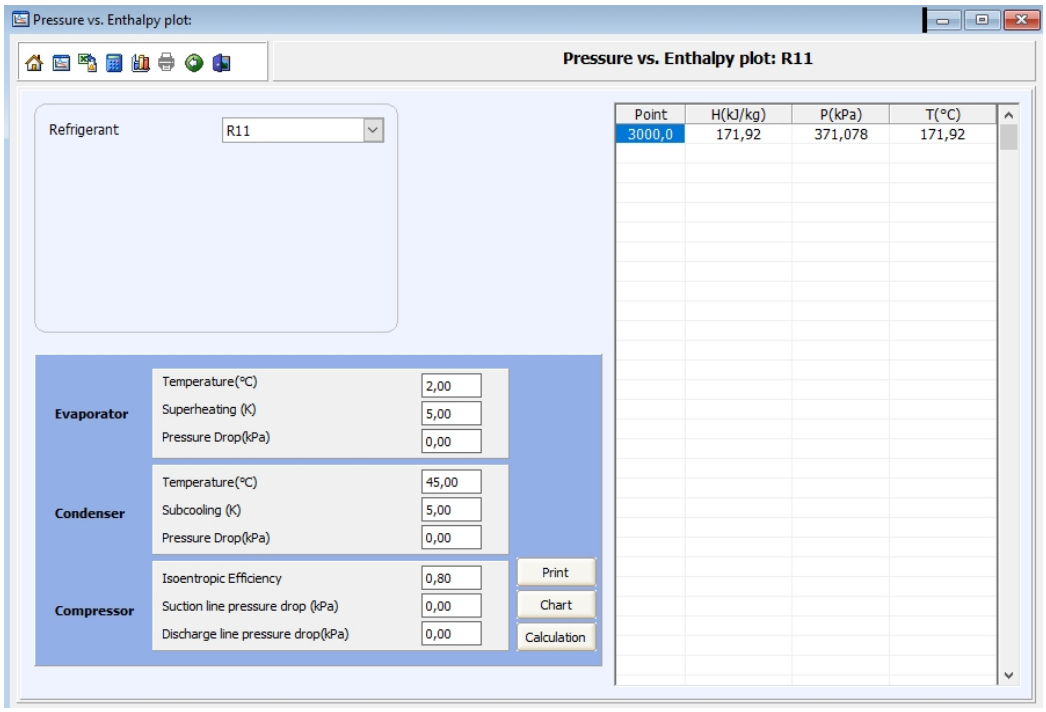
To start the chart we click on the  button



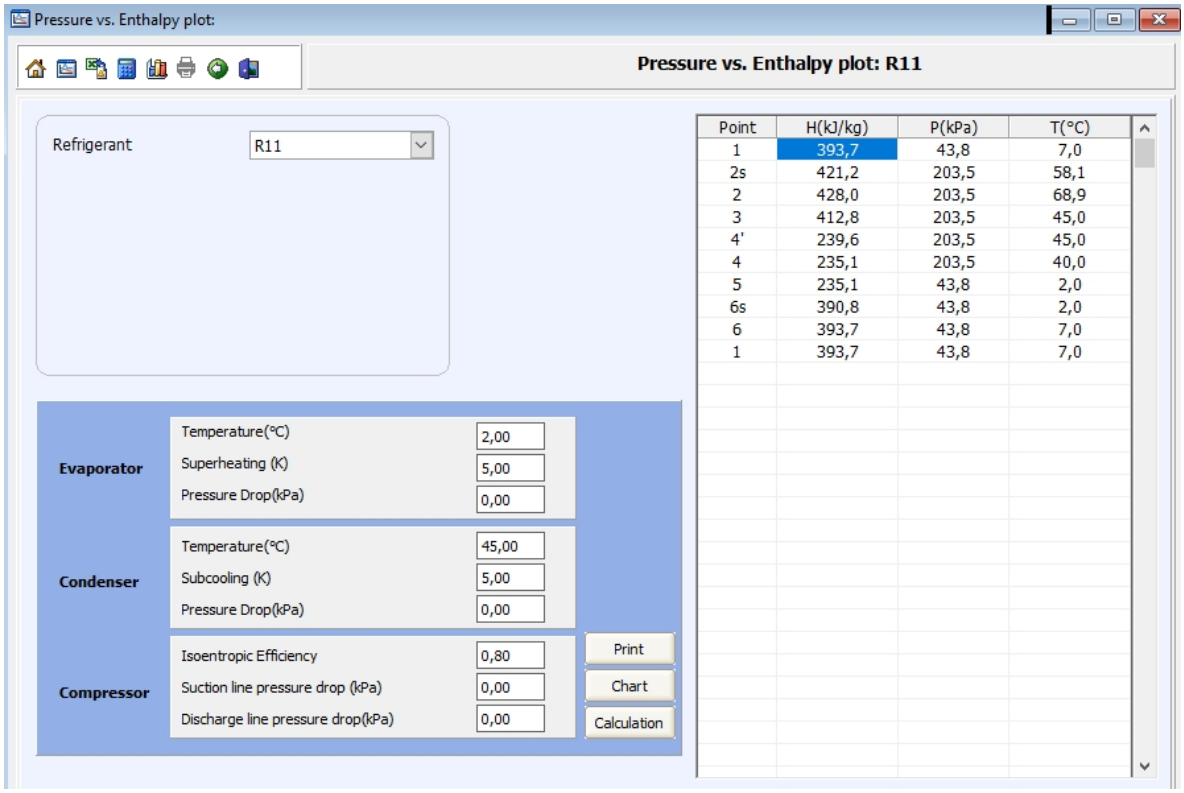
By clicking  button, we can export the graph into an excel file

By clicking  button, we can calculate a single saturation point

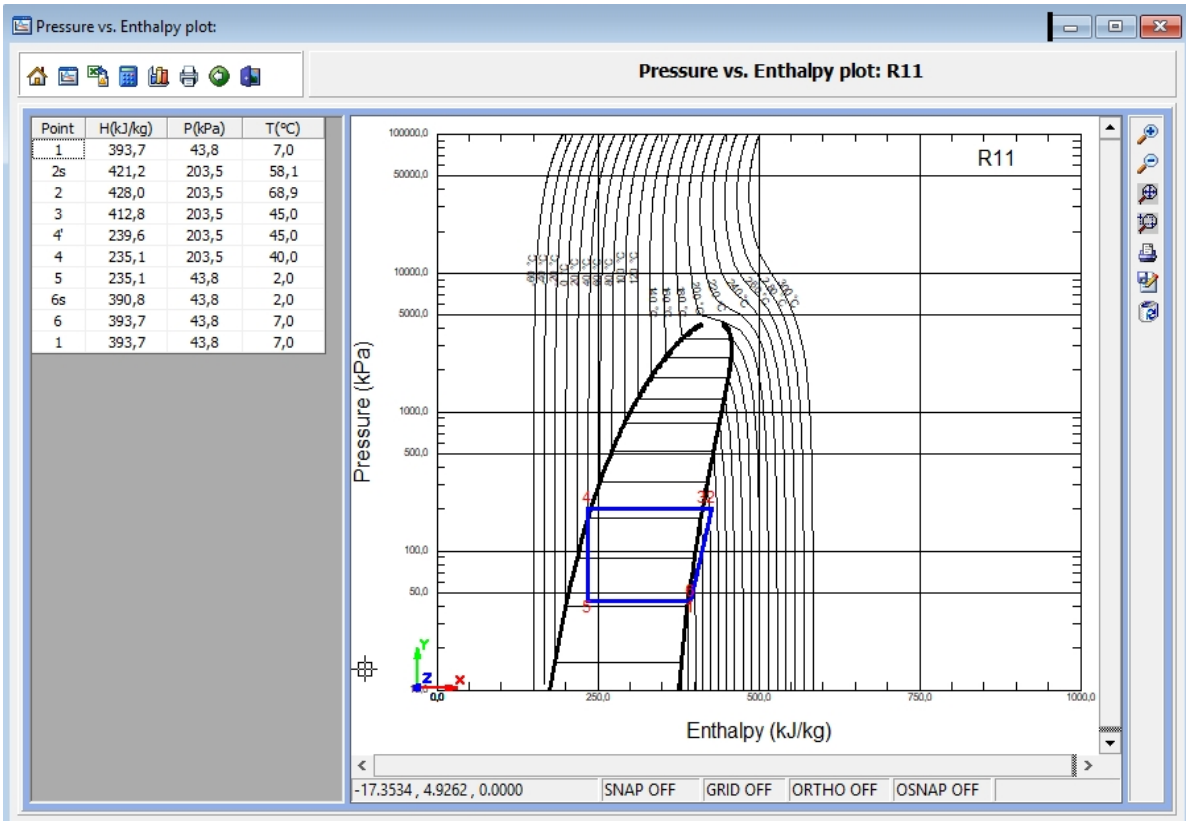
By clicking on the  , we can do the cycle



We click on the calculation button



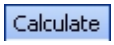
Now we click on the “Chart” button



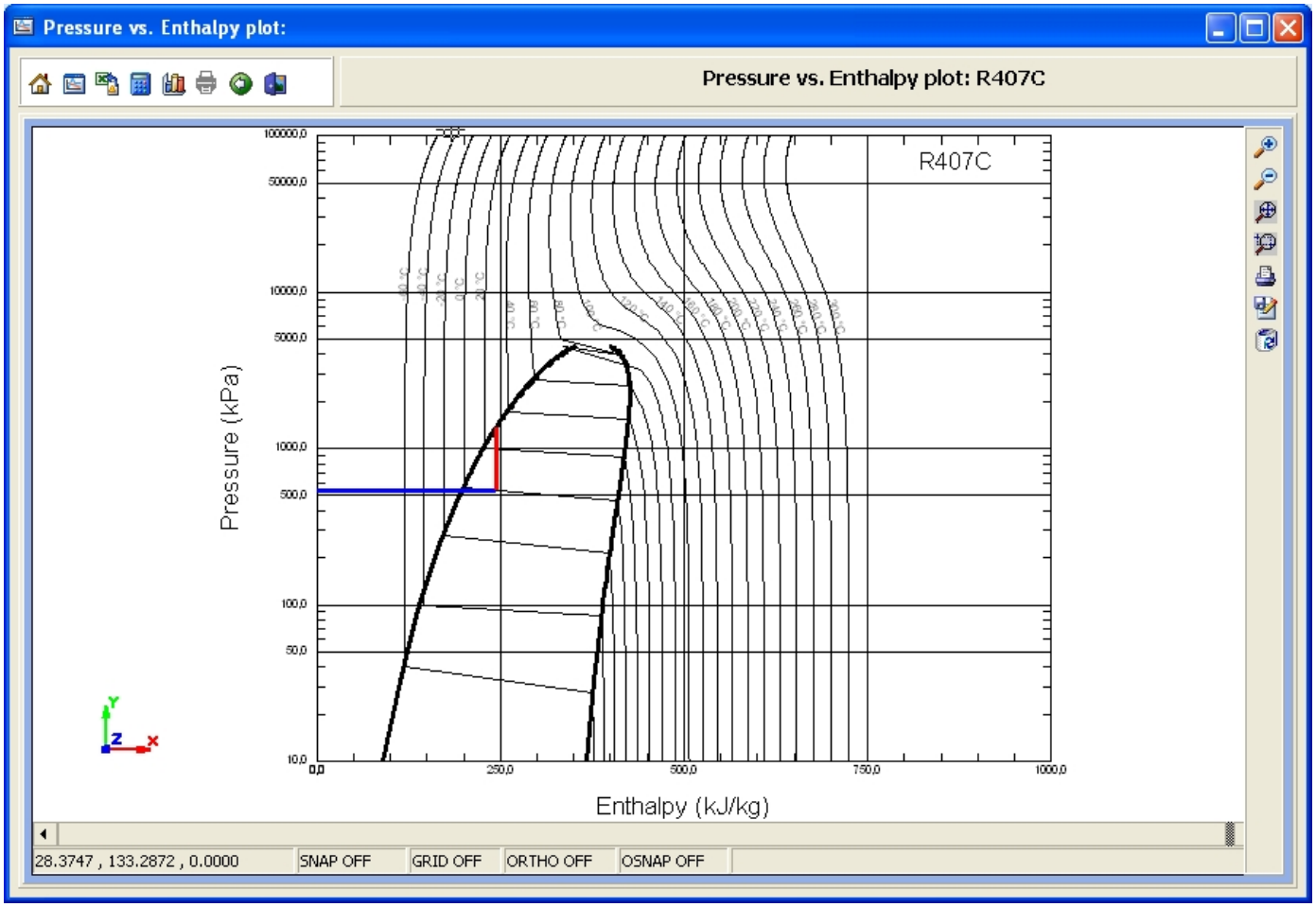
Functional point on the PH diagram

Functional point on the PH diagram

When we click on this voice 

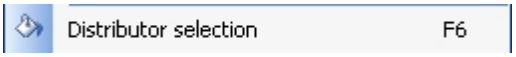
of the Calculate menu 

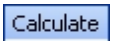
we get



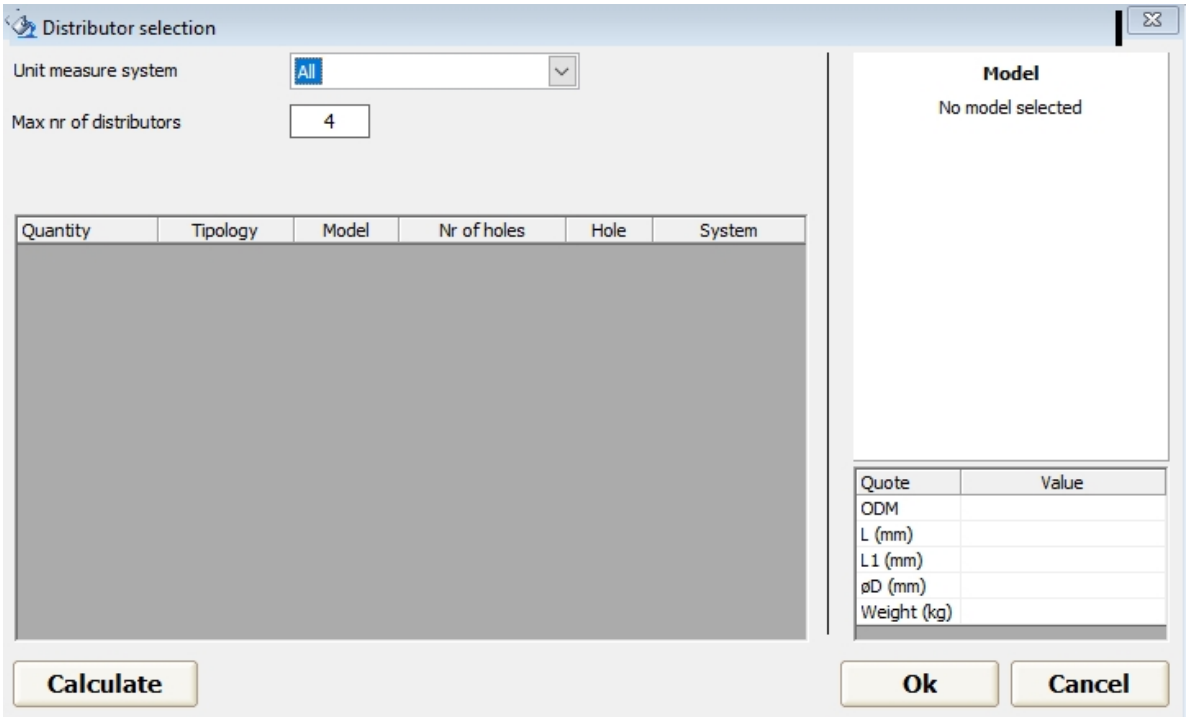
Distributor selection

Distributor selection

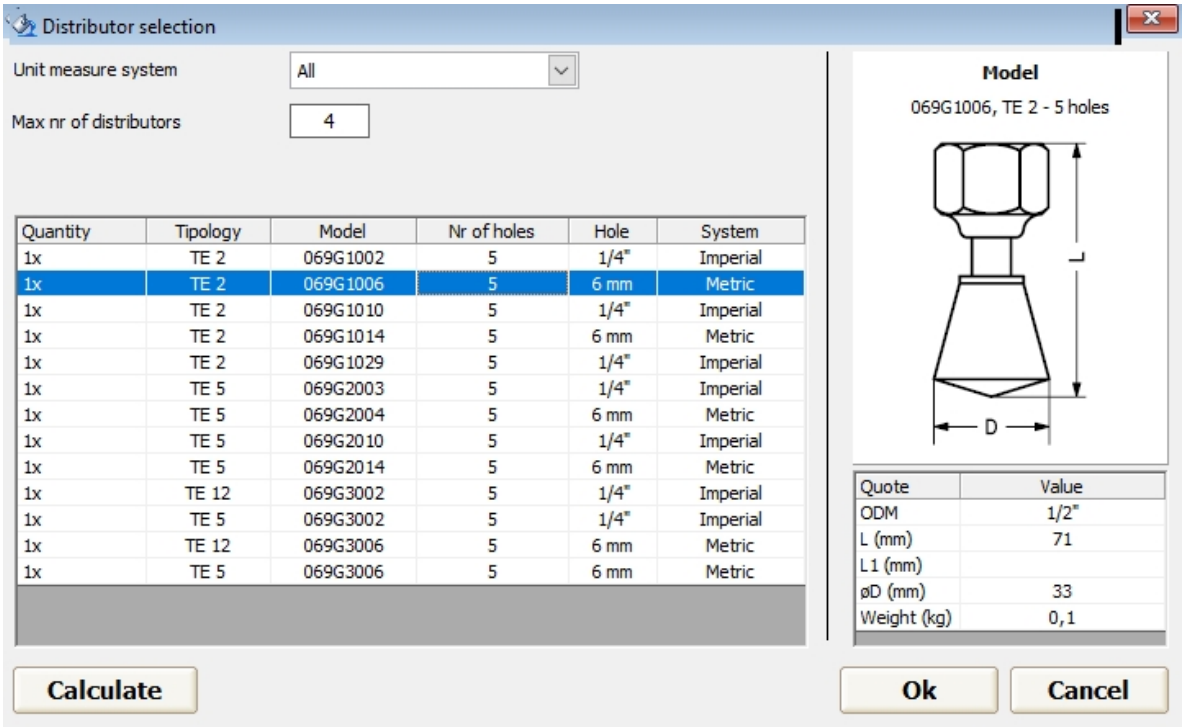
When we click on the "Distributor selection" voice 

of the Calculate menu 

we get

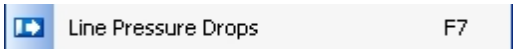


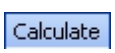
We click on the calculate button and get this. Please check a refrigerant type before, since the choice of distributors depends on this.



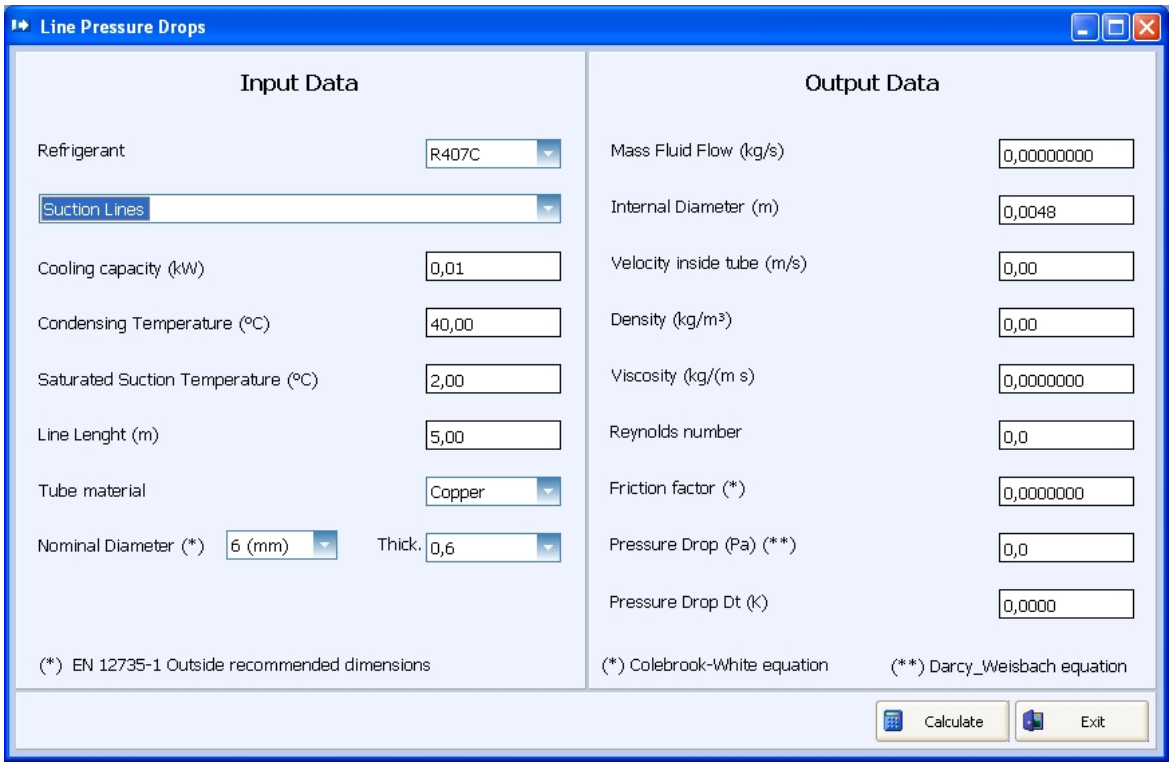
Line Pressure Drops

Line Pressure Drop

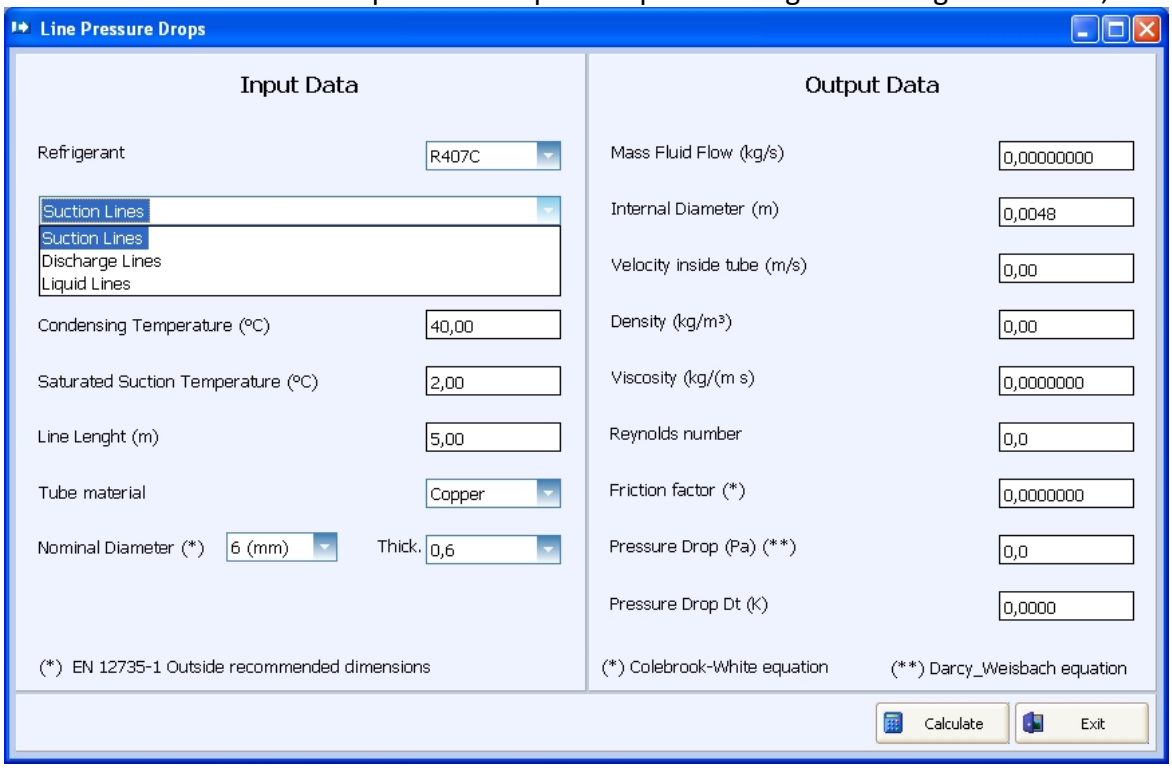
when we click on this voice 

of the Calculate menu 

we get



Where we can calculate the pressure drop for a specific refrigerant along the suction, discharge and liquid lines.



Recuperators – bFly

Recuperators – bFly

The Enterprise edition of Coils contains an application for the heat balance of heat plant of Energy recovery based on heat exchange coils linked together by an hydraulic circuit. In the most common case, usually we have only one coil air side as supply and one coil air side as return. At the moment, our software is the only one that allows the analysis, at the same time, with more coils on supply and return side. We have implemented the

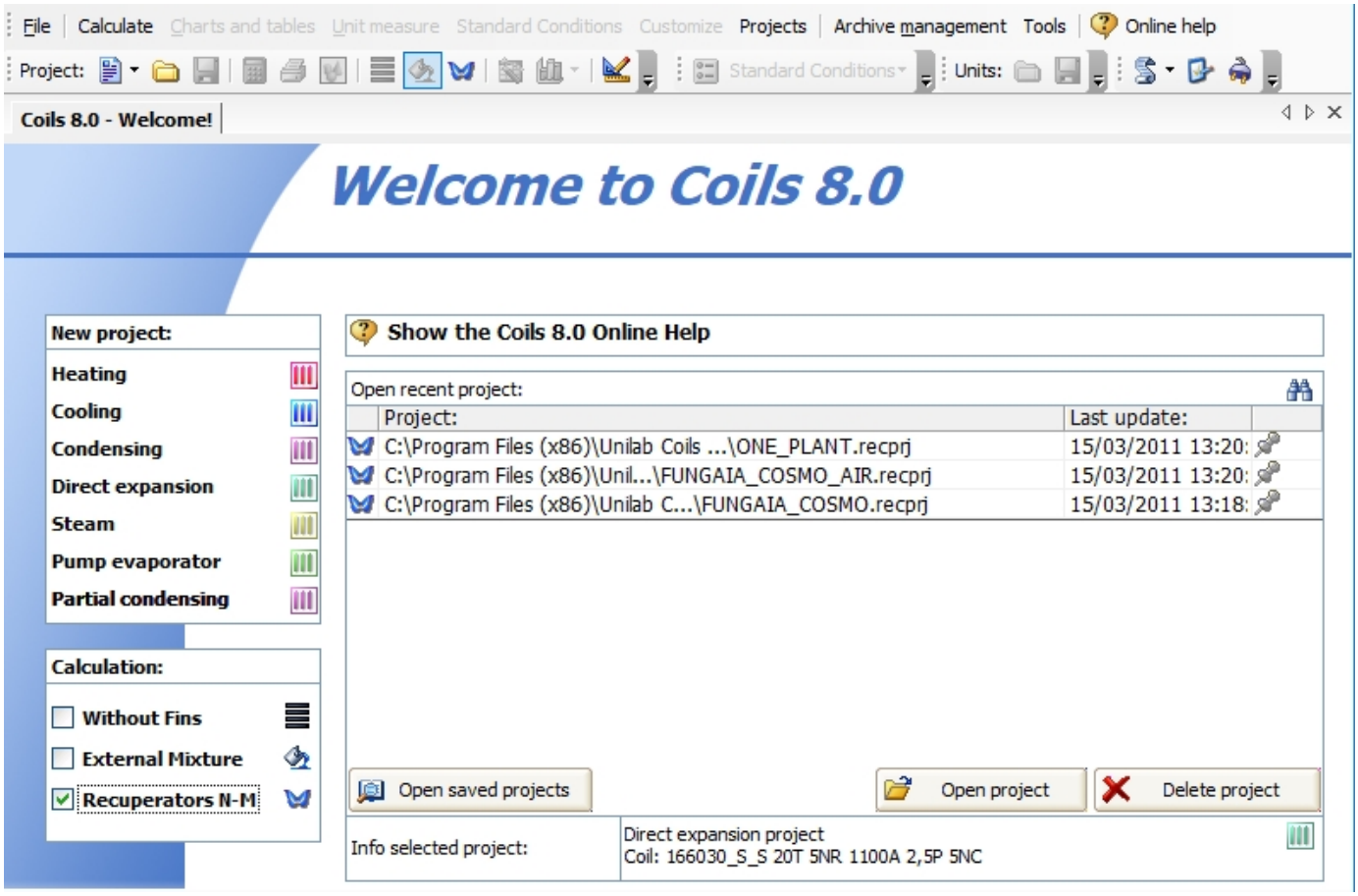
possibility of dividing in more, than one plant, homogeneous zones from the energy side. The actual limits of the software are:
Maximum number of simultaneous plants = 10
Maximum number of coils supply side = 50 for each plant
Maximum number of coils return side = 50 for each plant.

For each plant we can choose in an independent way the fluids both supply and return and naturally also the fluid hydraulic circuit side.

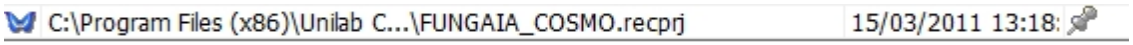
Calculation Recuperators M – N

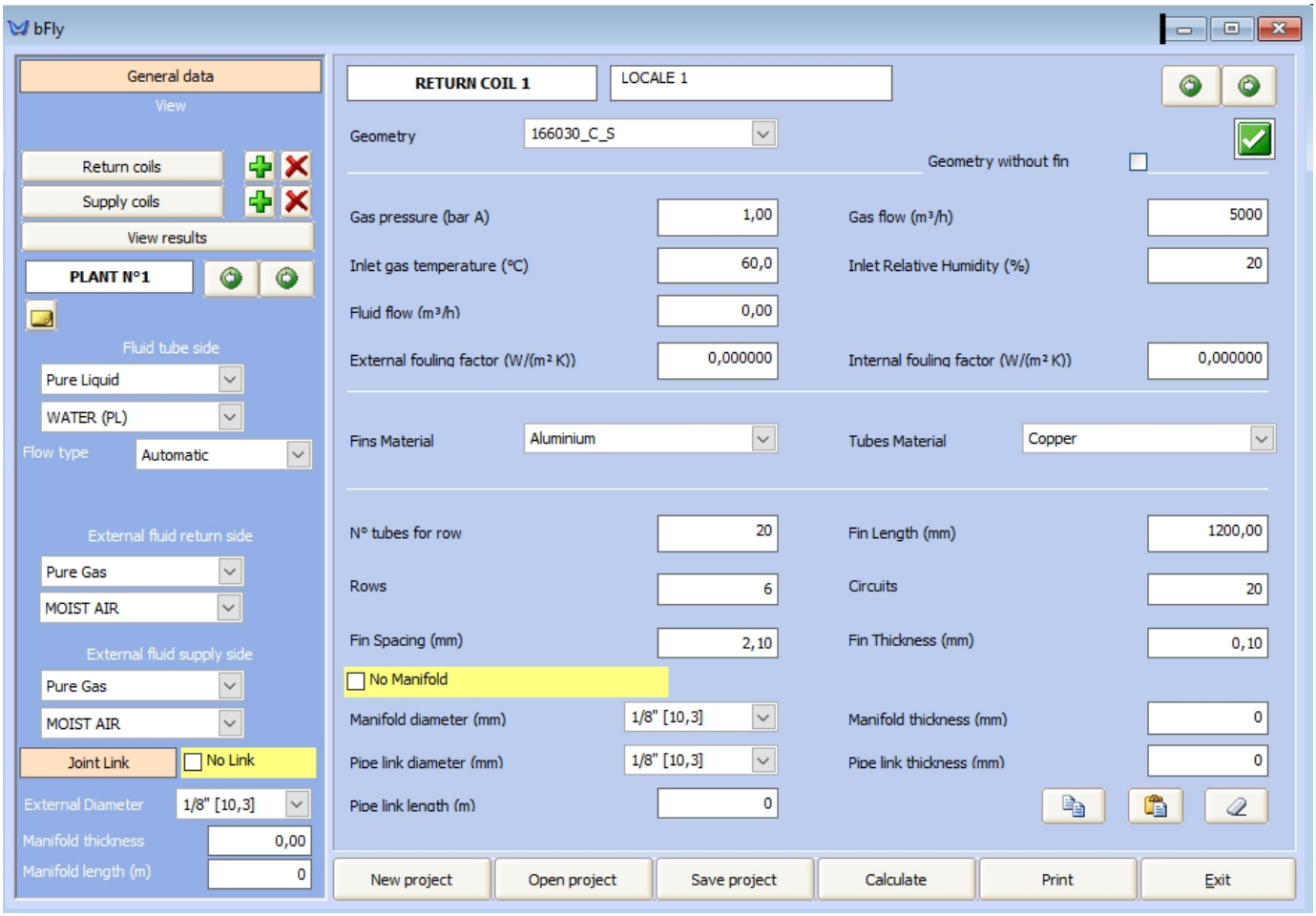
Calculation Recuperators N – M

Let's see an example of a project of Recuperator N- M as loaded in the software.
Click on the Recuperator N-M voice of the menu Calculation as in the following screen



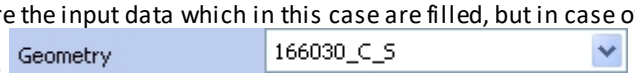
Now, as you can see, we have three examples of project already filled with data, but, just for example, let's open one that refers to recuperators N-M of a mushroom bed





You get the above input data for the current project.

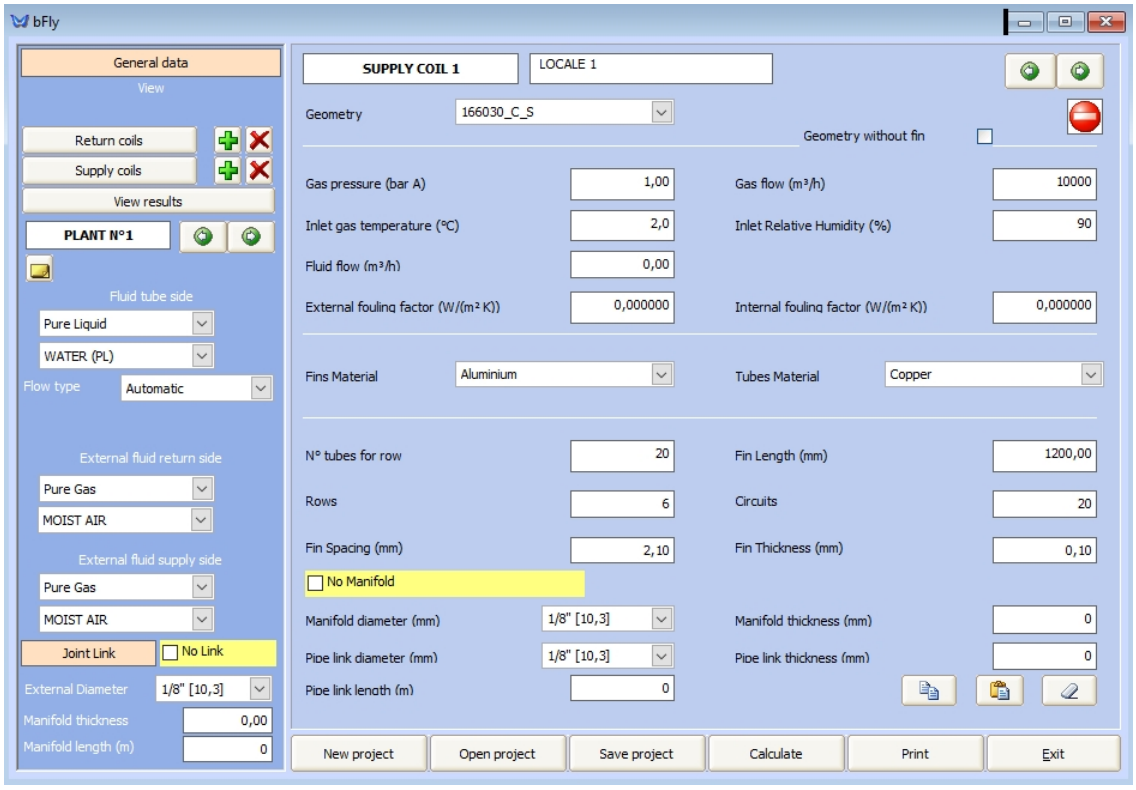
We can see the input data given for the Return Coil 1.

This are the input data which in this case are filled, but in case of new project, you can insert them on your own. In the “Geometry” combo 

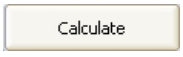
you can choose the geometry . The “Gas pressure” in bar, the inlet gas temperature, the “Gas Flow”. You can then choose the Fin and Tubes material. Afterwards, you can insert the physical data of the coil.

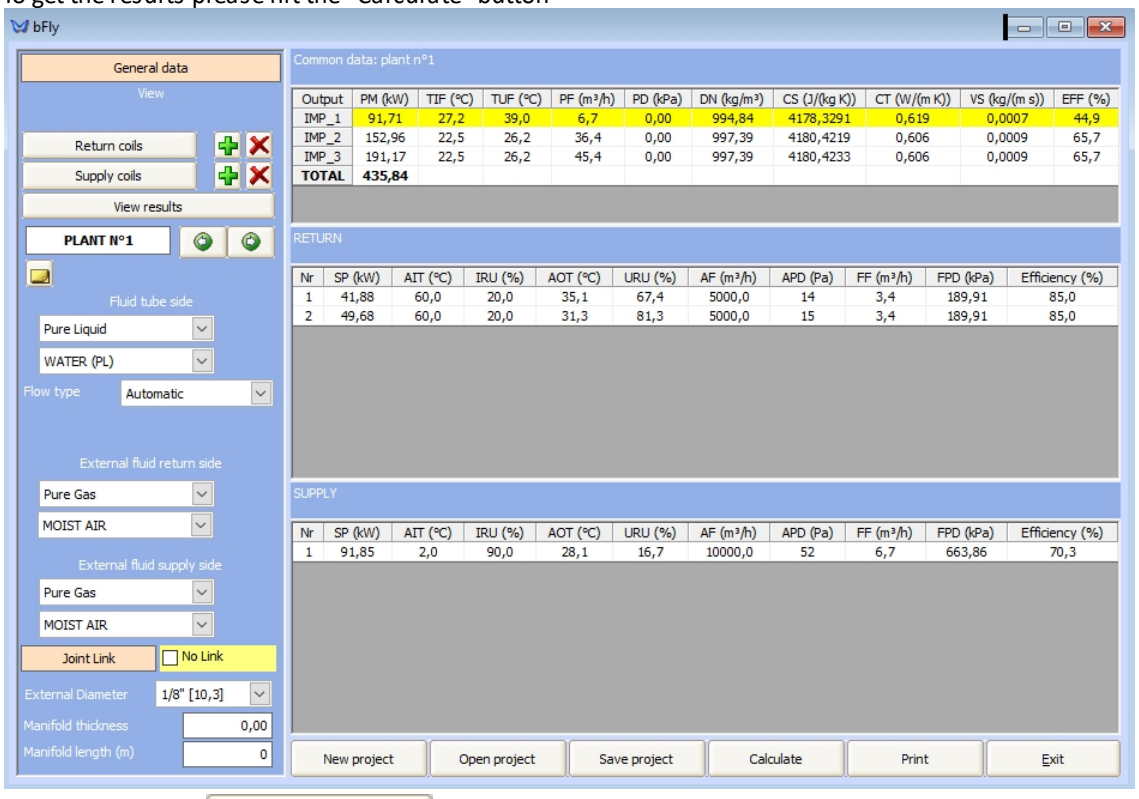
On the main menu, on the left side, by clicking on the “Supply Coils” button 

you see the following



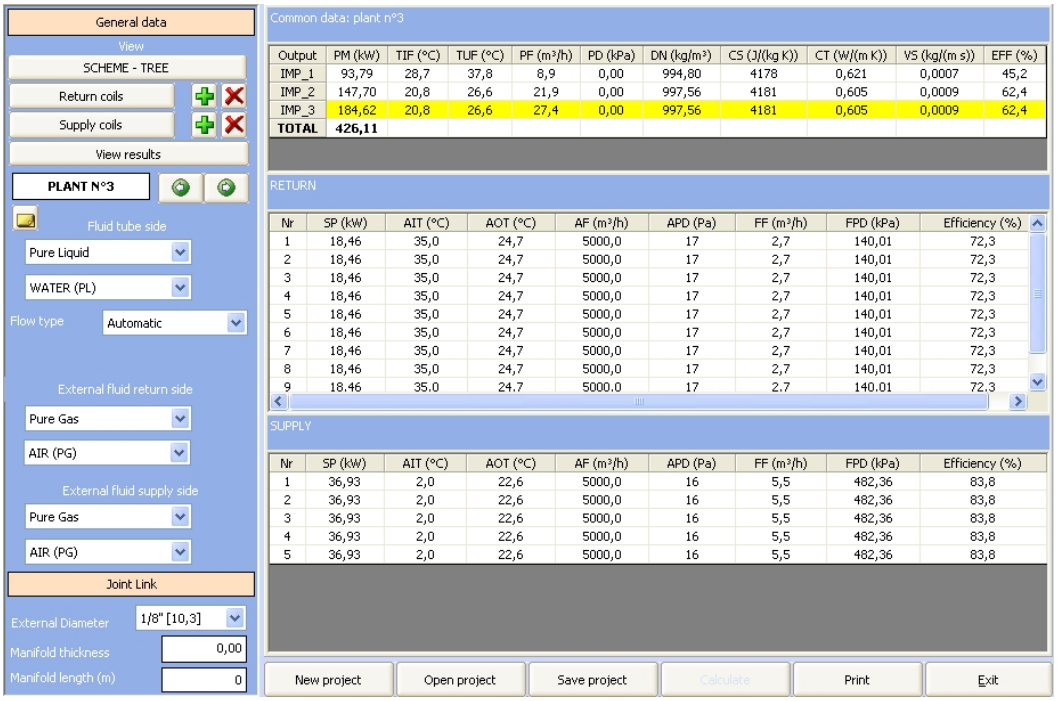
This is an example of the supply coil. As you can see, in the data inserted, the supply coil has lower inlet temperature, than the return.
You can choose also the Fluid tube side, the external fluid return side, the external fluid supply side, the joint link.

To get the results please hit the “Calculate” button 

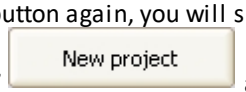


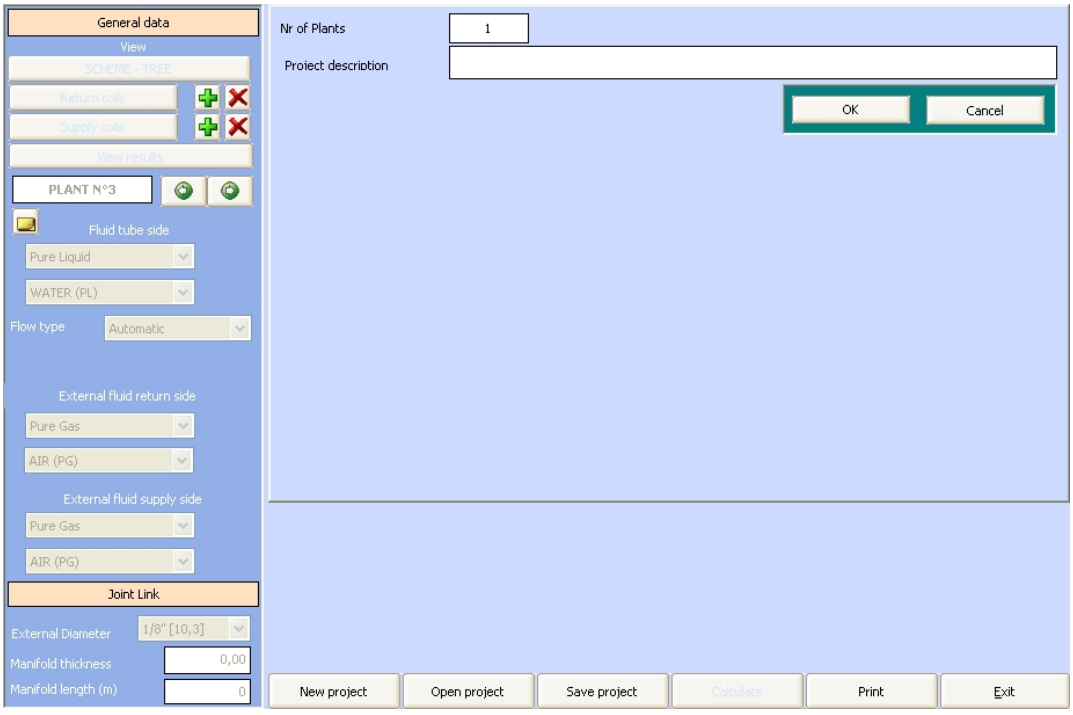
The “Print” button 

will give the following



After hitting the printing button again, you will see the print preview with all the results of calculation and scheme three.

The button “New project ”  allows to start a new project.



Catalogues Generator

Catalogues Generator

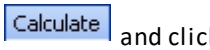
Automatic Generation of Catalogues and performance Tables

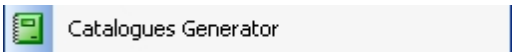
This feature allows the automatic creation of catalogues and performance tables in Excel format. This feature is particularly suitable for those, who must design a series of coils, unit coolers, air coolers, remote condensers, dry coolers, condensing units, motorevaporators, etc.. and insert a capacity table , calculated at different working conditions in the catalogue of the new series.

Advantages of this new feature:

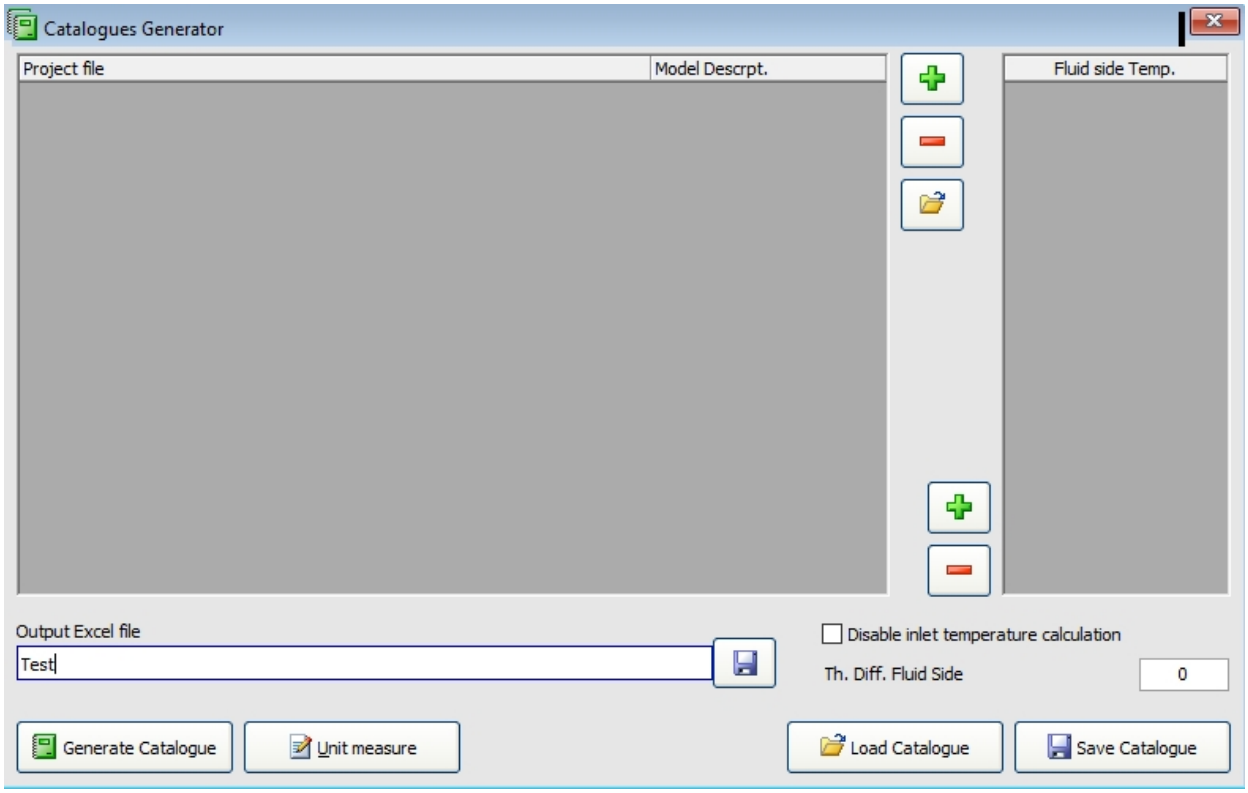
- Within minutes you can create tables of a hundred units
- The tables are saved in Excel format already formatted, and ready for use
- Three tables are generated: yields, air side pressure drop and pressure drop fluid side
- Working conditions are fully customizable
- The units are customizable
- You can save the design of the catalogue to a file so if one day you will need to update the data, simply load the project and create new catalogue

How to use this new function

Choose the menu "Calculate" 

and click on "Catalogues Generator" 

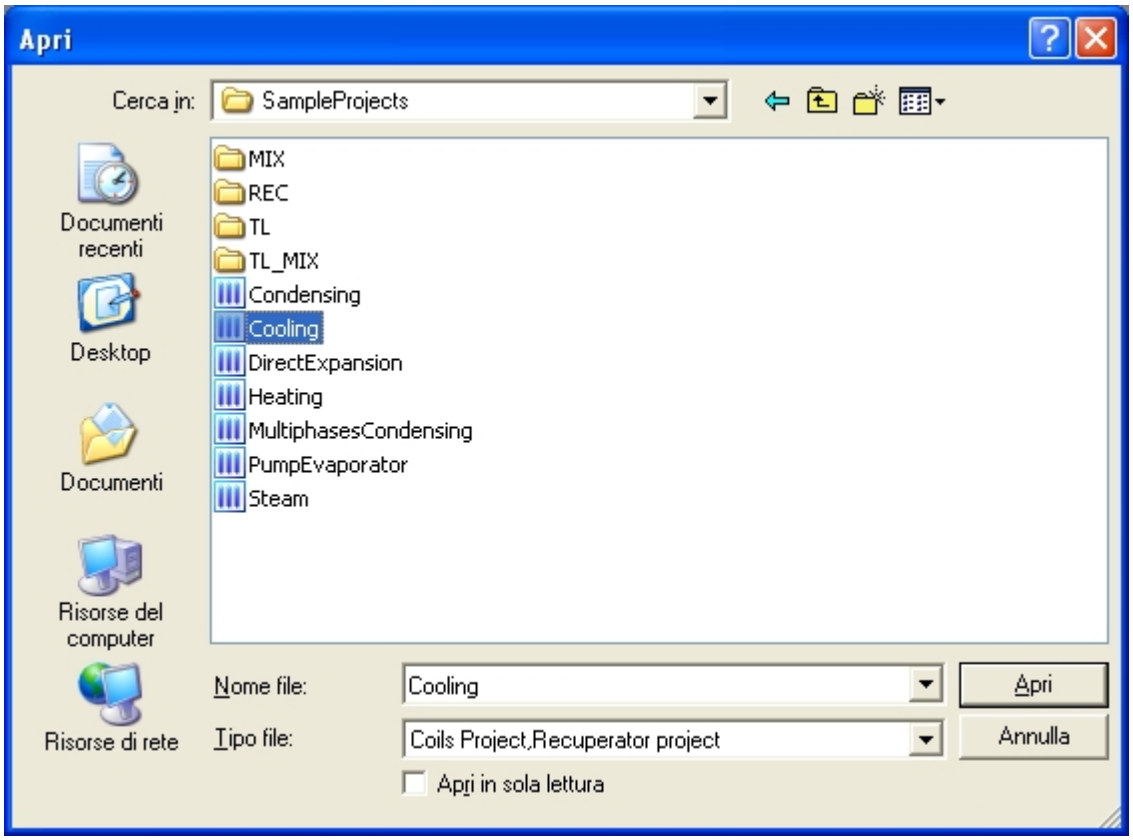
:
The following screen will appear:



On the top left end of the grid let's insert the project files of models we need to create the catalogue for.

For each model we have already created a Coils project. To expedite this, just follow a simple procedure at the end of this document.

Let's click on "+" green button  on the top right corner of the grid and we specify the project file to insert in the list:

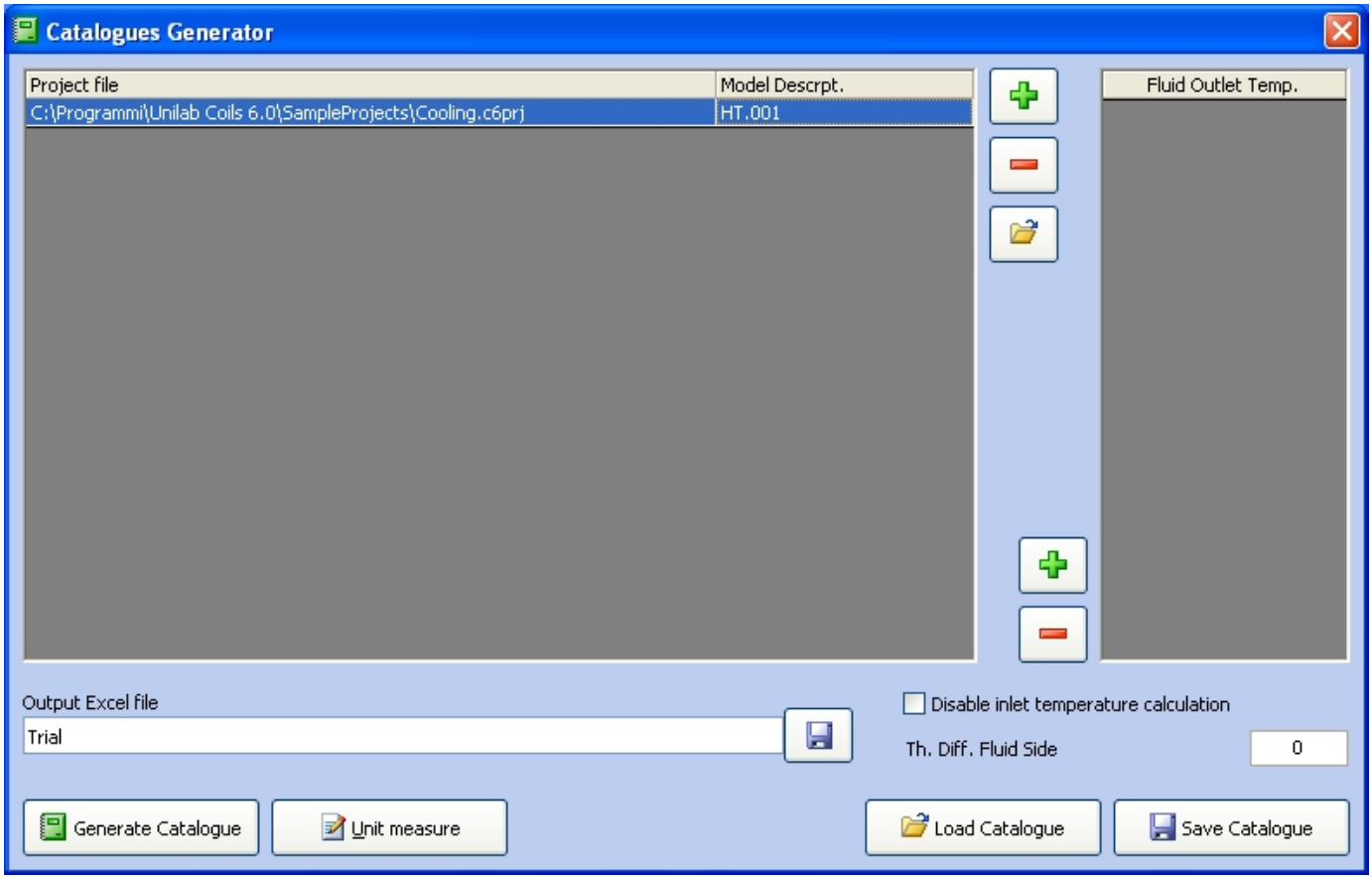


Attention: the projects need to be in the same calculation modality!

We need to specify the name of the model/size that corresponds to this project. Thus we write the name in the column "Descr. Modello"

	Model Descrpt.
	HT.001

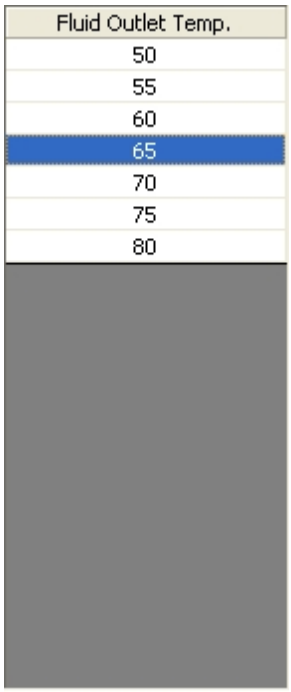
Now We click on the green button "+"  and we repeat the procedure to add the other models. In our example we have only one model.



In the grid at the top right hand side we insert the temperature fluid, which will vary will be included in the columns of the Excel sheet. These temperatures vary depending on the mode of calculation:

Heating: Inlet Fluid Temperature
Cooling: Outlet fluid Temperature
Condensing: Condensing Temperature (Middle Point)
Evaporating: Evaporating Temperature (Middle Point)
Vapour: Saturation Temperature
Pump Evaporator: Evaporating Temperature (Middle Point)

Let's click on the green button "+"  on the left hand of temperatures grid more than once we introduce these values:



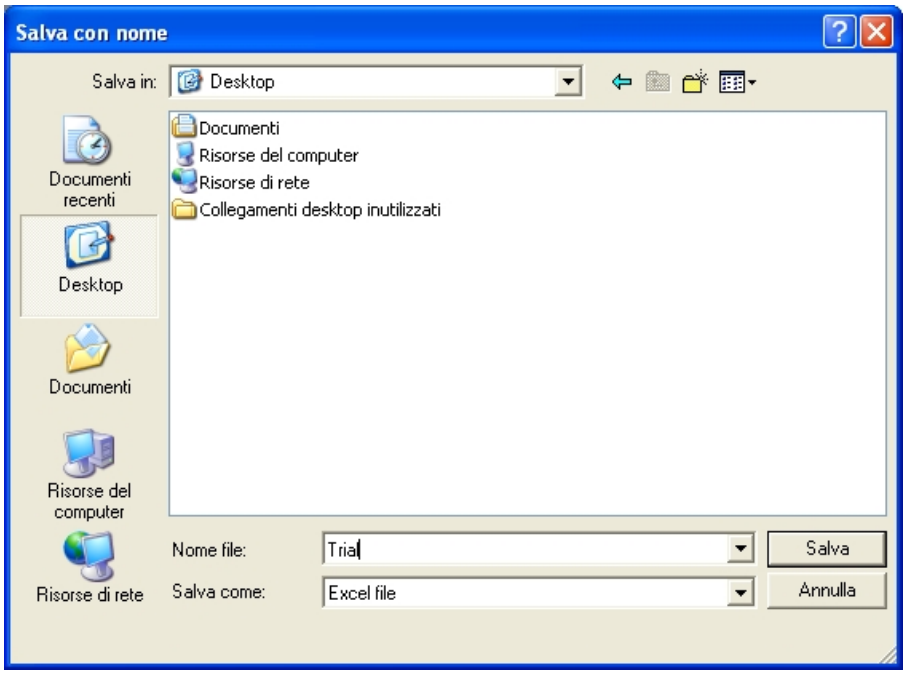
Just below we find the delta T: in the case of fluids without phase change, refers to the temperature difference between the input and output fluid side, in the case of fluids with phase change, refers to the difference between the temperature fluid side and the input side air. Here are some examples:

Modality	Temp. Fluid Side	Delta T	Set Value	Results
Heating	80	10	Outlet Temp.	70
Cooling	12	5	Inlet Temp.	7
Condensing	45	15	Inlet Air Temp.	30
Evaporating	5	6	Inlet Air Temp.	11
Vapour	120	100	Inlet Air Temp.	20
Pump Evaporator	5	6	Inlet Air Temp.	11

Let's set a delta T of 10 °C

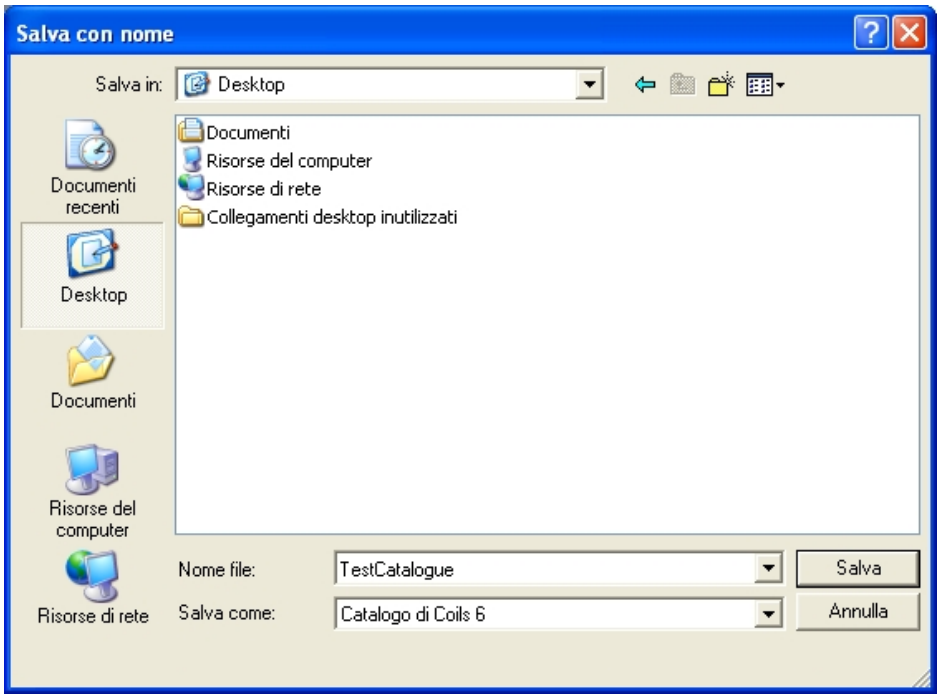
Once the temperatures are set, we specify the path on which we save the excel sheet by clicking on the button "Save"  with the disk "Output Excel file"

.



Now that the project is ready, let's click on the "Save Catalogue" button 

to save work done so far:



Attention: this operations saves the information contained in this mask, not the power table, the pressure drop, etc..

Let's click on "Generate catalogue" button 

and let's wait on the programme to finish the data generation.

Considerations and limitations

- Projects must all be set in the same mode of calculation. You can not mix projects in direct expansion cooling or condensation.
- The working conditions of the coil must be the same for each project. For example, if we calculate a set of coils in direct expansion, overheating and subcooling must be the same for each project, otherwise the power data will not be comparable. The same goes for: fluid selected, relative humidity / wet bulb temperatures, fouling factor, factor recycling, etc..
- In the direct expansion mode is possible to vary the temperature of evaporation, but not the pressure, in addition the calculation is performed at a constant condensing temperature of 45 ° C.
- In condensing mode, the evaporating temperature is fixed: 2 ° C

How to generate a set of project files, one for each unit

1. Create a new project of 6 coils in the desired mode
2. Set the working conditions of the first unit: temperature and humidity on the air side, air flow, fluid inside the tubes, inlet temperature / outlet or evaporation / condensation, etc..
3. Set construction data of the coil of the first unit: geometry, number of rows, number of circuits, step fins, finned pack size, presence or absence of the collectors
4. Perform the calculation and display the print preview
5. Verify that the data are correct and match the performance data of the first unit
6. Make corrections if necessary
7. Save the project and specify a file name similar or equal to that of the unit
8. Change the data construction of the coil by putting those in the second unit
9. Click on "File", then "Save As"
10. Specify the file name as that of the second unit
11. Repeat the steps from 8 onwards for each unit

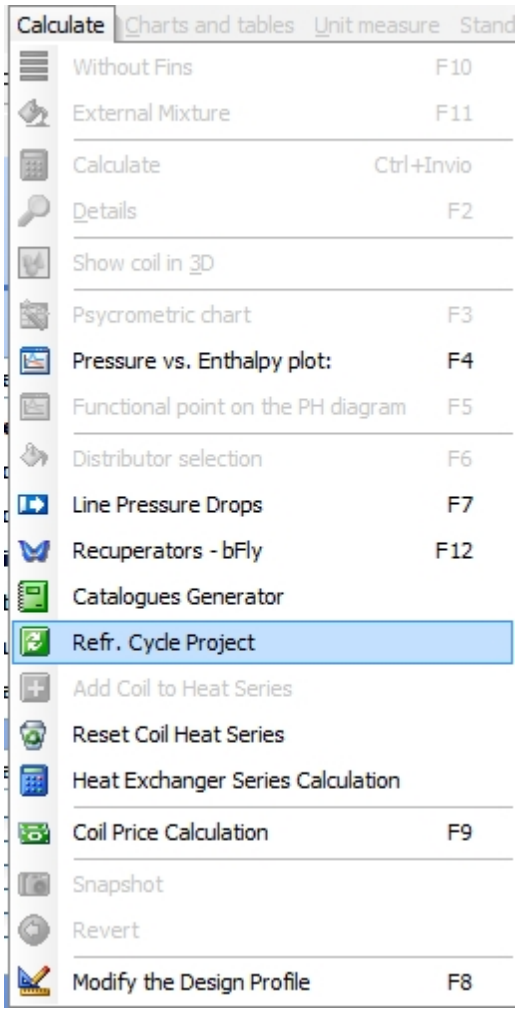
Refrigerant Cycle Project

Refrigerant Cycle Project

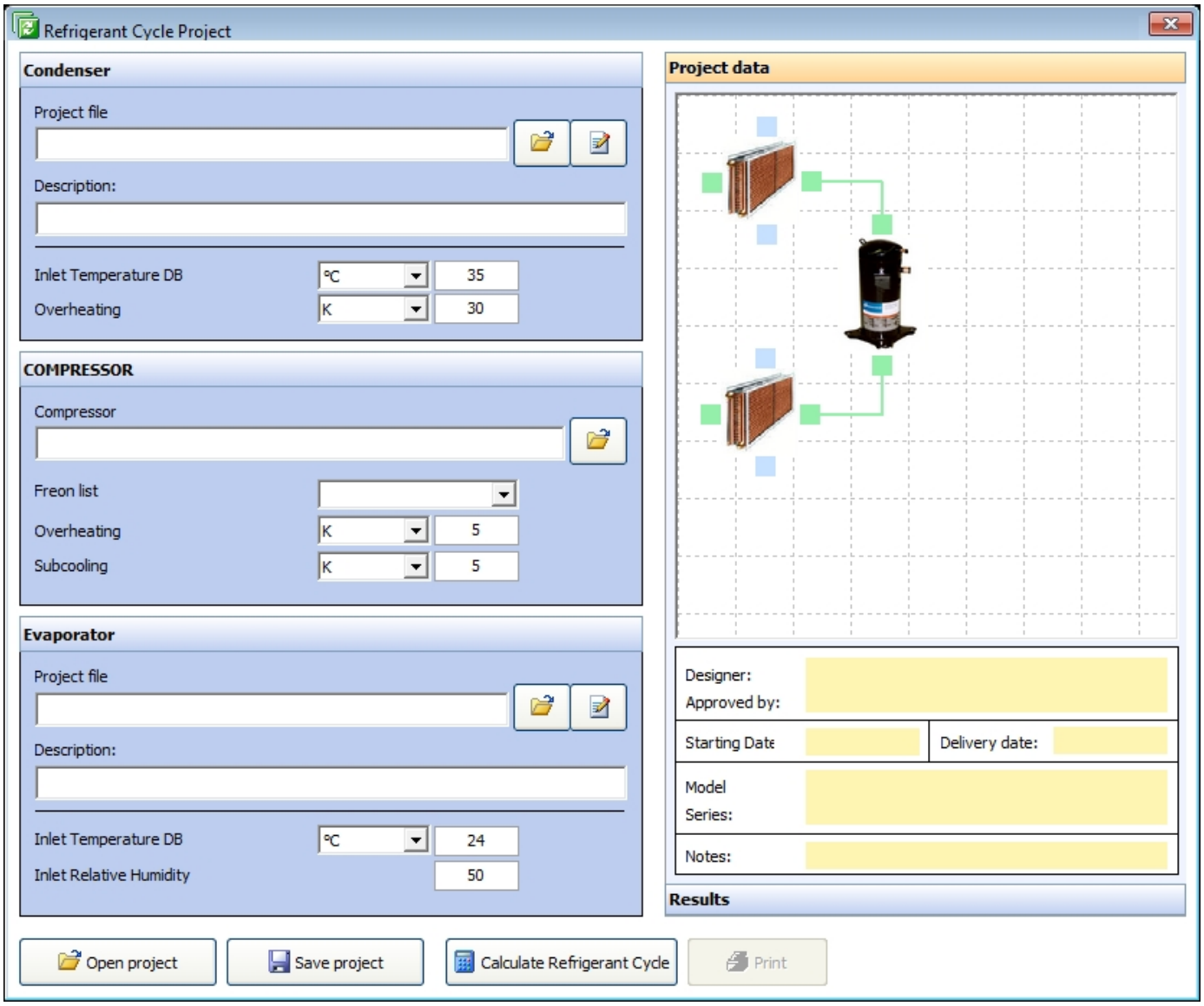
This option will give us the opportunity to balance a project of a unit made of a condenser coil, evaporator coil and a compressor.

Let us see an example of the same.

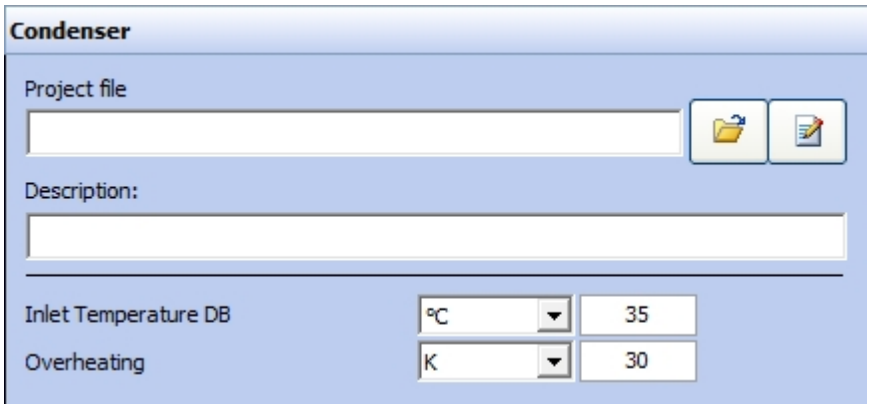
On the Calculate menu we click on “Refr Cycle Project”



Then we get

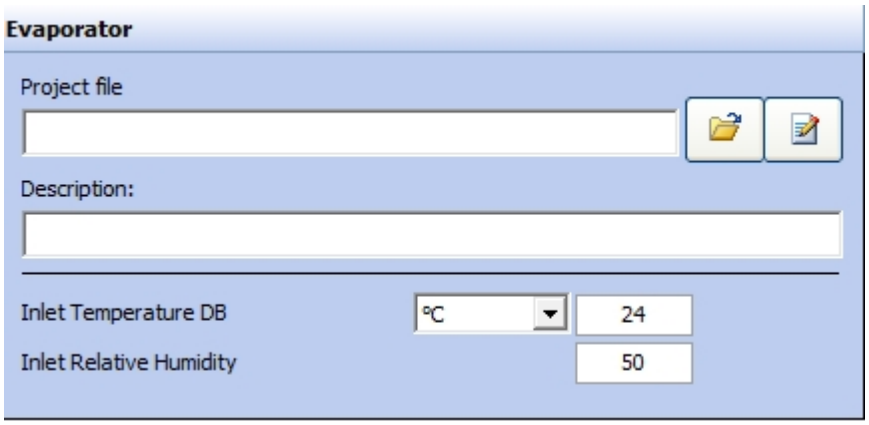


On the above screen we can see the parts relative to the three parts, the condenser



The compressor

And the evaporator



In order to do our calculate we have to have a condenser and an evaporator coil project

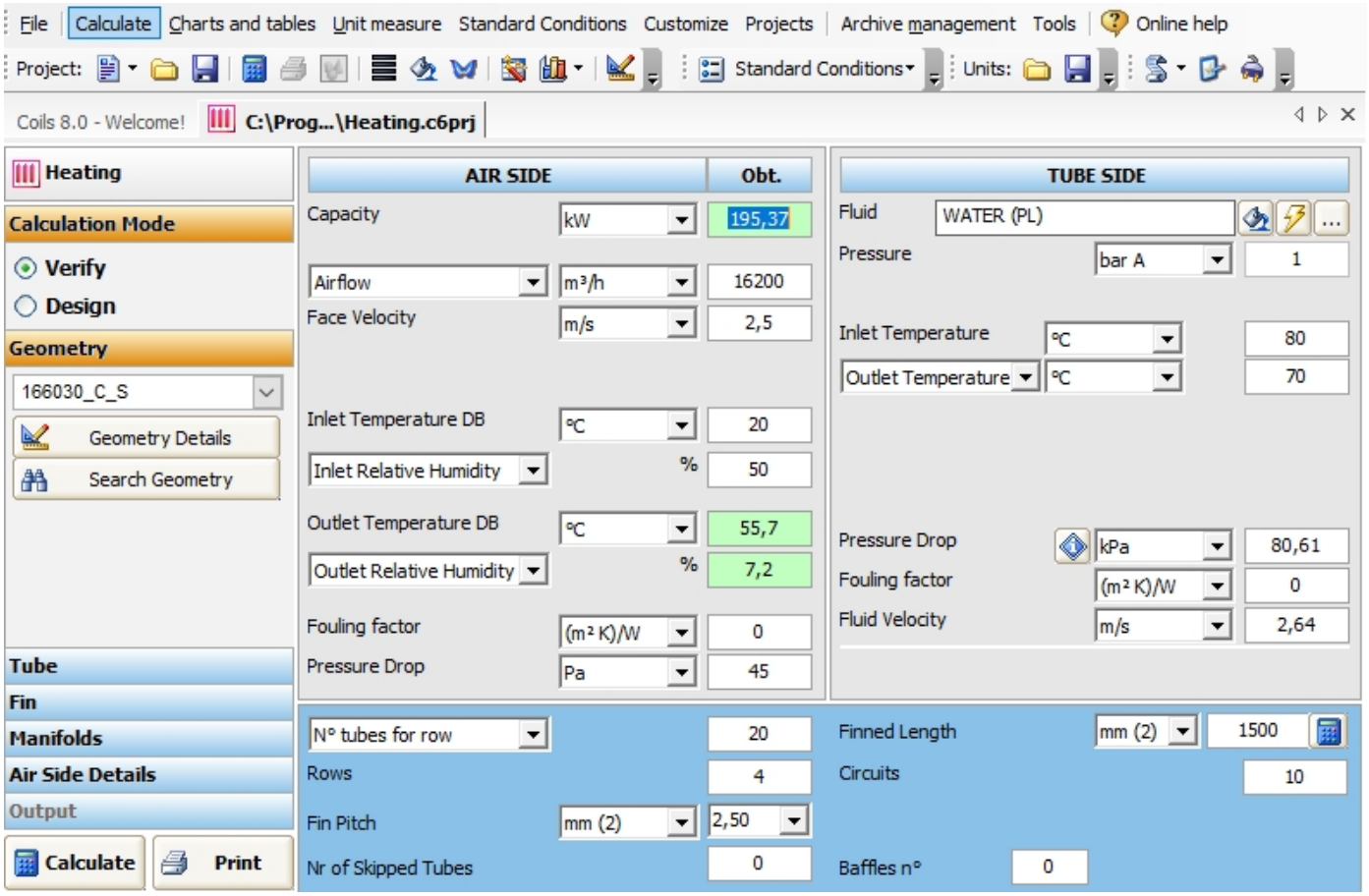
Heat Exchanger Series Calculation

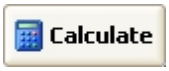
Heat Exchanger Series Calculation

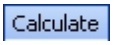
Let's make an example of how calculation of the heat exchangers in serie works.

Let's suppose we have a system made by several heating components, where we have the output of one thermodynamic calculation becomes the input to the second element and so forth. This can be accomplished with the heat exchanger series calculation.
First we open coils and open heating calculation projects to be added to the calculation in series system.

We open one heating coils project



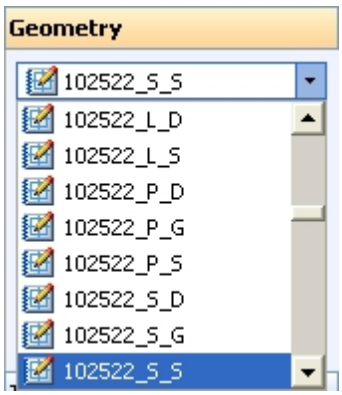
We click on the “Calculate” button 

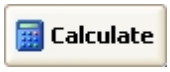
Then on the “Calculate” menu 

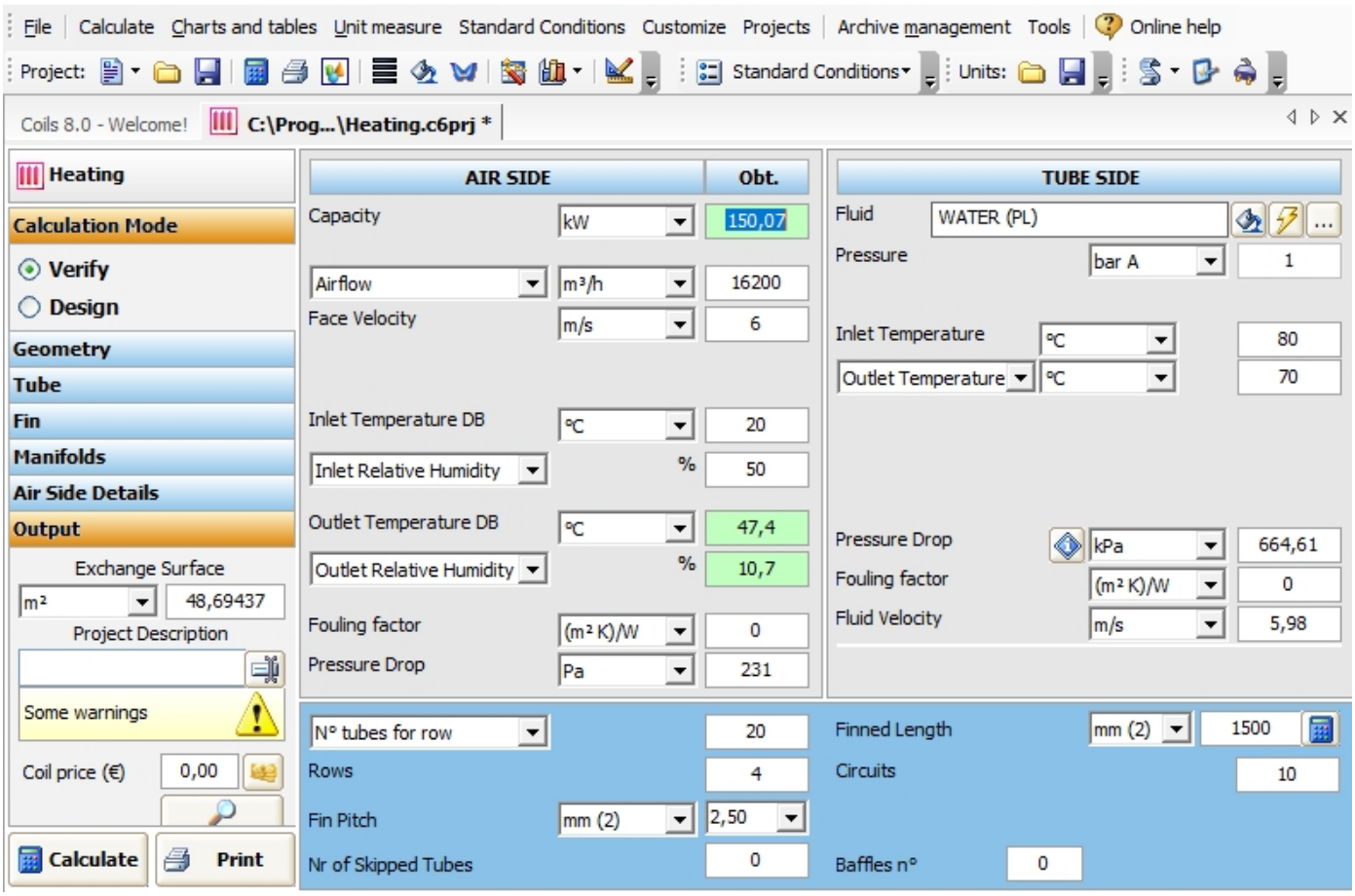
we click “Add Coil to Heat Series” button

We go back to the heating project to select another calculation to add to our catalogue

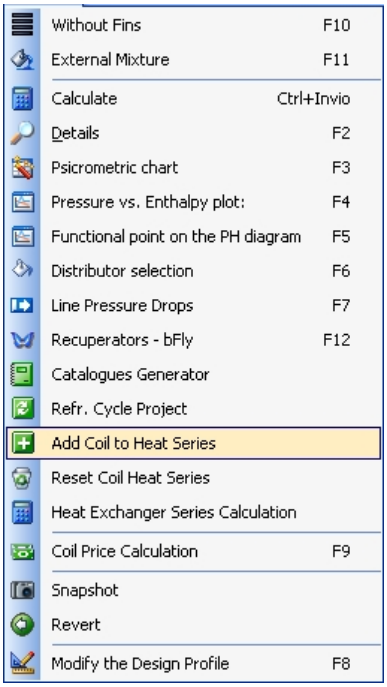
Now let’s change the geometry



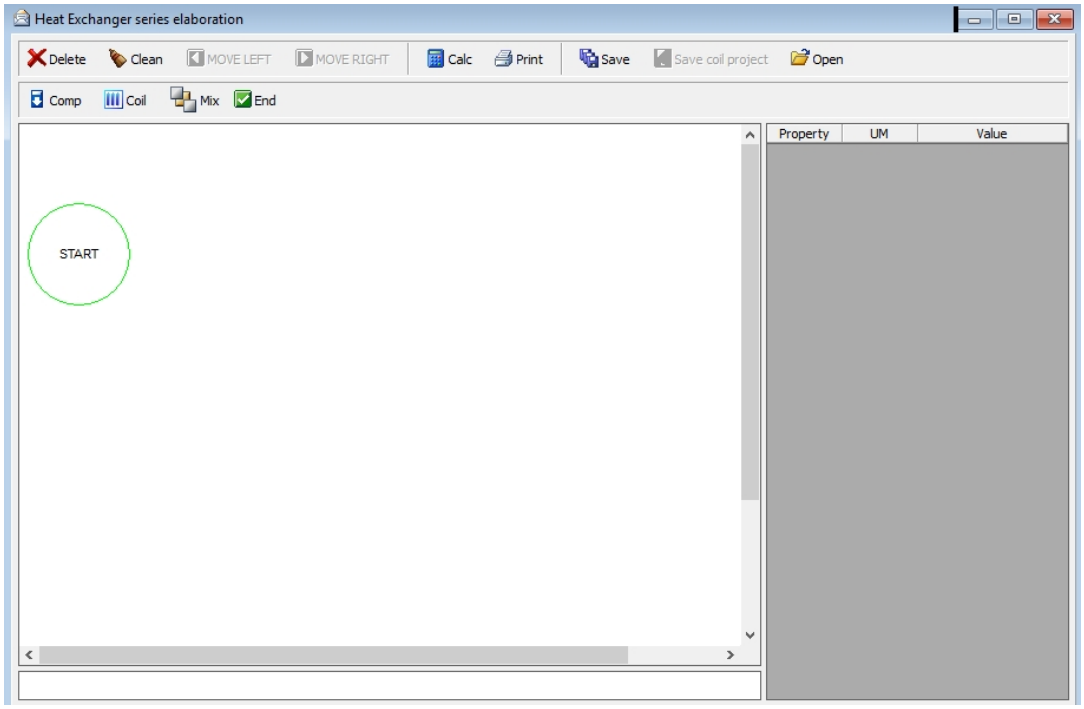
We click on “Calculate” 



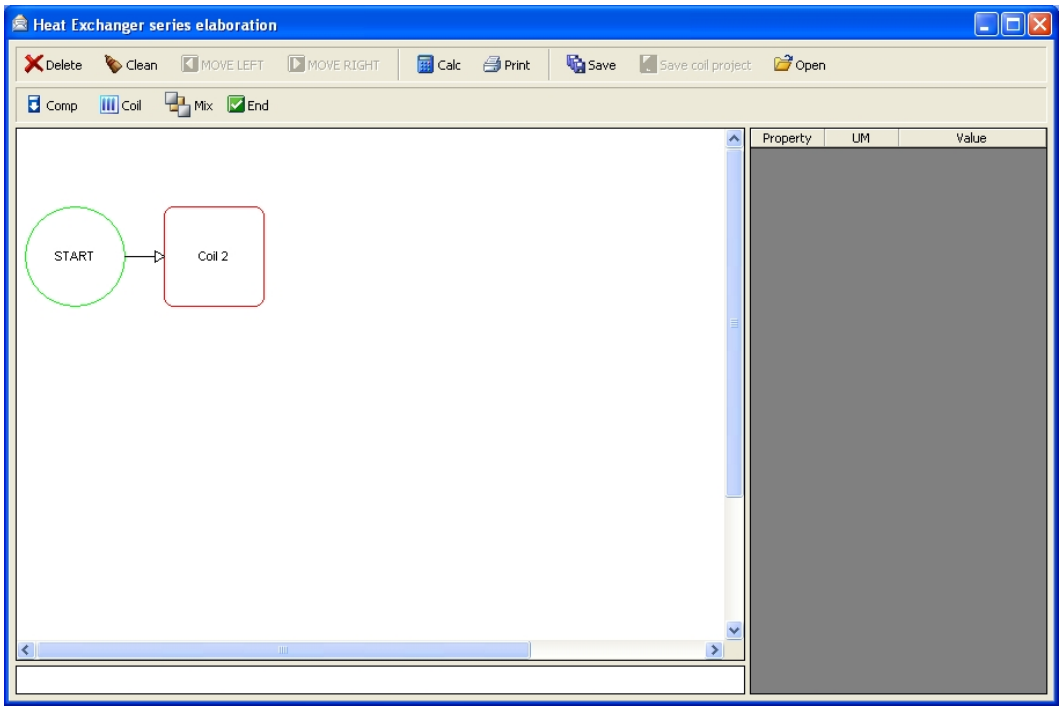
We add this project to the heat series calculation through the Calculate menu



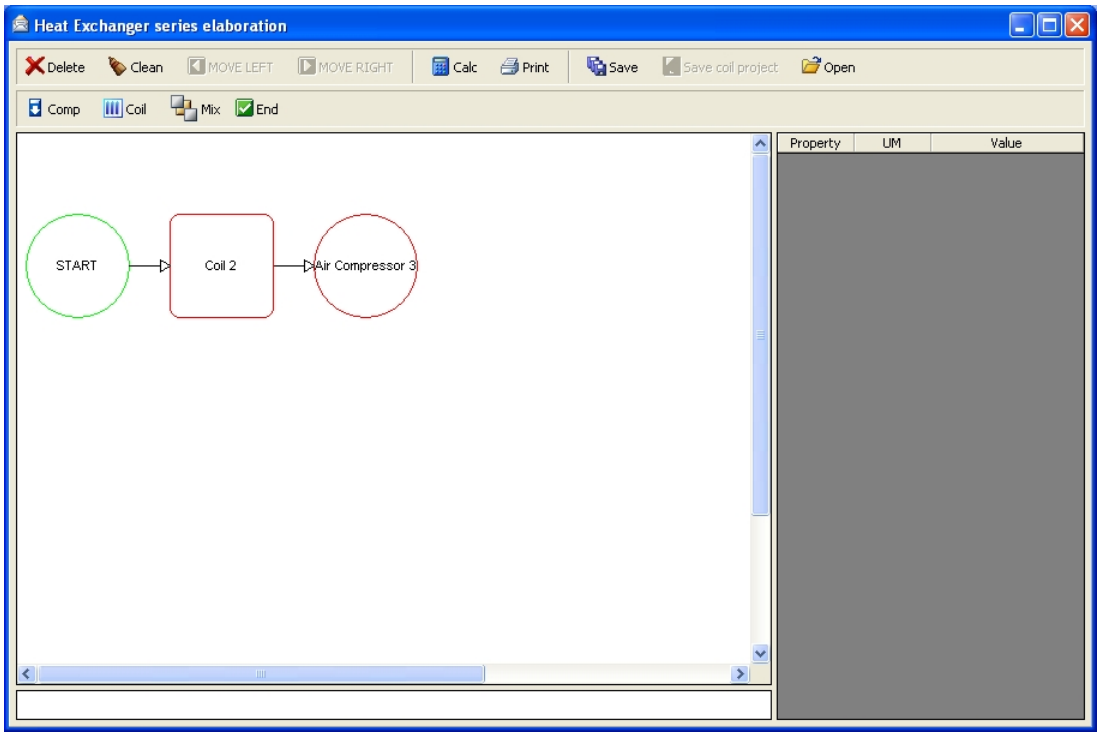
We proceed to Heat Exchanger Series Calculation



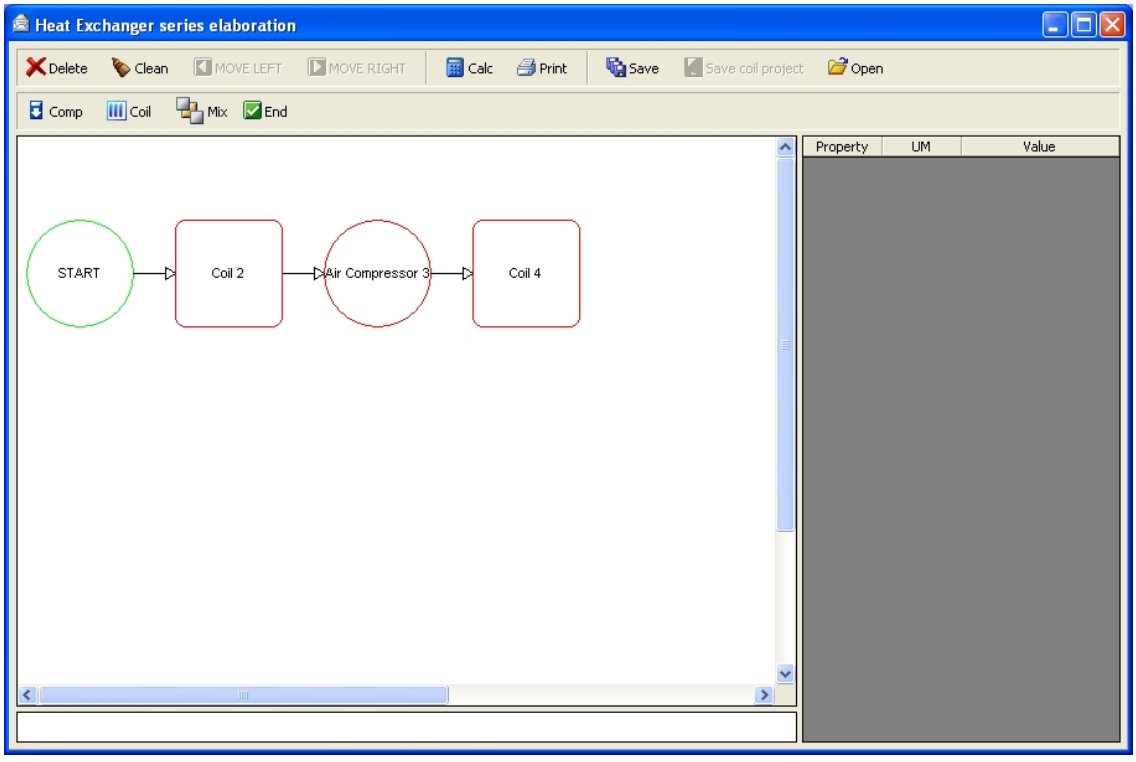
We click the  button to add a coil to our project

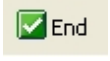


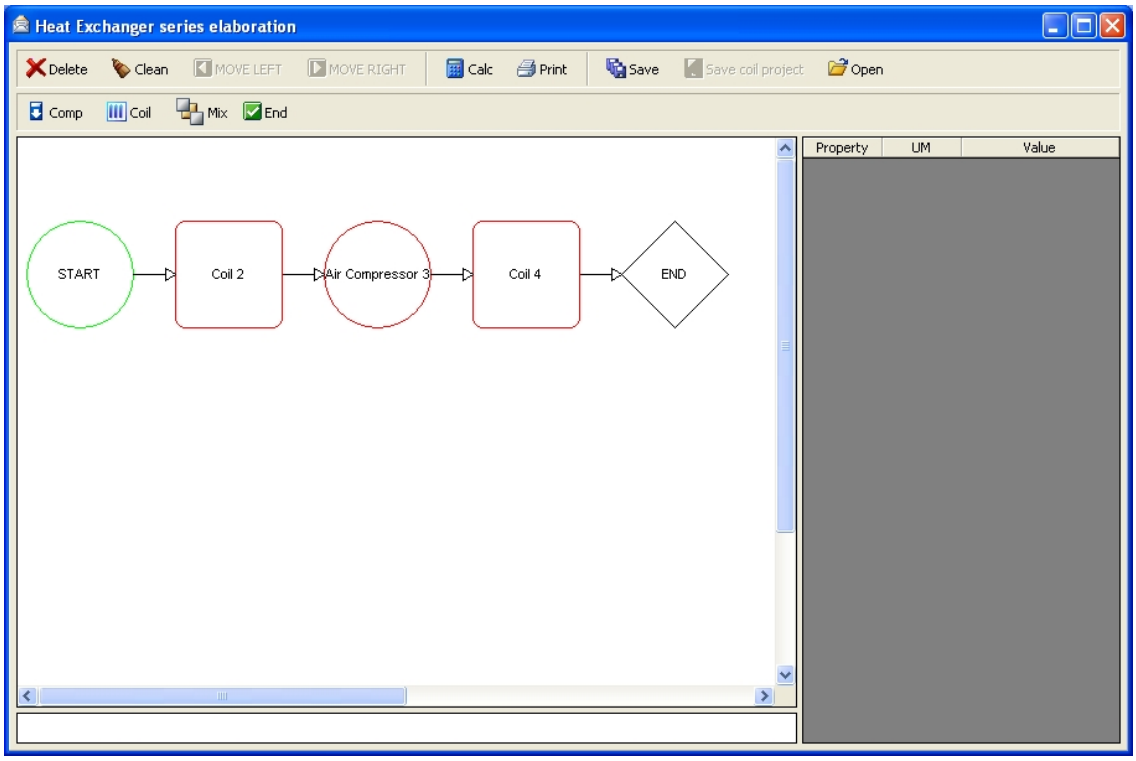
We click  to add a compressor



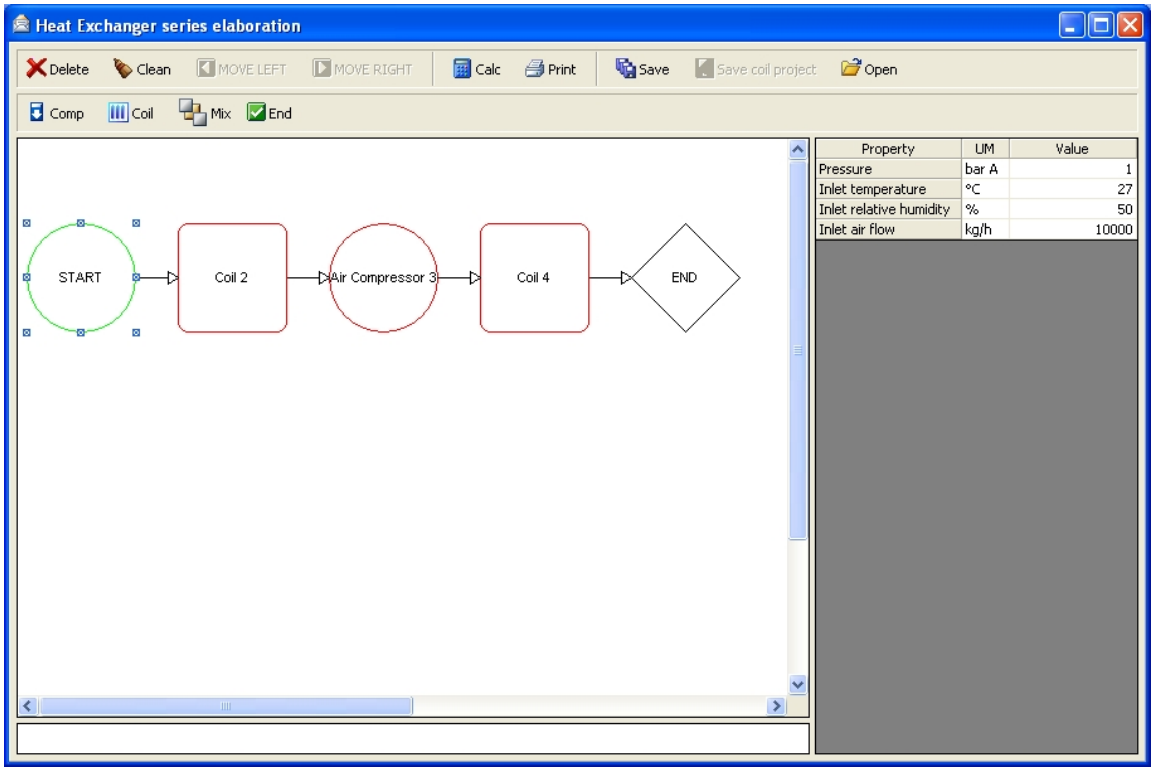
We click  to add another coil



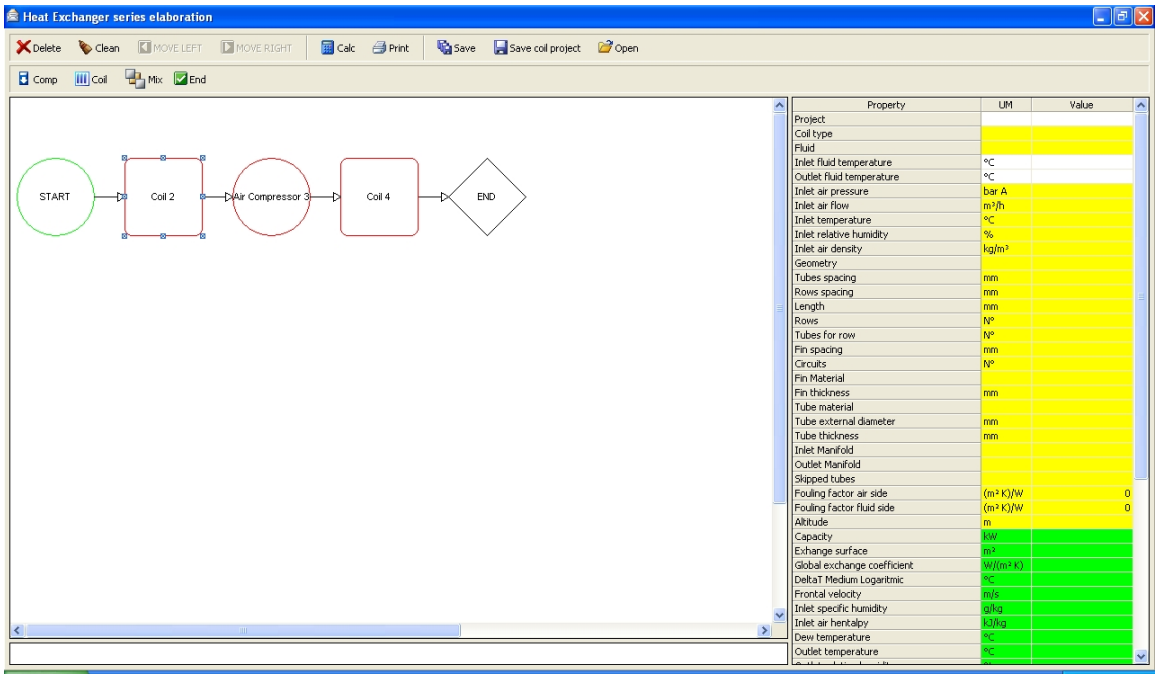
We click the  button to finish our unit



To set the data of each component we click on them

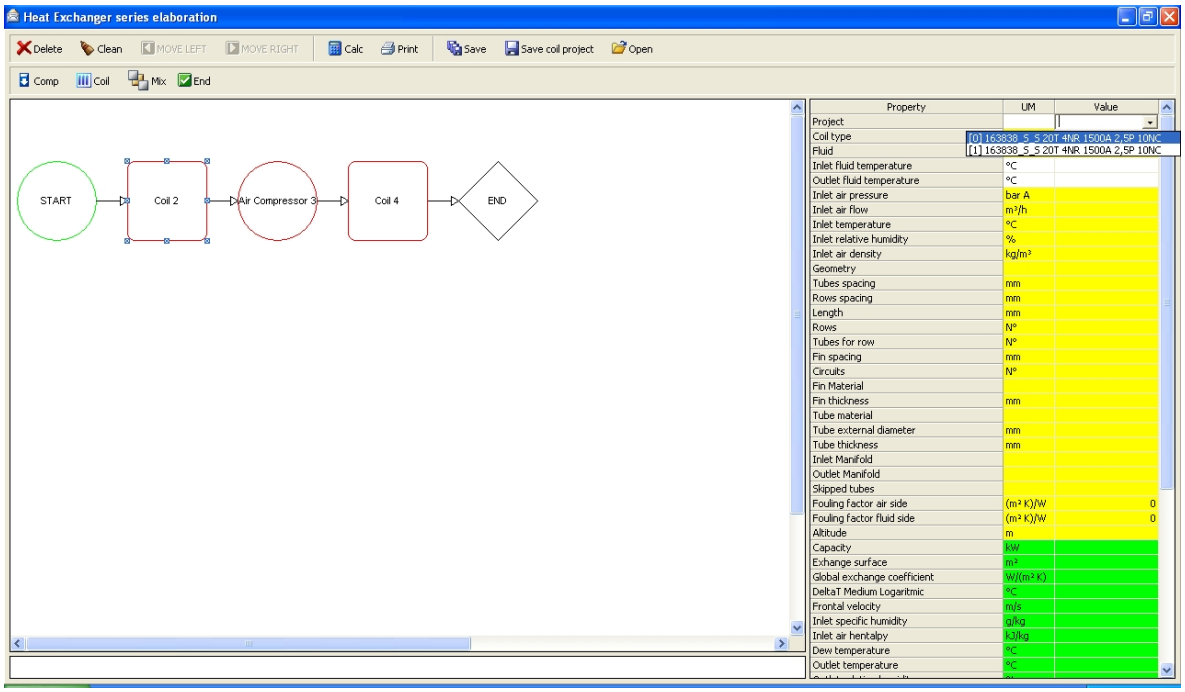


We click on “Coil 2”

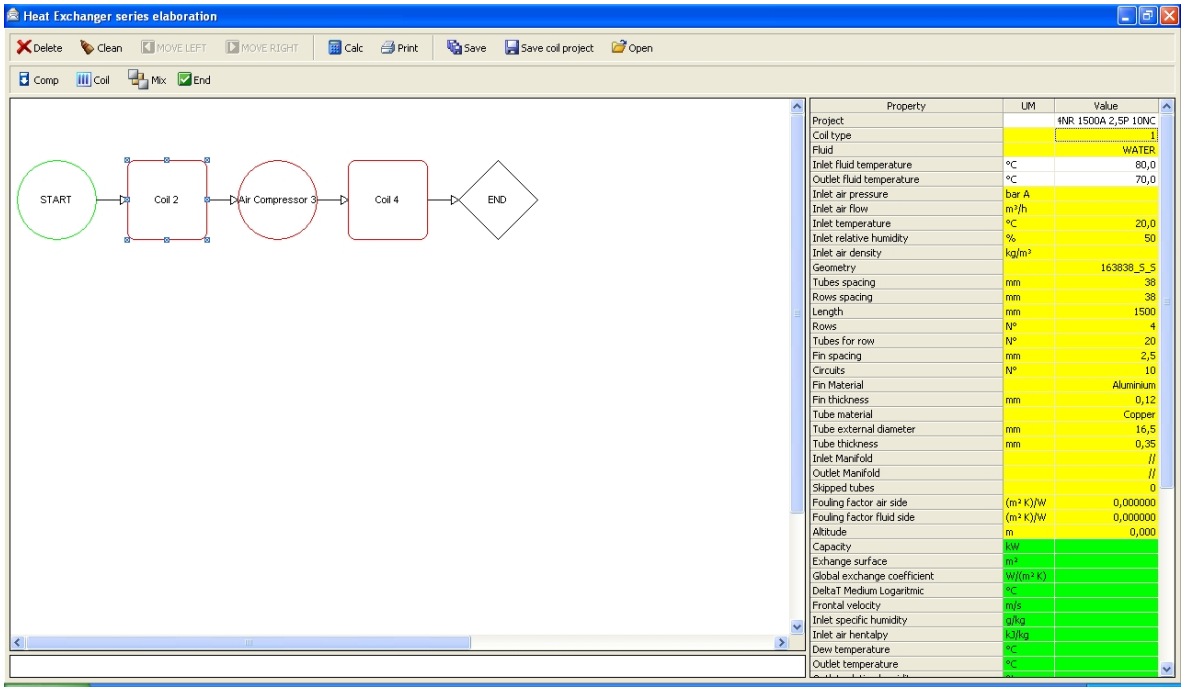


To select one of the project data we saved before we click on the “project” line into the value field

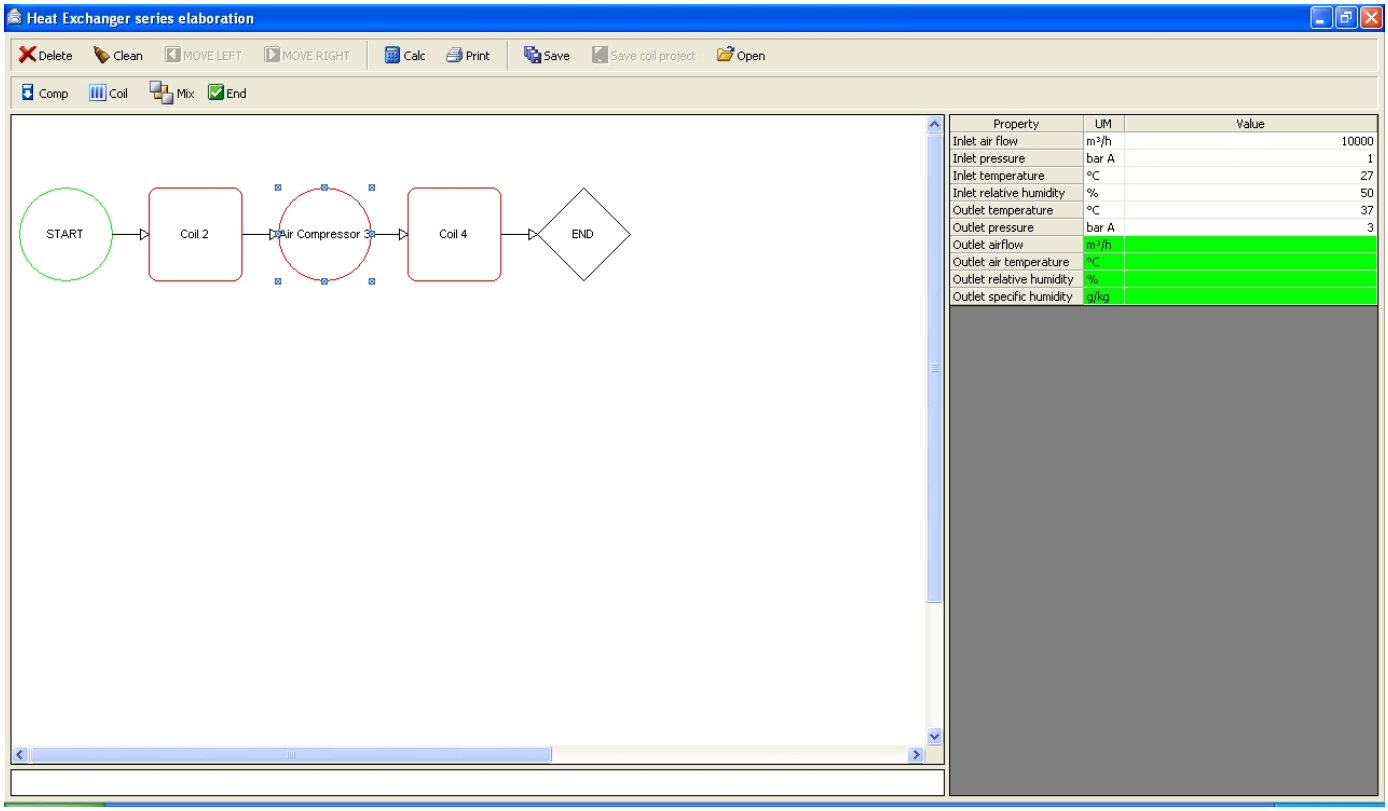
When we double click on it, we get



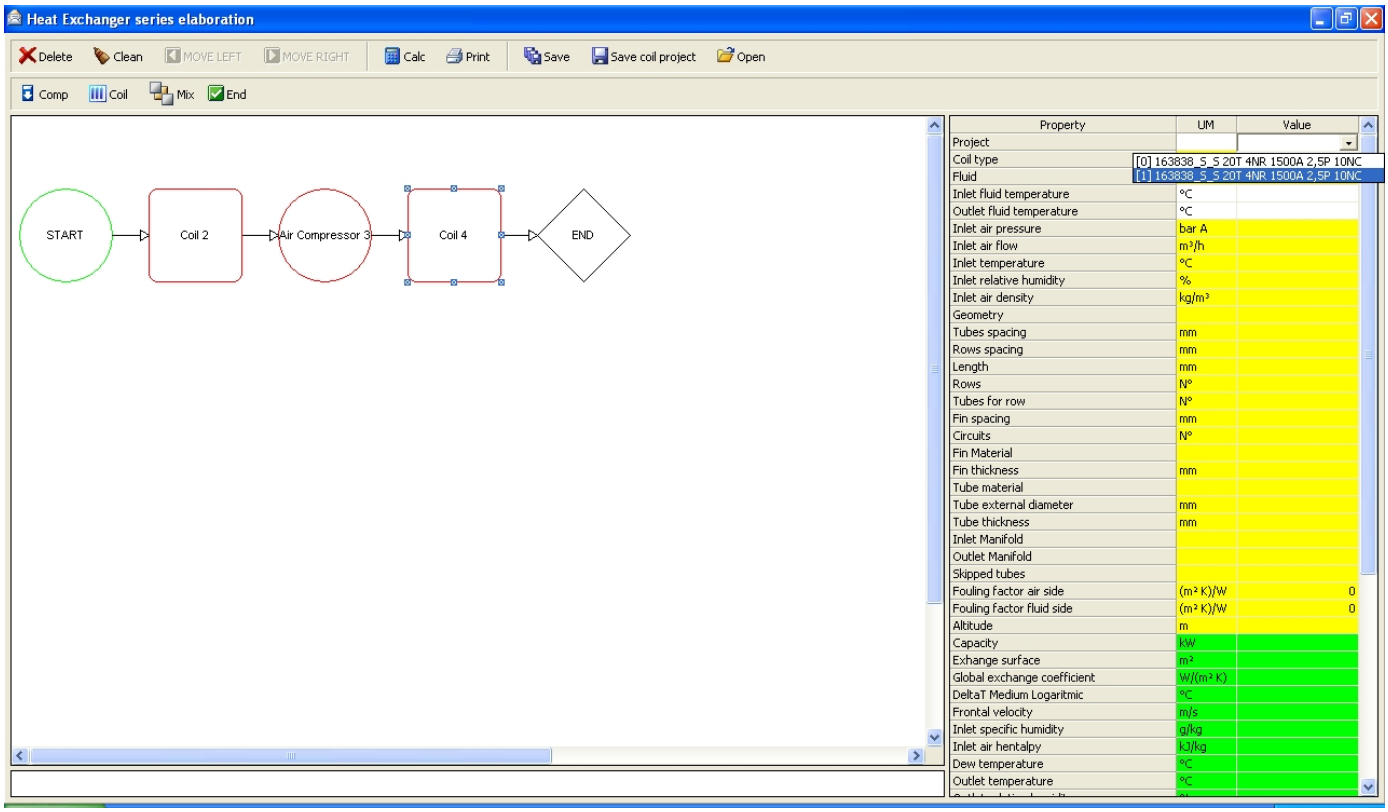
All relative data are automatically compiled (the data in yellow fields and white are input data)



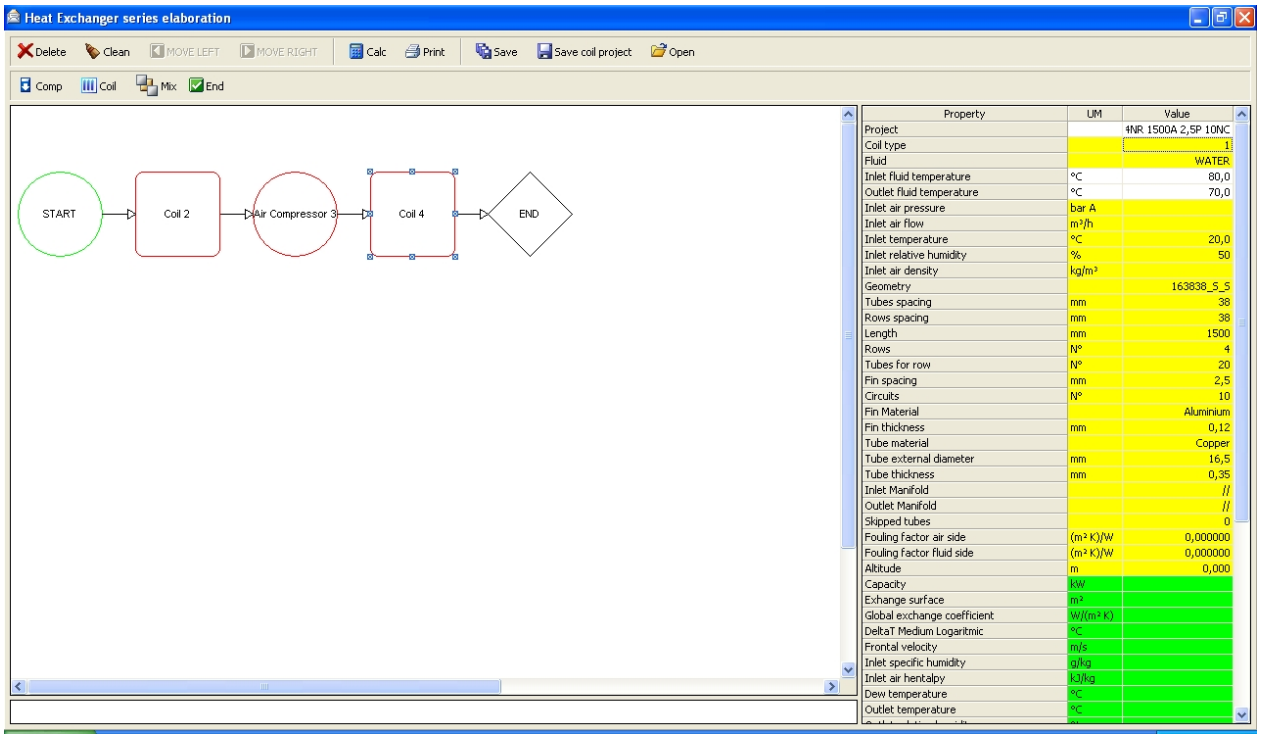
We click on “Air Compressor 3”

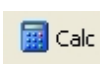


We click on “Coil 4”

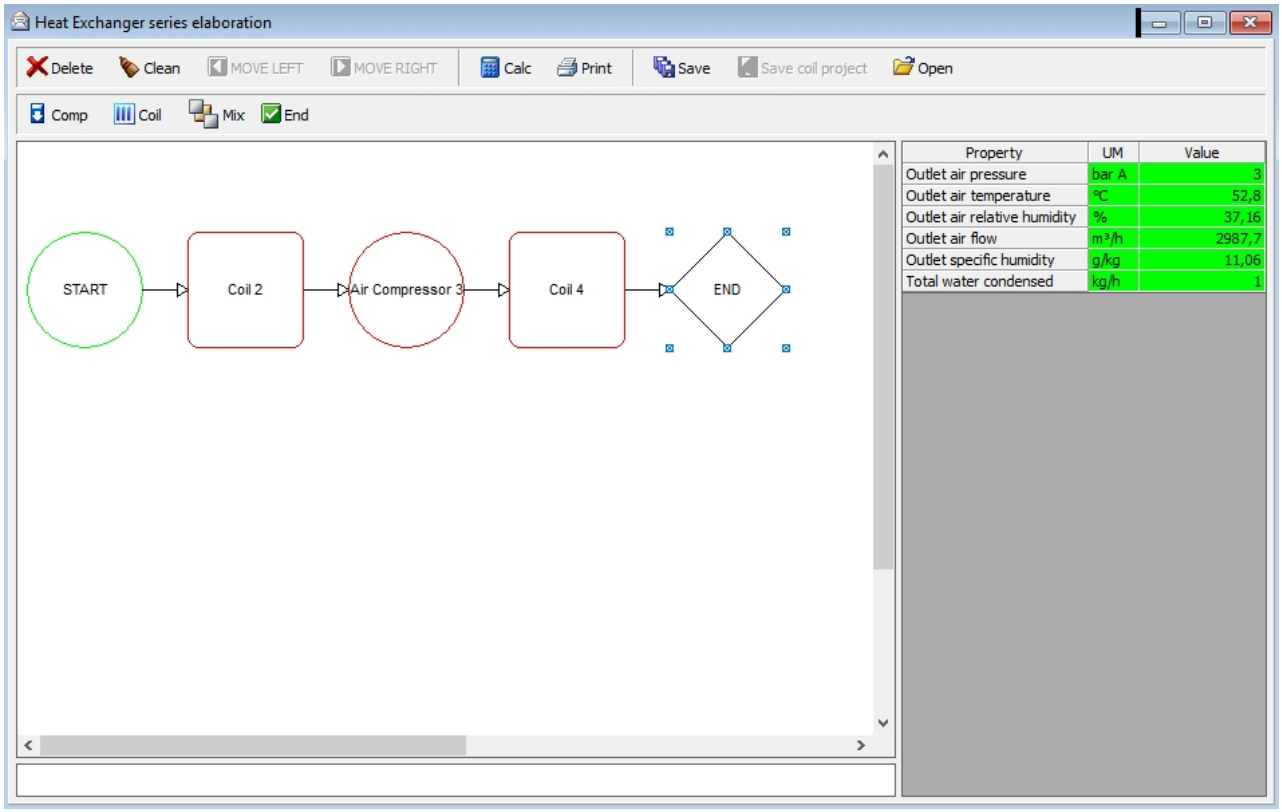


All data are automatically compiled (the data in yellow fields and white are input data)



To calculate our system we click on the 

button and get

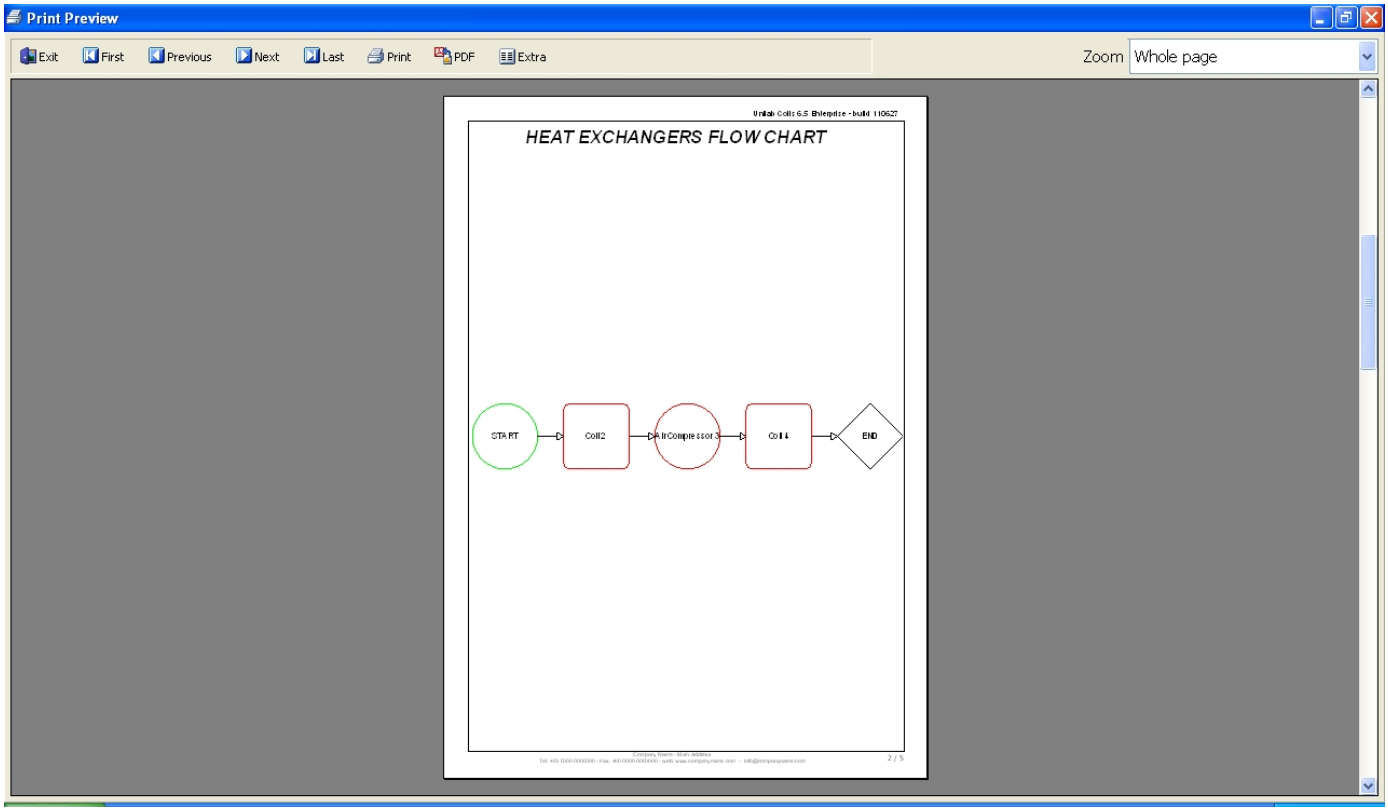


Where we can see our results

Property	UM	Value
Outlet air pressure	bar A	3
Outlet air temperature	°C	52,8
Outlet air relative humidity	%	37,16
Outlet air flow	m³/h	2987,7
Outlet specific humidity	g/kg	11,06
Total water condensed	kg/h	1

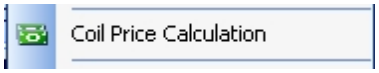
To print our calculation we click on the 

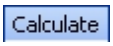
button and get

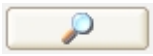


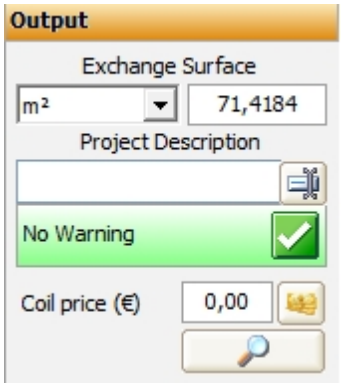
Coils Price Calculation

Coils Price Calculation

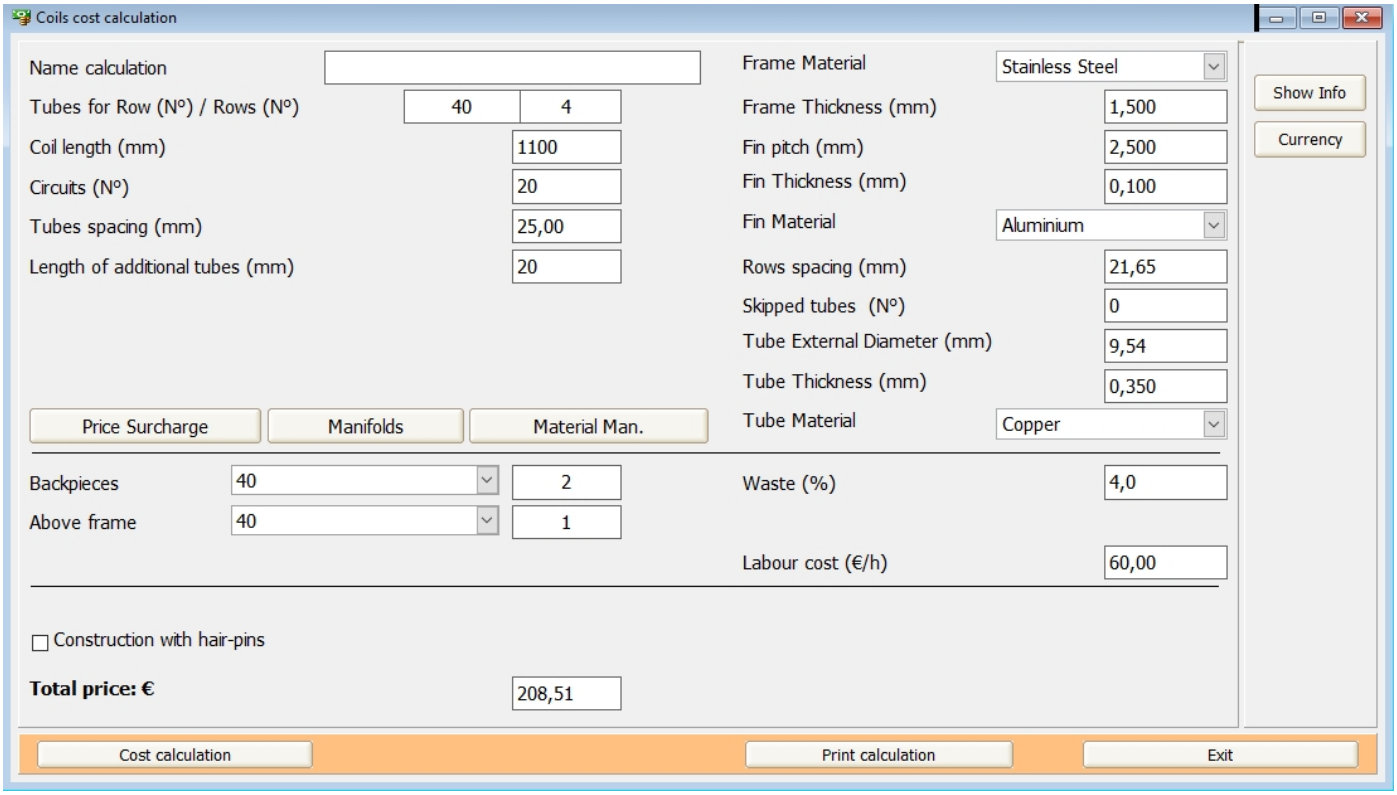
1. The "Coil Price Calculation" voice 

of the Calculate menu 

was disable: now you can click on the button  available in each project inside the "Output" section of the form:

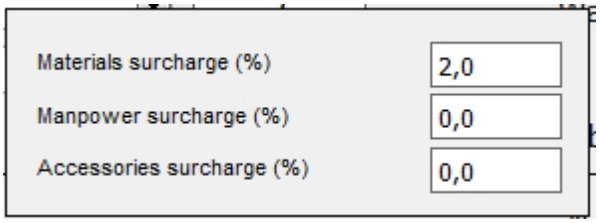


And you get:

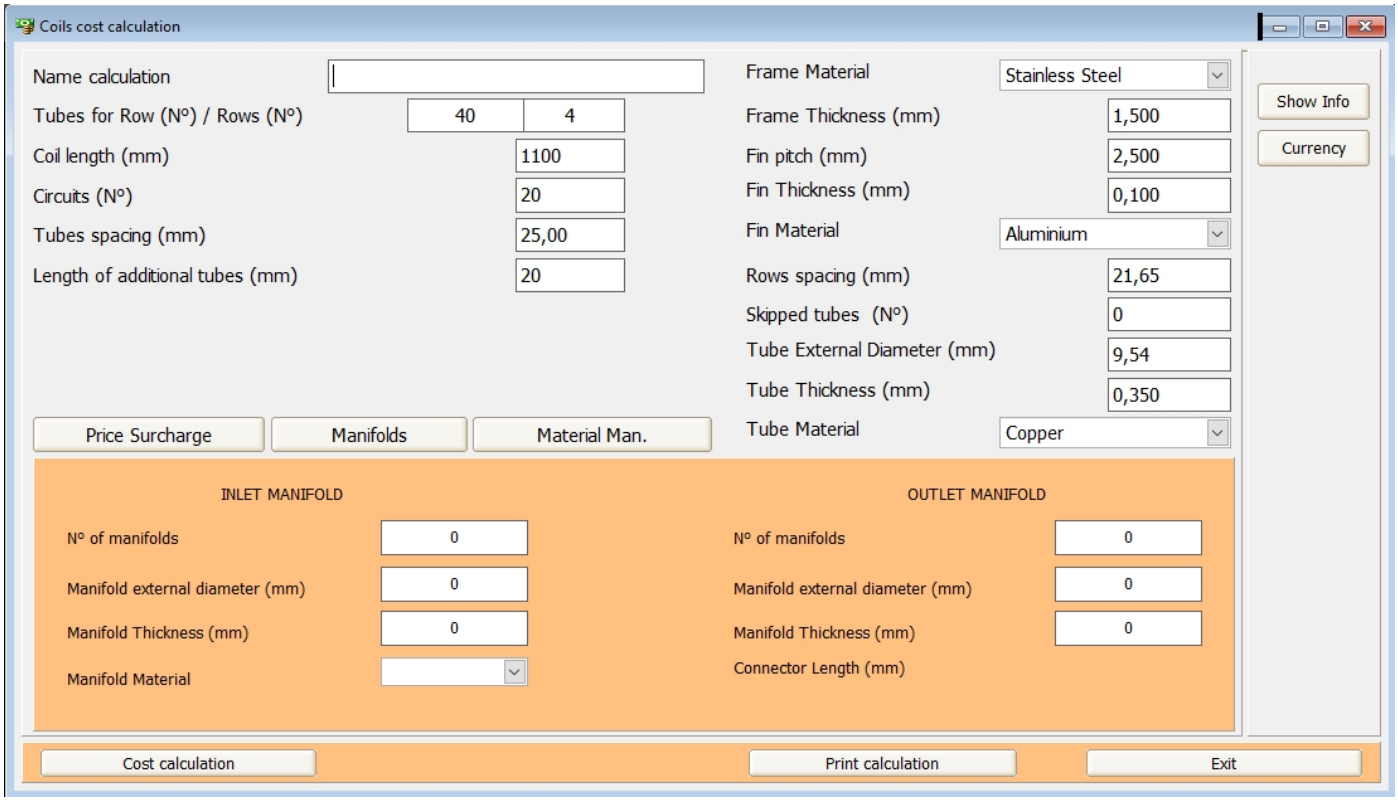


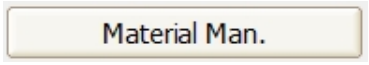
Here we fill with a name the “Name Calculation” field:

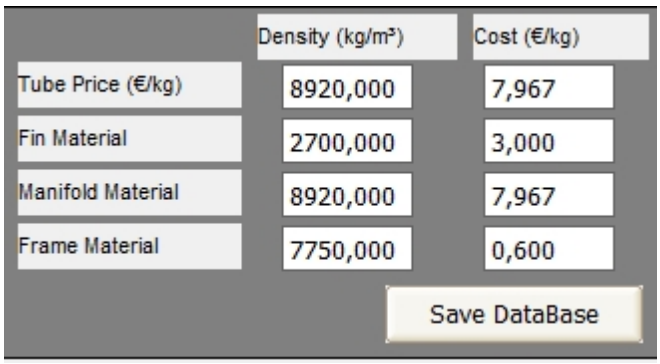
After clicking on the button “Price Surcharge”  you can set Materials, Manpower and Accessories extra costs calculated from the related costs:



After clicking on “Manifolds” button  you can set the manifolds data:

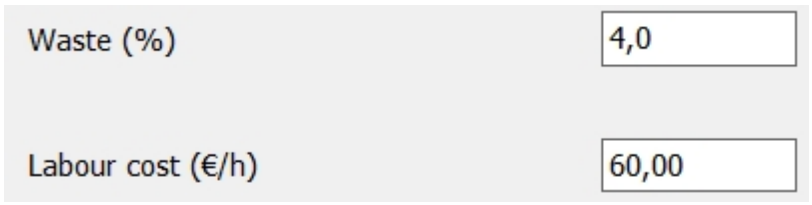


Click on “Material Man.”  you can set the cost and density for each materials:

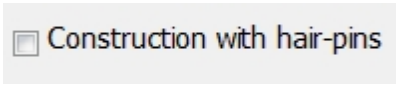


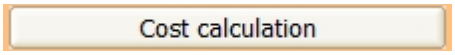
In the main mask, you see also the width of backpieces (40 mm) and the number which can be set as 0, 1 or 2:

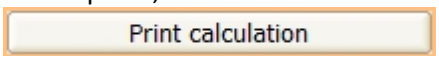
Then in the same mask, you can set the percentage of waste material, the labour cost and an extra cost to the material original cost already set in the previous step:



If we have a coil built with hair-pins, we can flag the related box:



At this point, we can click on “Cost calculation” 

and 

and we get the costs report:

Date 09/17/2018 **Reference**

Coil 25 22 40T - 4R - 1100A - 20NC Tubi ut. :160

Cost of fins material 3,00 €/kg
Cost of tubes material 7,97 €/kg
Cost of plate material 0,6000 €/kg

DESCRIPTION	THICKNESS	AMOUNT	WEIGHT	COST
TUBES	0,3500 (mm)	186 (m)	16,8 (kg)	134,00 €
FINNED PACK	0,1000 (mm)	38,1 (m²)	10,3 (kg)	30,90 €
SIDES	1,50 (mm)	0,3332 (m²)	3,87 (kg)	2,32 €
CLOSING FRAMES	1,50 (mm)	0,2273 (m²)	2,64 (kg)	1,59 €
COLLECTORS	0 (mm)	2,00 (m)	0 (kg)	0,0000 €
CURVETTES	0,3500	140 (N°)	0,4522 (kg)	3,60 €

Material	172,00 €
Labour Cost from Materials Percentage	15 %
Manpower (60,00 €/h)	25,80 €
Waste (4,00 %)	6,89 €
Total material	179,00 €
Price	205,00 €
Surcharge (2,00 %) Material	3,58 €
Surcharge (0 %) Manpower	0,0000 €
Final Price	209,00 €
Total Time (Minutes)	25,8
Weight (kg)	34,1
Total meters (tubes)	186
Price at kg	6,12
Price at meter	1,12 €/m

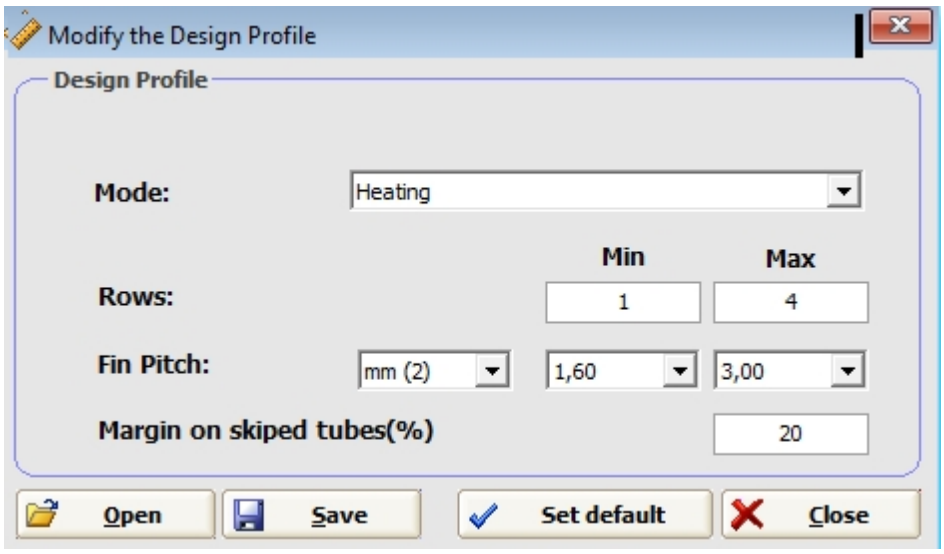
Modify The Design Profile

Modify The Design Profile

1. 

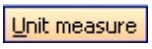
permits to set some fundamental information (like min and max

number of rows, of the fin pitch) for the each calculation mode, when you calculate in “Design”: for example, if you set min nr.of rows as 1 and max as 4, you will not get the coils with more than 4 rows among the results, and the same for fin pictch and skipped tubes.

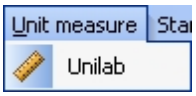


Unit Measure

Unit Measure

To set a unit measure system, we have to click on the “Unit measure” menu 

on the menu bar

And choose the system selected 

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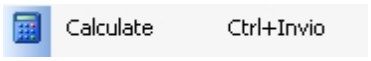
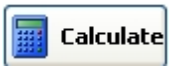
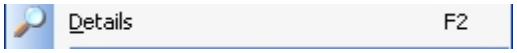
Calculate

The “Calculate” voice 

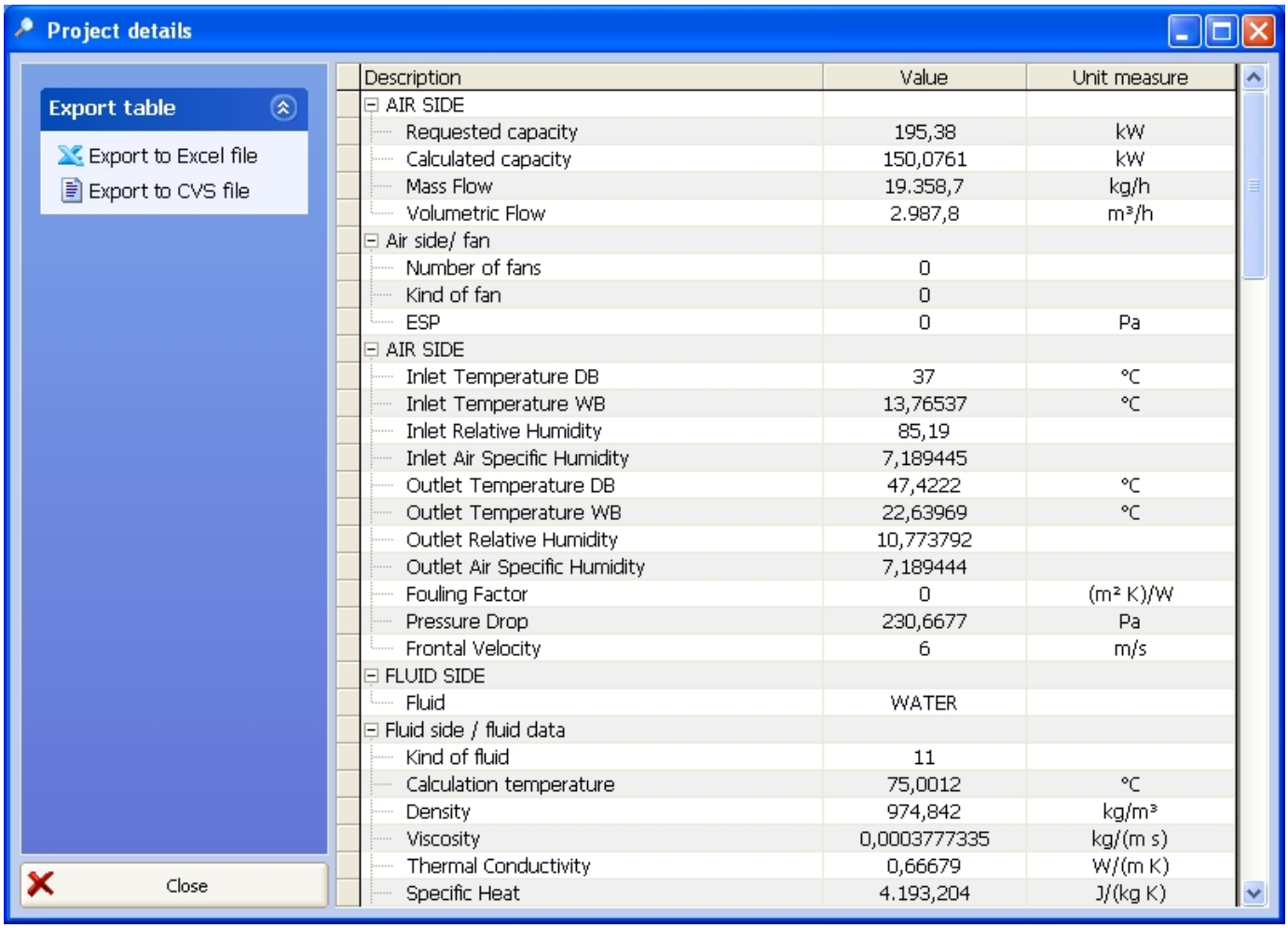
is equal to “Calculate” button 

and it executes the calculation

Details

The “Details” voice 

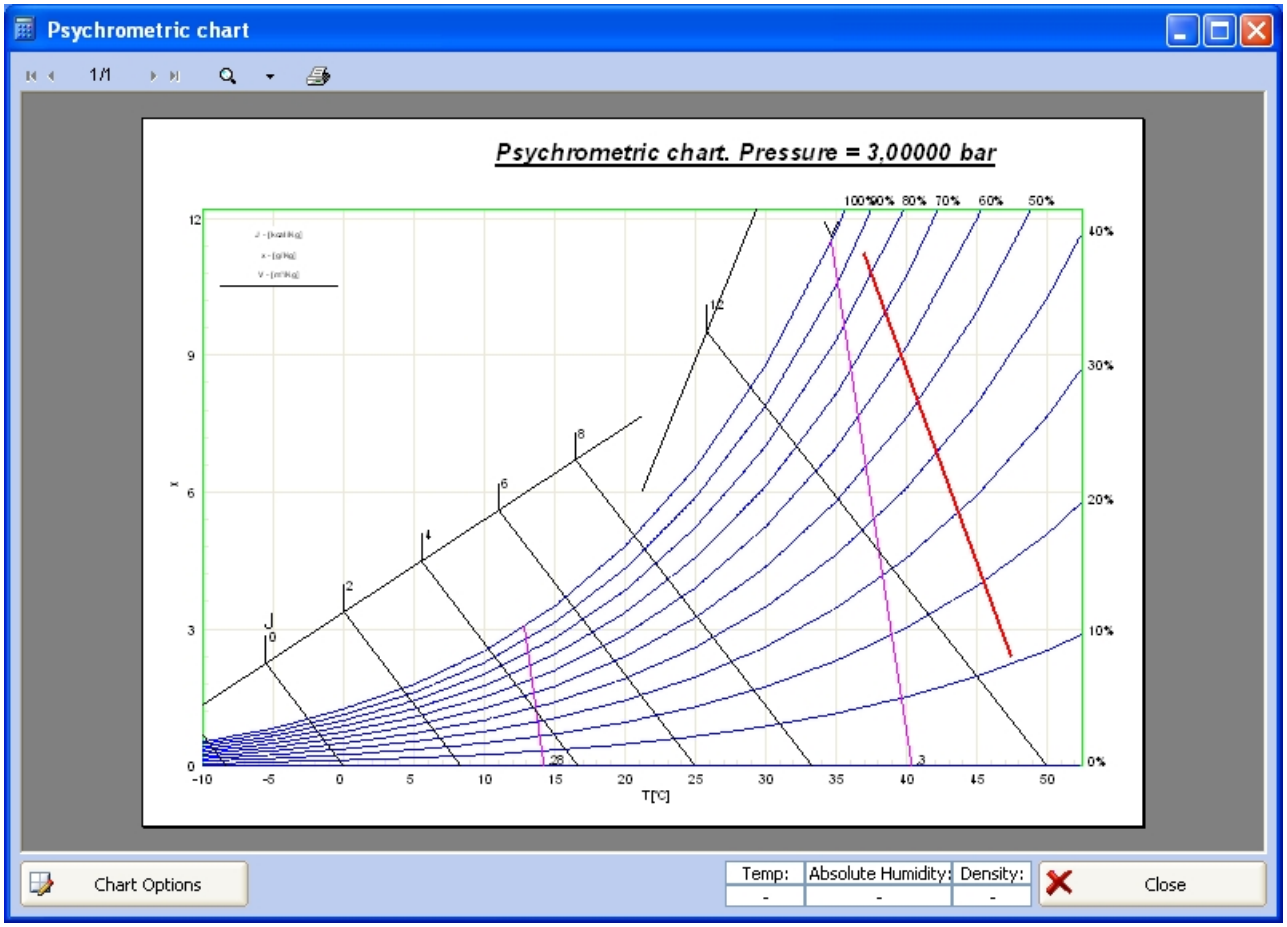
shows the following project details including all variables that We can export either to an Excel file or to cvs file



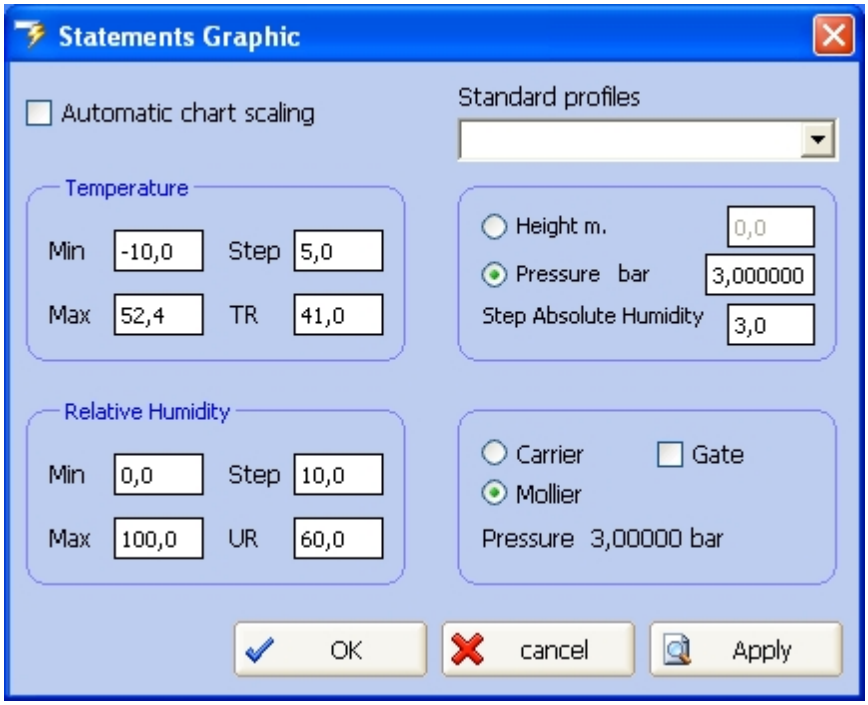
Description	Value	Unit measure
AIR SIDE		
Requested capacity	195,38	kW
Calculated capacity	150,0761	kW
Mass Flow	19.358,7	kg/h
Volumetric Flow	2.987,8	m³/h
Air side/ fan		
Number of fans	0	
Kind of fan	0	
ESP	0	Pa
AIR SIDE		
Inlet Temperature DB	37	°C
Inlet Temperature WB	13,76537	°C
Inlet Relative Humidity	85,19	
Inlet Air Specific Humidity	7,189445	
Outlet Temperature DB	47,4222	°C
Outlet Temperature WB	22,63969	°C
Outlet Relative Humidity	10,773792	
Outlet Air Specific Humidity	7,189444	
Fouling Factor	0	(m² K)/W
Pressure Drop	230,6677	Pa
Frontal Velocity	6	m/s
FLUID SIDE		
Fluid	WATER	
Fluid side / fluid data		
Kind of fluid	11	
Calculation temperature	75,0012	°C
Density	974,842	kg/m³
Viscosity	0,0003777335	kg/(m s)
Thermal Conductivity	0,66679	W/(m K)
Specific Heat	4.193,204	J/(kg K)

Psychrometric chart

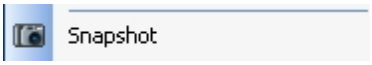
1. The “Psychrometric chart” shows the following



Where can also set other options by clicking “Chart Options”

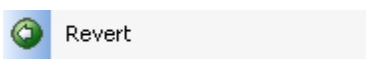


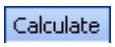
Snapshot

The “Snapshot” voice 

permits to have a snapshot of the screen

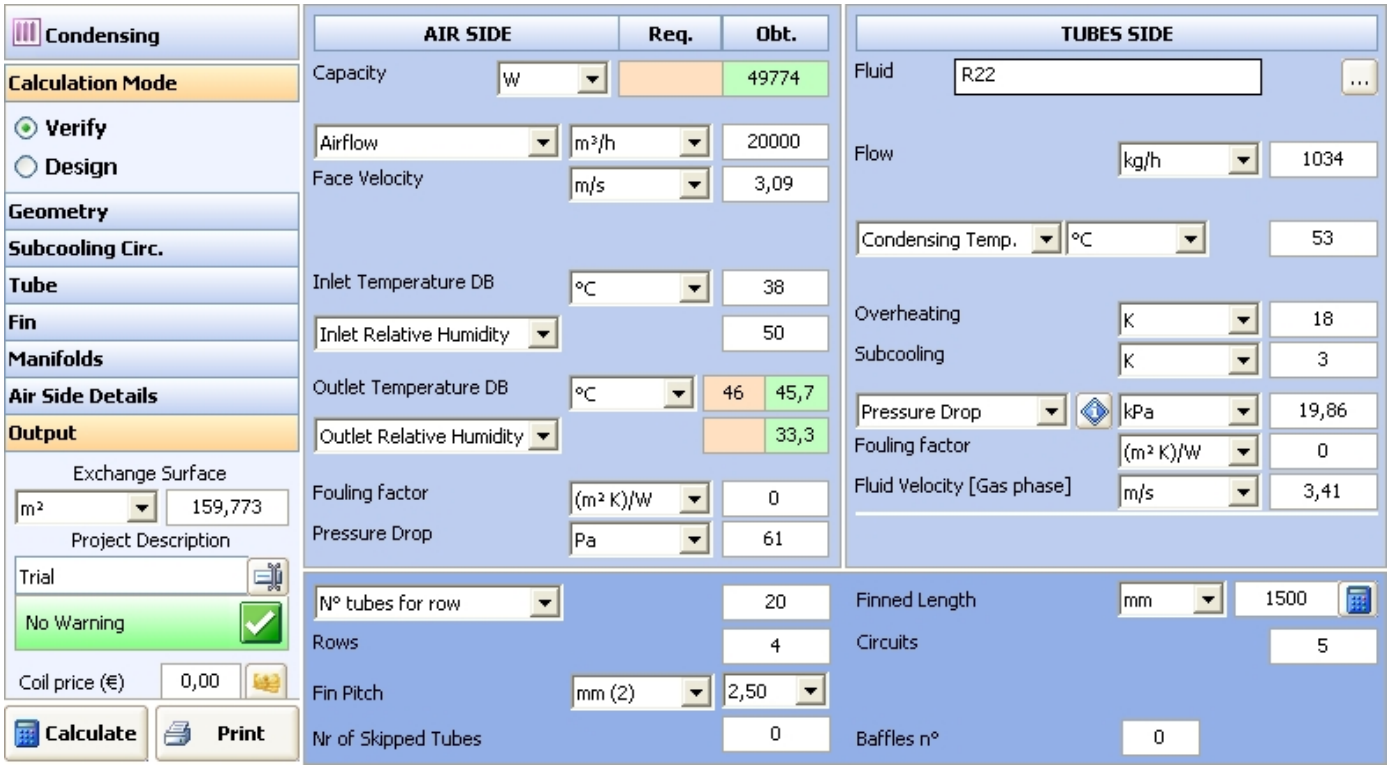
Revert

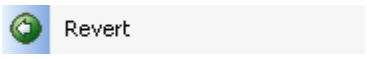
5. The “Revert” voice 

of the Calculate menu 

permits to go back to a

condition, saved like a snapshot, before the calculation



the above screen is shown before clicking the “Revert” voice 

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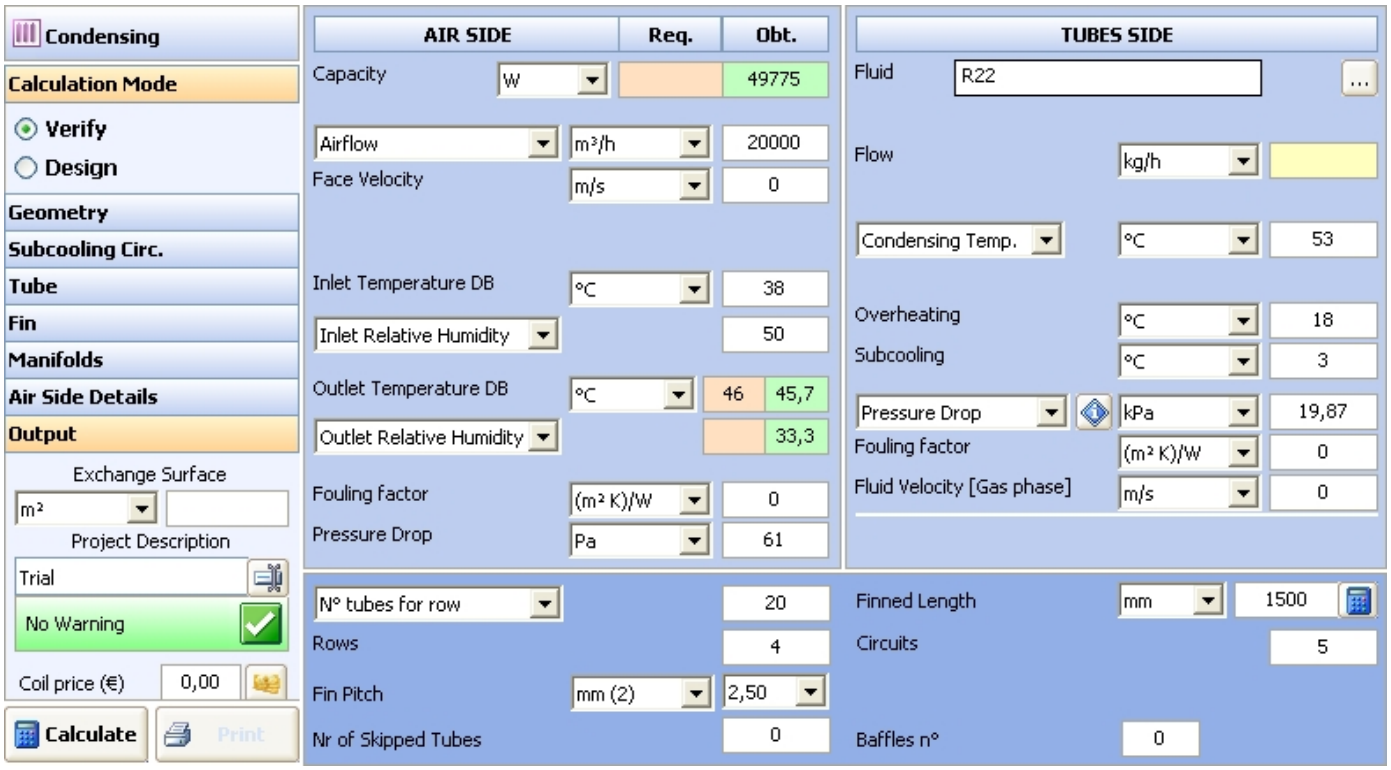
The screen after the revert voice is chosen, as you can see, the Face Velocity is set to 0 m/s.



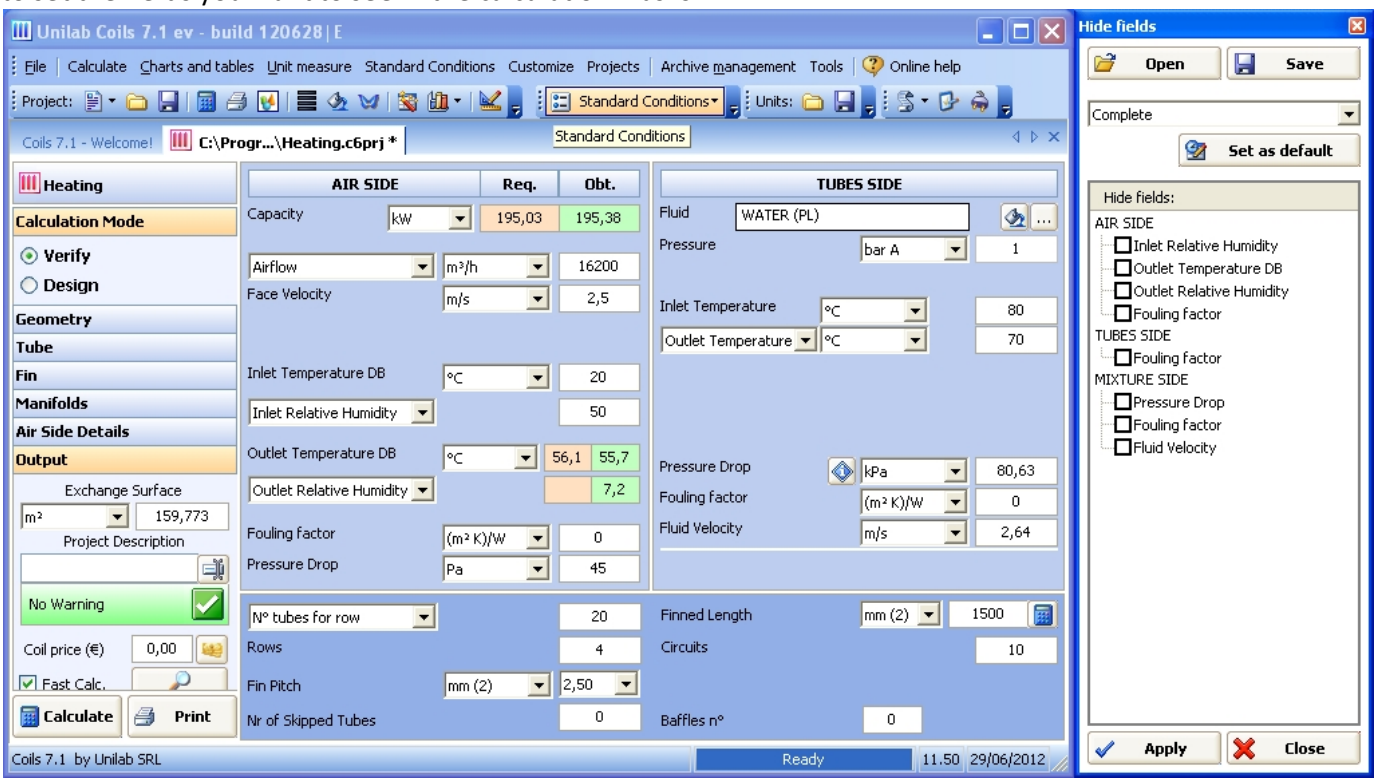
CUSTOMIZE

CUSTOMIZE

The “Hide Fields” button 

on the “Customize” menu 

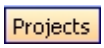
on the top of the mask, allows to set the fields you want to see in the calculation masks.



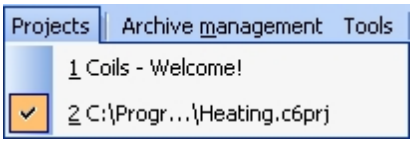
You can select the fields you want to hide for the particular mode of the coil (heating, cooling, etc.) and save this setting to open it in a future calculation.

PROJECTS

PROJECTS

The “Projects” menu 

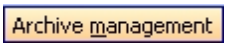
shows only the currently open projects

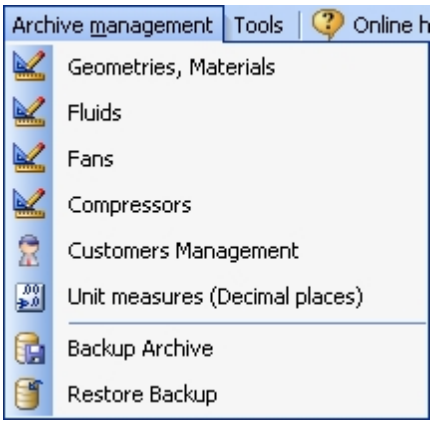


ARCHIVE MANAGEMENT

ARCHIVE MANAGEMENT

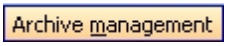
In this section, we will see how we can work with various archives of our software.

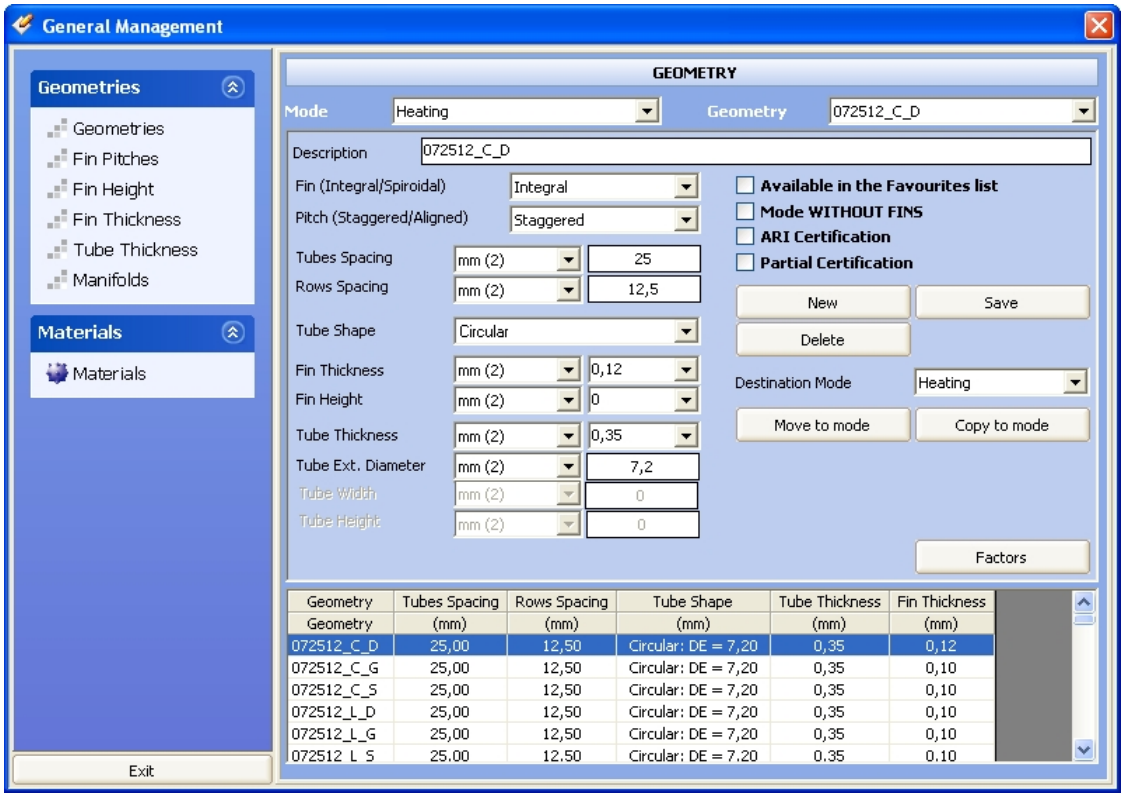
- Let's click on the "Archive management"  on the menu bar.



Geometries, Materials

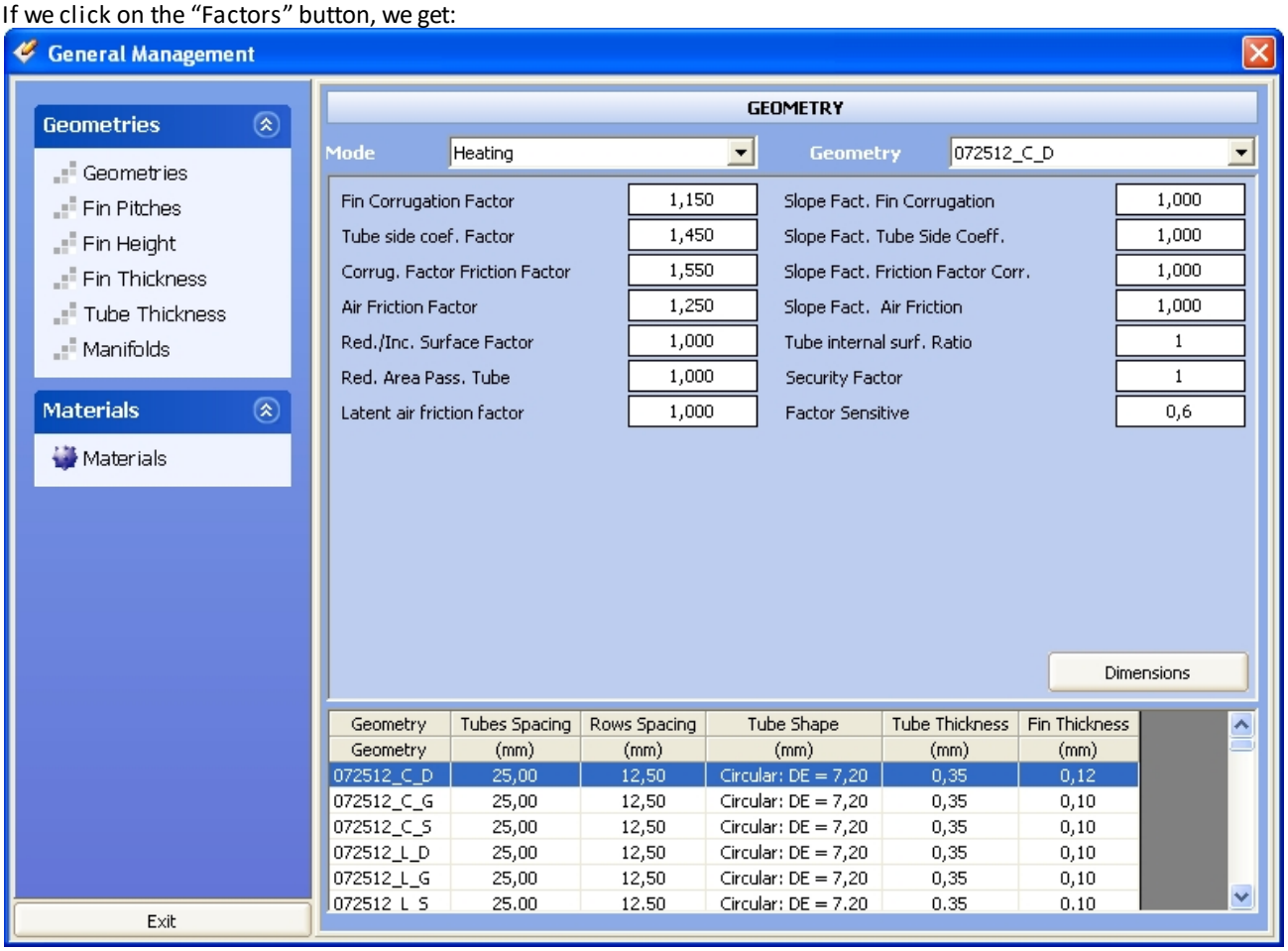
Geometries, Materials

- Let's click on  of the "Archive management" menu 



where we can add, delete or modify data relative to geometries and materials.

If we click on the "Factors" button, we get:



Here we can specify the factors related to the geometry. These factors are:

Fin corrugation factor/slope: this parameter, defined as fin corrugation factor, represents the ratio (with the same air frontal velocity) between the exchange coefficient of a corrugated finned coil, and the corresponding exchange coefficient of a plain fin coil. This value is equal to 1 for plain fin. For further corrugation cases, the factors must be experimentally determined.

Tube side coef. factor/slope: this parameter, defined as "coefficient factor inside tubes/slope", represents the ratio between the real exchange coefficient of internal tubes and the ideal one. This value is equal to 1 for cylindrical tubes with internal plain surface. For further cases, the factor must be experimentally determined

Correction factor of friction factor/slope: this parameter, defined as "correction factor of friction factor/slope", represents the ratio between the real tubes internal side friction factor and the ideal one. This value is equal to 1 for cylindrical tubes with internal plain surface. For further cases, the factor must be experimentally determined.

Friction factor air side/slope: this parameter, defined as "friction factor air side/slope", represents the ratio between the real tubes external side friction factor and the ideal one. This value is equal to 1 for plain fins. For further cases, the factor must be experimentally determined.

"Slope" factors the coefficient of proportionality in logarithmic coordinates between the item at issue (fin etc...) and the related fluid speed. This parameter enables the user to find the correction factor in function of speed.

Red/Inc Surface factor: this parameter, defined as the surface reduction/increase factor, is a nondimensional parameter which considers the possible calculation differences of the exchange surface. This factor permits to analyze those cases in which the geometry parameters are not constant, such as differentiated spacing coils (typical for direct expansion coils at very low temperature) or differentiated fin height coils.

Reduction Area Pass. Tube: this parameter, defined as "tube passage reduction area", permits to consider possible elements which may reduce the fluid passage area. The value goes from 0 to 1.

Latent air friction factor this factor applies specifically to calculations with dehumidification. In this type of application the fin is covered by water, which makes an increment on the air side pressure drops, calculated by a specific equation. This factor lets you trim the behavior of this equation.

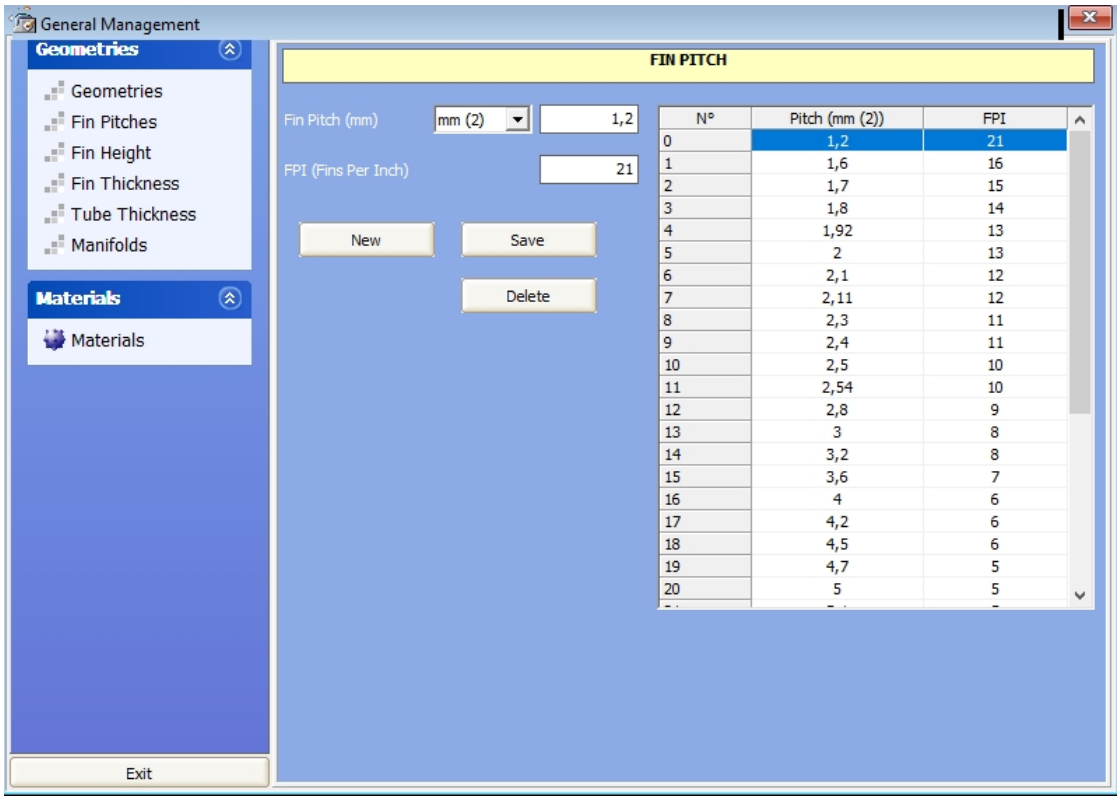
Tube internal surface ratio this parameter applies to grooved tubes and it lets you specify the ratio of the internal surface calculated like (Internal Grooved Surface / Internal Smooth Surface). This parameter is very important when the controlling resistance is tubes side. For a detailed explanation, please see the FAQ called "Considerations about grooved tubes" at the end of the manual.

Security factor this parameter affects the entire calculation, and lets you increase or decrease the performance of the coil. It's intended to be a factor to gain some security margin.

Sensible factor this parameter affects the sensible capacity of the coil. The standard value is 0.6 and it is not proportional.

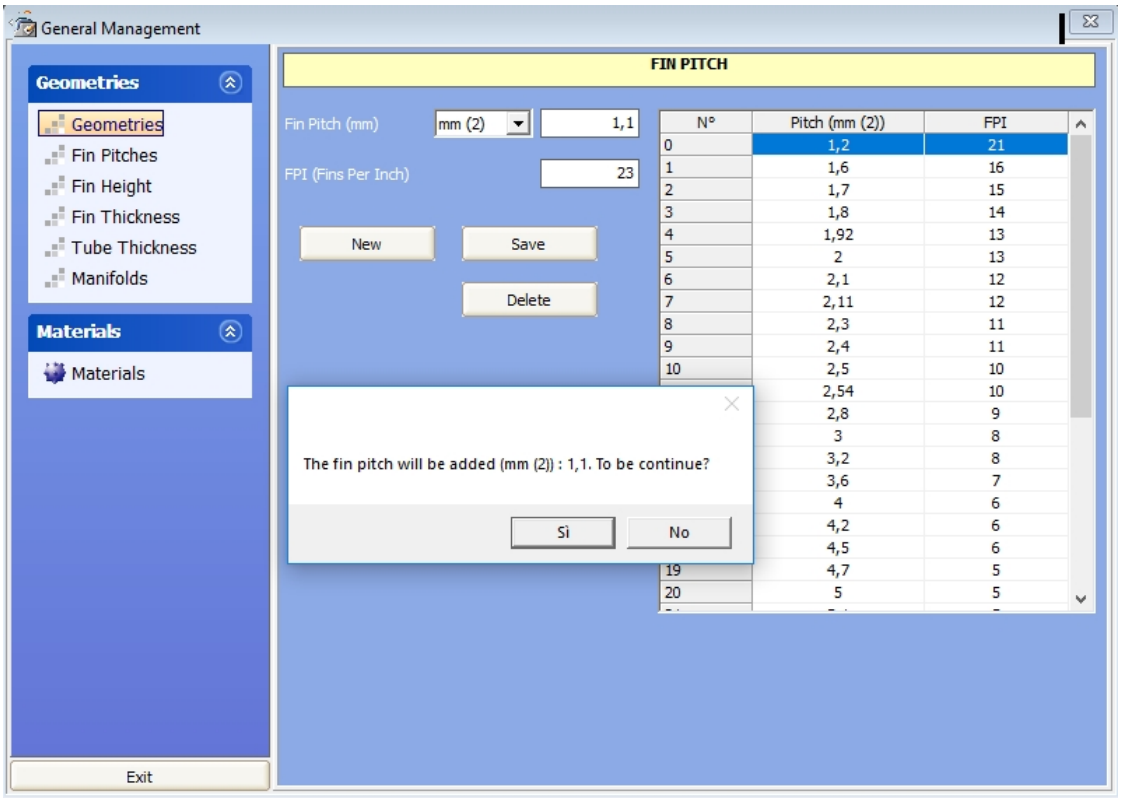
All the above factors can have a positive effect on the calculation only if obtained by laboratory test. They should not be used to trim performances of the coils without knowing the possible consequences

- Let's click on the "Fin Pitches" option 

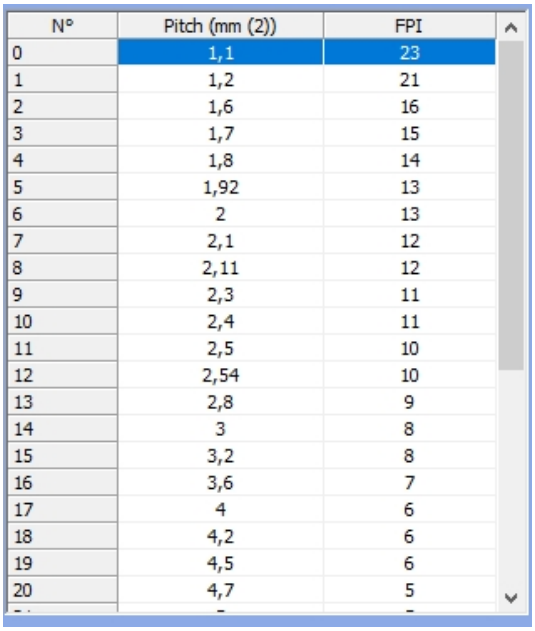


We have a possibility to add / delete Fin Pitch.

- Let's add a pitch of 1,1 mm by writing "1,1" in the box relative to the Fin Pitch

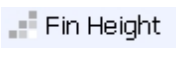


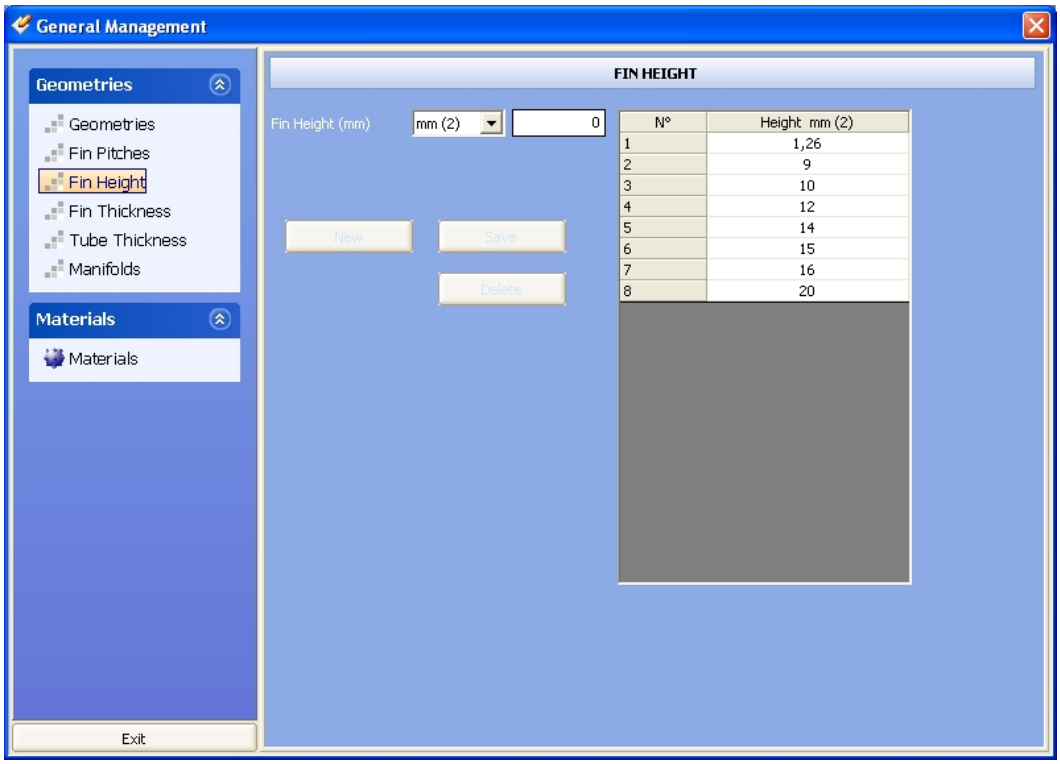
- of course, to continue let's click "Yes" ("Sì"), otherwise click "No"
- We can see the pitch We have just added the 1,1 pitch

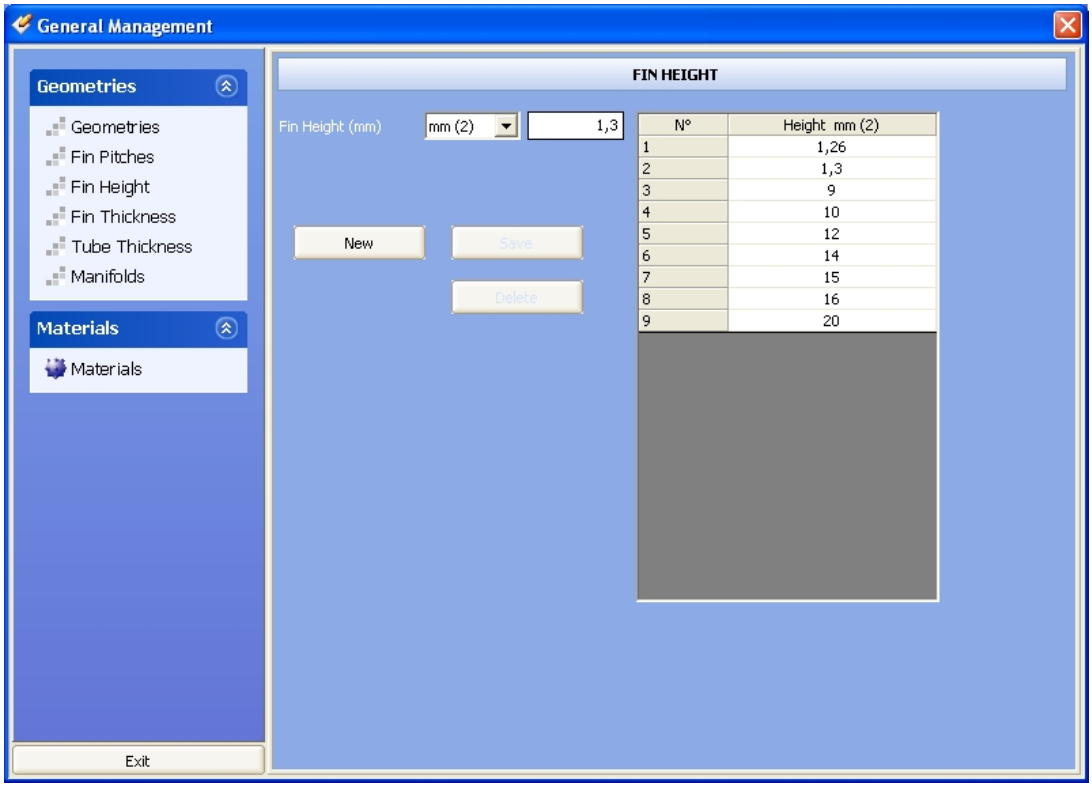


N°	Pitch (mm (2))	FPI
0	1,1	23
1	1,2	21
2	1,6	16
3	1,7	15
4	1,8	14
5	1,92	13
6	2	13
7	2,1	12
8	2,11	12
9	2,3	11
10	2,4	11
11	2,5	10
12	2,54	10
13	2,8	9
14	3	8
15	3,2	8
16	3,6	7
17	4	6
18	4,2	6
19	4,5	6
20	4,7	5

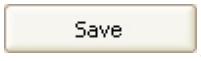
- instead if we want to overwrite an already existing pitch, it's just a matter of clicking on the pitch to be overwritten inserting the value in the pitch box and click on the "Save" button

  - Here is the "Fin Height" option 

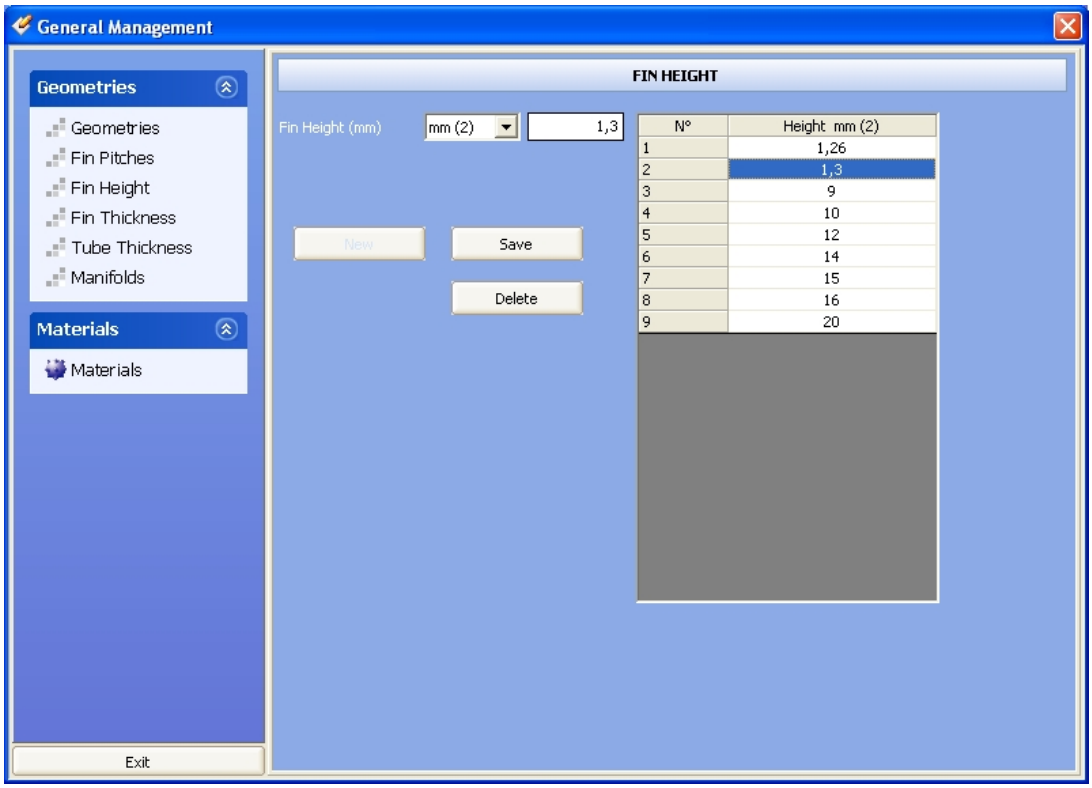




Here again to add a new Height to see in the main program , we have to insert the value in the Fin Height box, then click on the "New" button 

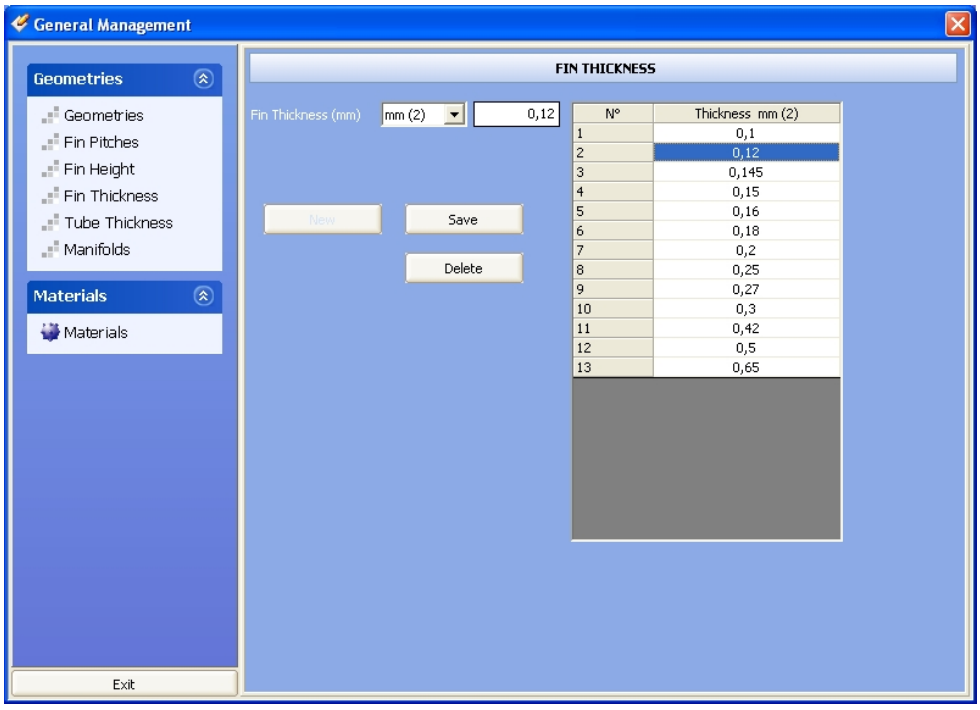
. To replace an already existing Height, just insert the value in the box, then we click on "Save" button 

.

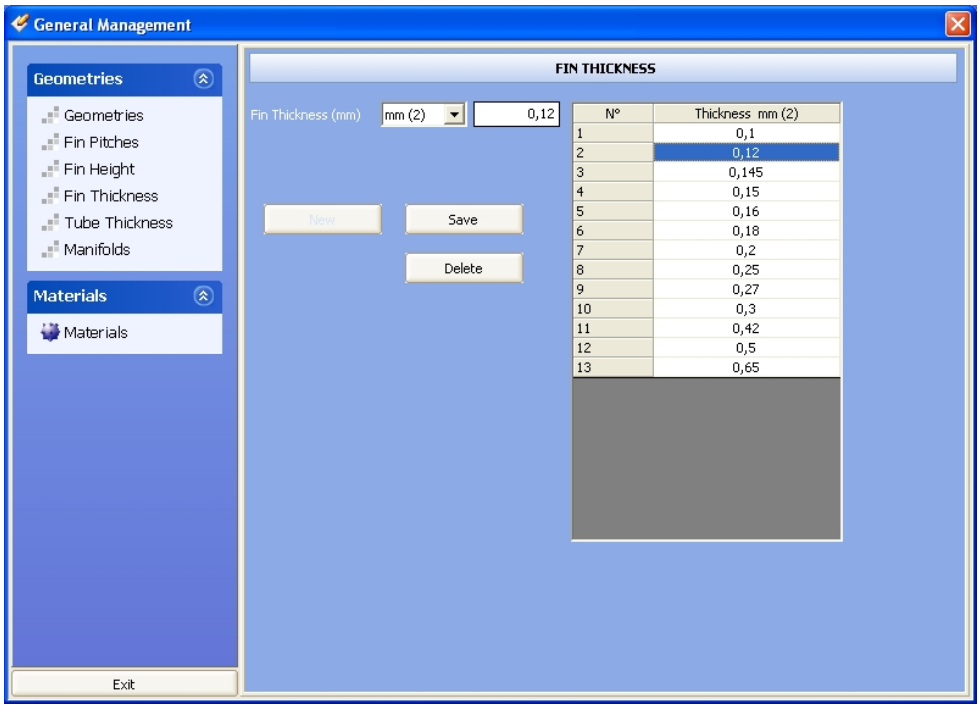


to delete a value , just click on it and then click on the "Delete" button Delete .

- Fin Thickness Fin Thickness

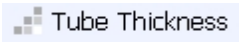


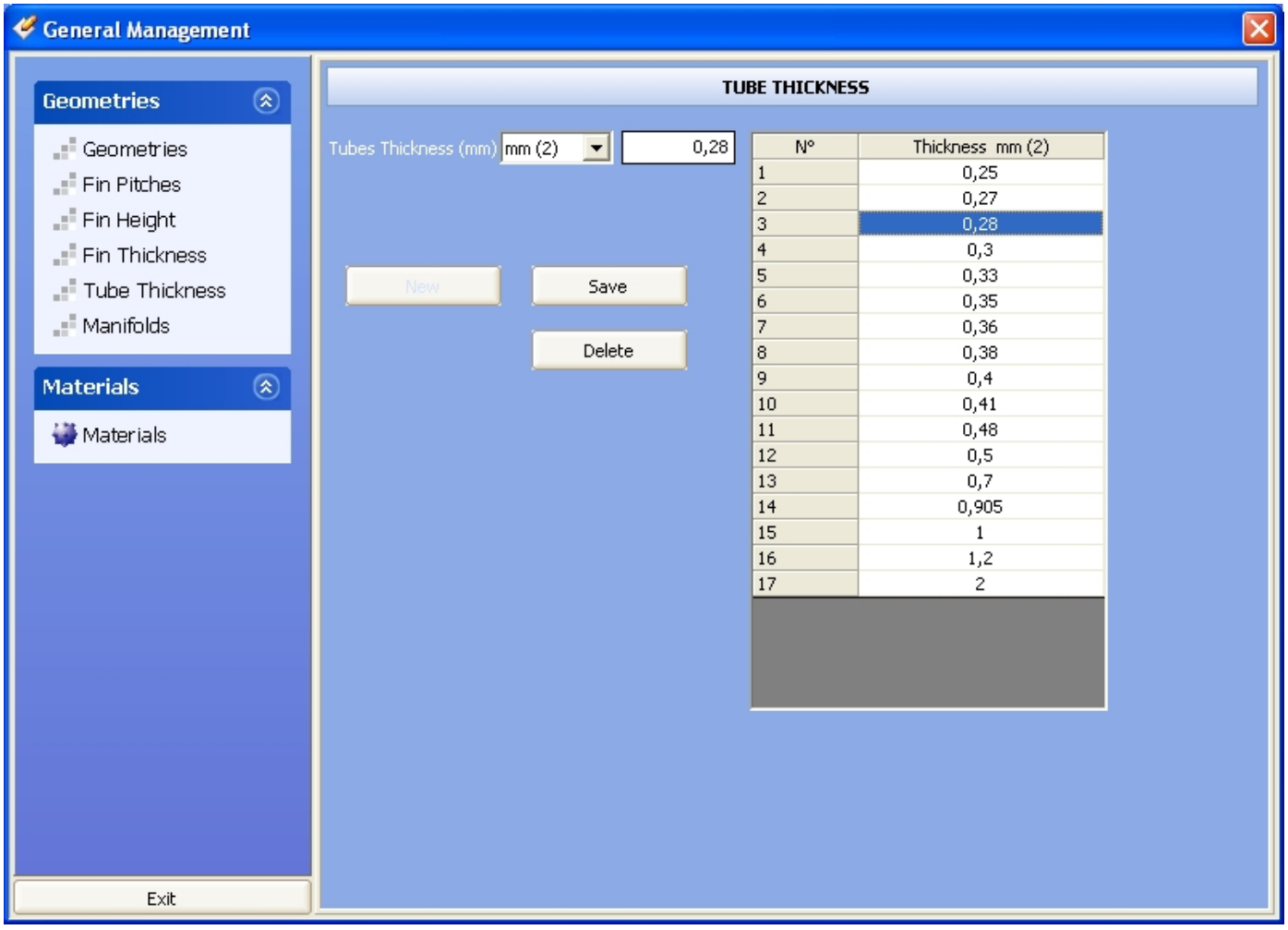
Here again to add a new Thickness to see in the main program , we have to insert the value in the Fin Thickness box, then click on the "New" button New . *To replace an already existing Thickness, just insert the value in the box, then we click on "Save" button* Save .



to delete a value , just click on it and then click on the "Delete" button 

.

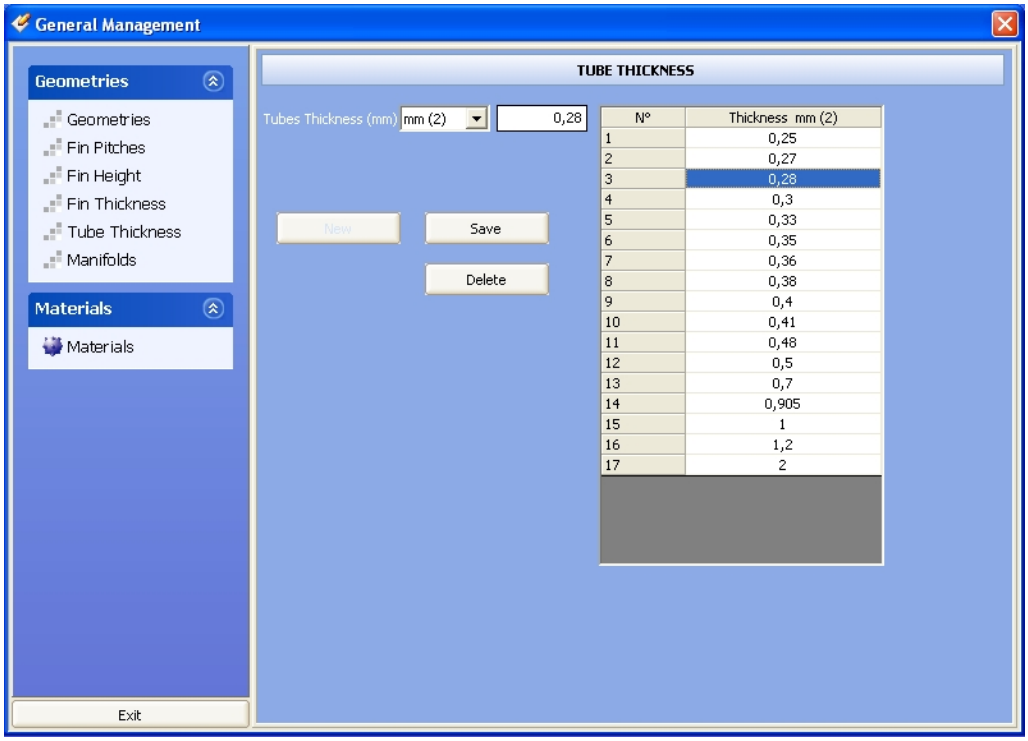
- Tube Thickness 



Here again to add a new Thickness to see in the main program , we have to insert the value in the Tubes Thickness box, then click on the "New" button 

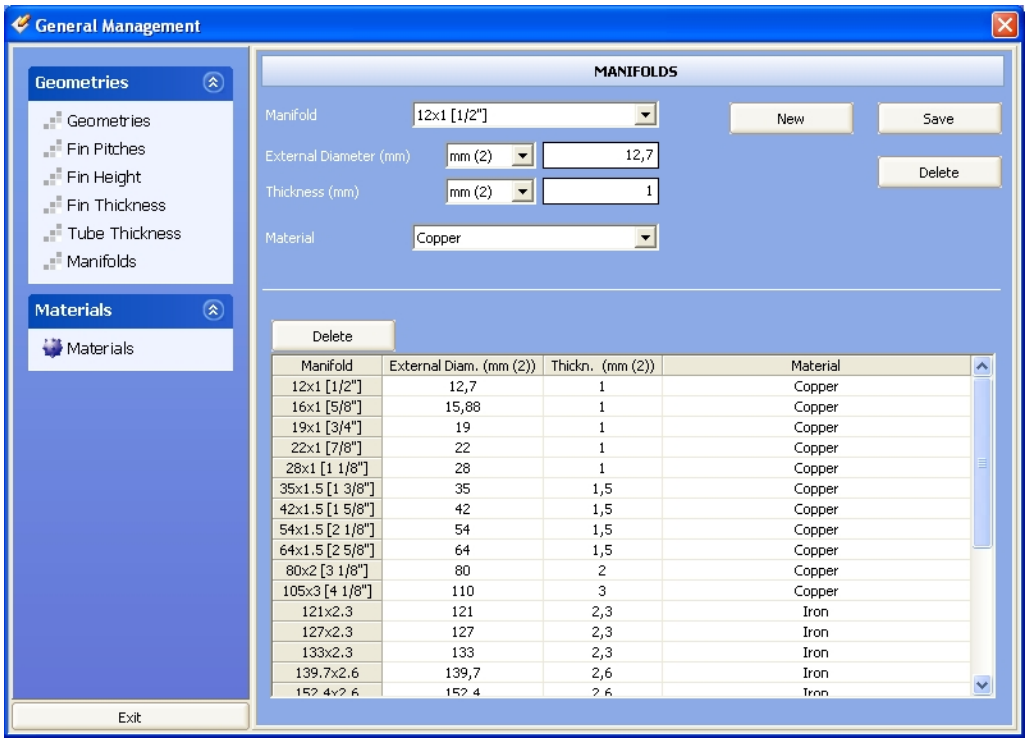
. To replace an already existing Thickness, just

insert the value in the box, then we click on "Save" button Save .



to delete a value , just click on it and then click on the "Delete" button Delete .

- The Manifolds option Manifolds is shown below

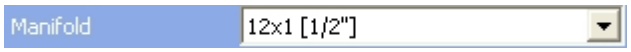


Here we can manage the data of the manifolds to use in the main program. With the button New you can insert a new manifold and the relative data.

With the button Save you can modify the data of the manifold selected in the combo

Manifold 12x1 [1/2"] .

The button Delete in the higher section of the mask, allows to delete the manifold selected in the combo

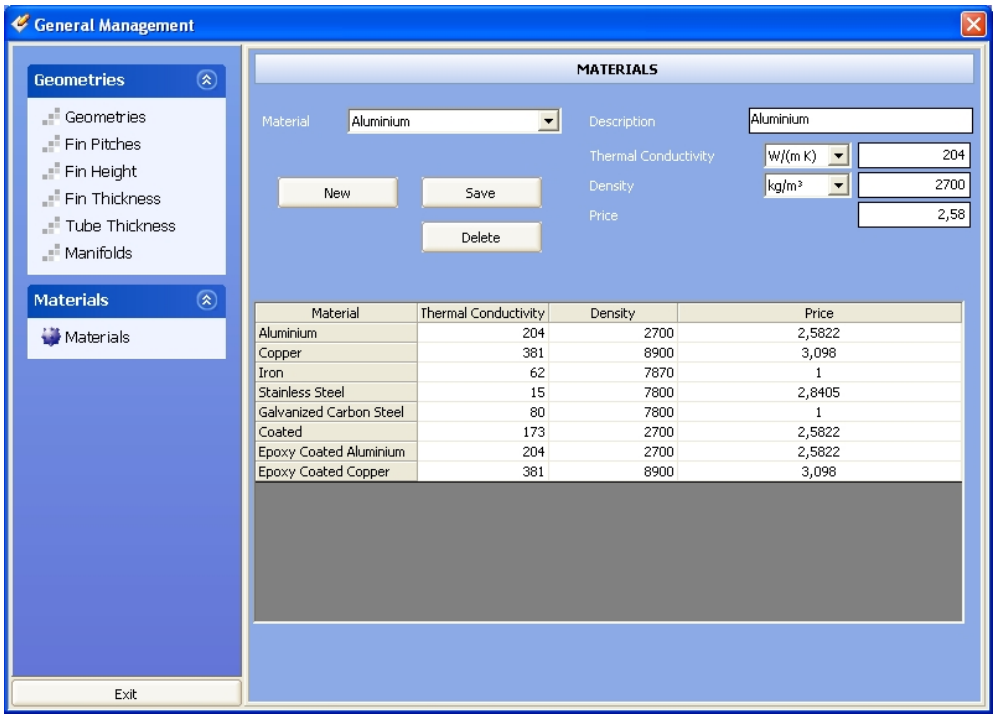


The other button 

, just above the table, containing the complete list of manifolds saved in the archive, allows to delete the manifold selected in the table

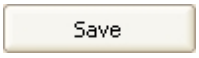
Manifold	External Diam. (mm (2))	Thickn. (mm (2))	Material
12x1 [1/2"]	12,7	1	Copper
16x1 [5/8"]	15,88	1	Copper
19x1 [3/4"]	19	1	Copper
22x1 [7/8"]	22	1	Copper
28x1 [1 1/8"]	28	1	Copper
35x1.5 [1 3/8"]	35	1,5	Copper
42x1.5 [1 5/8"]	42	1,5	Copper
54x1.5 [2 1/8"]	54	1,5	Copper
64x1.5 [2 5/8"]	64	1,5	Copper
80x2 [3 1/8"]	80	2	Copper
105x3 [4 1/8"]	110	3	Copper
121x2.3	121	2,3	Iron
127x2.3	127	2,3	Iron
133x2.3	133	2,3	Iron
139.7x2.6	139,7	2,6	Iron
152.4x2.6	152.4	2.6	Iron

- The “Materials” voice



Here we can manage the data of the materials to use in the main program. With the button 

you can insert a new material and the relative data.

With the button 

you can modify the data of the material selected in the combo 

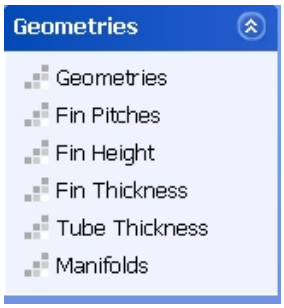
.

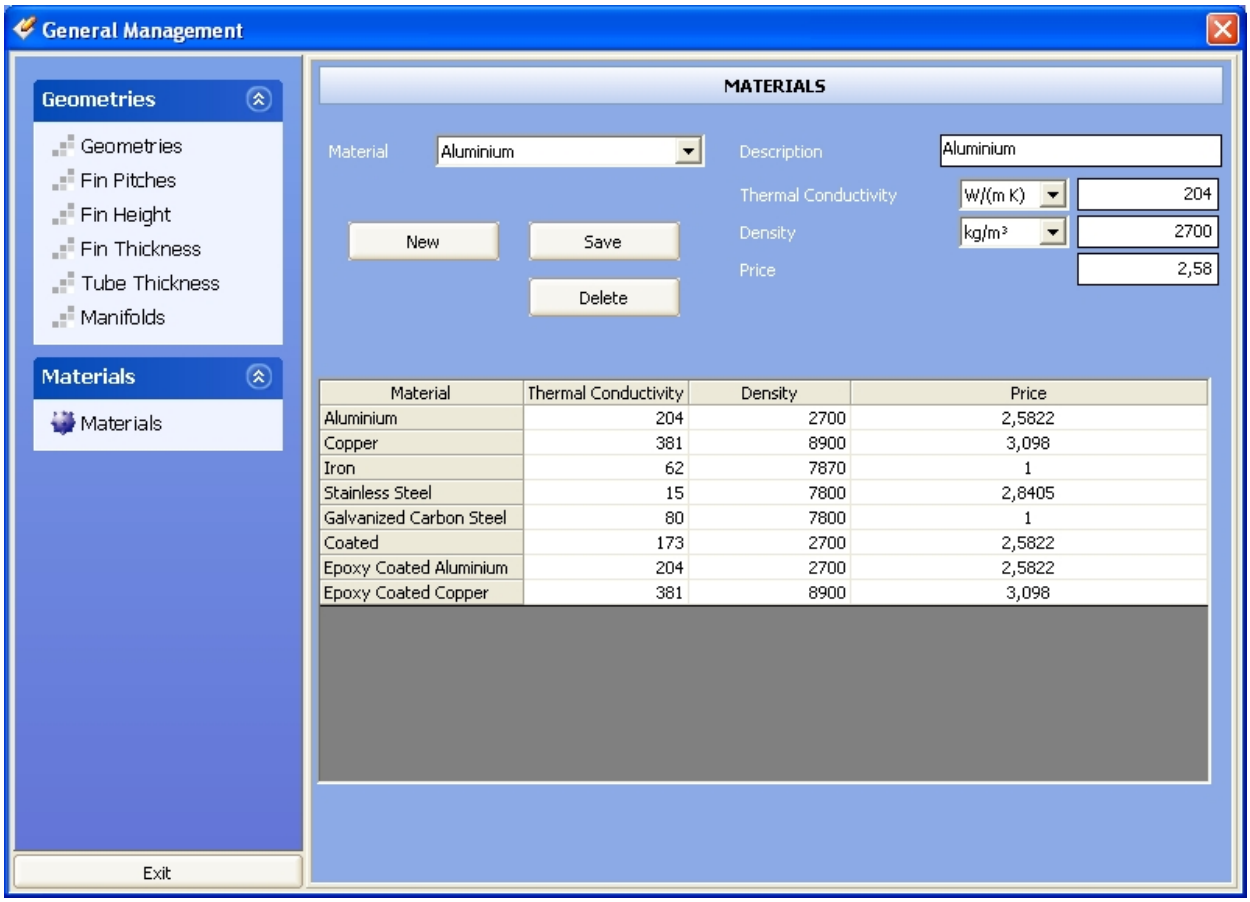
The button 

allows to delete the material selected in the combo 

.

- to hide the menu on the side, just click on the arrows. 





To exit this part, just click on the button 

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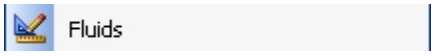
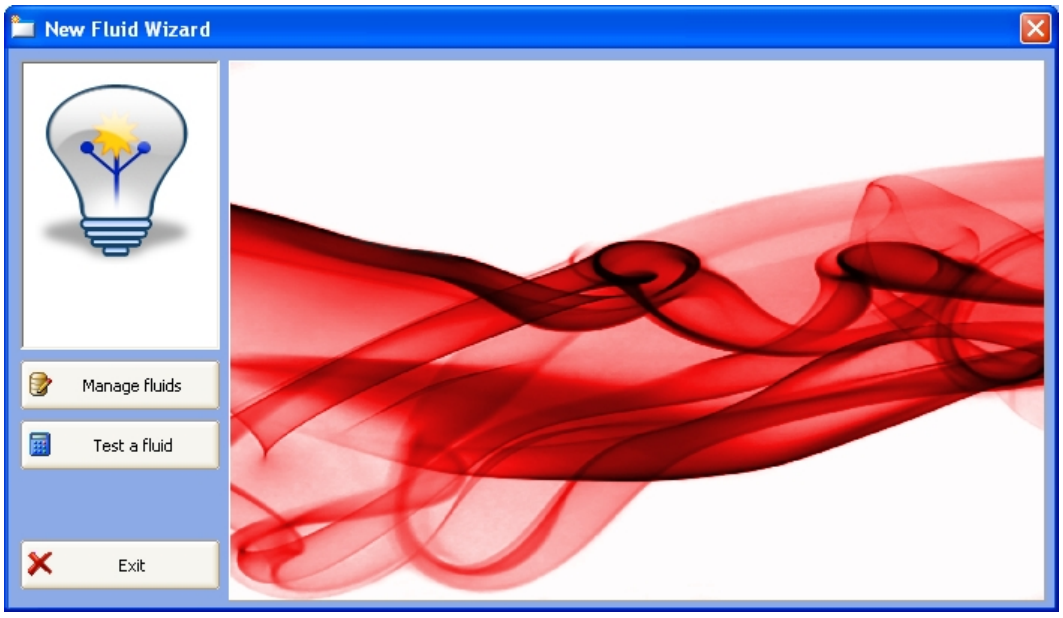
Fluids archive management

Fluids archive management

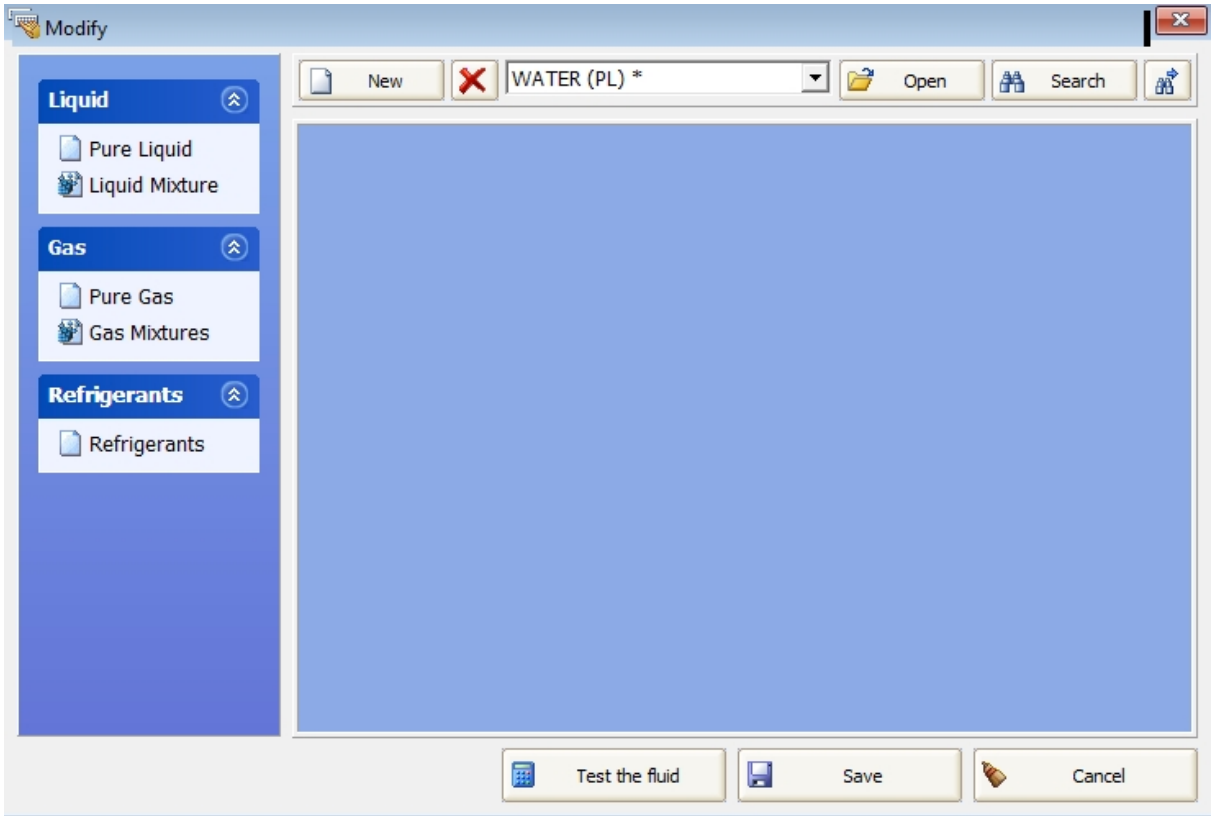
Let's click on the "Fluids" voice 

of the menu

- The following opens



Let's click on the button 



Here are the data relative to the liquids , gas, and freons and can be changed.

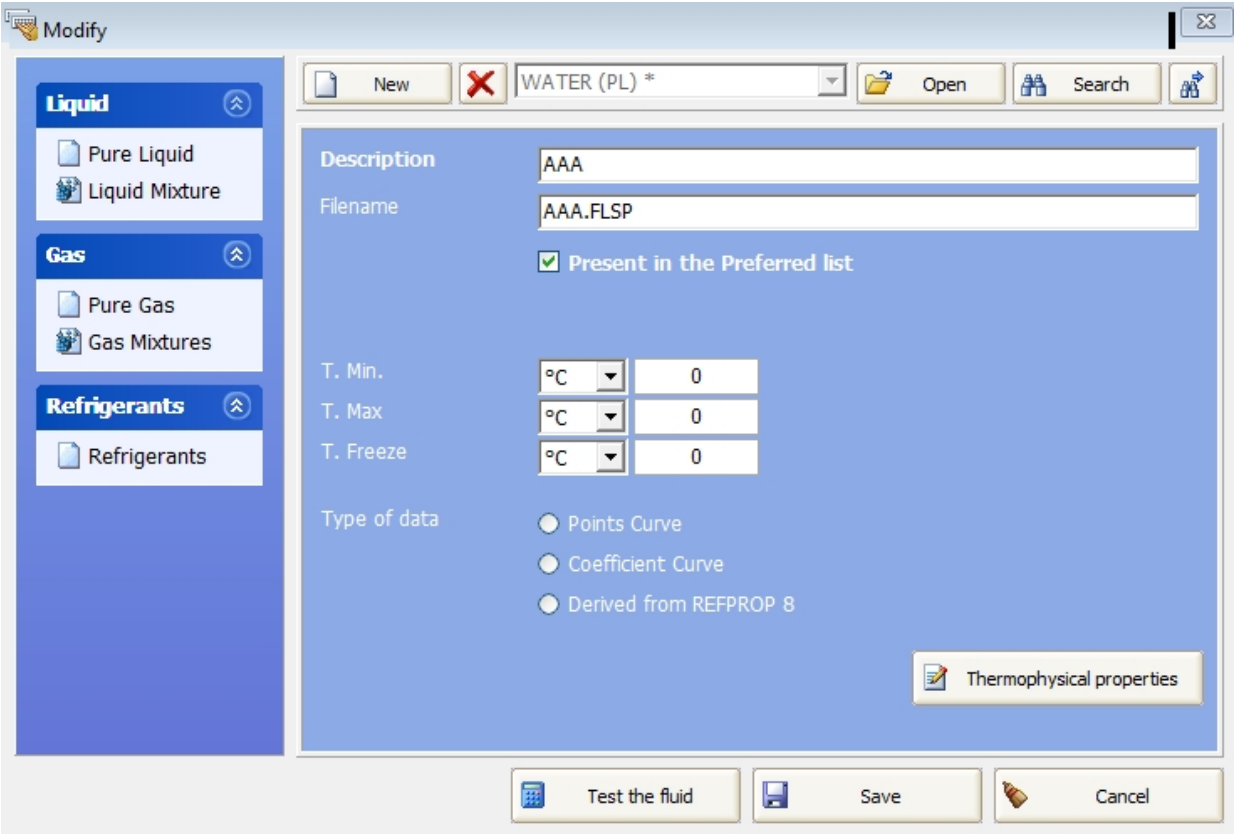
To insert a new fluid:

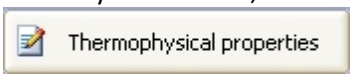
- *Choose the types of the fluid between:*
  - *"Pure Liquid" (PL)*
  - *"Liquid Mixture" (LM)*
  - *"Pure Gas" (PG)*
  - *"Gas Mixtures" (GM)*

(The 4 codes (PL, ML, PG, GM) that you find near the name of the fluids when you use the program indicates the type between above).

- *"Refrigerants".*

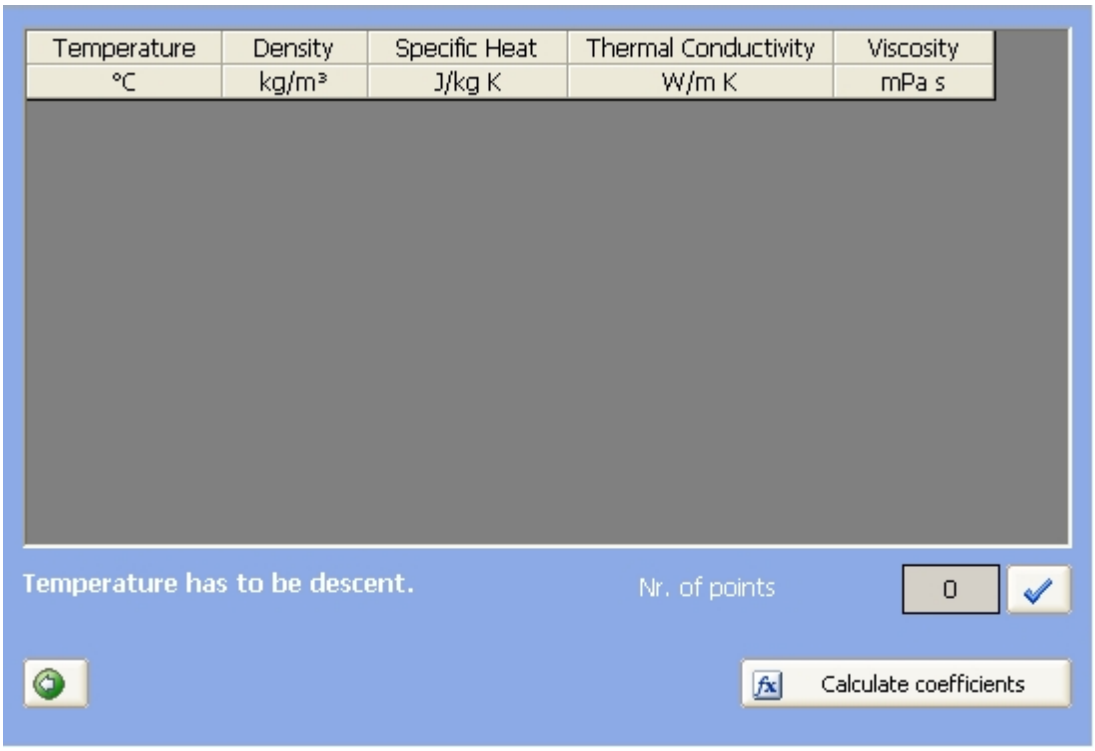
Now let's insert a new liquid, clicking on "New", then choose "Pure Liquid", insert the name of liquid "AAA" and the mask which appear is the following:



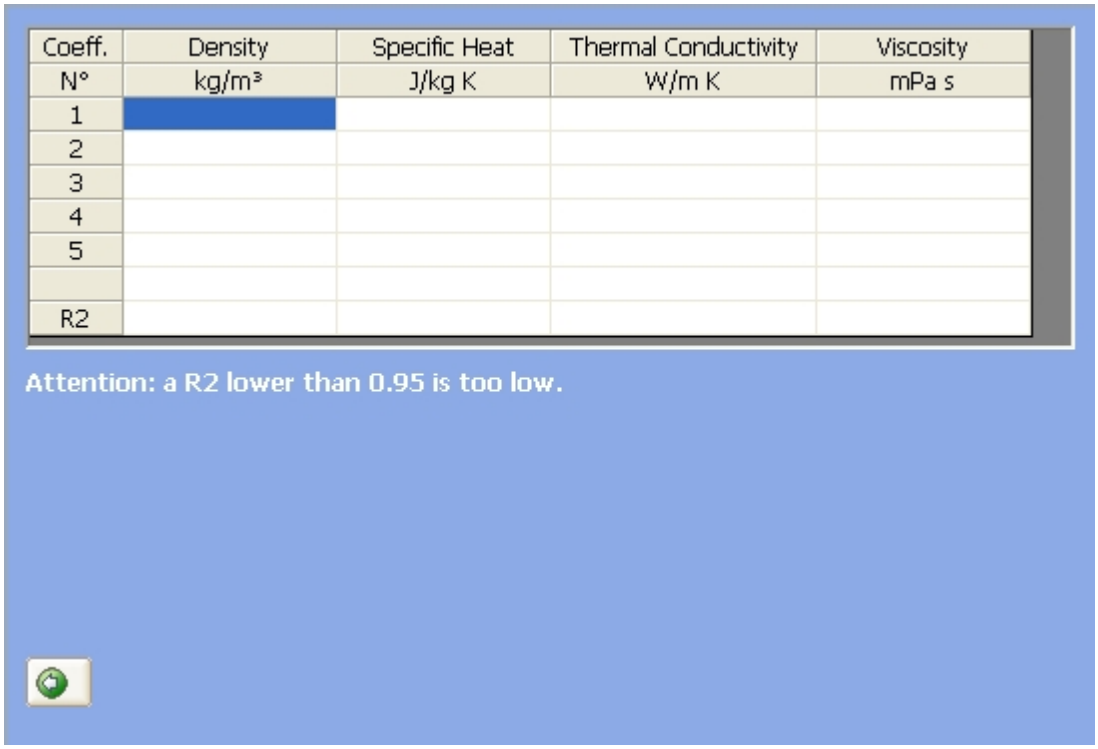
•Here you can insert the minimum and maximum temperature of validity of the fluid, the freeze temperature and the type of data that describe the fluid. Clicking on the button 

, the software shows you three different masks, according to the type of data selected before:

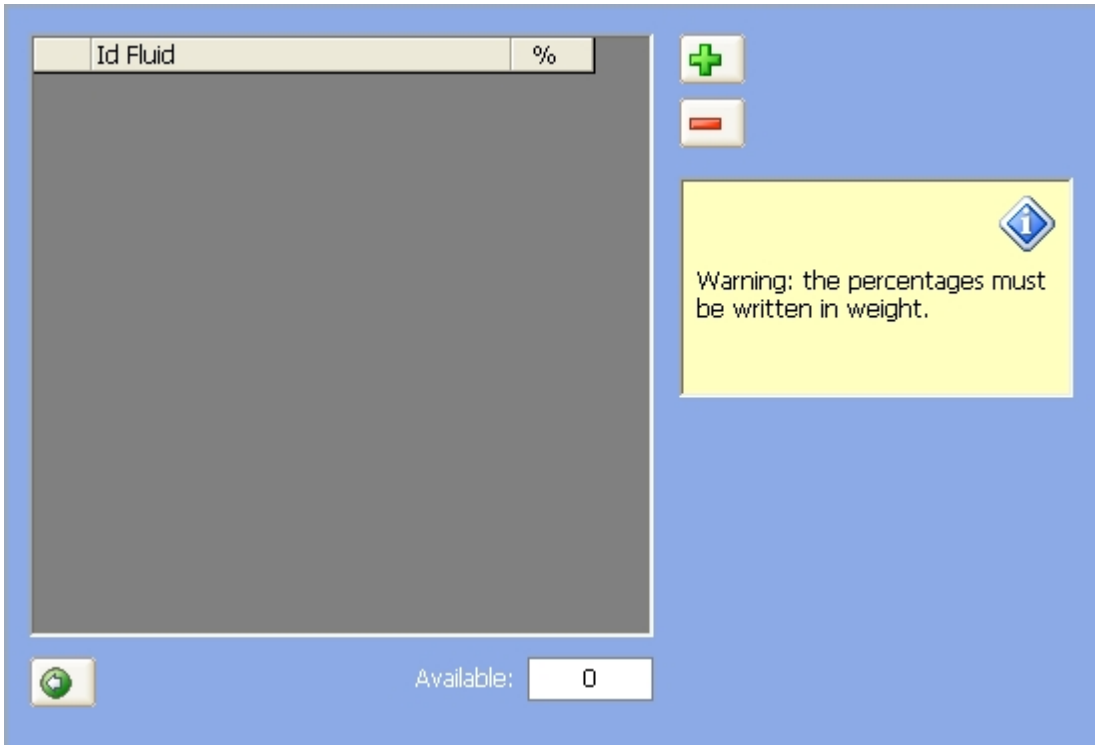
- *o* Points Curve

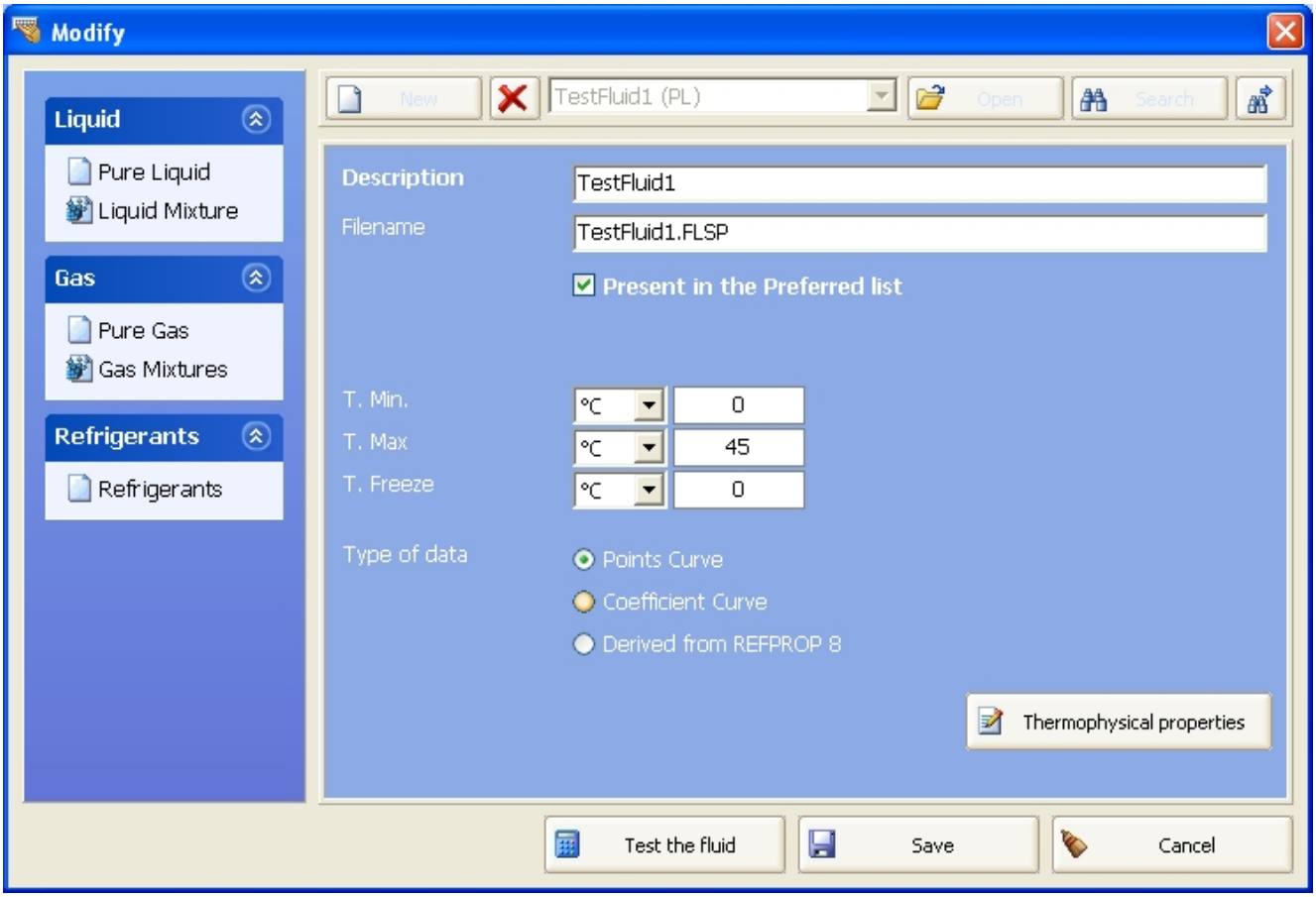


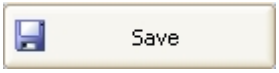
- *o* Coefficient Curve



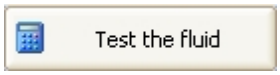
- Derived from REFPROP library

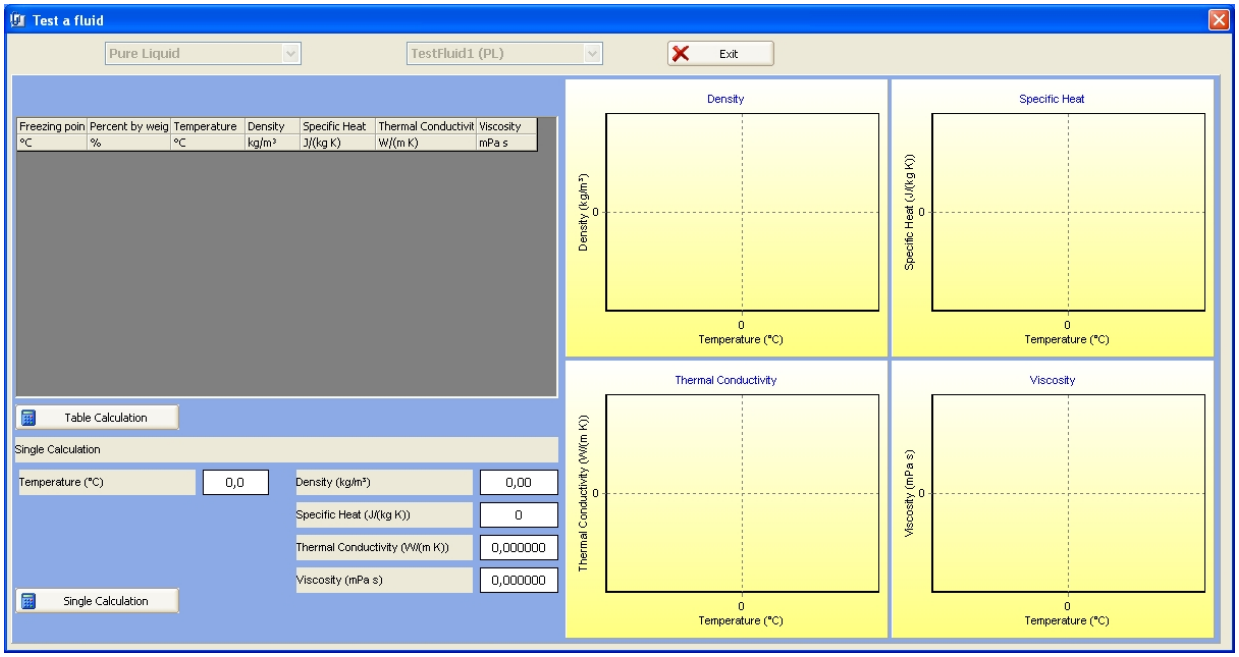




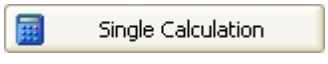
•Click on the button 

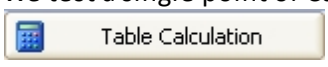
to save the setting of the fluid.

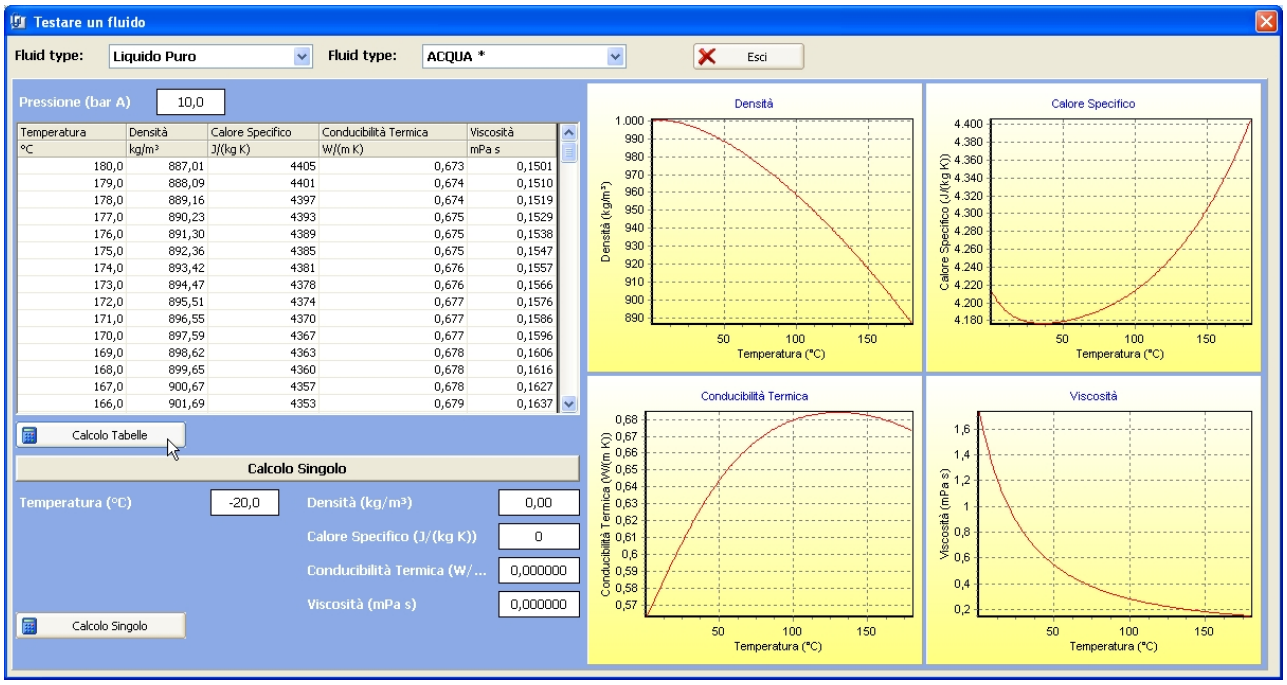
By Clicking the button 

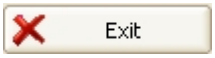


Where after choosing the Fluid Type and the Fluid

We test a single point of Calculation with the relative button 

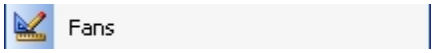
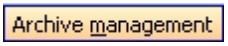
or create a calculation table 

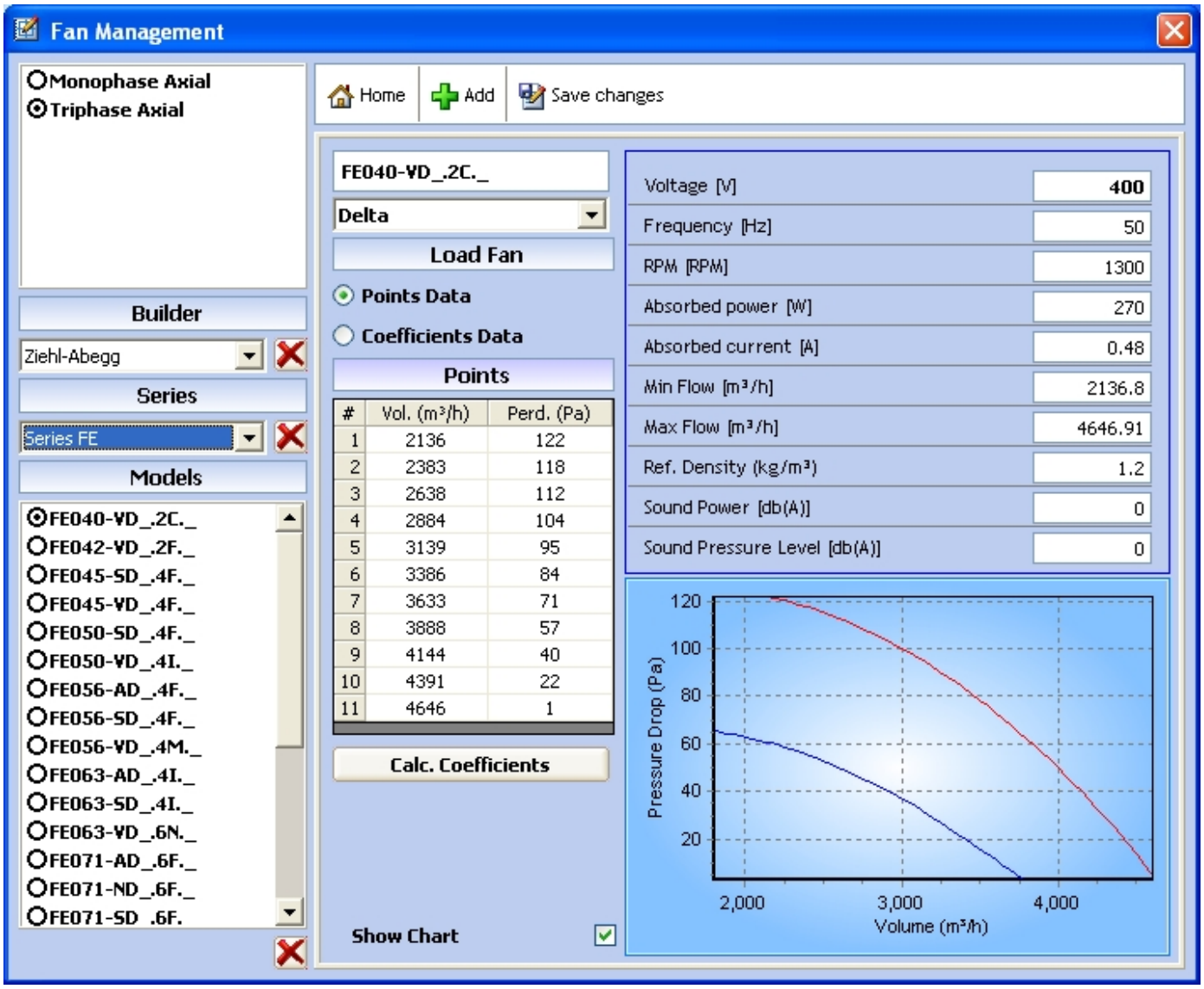


The button  closes the test Fluid section.

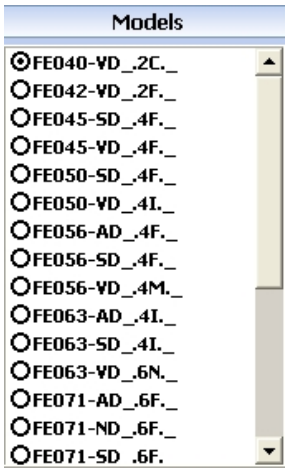
Fans Management

Fans Management

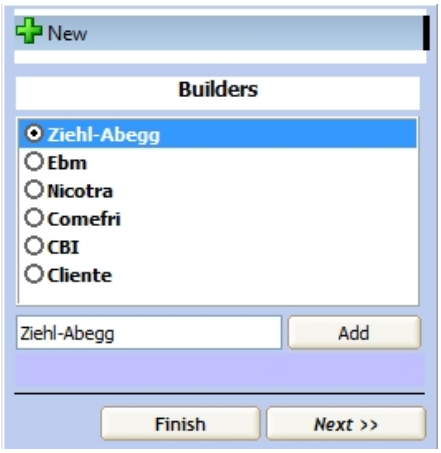
- Let's click on the voice  of the Archive management menu  . Will be open the following mask:



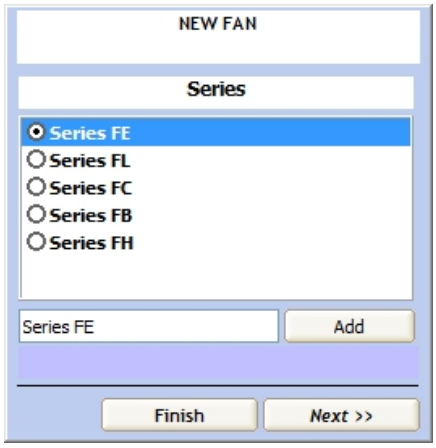
Here you can modify the data of the fans already inserted in the archive, insert a new one by the button Add, or delete a model selected in the left list:



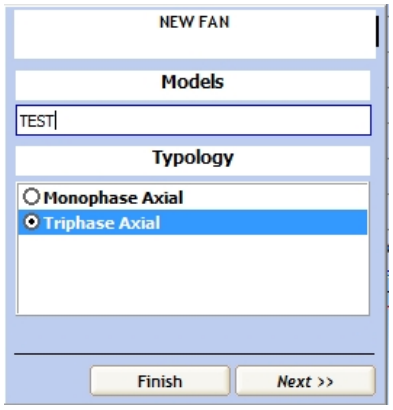
If you click on Add you have to choose a builder from the list or insert a new builder, inserting his name and clicking on “Add”:



Then click on “Next” and do the same for series:



Now you can insert the name of the model and choose the typology:

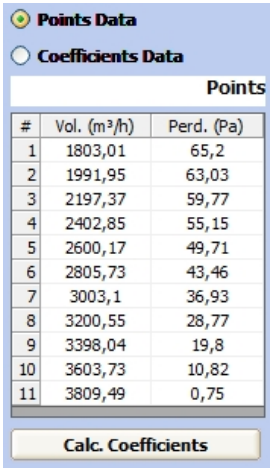


At this point for each electric supply:

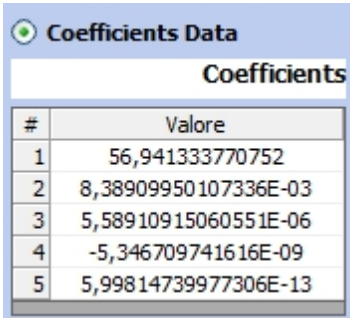
You can insert the fan data:

Voltage [V]	400
Frequency [Hz]	50
RPM [RPM]	1300
Absorbed power [W]	270
Absorbed current [A]	0,48
Min Flow [m³/h]	2136,8
Max Flow [m³/h]	4646,91
Ref. Density (kg/m³)	1,2
Sound Power [db(A)]	0
Sound Pressure Level [db(A)]	0

And the points of the curve:



Or the coefficients already given by the builder:

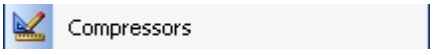


Then click on “Save changes” and the fan will be saved into the database.

To close the mask click on the button 

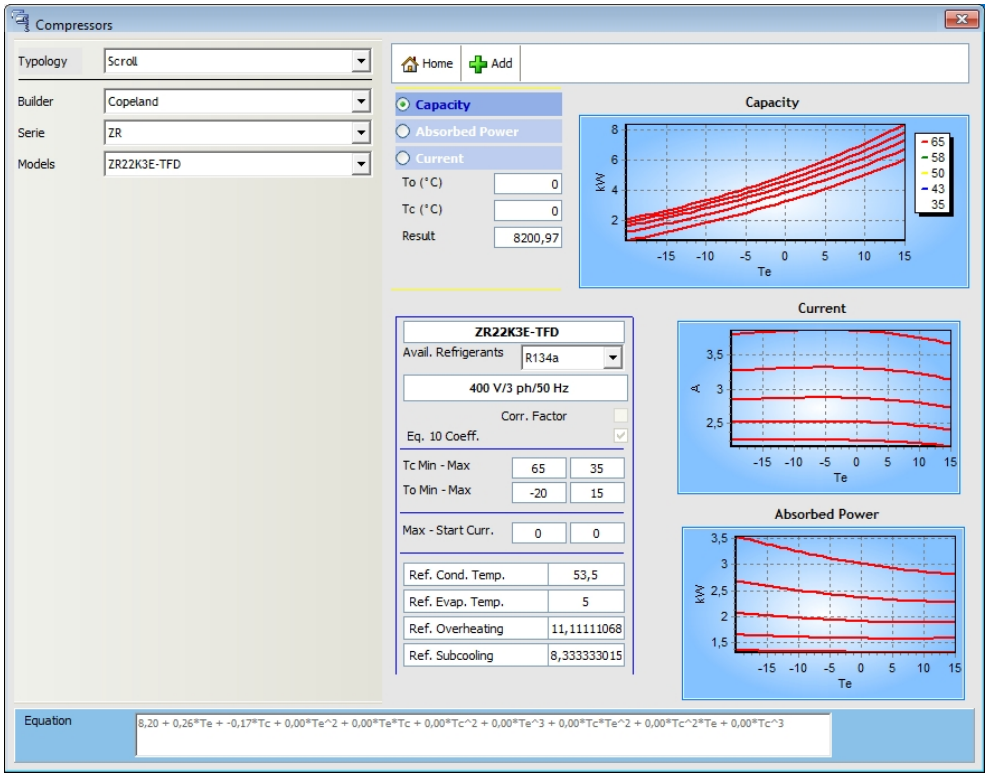
Compressors Management

Compressors Management

- Let’s click on the voice 

of the Archive management menu 

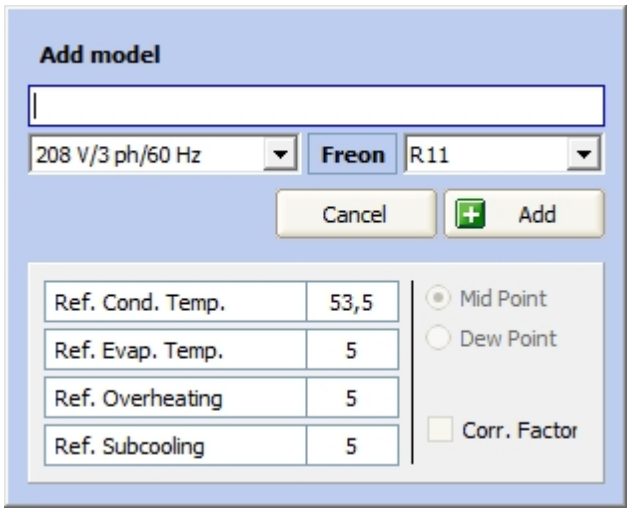
. Will be opened the following mask:



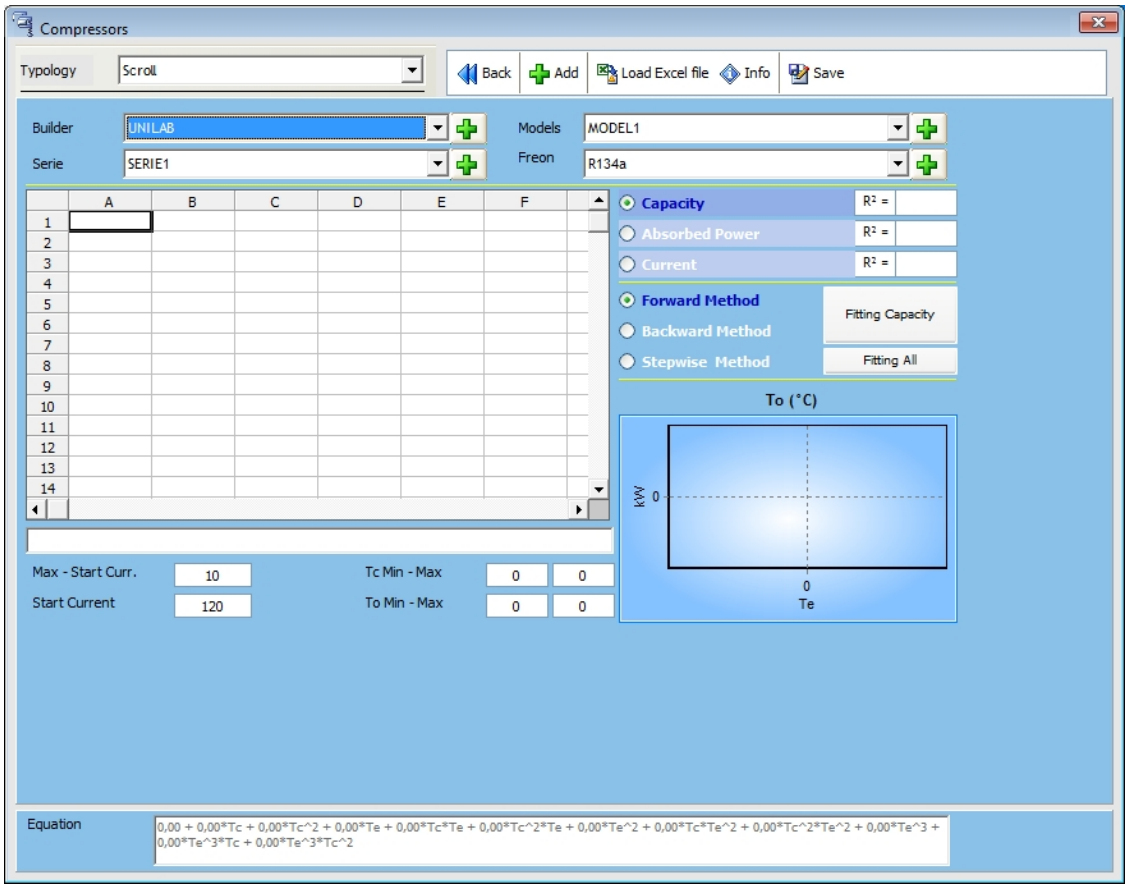
Here you can modify the data of the compressors already inserted in the archive, insert a new one by the button

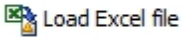
Add

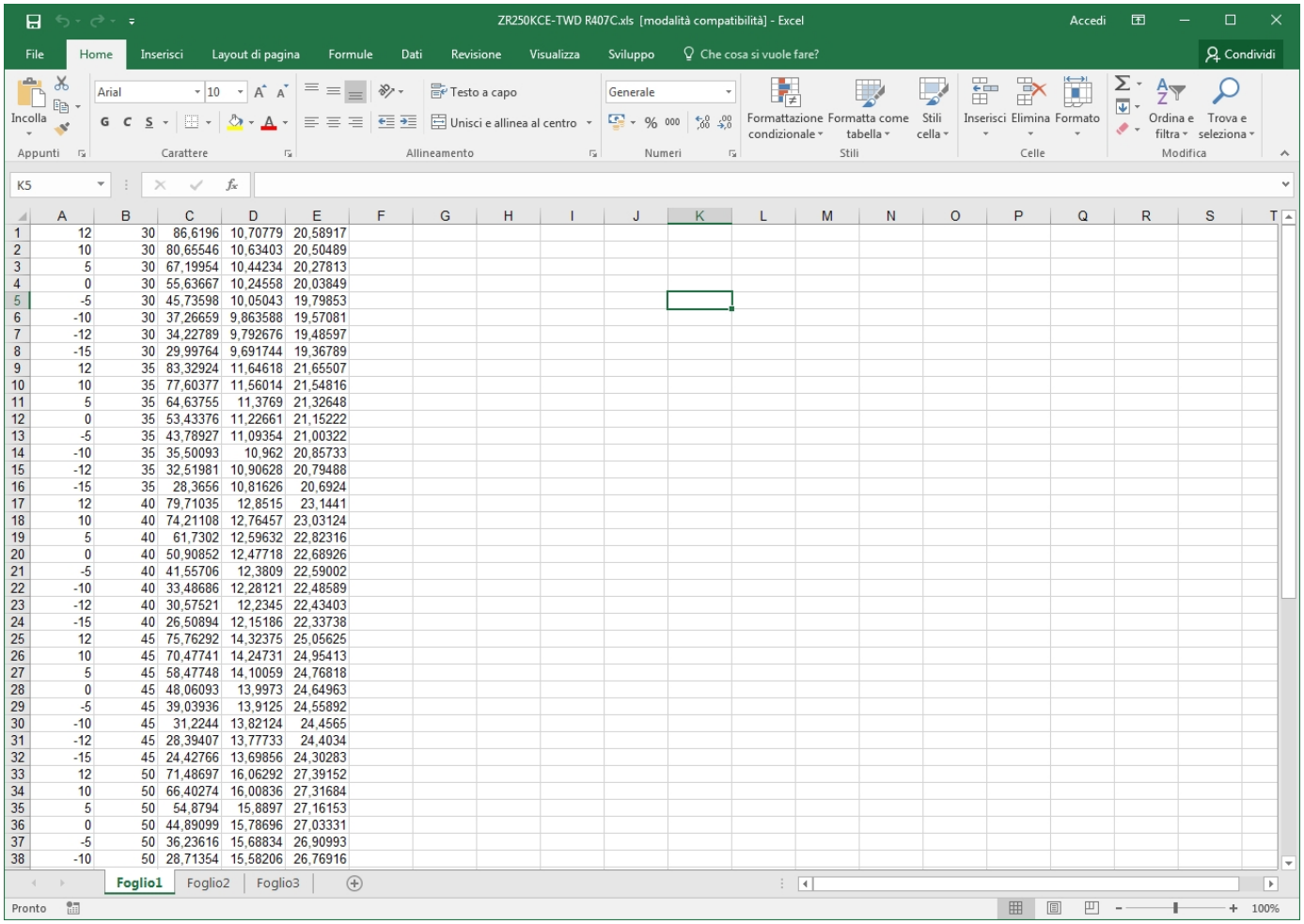
If you click on Add you have to choose a builder from the list or insert a new one with button
The same for “Serie”, “Models” and “Freon”:



You see this page:



Now you can click on “Load excel file ”  to load the data from a previously saved excel file with this layout:

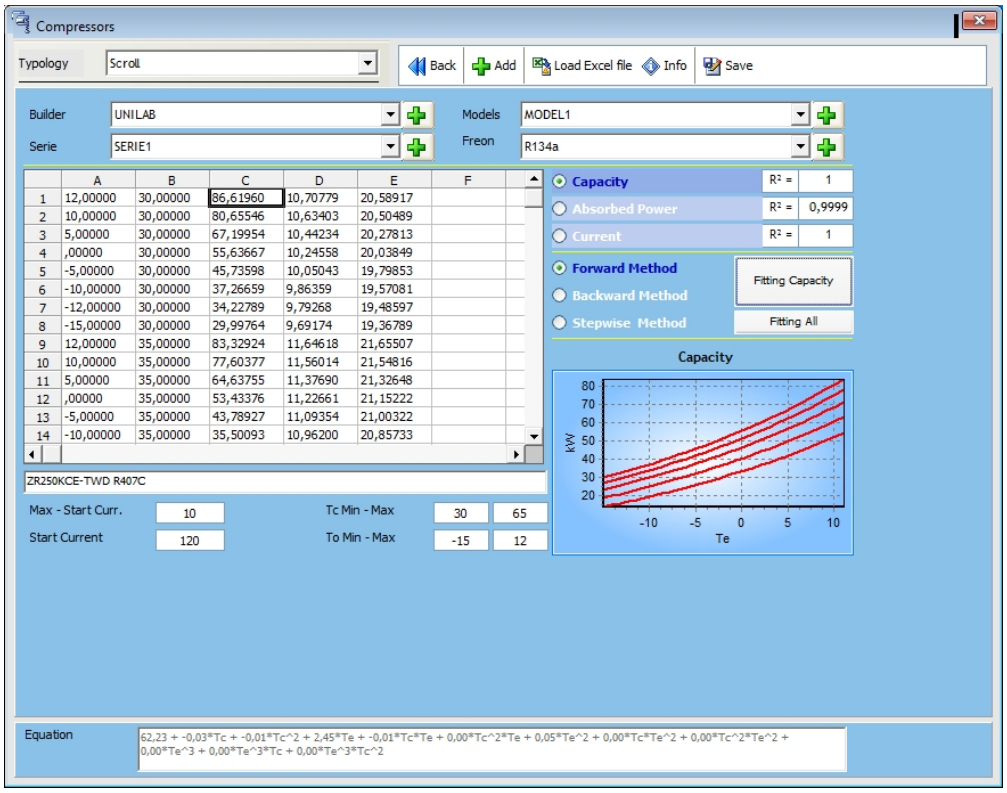


	A	B	C	D	E
1	12	30	86,6196	10,70779	20,58917
2	10	30	80,65546	10,63403	20,50489
3	5	30	67,19954	10,44234	20,27813
4	0	30	55,63667	10,24558	20,03849
5	-5	30	45,73598	10,05043	19,79853
6	-10	30	37,26659	9,863588	19,57081
7	-12	30	34,22789	9,792676	19,48597
8	-15	30	29,99764	9,691744	19,36789
9	12	35	83,32924	11,64618	21,65507
10	10	35	77,60377	11,56014	21,54816
11	5	35	64,63755	11,3769	21,32648
12	0	35	53,43376	11,22661	21,15222
13	-5	35	43,78927	11,09354	21,00322
14	-10	35	35,50093	10,962	20,85733
15	-12	35	32,51981	10,90628	20,79488
16	-15	35	28,3656	10,81626	20,6924
17	12	40	79,71035	12,8515	23,1441
18	10	40	74,21108	12,76457	23,03124
19	5	40	61,7302	12,59632	22,82316
20	0	40	50,90852	12,47718	22,68926
21	-5	40	41,55706	12,3809	22,59002
22	-10	40	33,48686	12,28121	22,48589
23	-12	40	30,57521	12,2345	22,43403
24	-15	40	26,50894	12,15186	22,33738
25	12	45	75,76292	14,32375	25,05625
26	10	45	70,47741	14,24731	24,95413
27	5	45	58,47748	14,10059	24,76818
28	0	45	48,06093	13,9973	24,64963
29	-5	45	39,03936	13,9125	24,55892
30	-10	45	31,2244	13,82124	24,4565
31	-12	45	28,39407	13,77733	24,4034
32	-15	45	24,42766	13,69856	24,30283
33	12	50	71,48697	16,06292	27,39152
34	10	50	66,40274	16,00836	27,31684
35	5	50	54,8794	15,8897	27,16153
36	0	50	44,89099	15,78696	27,03331
37	-5	50	36,23616	15,68834	26,90993
38	-10	50	28,71354	15,58206	26,76916

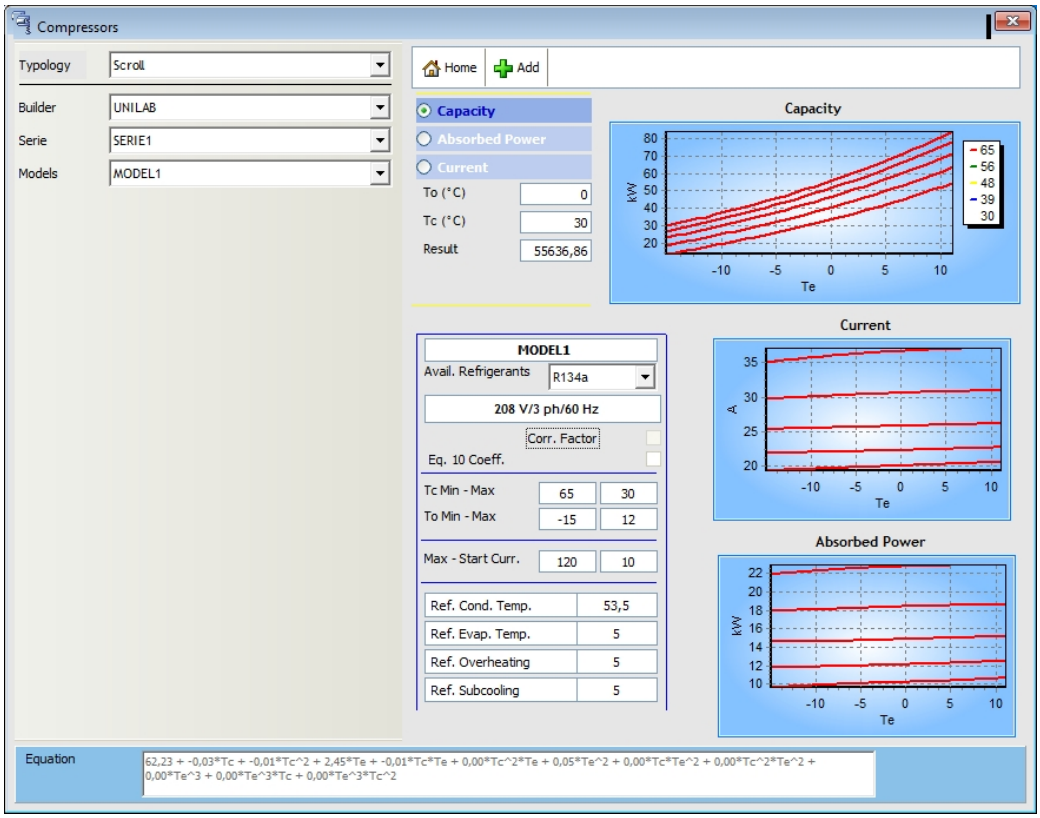
Where we have 5 columns which are

1. **is for evaporating temperature C° which needs to be decreasing**
2. **is for condensing temperature in C° which needs to be increasing**
3. **Capacity in kW**
4. **Absorbed Power in kW**
5. **Absorbed Current in A**

Then you click on “Fitting All” and you get:



Then click on “Save” and “Back”, you will see the capacity, current and absorbed power curves in the main mask:



To close the mask click on the button 

.

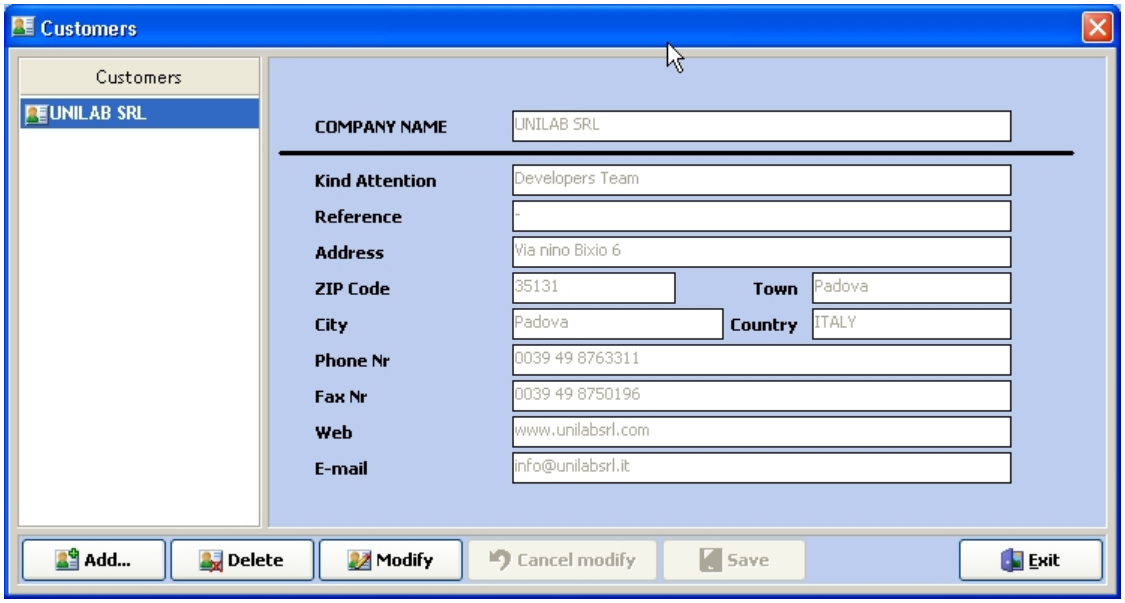
Customer’s Management

Customer’s Management

- Let’s click on the voice 

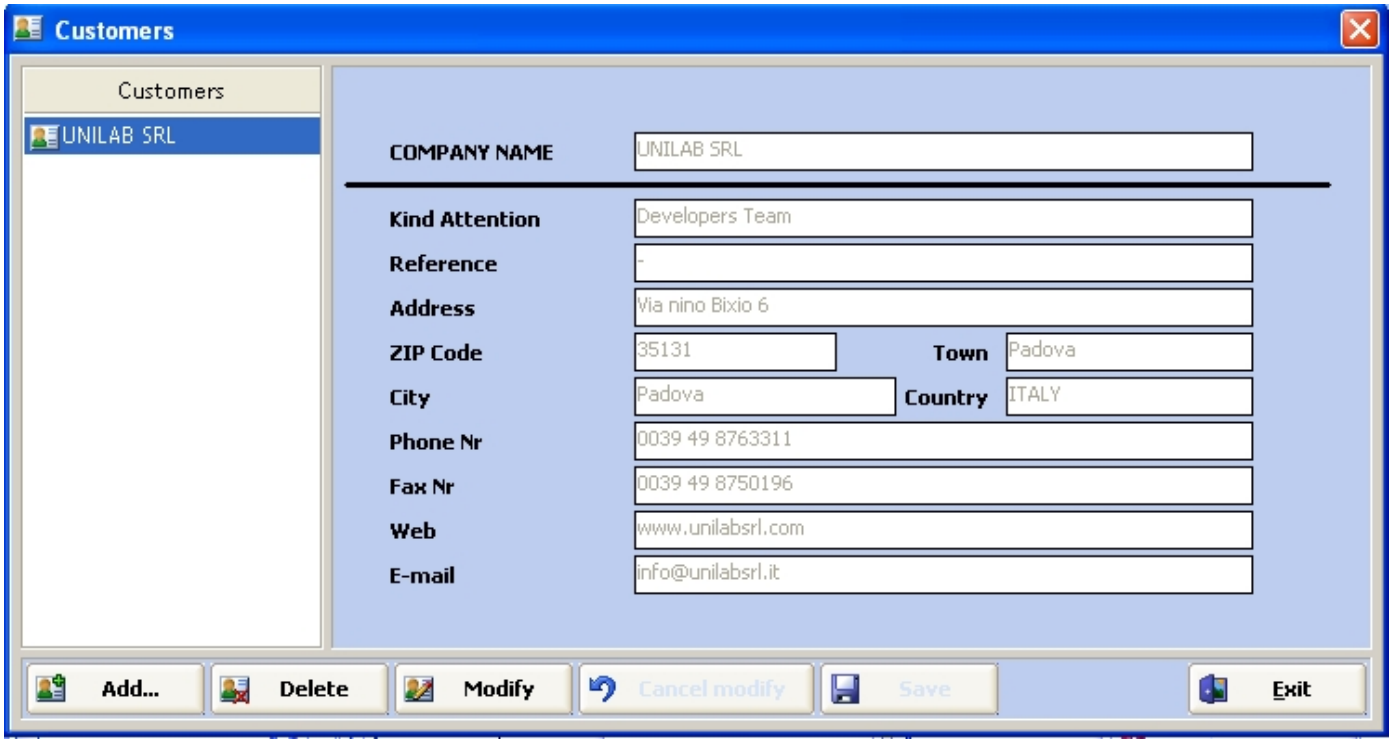
of the Archive management menu

Archive management

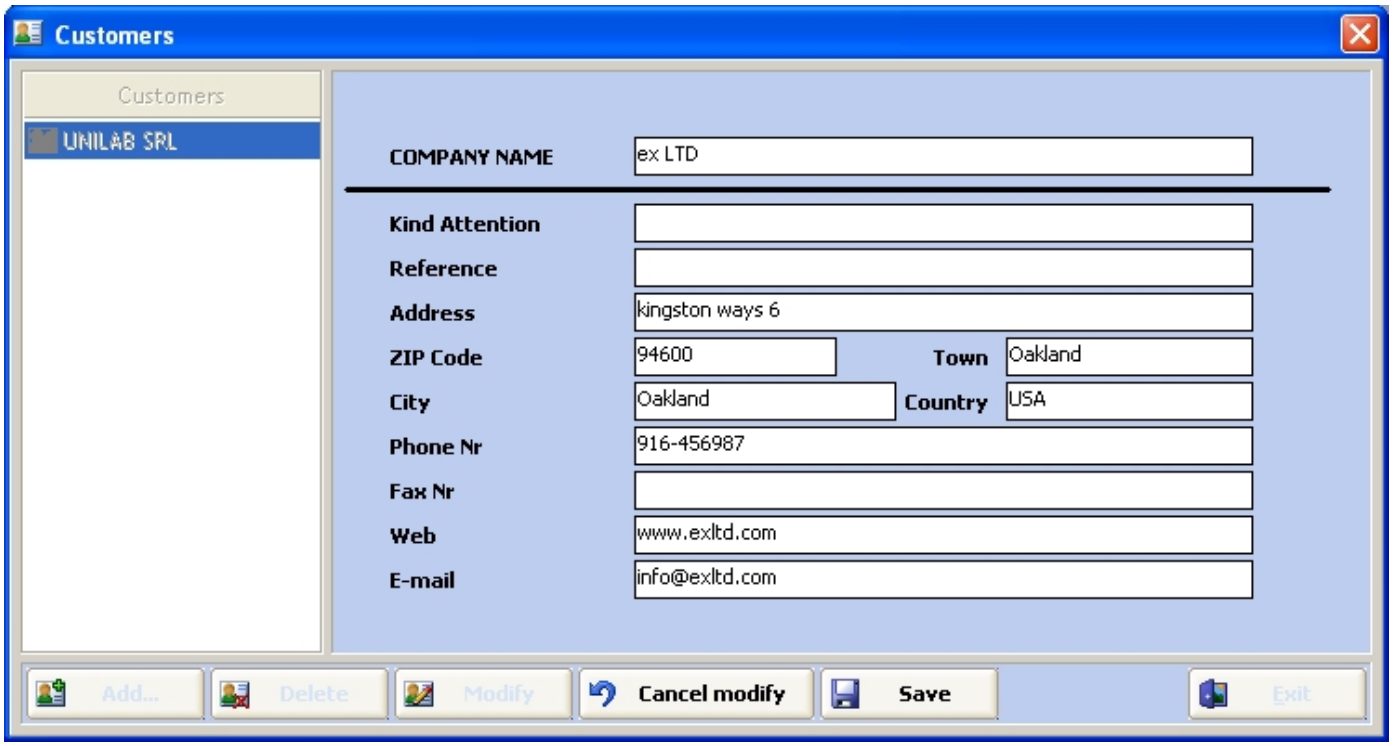


here it's possible to add, delete or modify customer data.

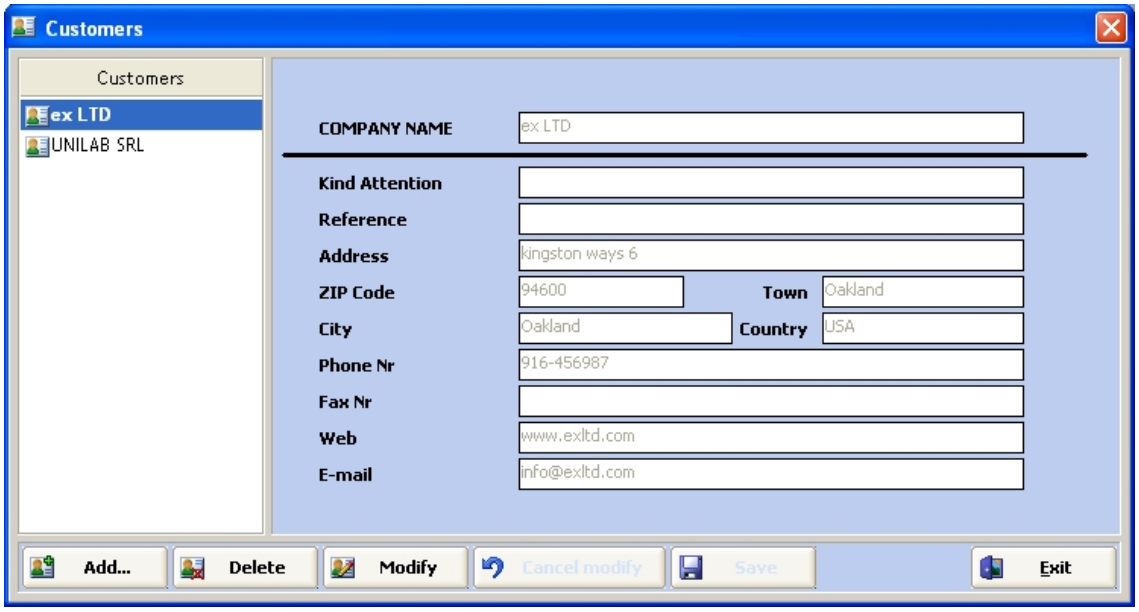
- Let's click on the "Modify" button



- For example, we could enter a new customer as in the next figure.



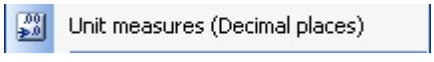
- then click the "Save" button

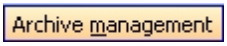


our company "ex LTD" has been added.

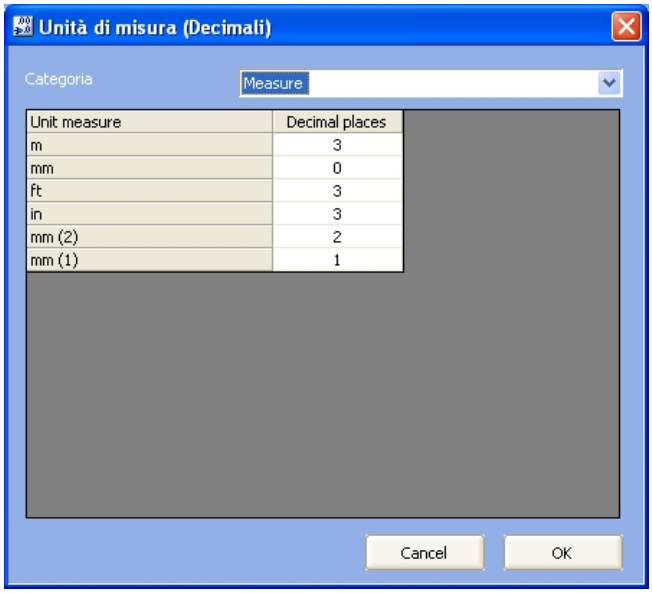
Unit measures (Decimal places)

Unit measures (Decimal places)

- Let's click on the voice 

of the Archive management menu 

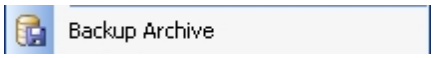
.

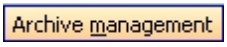


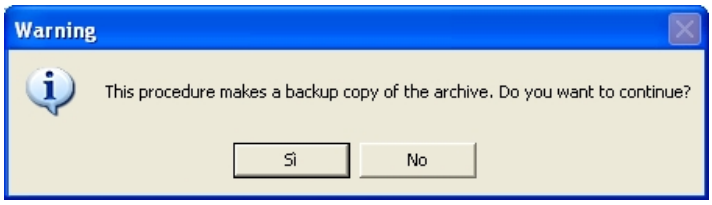
- Here you can set for each unit measure the number of decimals showed in the program.

Backup Archive

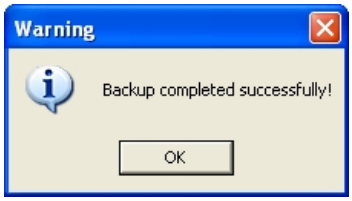
Backup Archive

- Let's click on the voice 

of the Archive management menu 



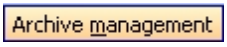
- If we click "Yes" (Sì) , will get

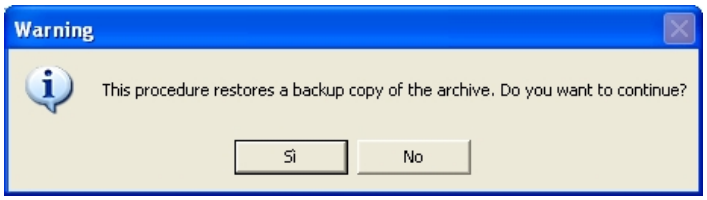


Restore Backup

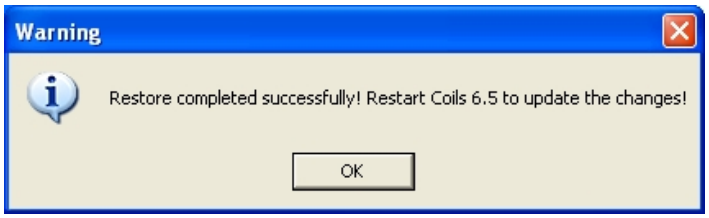
Restore Backup

- Let's click on the voice 

of the Archive management menu 



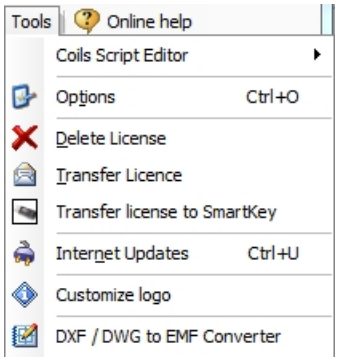
- If we click “Yes” (Sì) , will get



TOOLS

TOOLS

This is the Tool menu Tools:

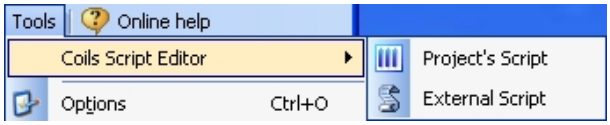


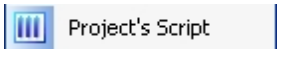
Coils script editor

Coils script editor

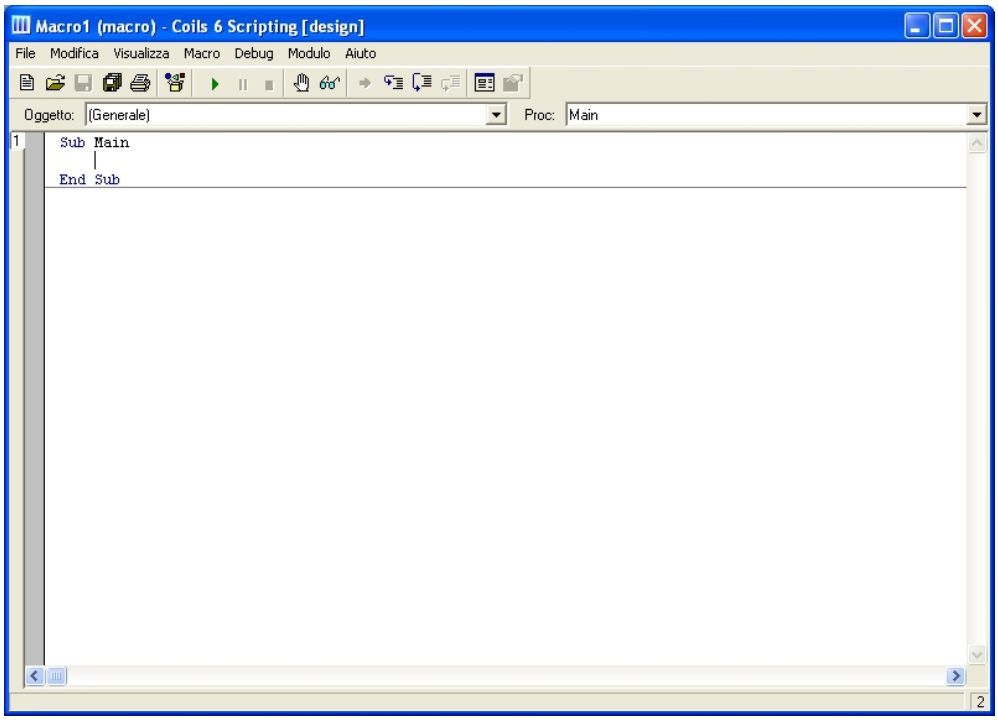
- By clicking on 

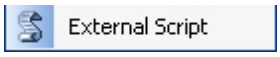
we get a sub menu with two voices



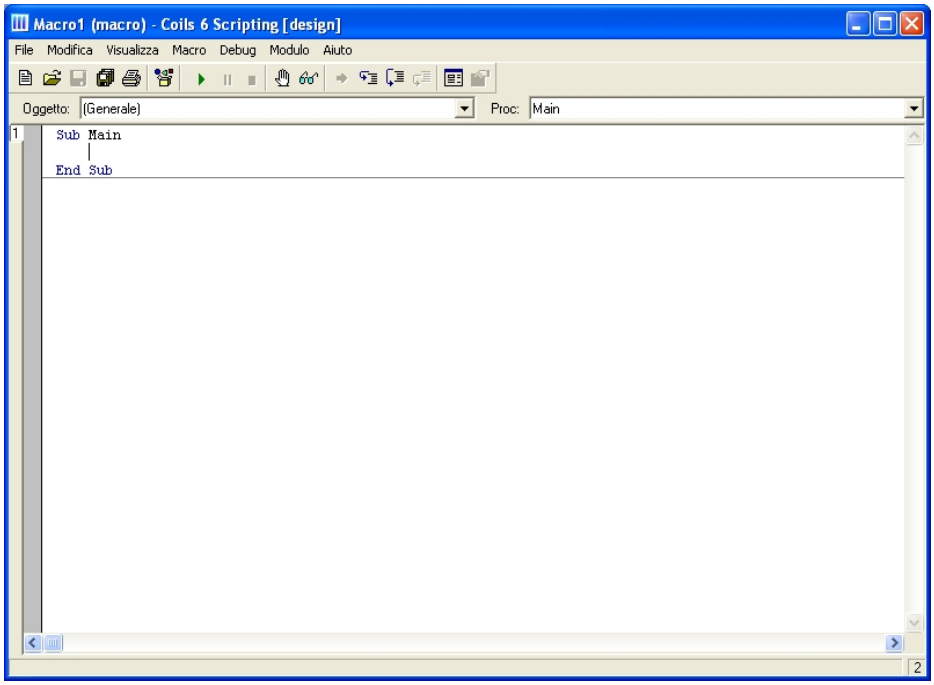


permits to write in a programming environment a script and it is meant or either light or experienced programmers





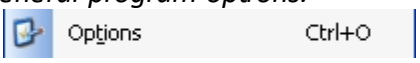
permits to load and write an external script



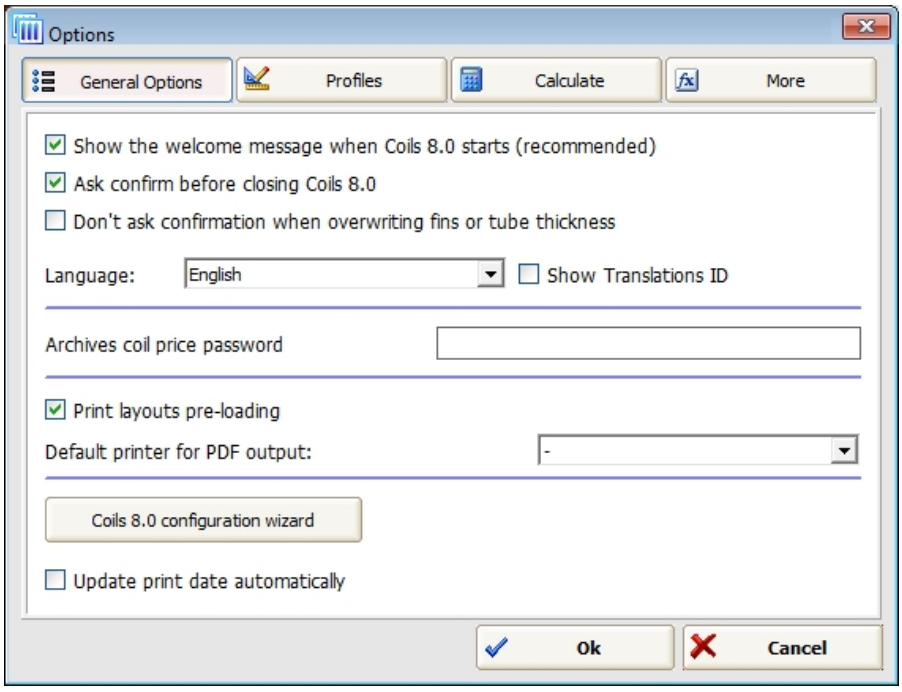
Options

Options

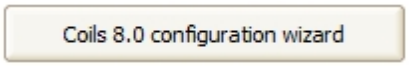
This voice permits to set general program options.

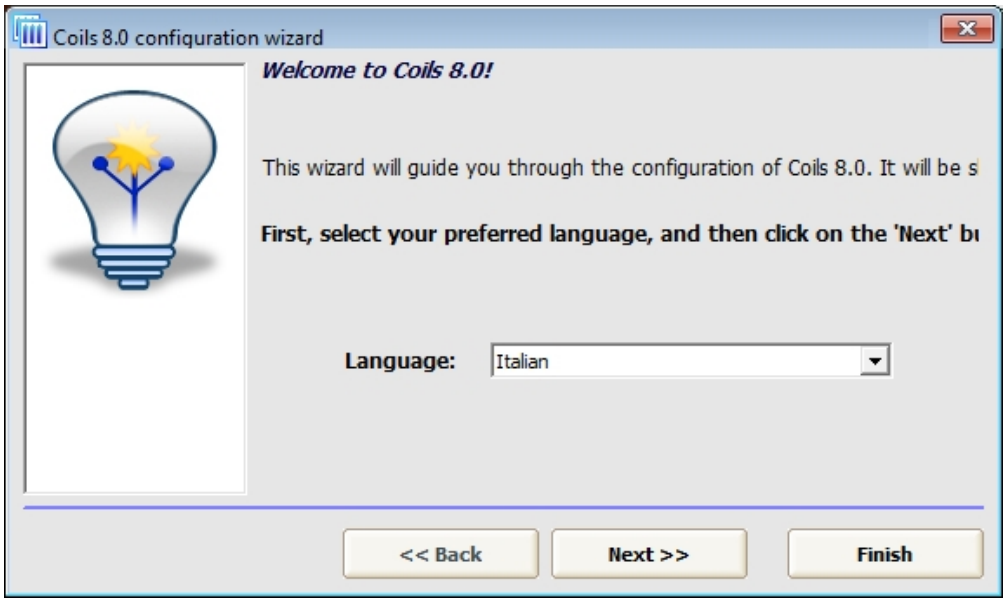
- Let's click on voice 

of the "Tool" menu 

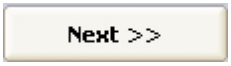


In the general options mask you can set welcome message, language, calculation of cooling projects with Freons, allows subcooling analysis, ecc.

- If we click on the button 

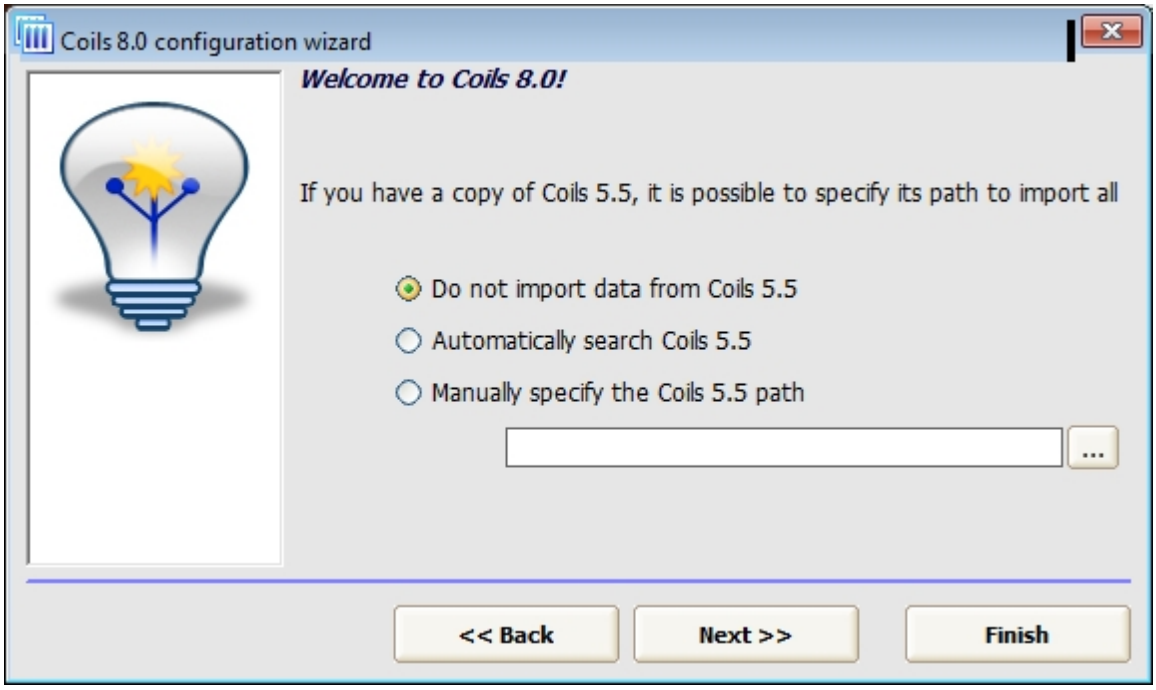


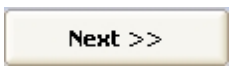
We can choose the language shown the first time you run the software.

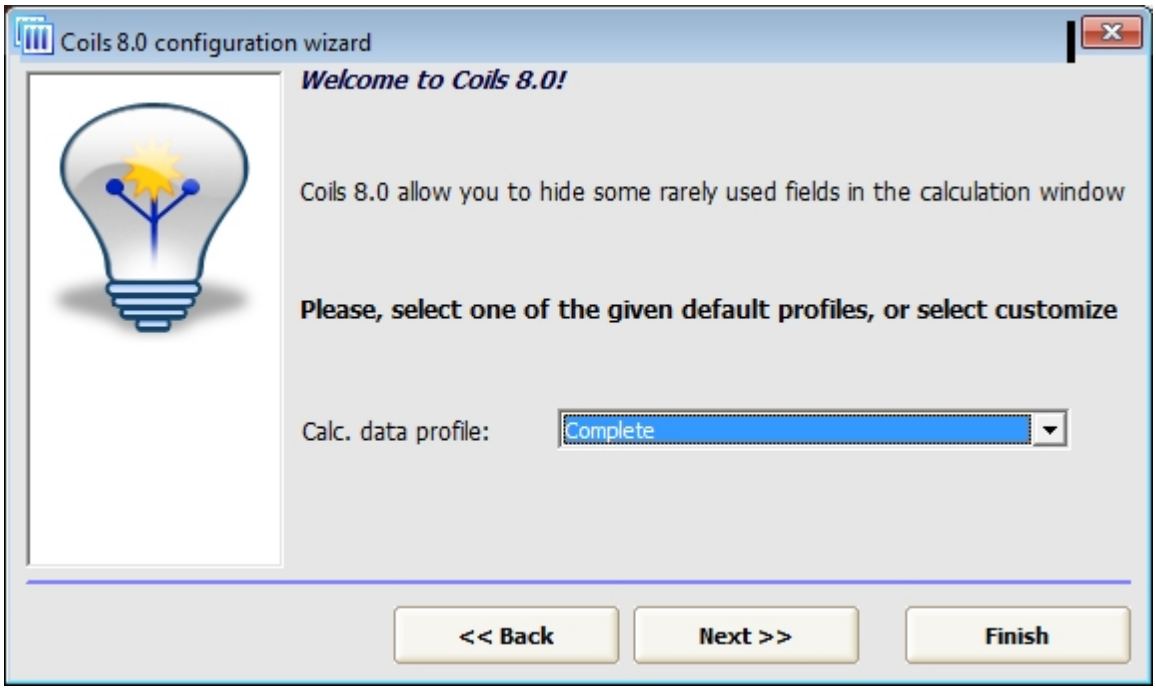
- After clicking the button 

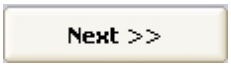
- After clicking again on the 

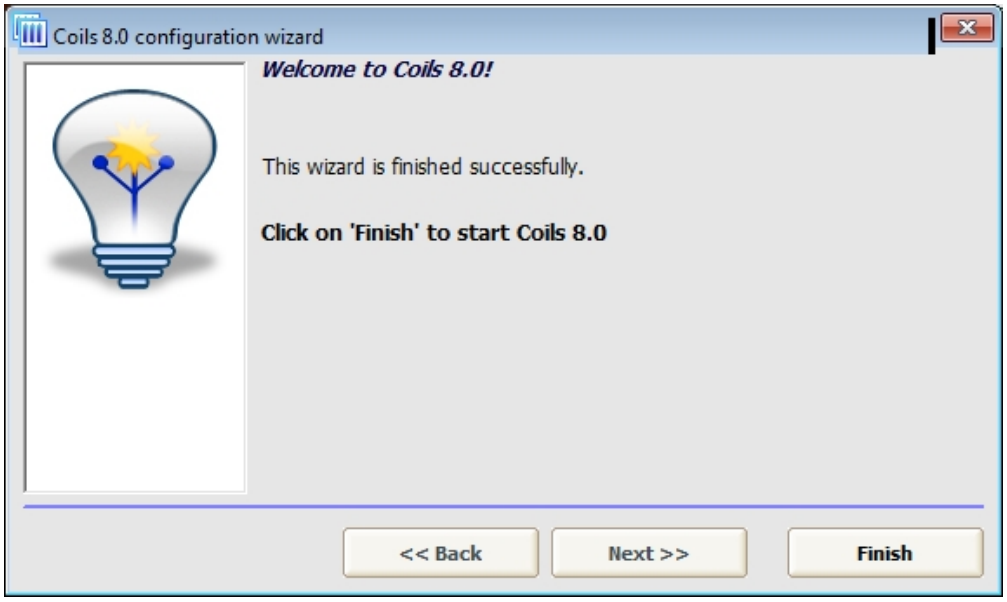
Here we can choose to import the geometries from the previous Coils



- After clicking again on the 

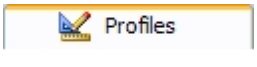


By clicking 

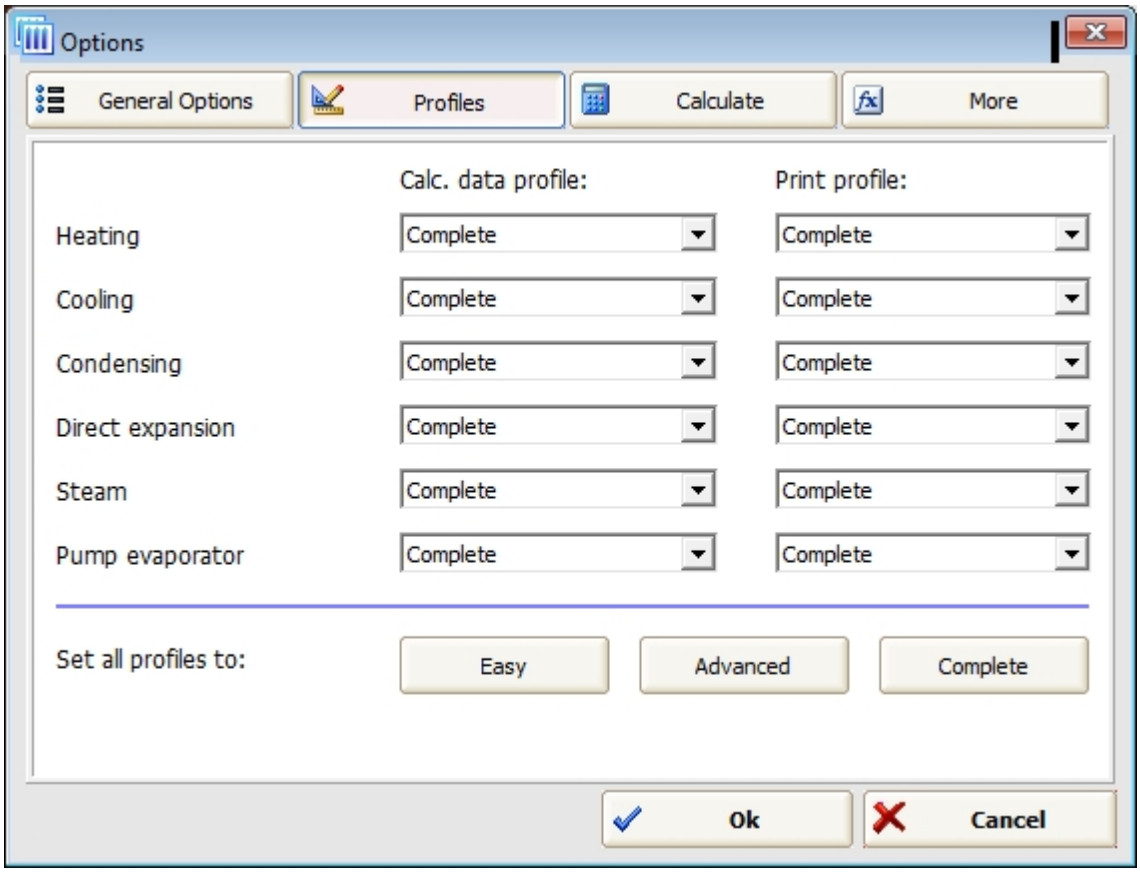


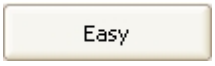
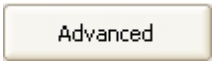
Click on the button 

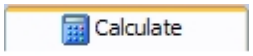
to close the Configuration Wizard.

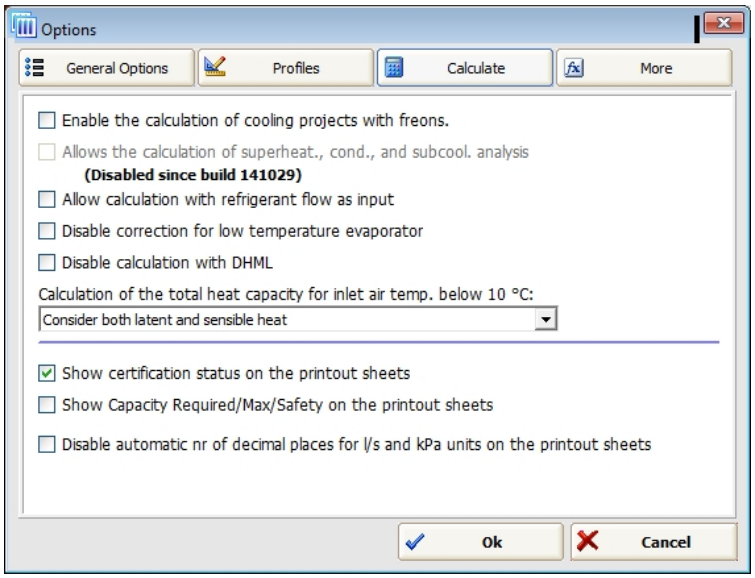
In the “Options” mask in the page 

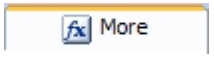
we have the following profiles

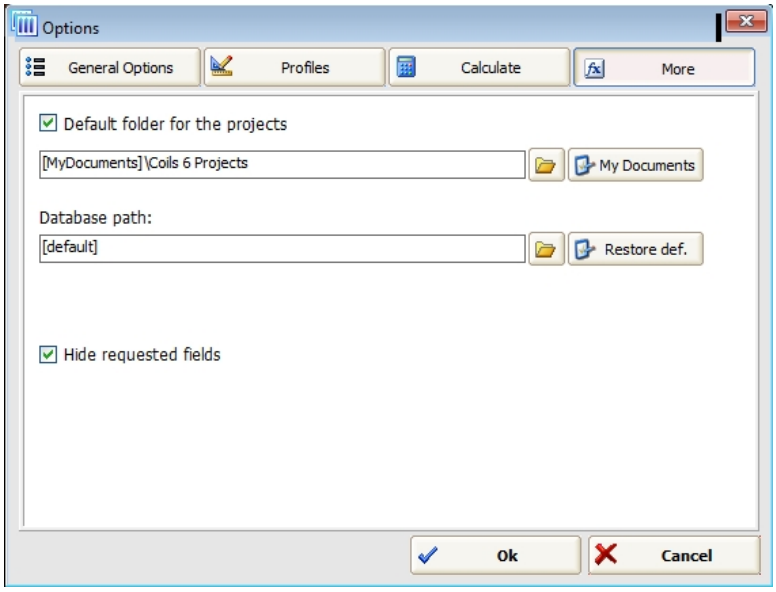


than can be set one by one or all by the buttons:  ,  or 

The page  allows to manage some information and settings about the coils calculation and the printouts, like the calculation of the superheating, the subcooling, the enable of the calculation of the cooling projects with freons, etc.



The page  allows to set the default path where save the projects, and the path of the database.

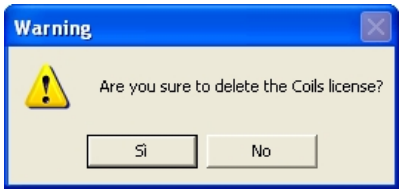


To confirm the settings of the Options click on Ok, otherwise to discard them click on Cancel.

Delete License

Delete License

By clicking on Delete License of the Tool menu Tools, we can delete the license. The following message appears



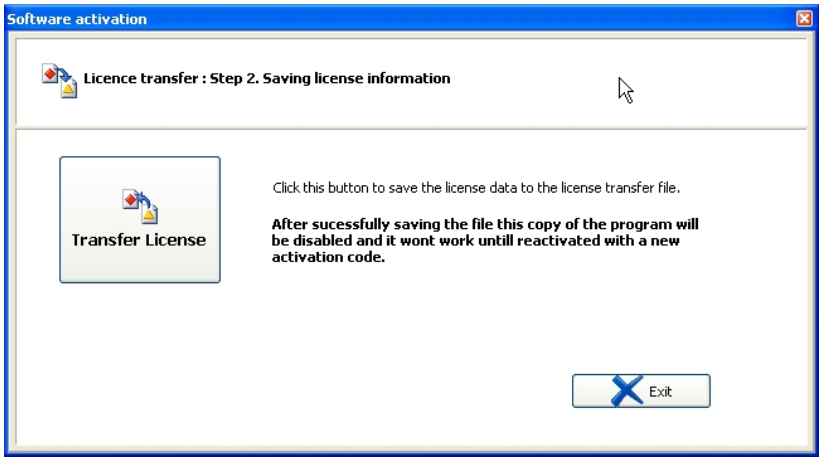
"Yes"("Sì") confirms the elimination of the license.

Transfer License

Transfer License

This option allows to transfer the software license from the current computer to another one. It means, that using such procedure the same license cannot be used on the more than one computer at the same time.

By clicking the Transfer Licence of the Tool menu Tools, you will see get

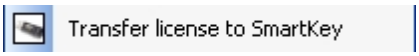


To continue, we would click on the "Transfer License" button.
To exit, click on the "Exit" button.

Transfer license to SmartKey

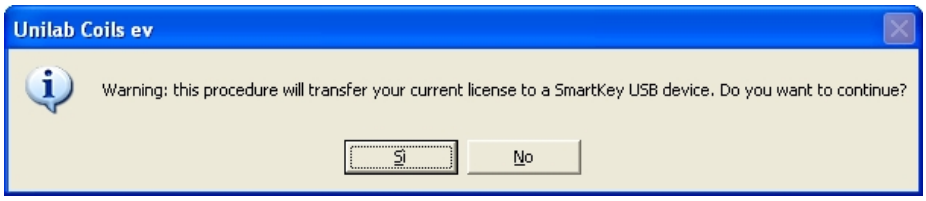
Transfer license to SmartKey (for clients with OLD activation system only)

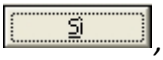
This option allows to transfer the license information to a smart usb key, which is useful to avoid loss of license in case of computer damage. But even in this case, software cannot work at the same time on different more than one computer.

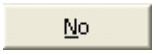
By clicking the 

of the Tool menu 

, we get the following message



By clicking "Yes"(Sì) 

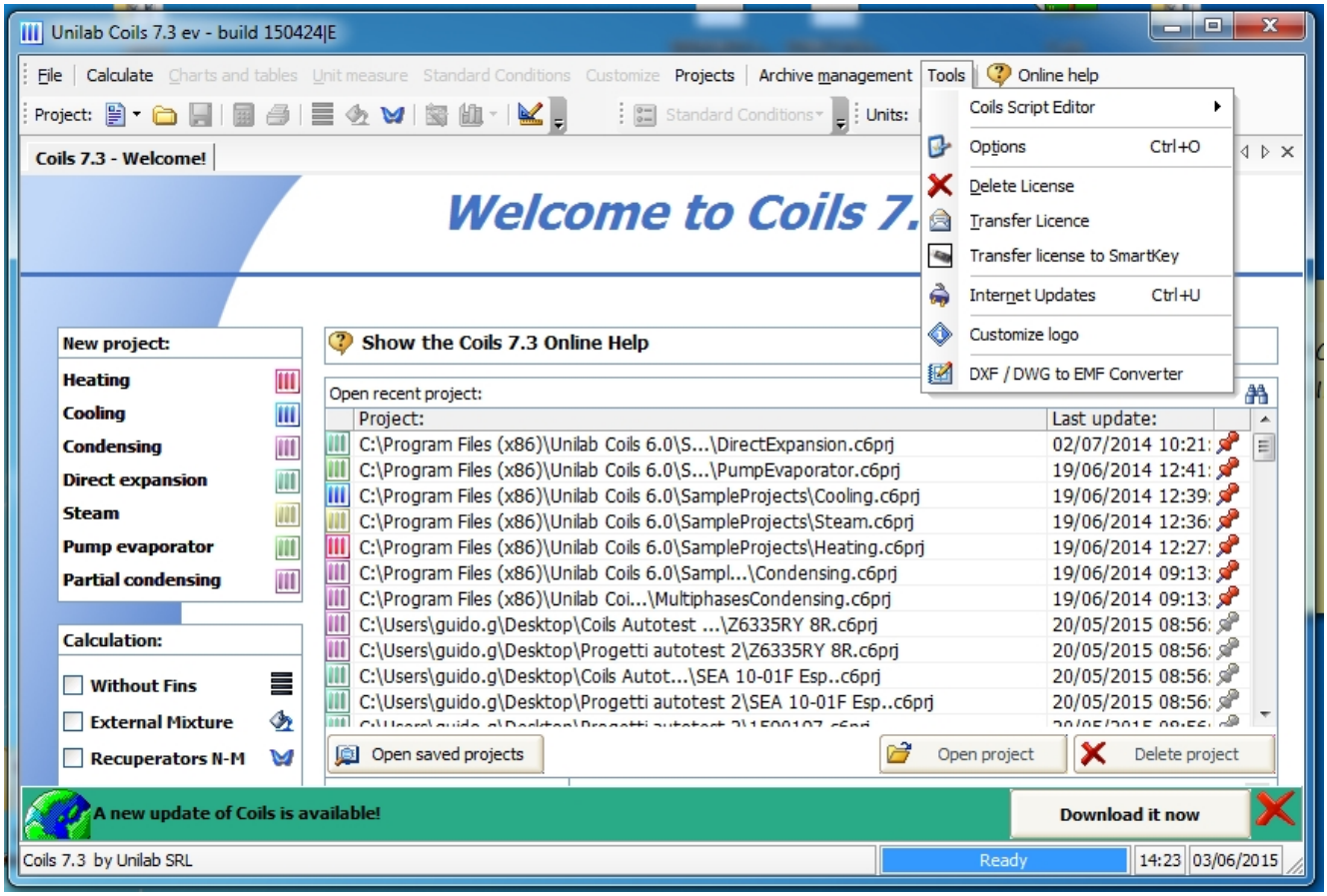
, we continue the process, otherwise we click "No" 

Transfer online license

LICENSE TRANSFER TO ANOTHER PC

The following points show the procedure to transfer the program license from a computer where the program was installed and the license was activated to another pc:

1) Open the program in the computer where license is active and delete it with "Delete License" in its menu;



2) Launch the program in the pc where you want to transfer license;

3) Input the same activation code you used on the other pc.

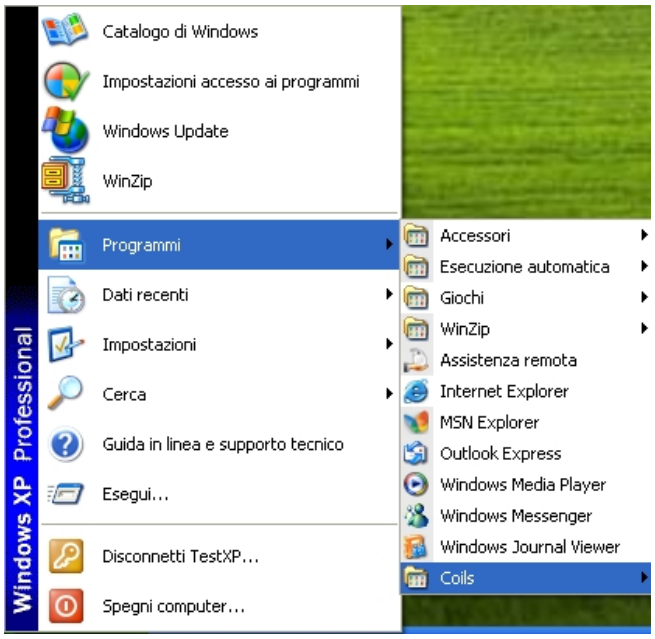
INTERNET UPDATE

INTERNET UPDATE

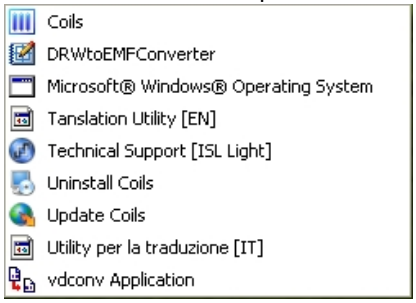
In order to perform the update of "Coils" software these are the steps to be followed:

- Click on the Start button  on the start bar
- Click on the "Program" voice of menu

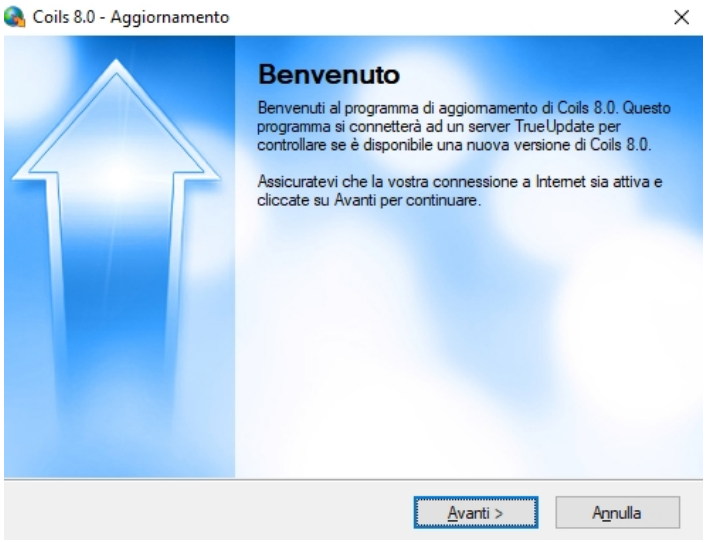
- Click on the “Unilab Coils ” voice of the menu and

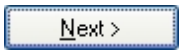


- Click on the “Update Coils”

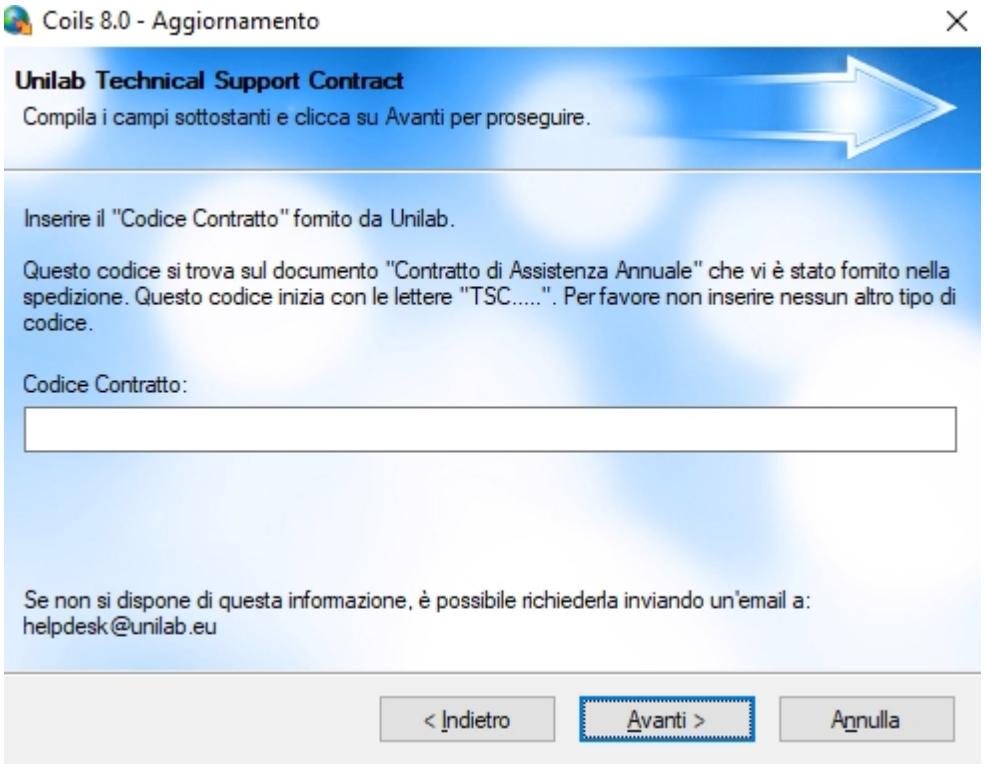


- The following screen appears

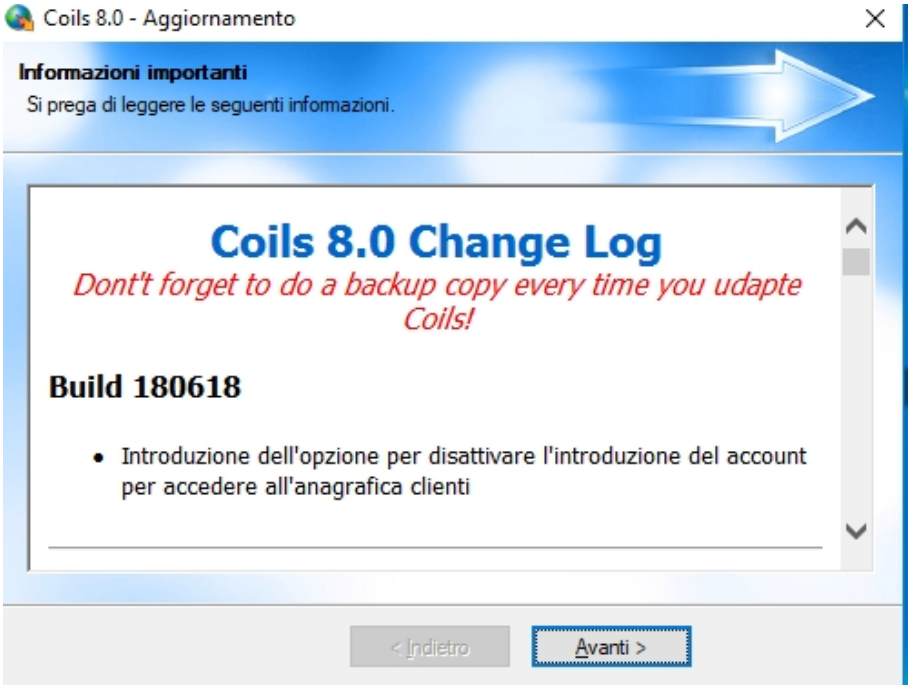


- Click on the button 

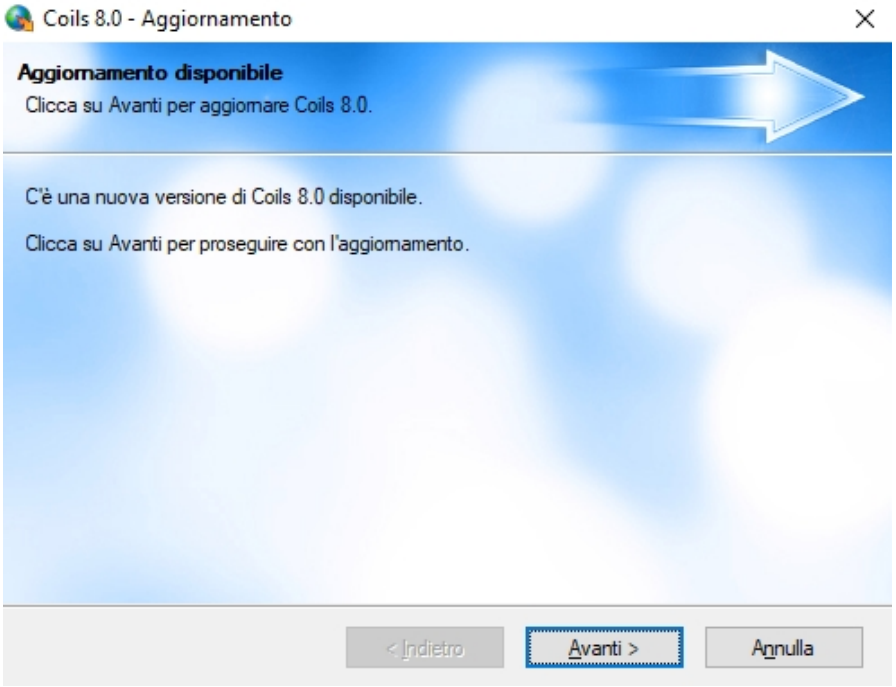
- The following screen opens and it asks for **contract code (= activation code)**, that you should have received with the download link or you can ask Unilab by sending an email to sales@unilab.eu

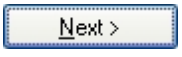


Please insert your code, for example, “TSC1234U” and the program goes to the next screen

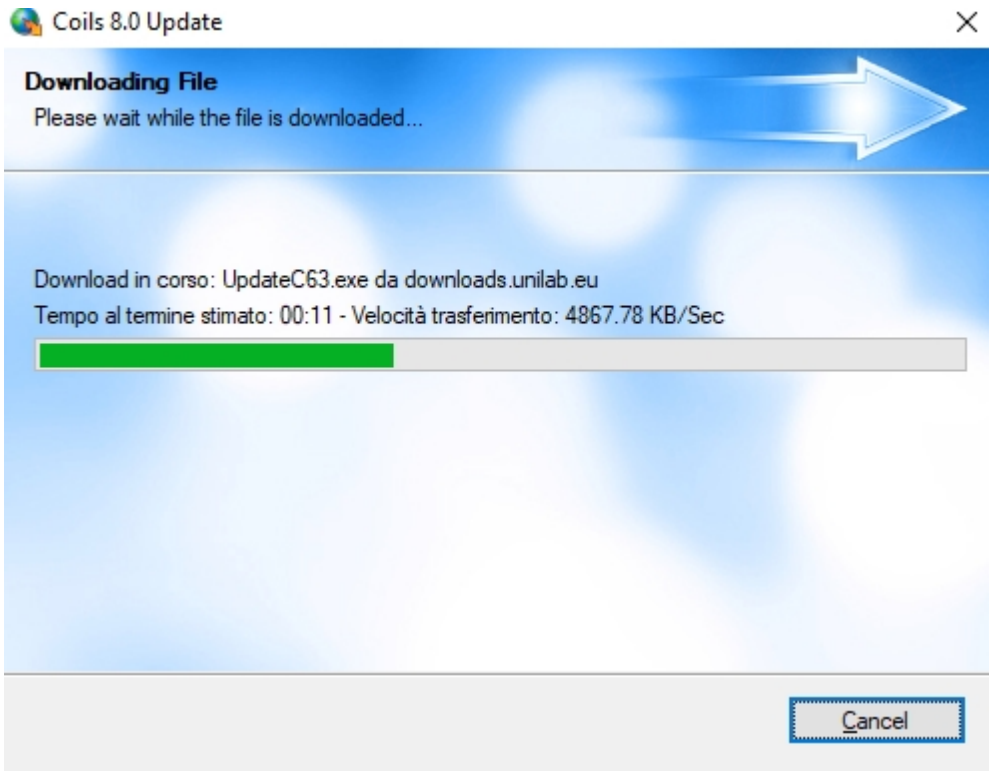


- A message that says that there is a newer version of the program

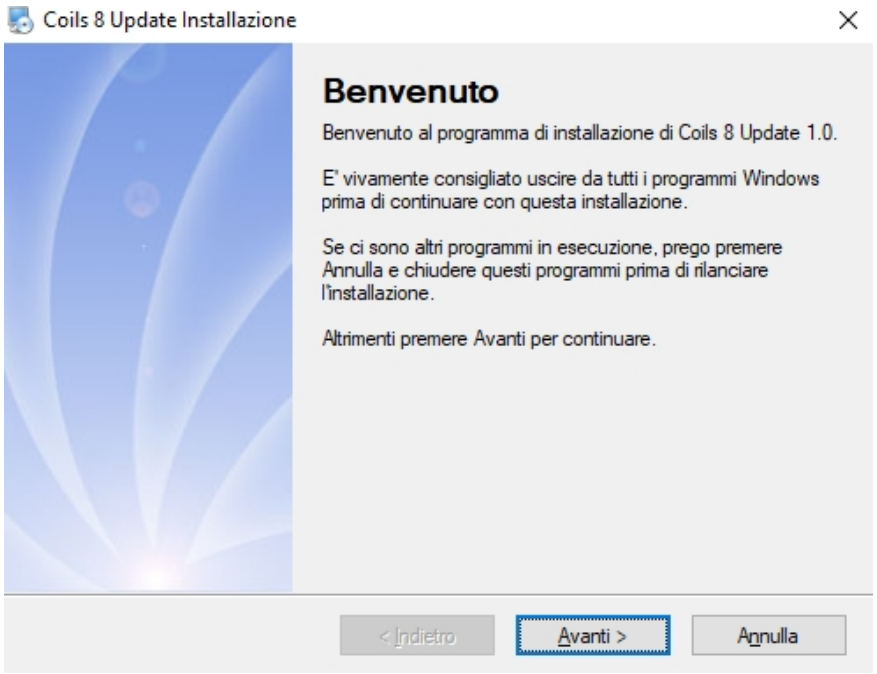


- We can click on the button 

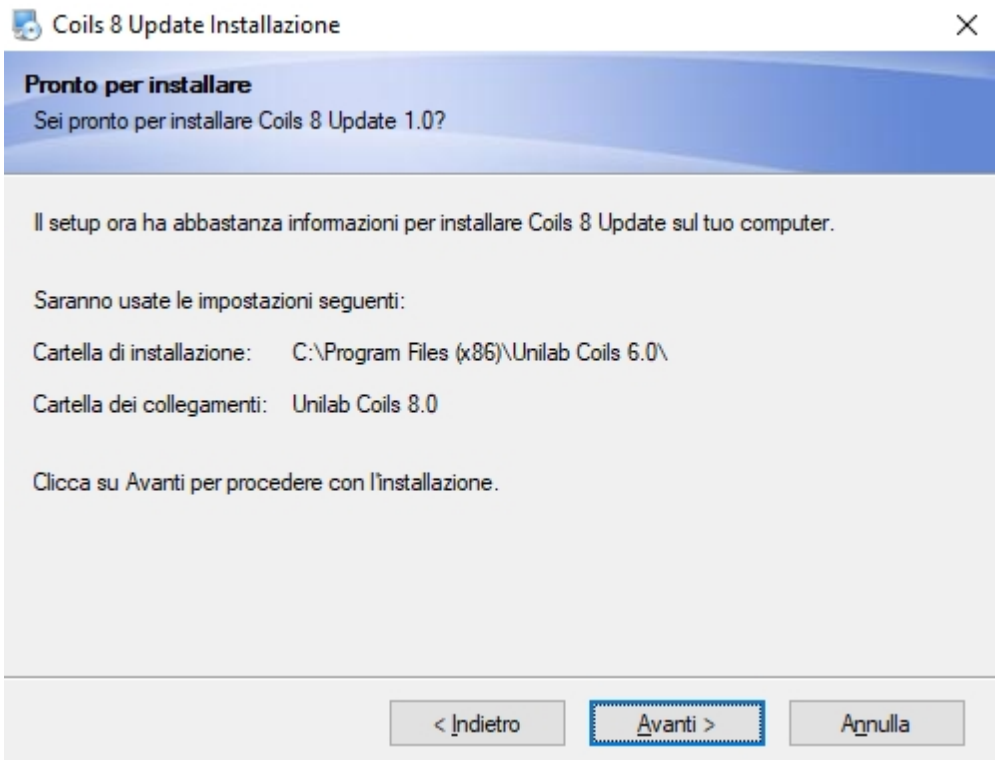
to start downloading the new version

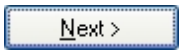


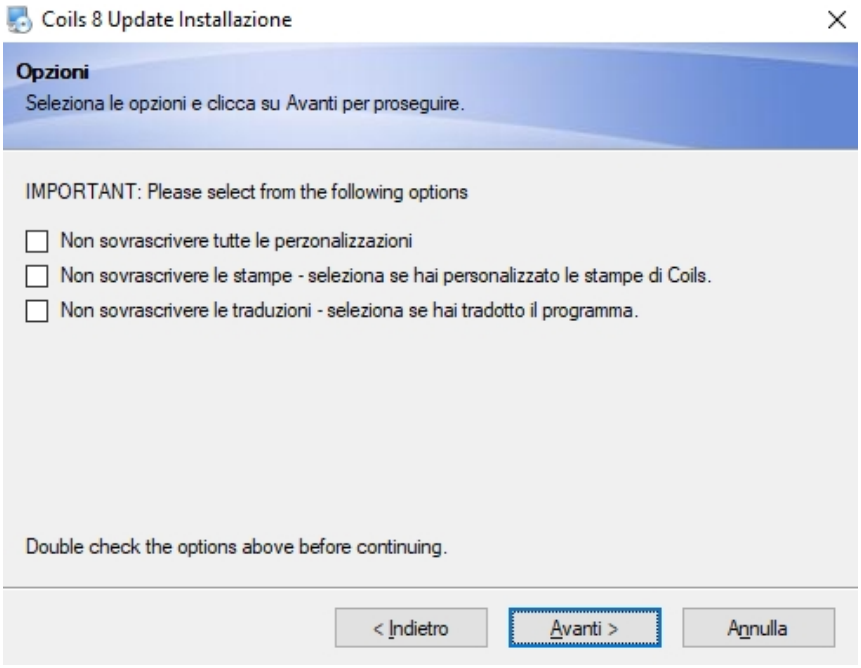
- The following screen shows, that we are about to start to download.



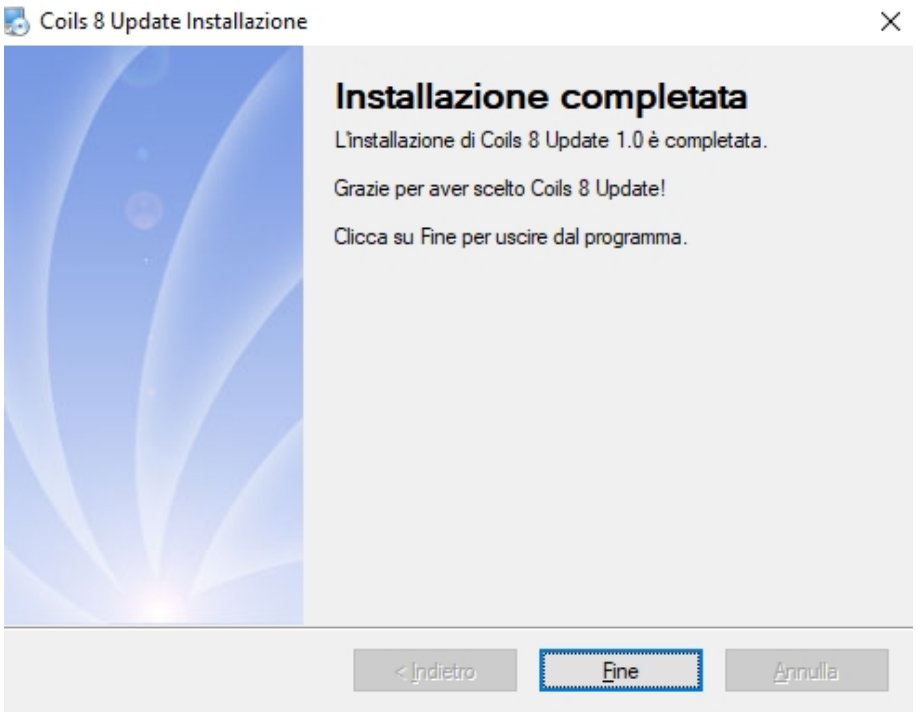
- After that we click on the button 

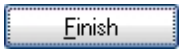


- The software tells where it will be installed and ask to go to  to continue



When the installation of the update software completes, the following screen appears



To end the process, please click on 

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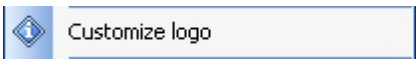
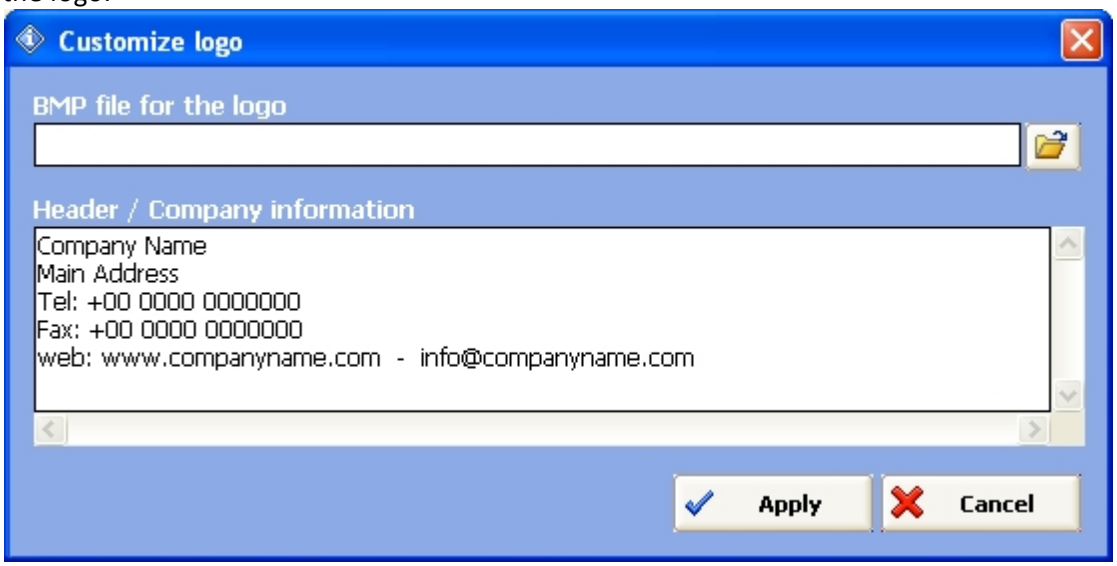
Customize logo

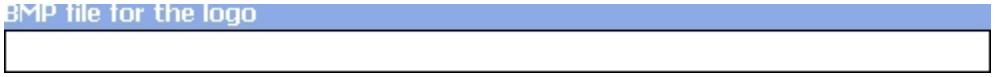
Customize logo

The voice 

on the Tools menu 

allows to insert the company information and the logo.



The field 

allows you to insert the path of the image to use like logo. Click on the button  near it to select the image.

In the “Header / Company information” field

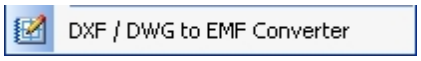
allows you to insert the main information about the company.

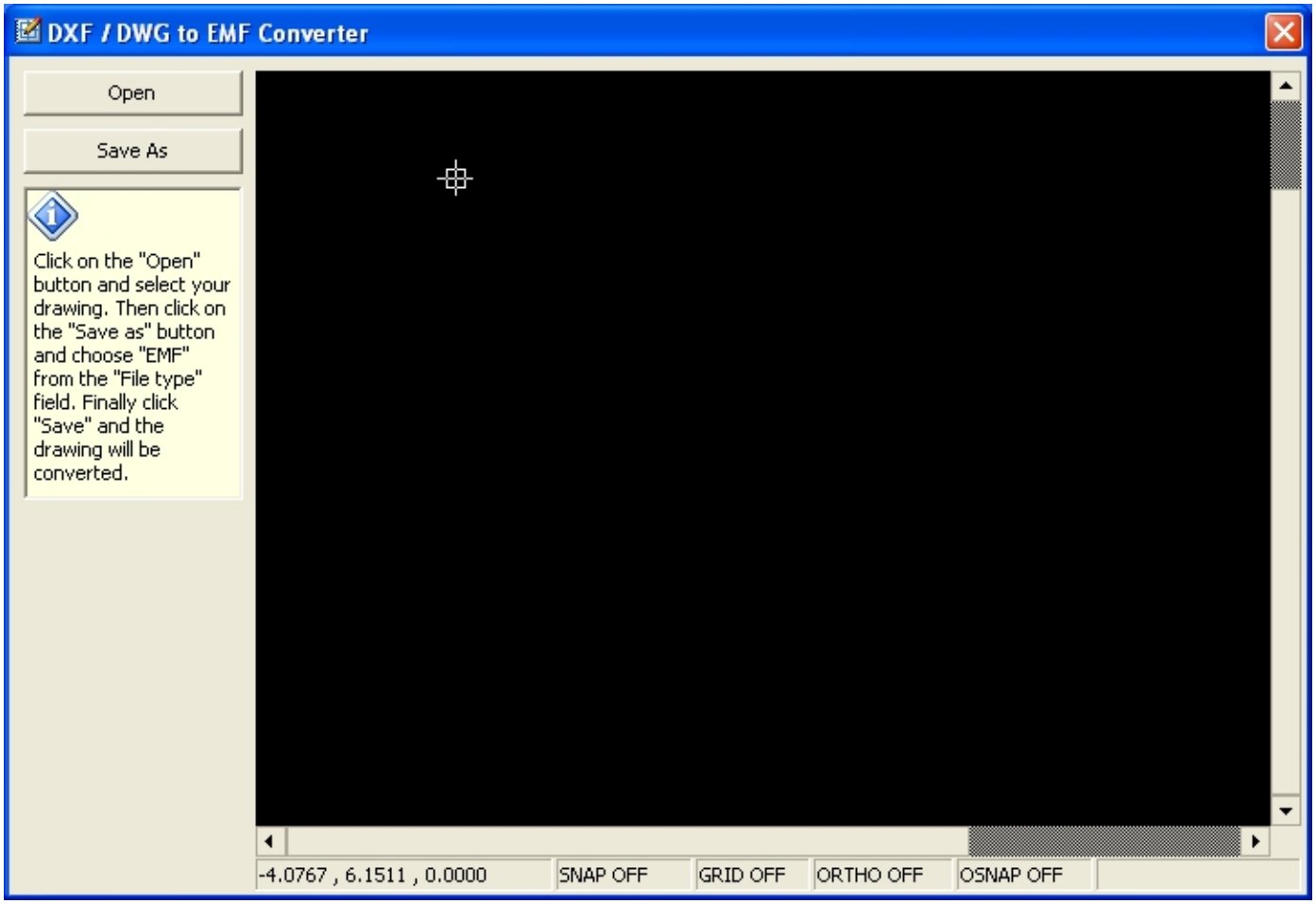
The button  allows to confirm the data inserted in previous fields.

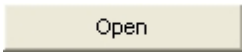
The button  allows to discard the data inserted.

DXF / DWG to EMF Converter

DXF / DWG to EMF Converter

The voice  on the Tools menu  allows to convert a DXF file into an EMF file.



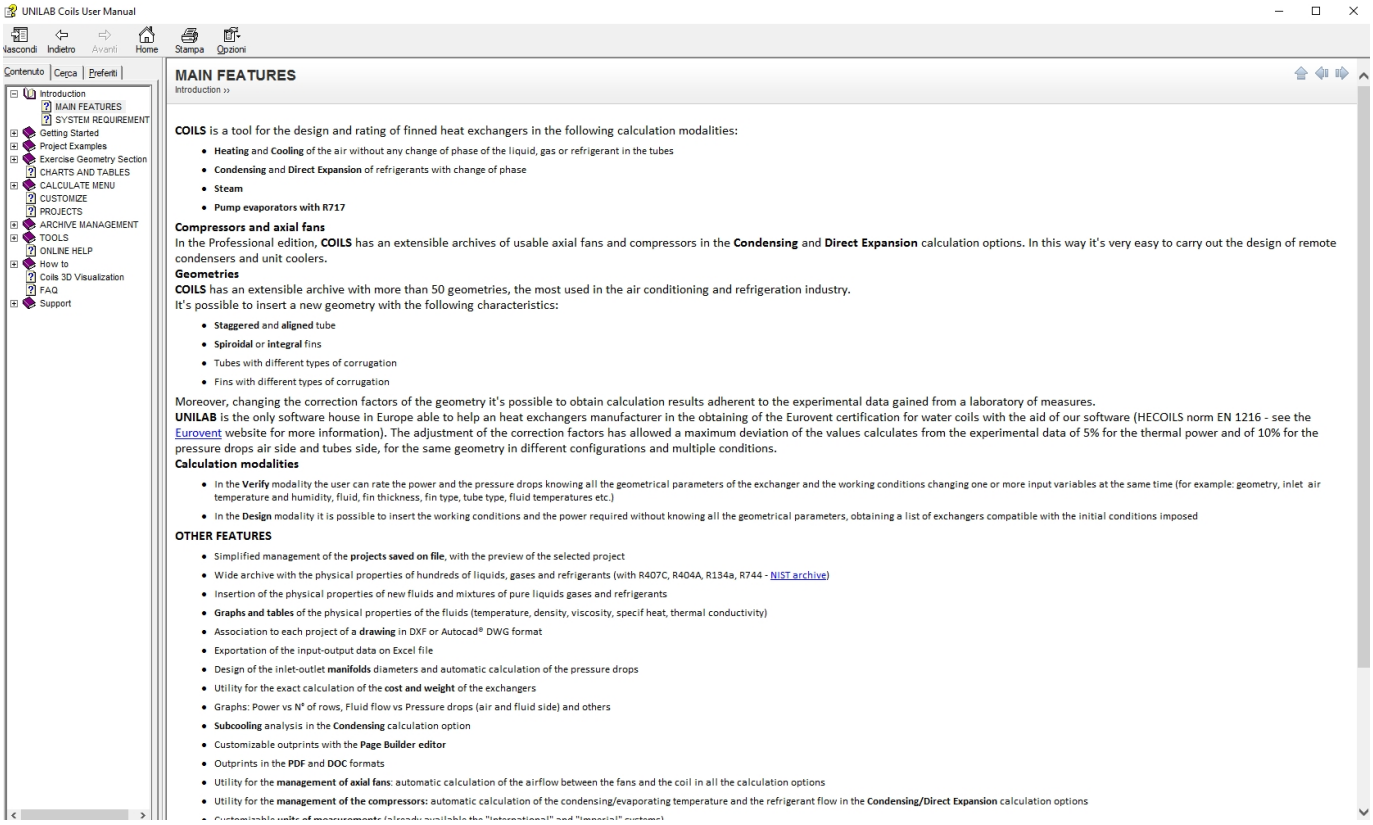
Here you can open a DXF / DWG file by  and save it into an EMF file by  .

ONLINE HELP

ONLINE HELP

The menu 

of the top bar allows to find needed information directly in Coils User Manual



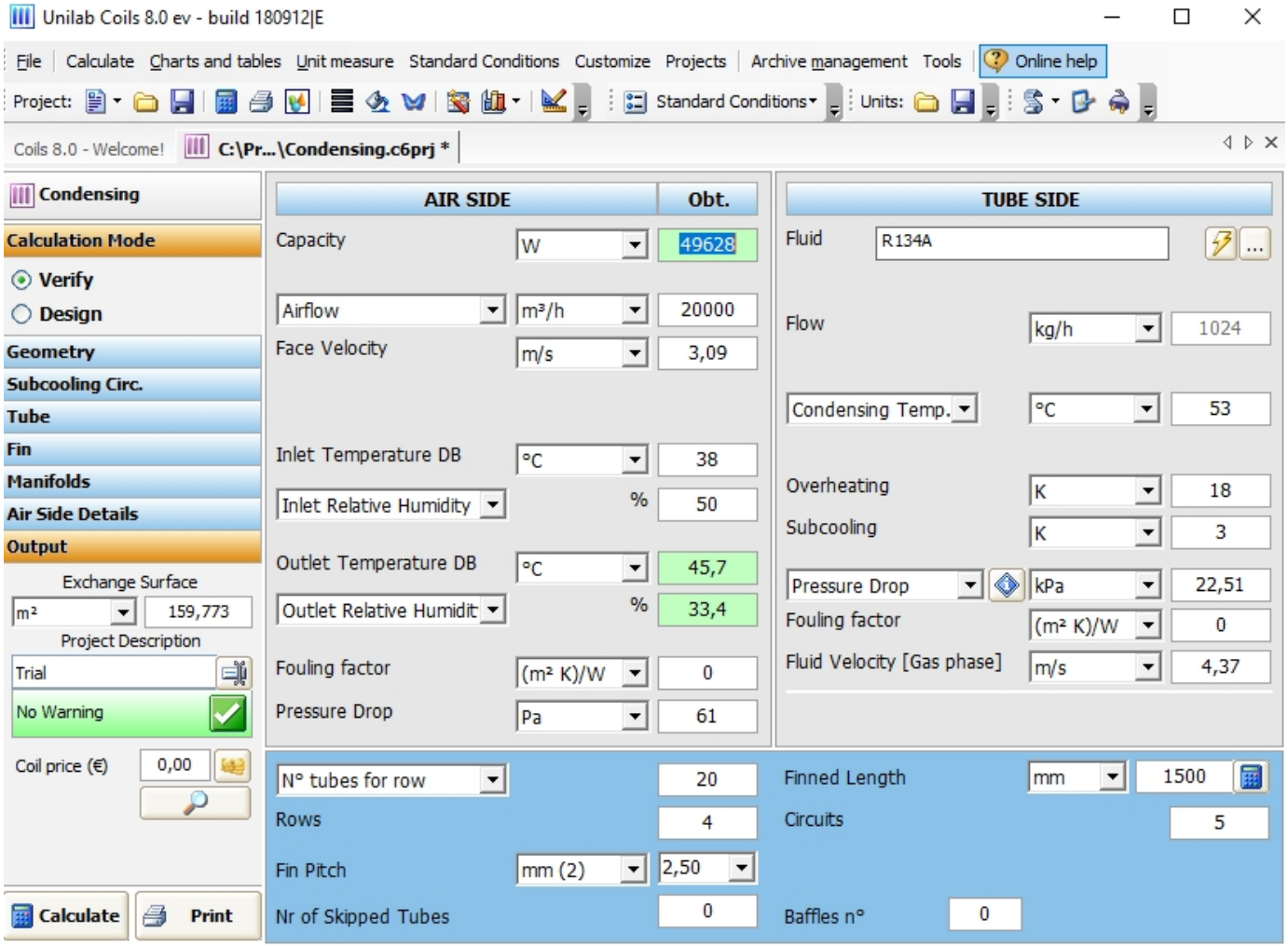
How to

How to change unit measure in page print out

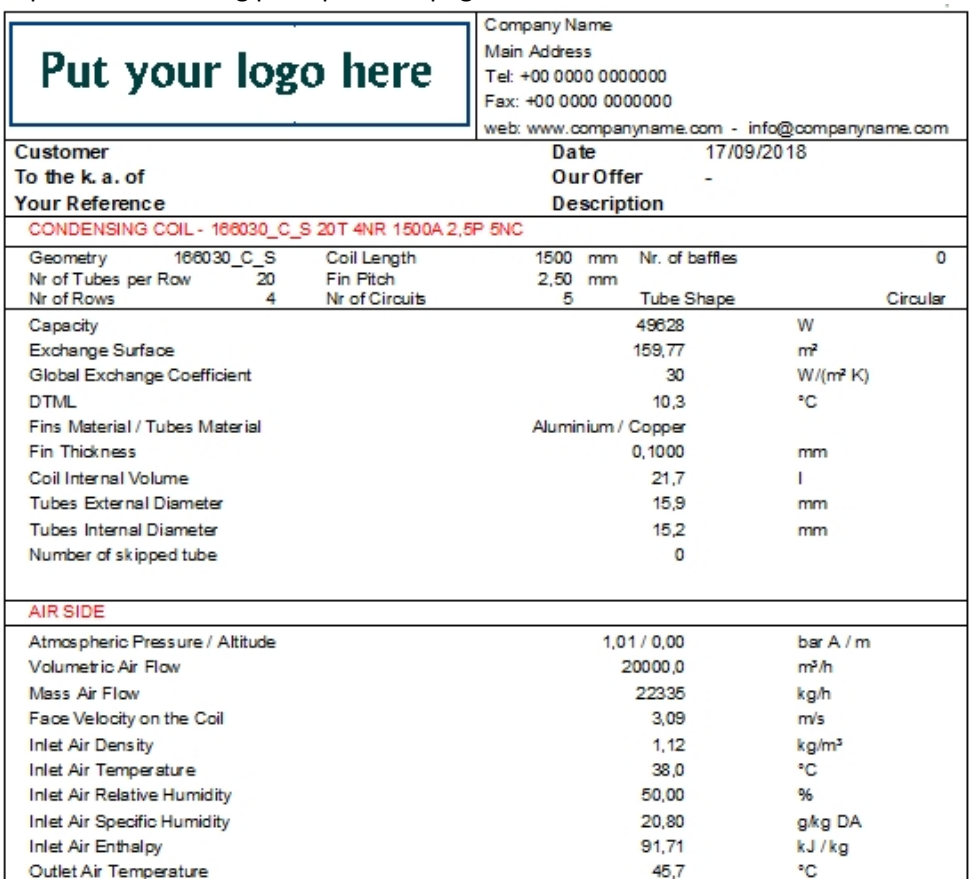
How to

How to change unit measure in page print out

- After performing a Calculation, we click on the “Print” button



We open the following print preview page



Put your logo here

Company Name
Main Address
Tel: +00 0000 0000000
Fax: +00 0000 0000000
web: www.companyname.com - info@companyname.com

Customer		Date	17/09/2018
To the k. a. of		Our Offer	-
Your Reference		Description	

CONDENSING COIL - 166030_C_S 20T 4NR 1500A 2,5P 5NC

Geometry	166030_C_S	Coil Length	1500	mm	Nr. of baffles		0
Nr of Tubes per Row	20	Fin Pitch	2,50	mm			
Nr of Rows	4	Nr of Circuits	5		Tube Shape		Circular

Capacity	49628	W
Exchange Surface	159,77	m²
Global Exchange Coefficient	30	W/(m² K)
DTML	10,3	°C
Fins Material / Tubes Material	Aluminium / Copper	
Fin Thickness	0,1000	mm
Coil Internal Volume	21,7	l
Tubes External Diameter	15,9	mm
Tubes Internal Diameter	15,2	mm
Number of skipped tube	0	

AIR SIDE

Atmospheric Pressure / Altitude	1,01 / 0,00	bar A / m
Volumetric Air Flow	20000,0	m³/h
Mass Air Flow	22335	kg/h
Face Velocity on the Coil	3,09	m/s
Inlet Air Density	1,12	kg/m³
Inlet Air Temperature	38,0	°C
Inlet Air Relative Humidity	50,00	%
Inlet Air Specific Humidity	20,80	g/kg DA
Inlet Air Enthalpy	91,71	kJ / kg
Outlet Air Temperature	45,7	°C

To change the capacity from W to HP

- click on the unit measure W

Put your logo here

Company Name
Main Address
Tel: +00 0000 0000000
Fax: +00 0000 0000000
web: www.companyname.com - info@companyname.com

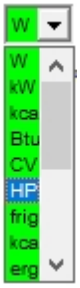
Customer		**Date**	17/09/2018
To the k. a. of		**Our Offer**	-
Your Reference		**Description**	

CONDENSING COIL - 166030_C_S 20T 4NR 1500A 2,5P 5NC

Geometry	166030_C_S	Coil Length	1500	mm	Nr. of baffles		0
Nr of Tubes per Row	20	Fin Pitch	2,50	mm			
Nr of Rows	4	Nr of Circuits	5		Tube Shape		Circular

Capacity	49628	W
Exchange Surface	159,77	m²
Global Exchange Coefficient	30	W/(m² K)
DTML	10,3	°C
Fins Material / Tubes Material	Aluminium / Copper	
Fin Thickness	0,1000	mm
Coil Internal Volume	21,7	l
Tubes External Diameter	15,9	mm
Tubes Internal Diameter	15,2	mm
Number of skipped tube	0	

- Let's click on the menu where We see W,



By changing unit measures, all values will be recalculated automatically.

Put your logo here

Company Name
Main Address
Tel: +00 0000 0000000
Fax: +00 0000 0000000
web: www.companyname.com - info@companyname.com

Customer		**Date**	17/09/2018
To the k. a. of		**Our Offer**	-
Your Reference		**Description**	

CONDENSING COIL - 166030_C_S 20T 4NR 1500A 2,5P 5NC

Geometry	166030_C_S	Coil Length	1500	mm	Nr. of baffles		0
Nr of Tubes per Row	20	Fin Pitch	2,50	mm			
Nr of Rows	4	Nr of Circuits	5		Tube Shape		Circular

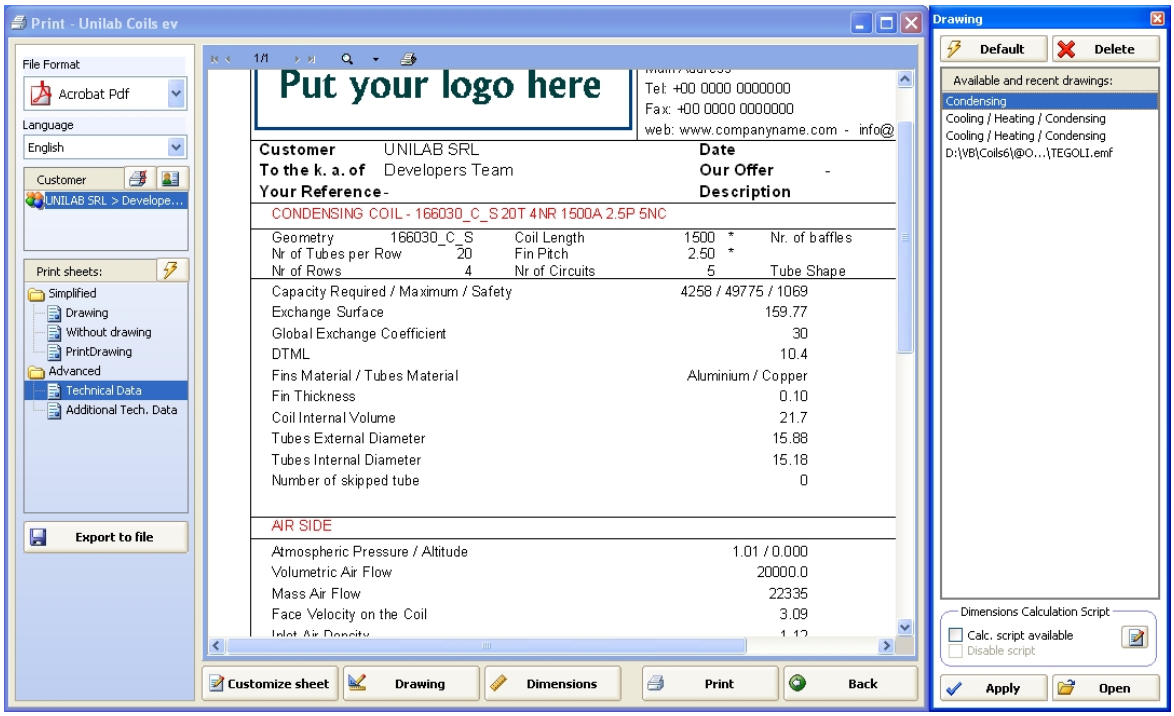
Capacity	66,55	HP
Exchange Surface	159,77	m²
Global Exchange Coefficient	30	W/(m² K)
DTML	10,3	°C
Fins Material / Tubes Material	Aluminium / Copper	
Fin Thickness	0,1000	mm
Coil Internal Volume	21,7	l
Tubes External Diameter	15,9	mm
Tubes Internal Diameter	15,2	mm
Number of skipped tube	0	

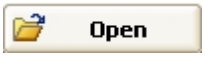
How to change the drawing

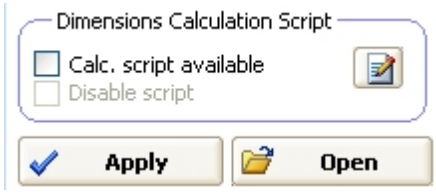
How to change the drawing

- In the "Print" page Let's click on the button 

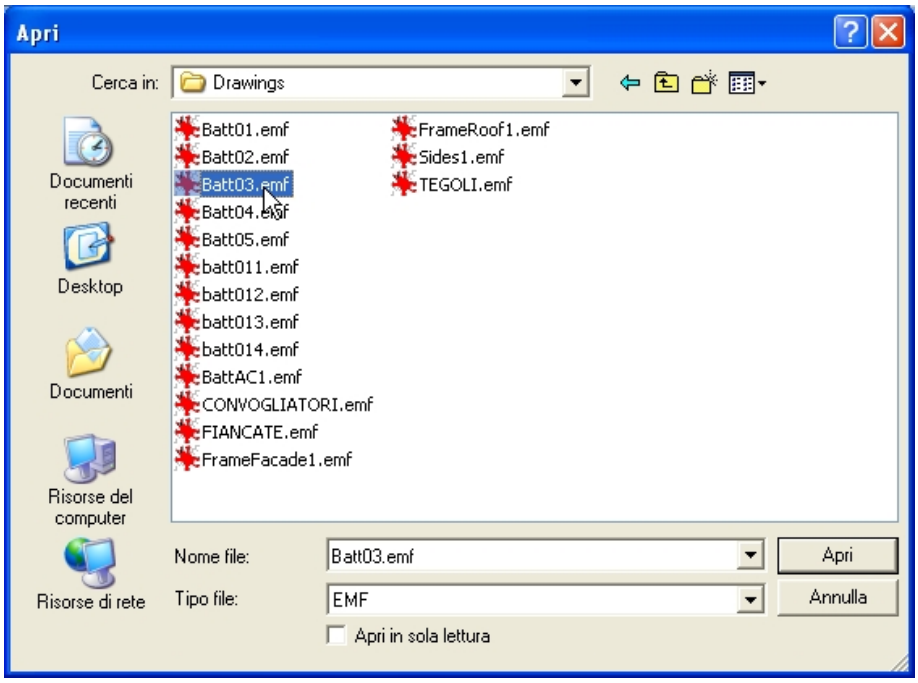
on the bottom of the mask:



By clicking the "Open" button 



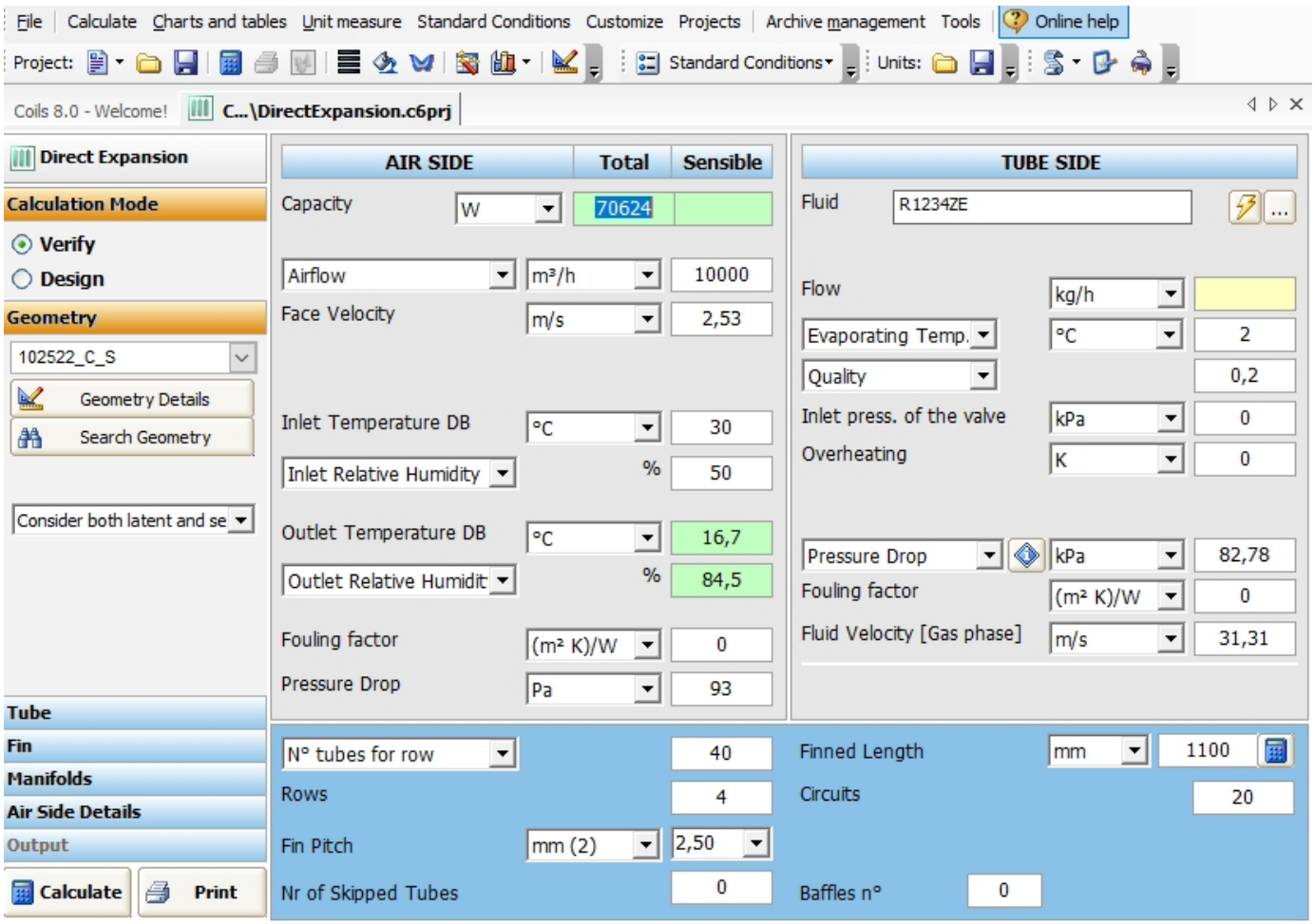
By clicking the open button, we can charge a previously saved AutoCAD drawing.



How to balance fans or compressors with coils

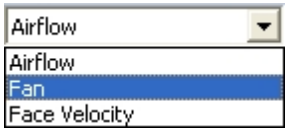
How to balance fans or compressors with coils

- Let's Open a Direct Expansion's project

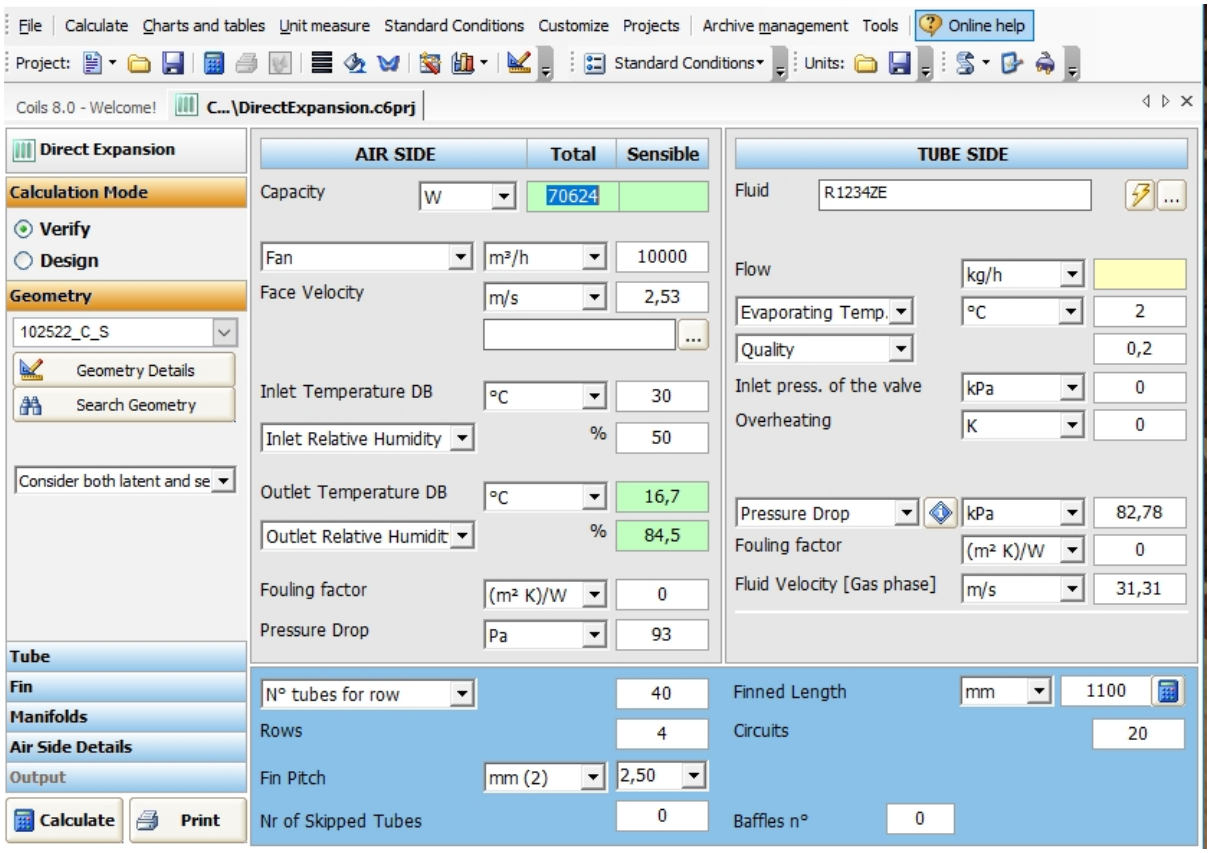


- Let's click on the "Airflow" combo 

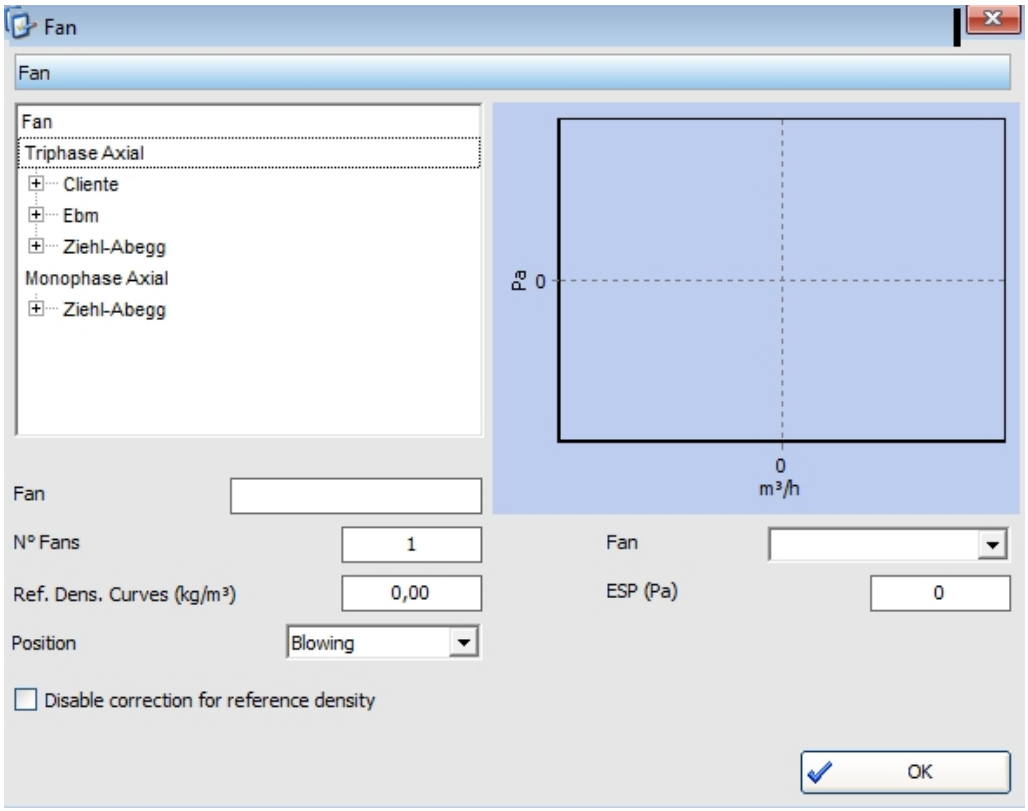
in the Air Side of the mask and choose the Fan item



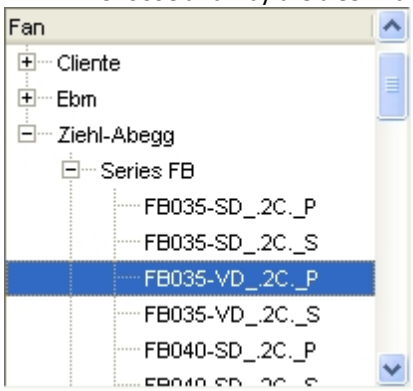
- The mask will be like the following:



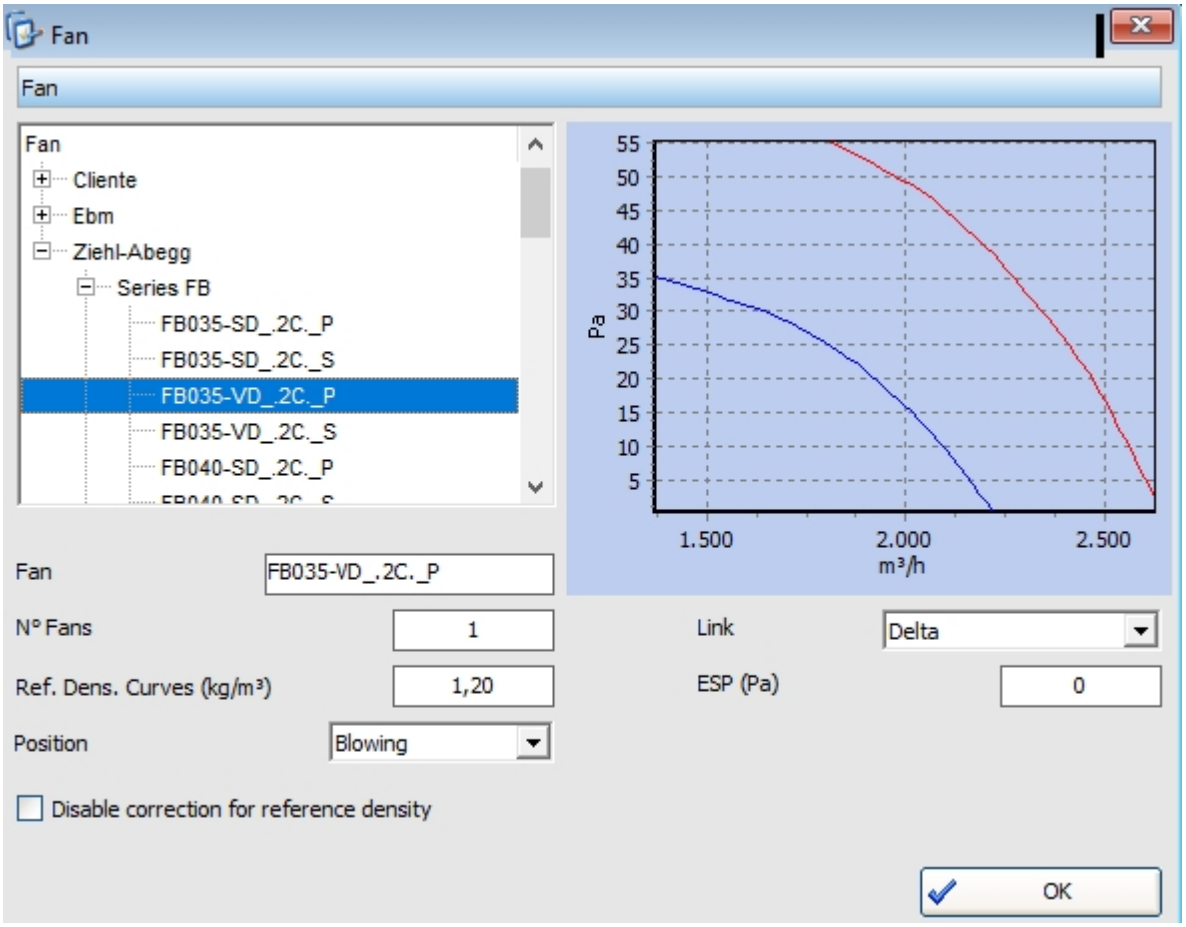
- Let's choose the "Fan" clicking on the button  appeared after the choose of the fan

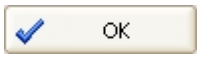


- Choose a fan by the tree in the top left side of the mask:

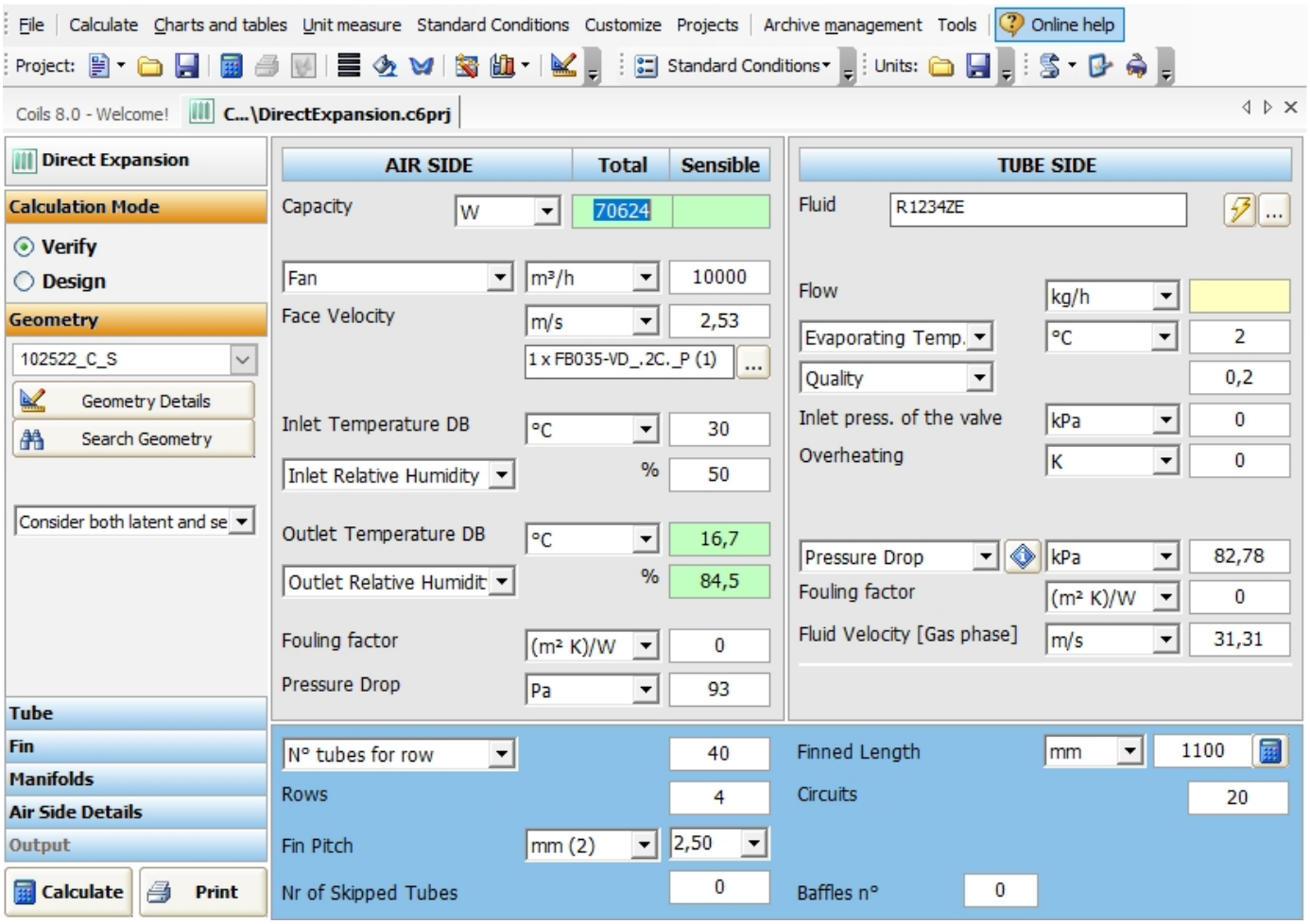


- The mask will be filled with the data of the selected fan model:

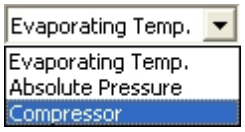


- Let's click on the button 

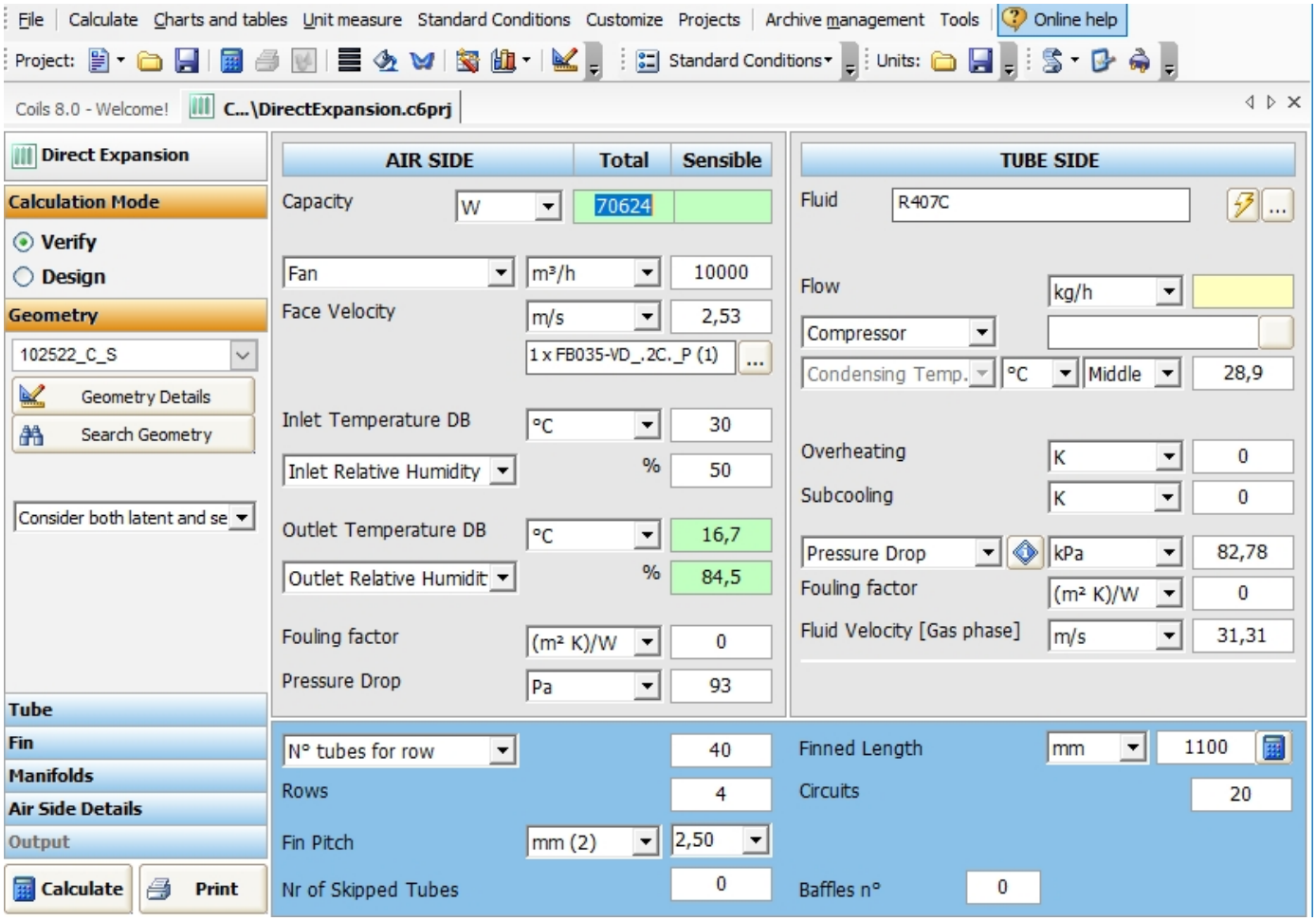
to close the mask and confirm the selection. The calculation mask will be like the following:



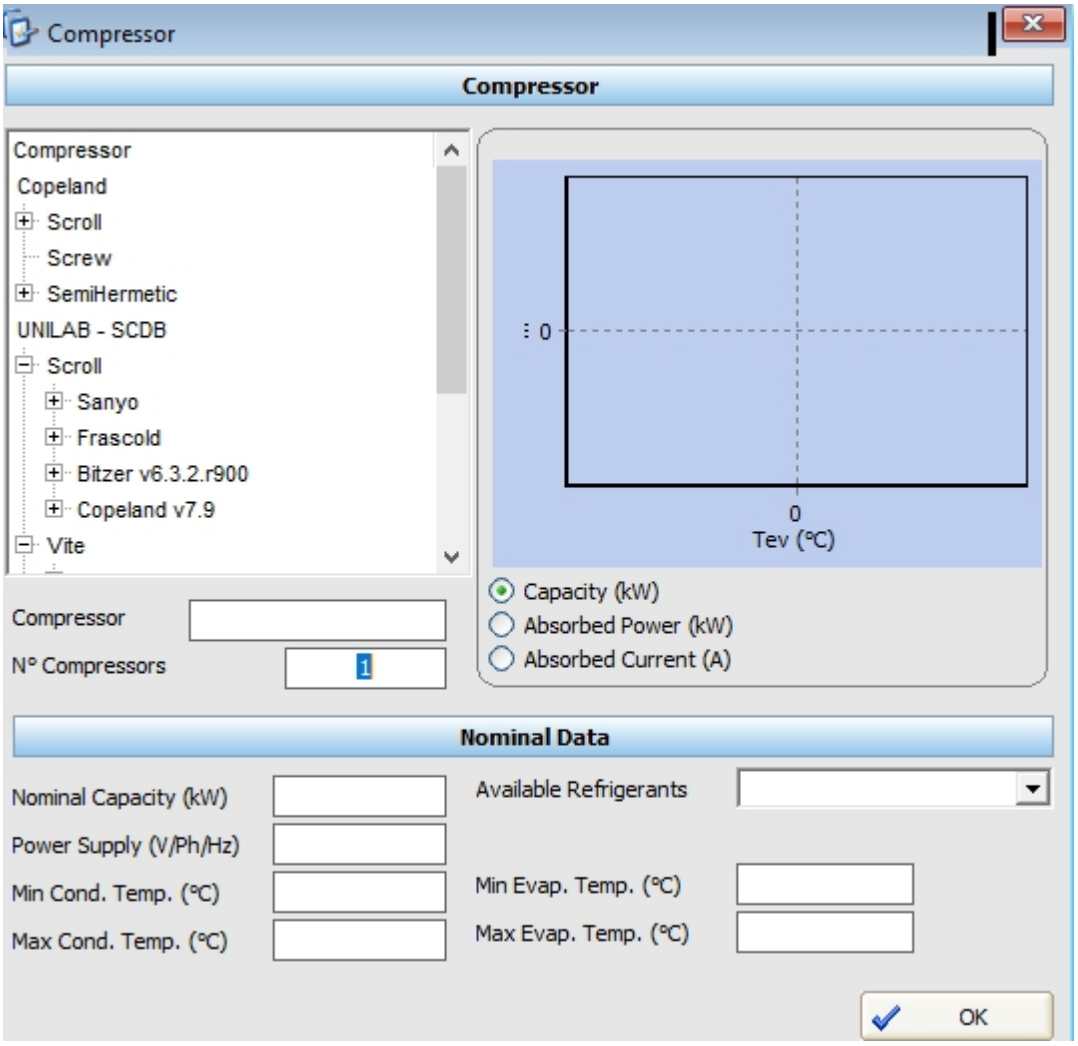
- Now let's choose the compressor. Then we have to choose from the "Evaporating Temp." combo  , in the Tubes Side section of the mask, the Compressor's item:



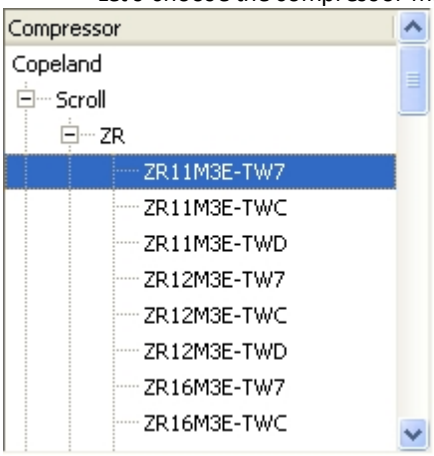
- The mask will be like the following:



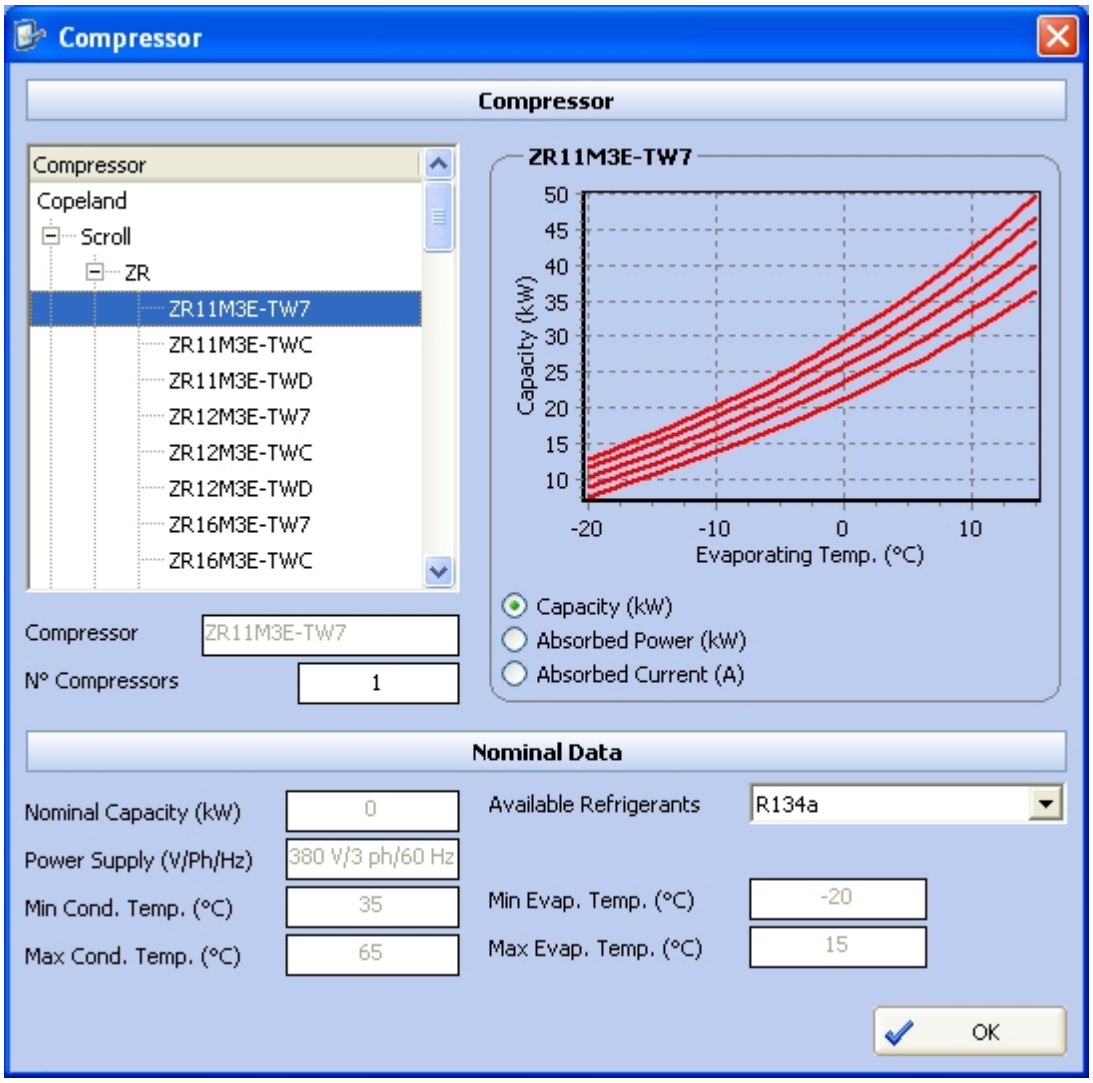
- Let's click on the " " button just appeared to choose the compressor to use. Will appear the following mask:

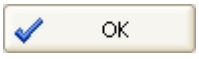


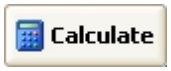
- Let's choose the compressor model by the tree in the top left side of the mask:



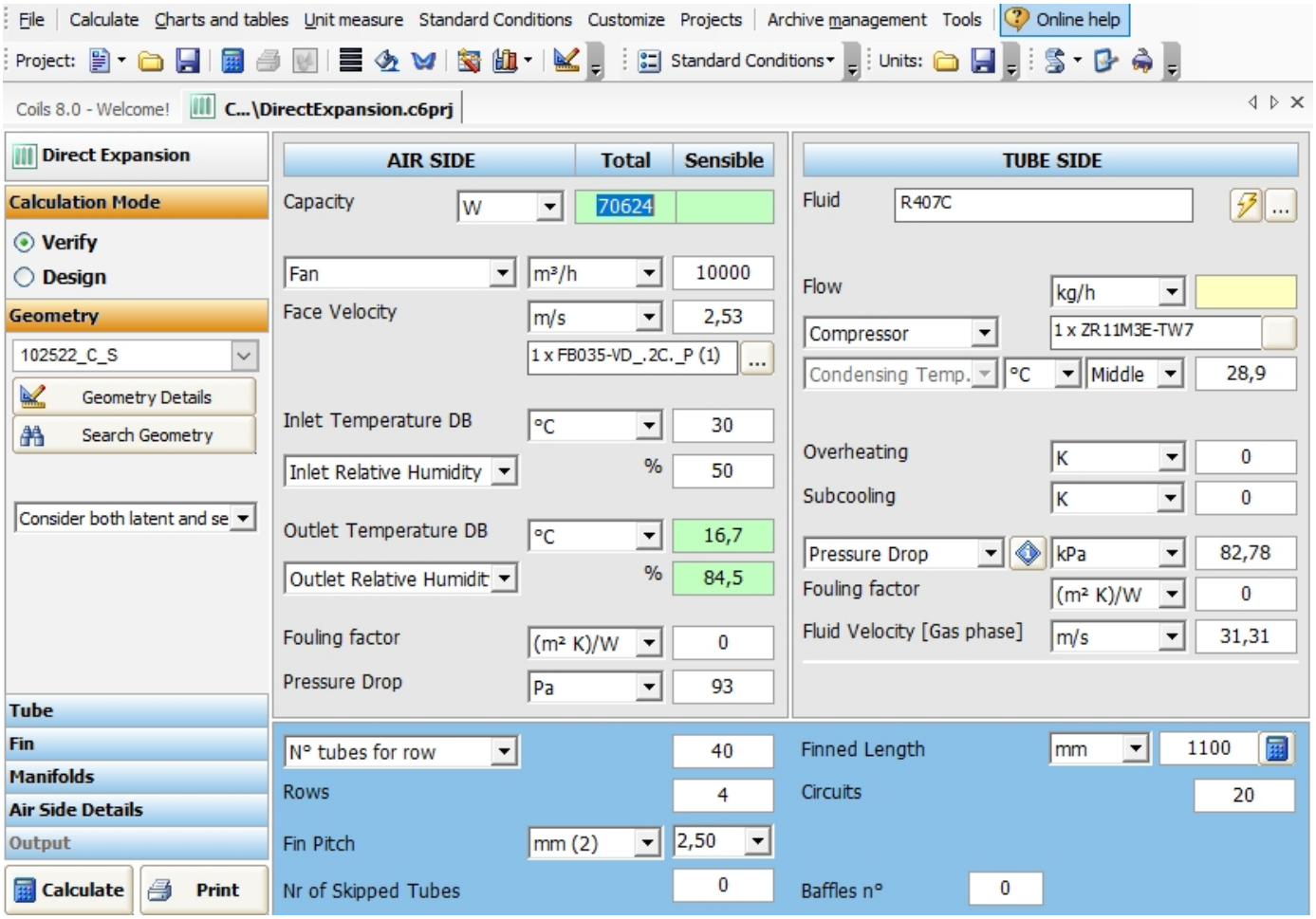
- The mask of the compressor will be filled with the data of the model selected:



- Click the button 

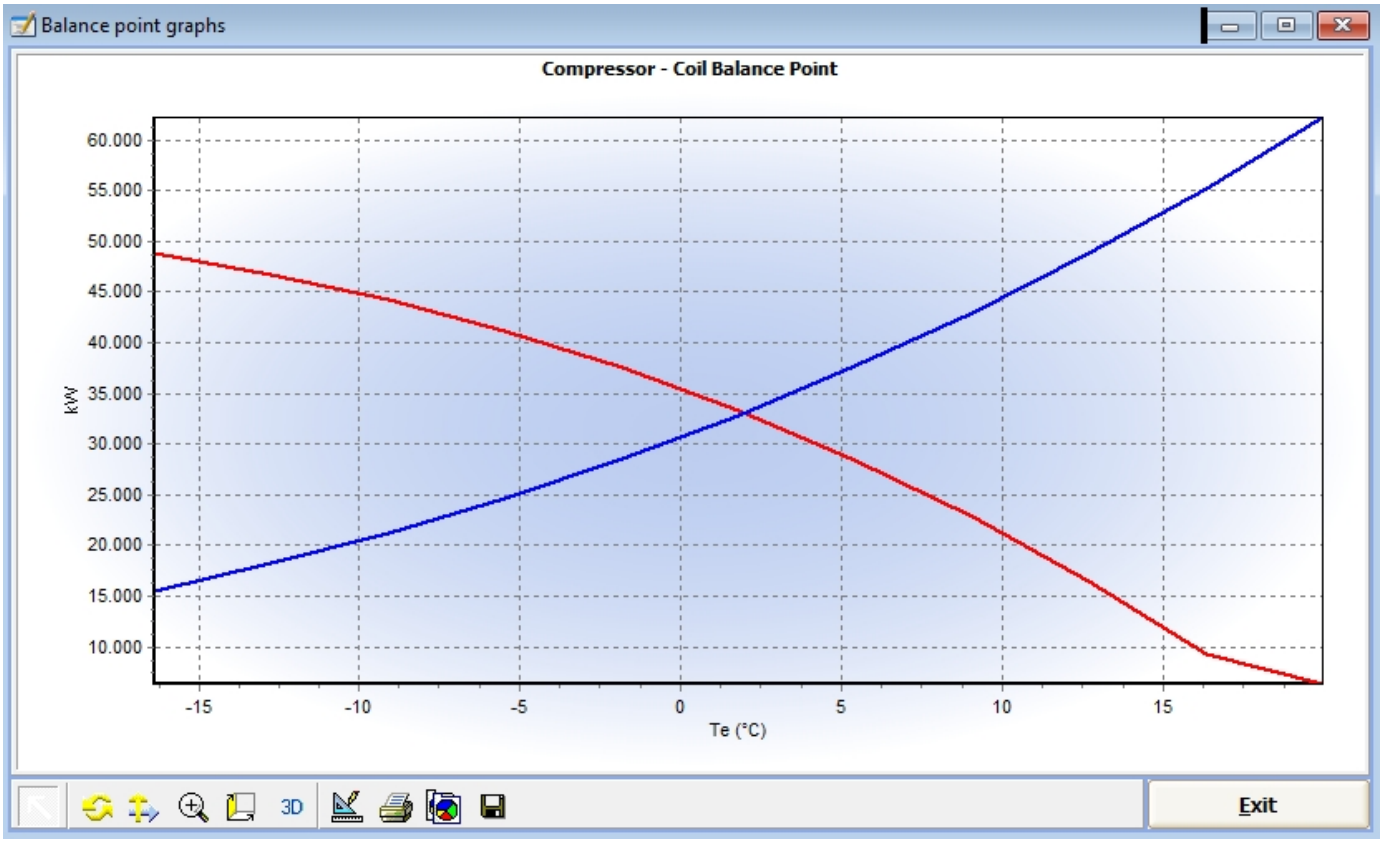
- The calculation mask will be set as following:
- We click the button 

and obtain a capacity result.



Thus we have balanced fan and compressor.

- If we want to see the balance point by graph, we can click the on Charts and tables of the menu bar
  - Clicking on Compressor balance point, we obtain the following graph.



Coils 3D Visualization

Coils 3D Visualization

For this option please refer to the software UNILAB EASY or visit

http://www.unilab.eu/prodotto/easy/

Considerations on Calculations that do not converge

Considerations on Calculations that do not converge

In the calculation of heat exchangers, although there are rules of general trends related to the construction of the heat exchanger configuration and thermophysical properties, it is necessar to analyze each situation individually.

In the particular case of heat exchangers with phase change, such as direct expansion, condensation and pump evaporator, the program COILS makes a correction of the benefits related to pressure drops of the refrigerant.

In this mode, the iterative calculation can, in some situations, lead to a stall situation in the process of convergence due precisely to the application of this fix.
The only way to remedy this situation is to vary the number of circuits of the coil set in the calculation.

HOW COILS CALCULATES CIRCUITS DURING A DESIGN ELABORATION

The "Design" functionality of Coils lets the user choose from a list of coils the best solution for a certain heat transfer and pressure drop requirement. But how does Coils generate the list of possible solutions? This will be discussed in the following document.

How does it work

Basically the software performs an automated calculation with all possible combinations of these three parameters:

1. Number of rows
2. Fin pitch
3. Number of passes (or nr of tubes in series)

The first two parameters changes between the minimum and maximum values set by the user in the "Design profile" form. The third parameter instead changes between 1 and 14 (*) and it's used to calculate the number of circuits with the following formula:

Nr of circuits = (Nr of tubes per row * Nr of rows) / Nr of passes

Where the Nr of tubes per row is set by the user in the input parameters.

Examples

A few practical example of these values are:

Nr of Rows: 2

Fin Pitch: 2.1 mm

Nr of Tubes per Row: 32

In this situation, the number of circuits will vary from:

Nr of Passes: 1

Nr of Circuits = (32 * 2) / 1 = 64

To:

Nr of Passes: 14

Nr of Circuits = (32 * 2) / 14 = 4,57 = 5

Another example:

Nr of Rows: 3

Fin Pitch: 2.1 mm

Nr of Tubes per Row: 32

In this situation, the number of circuits will vary from:

Nr of Passes: 1

Nr of Circuits = (32 * 3) / 1 = 96

To:

Nr of Passes: 14

Nr of Circuits = (32 * 3) / 14 = 6,85 = 7

Another example:

Nr of Rows: 4

Fin Pitch: 2.1 mm

Nr of Tubes per Row: 32

In this situation, the number of circuits will vary from:

Nr of Passes: 1

Nr of Circuits = (32 * 4) / 1 = 128

To:

Nr of Passes: 14

Nr of Circuits = (32 * 4) / 14 = 9,14 = 9

Considerations on the thickness of the ice of the heat transfer coils

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This question on the effects of the thickness of the ice in the heat transfer coils and why sometimes the duty/ capacity increases instead of decreasing ?

When we use the thickness of the ice we get two effects:

the ice introduces a thermal resistance that decreases the heat exchange coefficient .

the ice decreases the passage area of the air, therefore having the same flow , the cross velocity increases, thus the heat exchange coefficient air side increases. This (coefficient) usually in the heat transfer coils is the binding factor.

The addition of these two effects give an increase or a decrease of the duty.

If the flow instead is determined by adding a fan, the ice presence will give an increase of the pressure drops air side, thus bringing the balance point to a lower point, so decreasing the duty.

Considerations about grooved tubes

Considerations about grooved tubes

The corrugation of the tubes can both affect dramatically the coil performances or not, dependently on the typology of the fluid inside the tubes. For example, if the fluid is an oil with high viscosity, or it is an ethylene/propylene glycol, a grooved tube can increase the coil performances, otherwise the difference will not be even visible. If in the project we are using refrigerants, the difference may not be so high. Why it happens like this?

The equation to calculate the heat exchange coefficient of a finned pack heat exchanger is the following

K = 1 / (Air Resistance + Tubes Resistance + U)

Air Resistance is the air side resistance equals to Air Resistance = 1 / (Air H * Coil Eff)

Tubes Resistance is the tubes side resistance equals to Tubes Resistance = Si / Tubes H

Where:

- Air H is the partial exchange coefficient air side
- Coil Eff is the finned surface efficiency
- Si = (Partial primary surface + Secondary Surface) / Primary Surface
- Tubes H is the partial exchange coefficient tubes side
- U are other resistances usually ignored like the thermal resistance due to the tubes material and the fouling factors both sides.

The primary surface is the thermak exchange surface of the tubes, and the secondary is the total surface of the fins.

Suppose that we set the Air Resistance to = 0,018

When increasing the surface of the tube, using a grooved tube, you get a double effect: it increases the exchange coefficient tube side and it increases the ratio “Si”. If because of the type of fluid used we exchange fluid side of the coefficients of very high, for example 4000 (equal to water at 2.8 m/s), this effect will be negligible. Assuming a value for "SI" of 20 and a coefficient of 4000, the resulting Tubes Resistance will be equals to 20/4000 = 0.005. Consequently, the tube side resistance will be negligible.

If the fluid is very viscous, such as a thermal oil, the coefficient side tube will be much lower, such as 800. Therefore Tubes R = 20/800 = 0.25. Consequently the tube side resistance is dominant in the calculation of the overall coefficient, and therefore in this case is more useful to use a grooved tube to increase both the coefficient of exchange that the ratio between the surfaces, increasing therefore the coil performance significantly.

In this situation it is very important to set the parameter “***Tube internal surface ratio***” of the geometry, which specifies the increment of the surface of the grooved tube. This ratio is calculated as: (Tubes Internal Grooved Surface / Surface of the corresponding smooth tube).

Support