HydrauCalcXL

2024a Release

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What is HydrauCalcXL Add-in?

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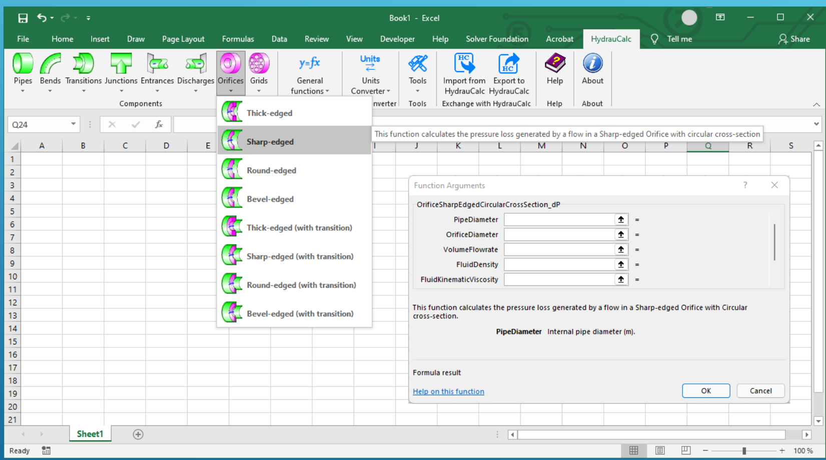
What is HydrauCalcXL Add-in?

- HydrauCalcXL Add-in is a library of functions that has been developed to calculate the pressure losses of hydraulic components in Microsoft Excel®. This library allows the direct call of functions relating to the calculation of pressure losses. It comes from the HydrauCalc application which is based mainly on recognized and respected references in the field of flow and pressure losses calculation.
- The HydrauCalcXL functions can be used via the user interface of Excel, like the own integrated functions of Excel.
- The joint use of this library and the solver integrated in Excel® (solver of nonlinear systems of equations) makes it possible to solve iterative flow problems and to perform multi-variables optimization analyzes of fluid systems.

The Excel graphical interface

The Excel graphical interface (1)



- The HydrauCalc tab includes a ribbon that allows you to call up the different functions of the library.
- From this interface, the user inserts the functions of the components that he wishes to evaluate.
- This interface is intuitive and very easy-to-use.

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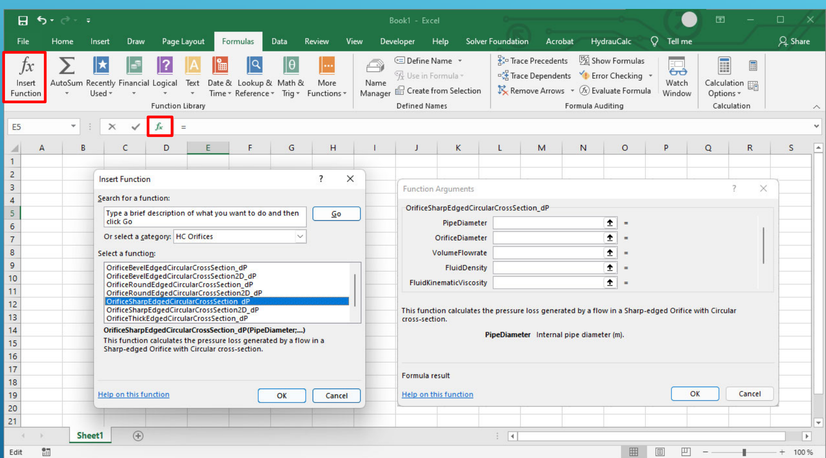
The Excel graphical interface (2)



- The functions of the library can also be selected from the "Insert Function" buttons of the "Formulas" tab or from the function bar.
- This interface is less friendly and less easy to use than the previous one.

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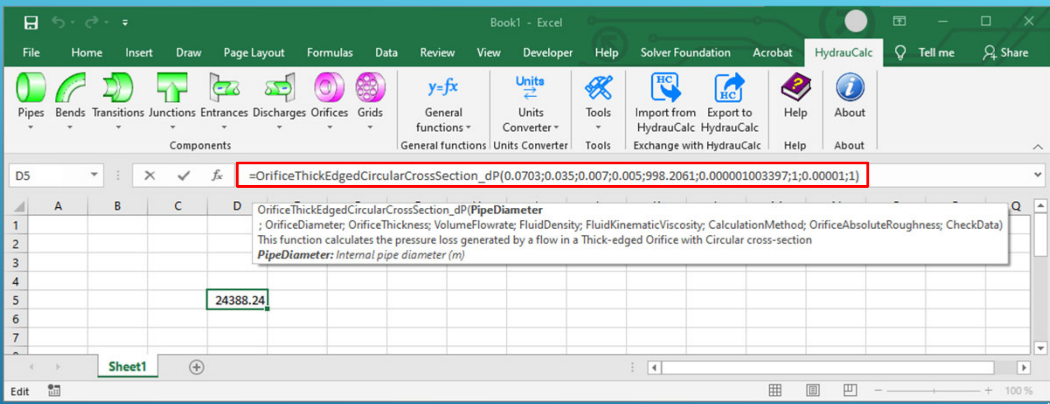
The Excel graphical interface (3)



When a function is inserted in a cell of the spreadsheet, it is possible, subsequently, to modify the parameters of the function by displaying it in the formula bar.

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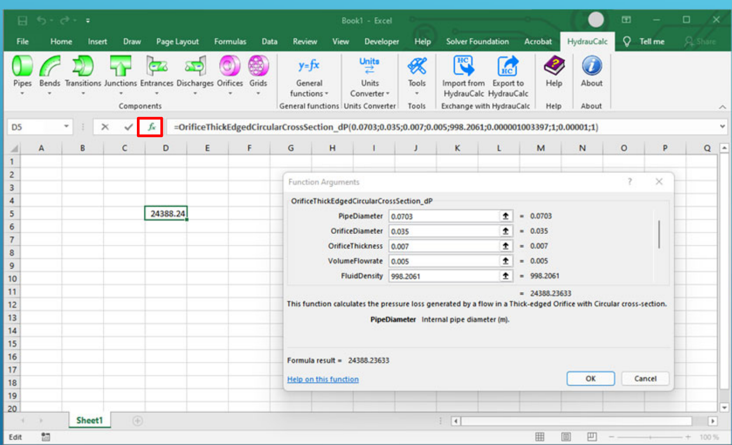
The Excel graphical interface (4)



- Function parameters can also be changed by selecting the "Insert Function" button on the function bar.

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The Functions of the HydrauCalcXL Library

The functions of the HydrauCalcXL library

The functions of the library are accessible via the ribbon of the HydrauCalcXL tab.

The library includes four types of functions:

- Functions for calculating pressure losses of piping components such as straight pipes, bends, transitions, junctions, pipeline entrances, pipeline discharges, orifices, grids (74 functions).
- Functions for calculation between the different variables entering into the general pressure loss formulas (pressure loss, pressure loss coefficient, flow coefficient, volume flow, mass flow, Reynolds number, flow velocity , ...) (103 functions).
- Functions to convert units of measure to each other (17 functions).
- Various functions (2 functions).

Piping Components

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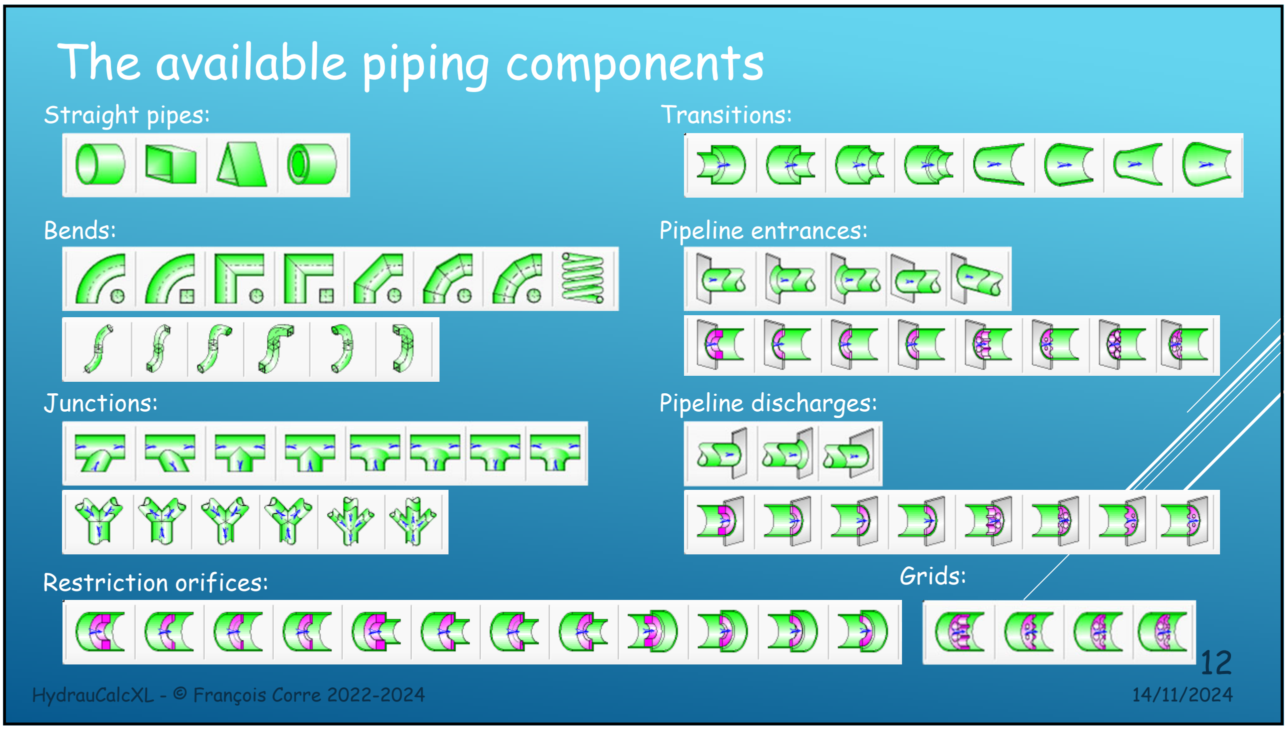

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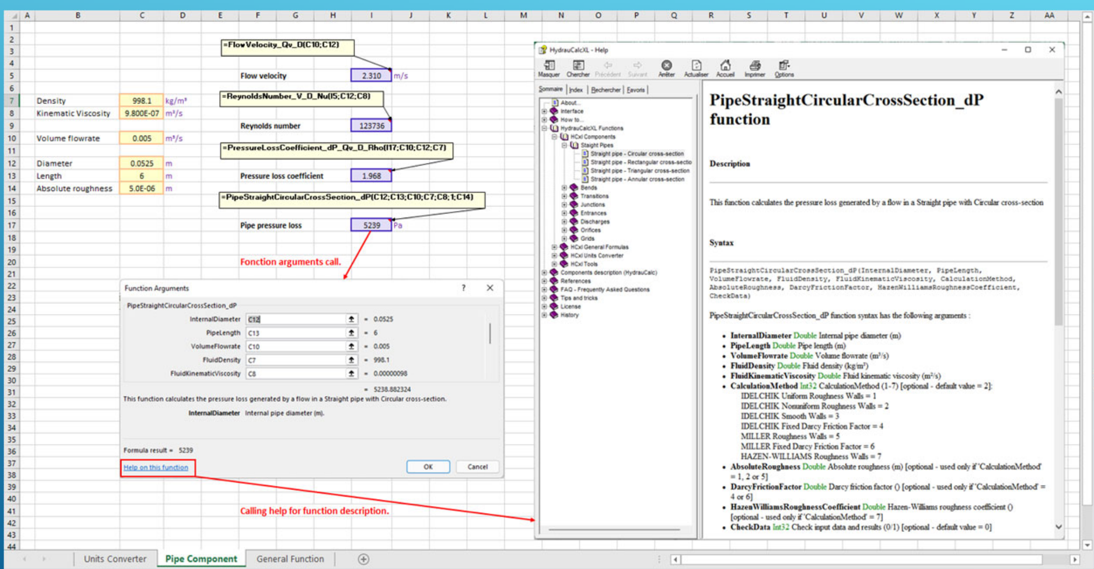
Component Function Arguments

The arguments of the component pressure drop calculation functions are:

- The geometry of the component (length, internal diameter, angle and radius of curvature, absolute roughness of the walls, etc.).
- The characteristic of the flow (volume flowrate).
- The properties of the conveyed fluid (density and kinematic viscosity).

Example of Using a Component Function



General formula functions

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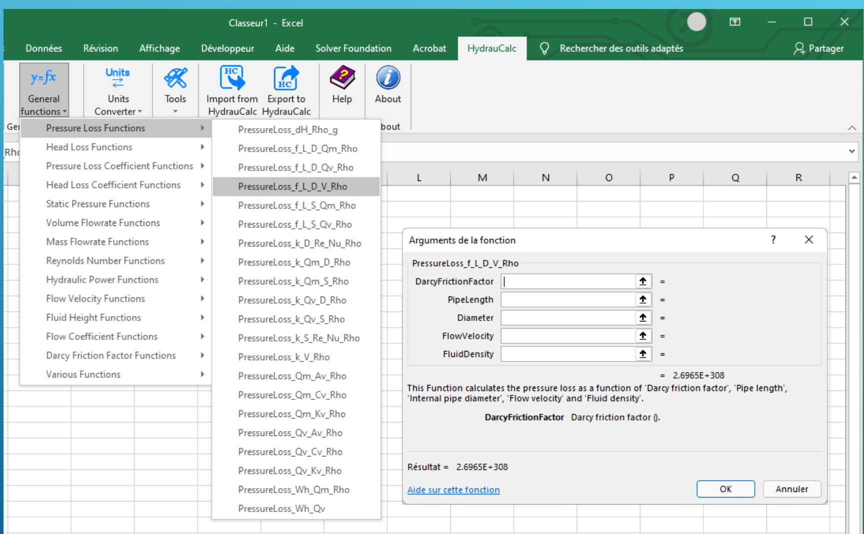
General formula functions



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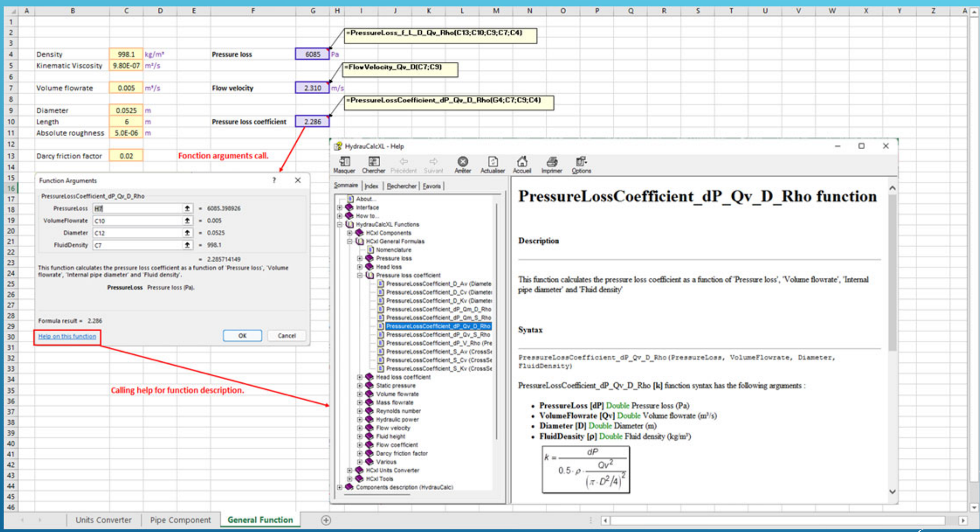
Example of using general formula functions



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Functions for converting units of measurement

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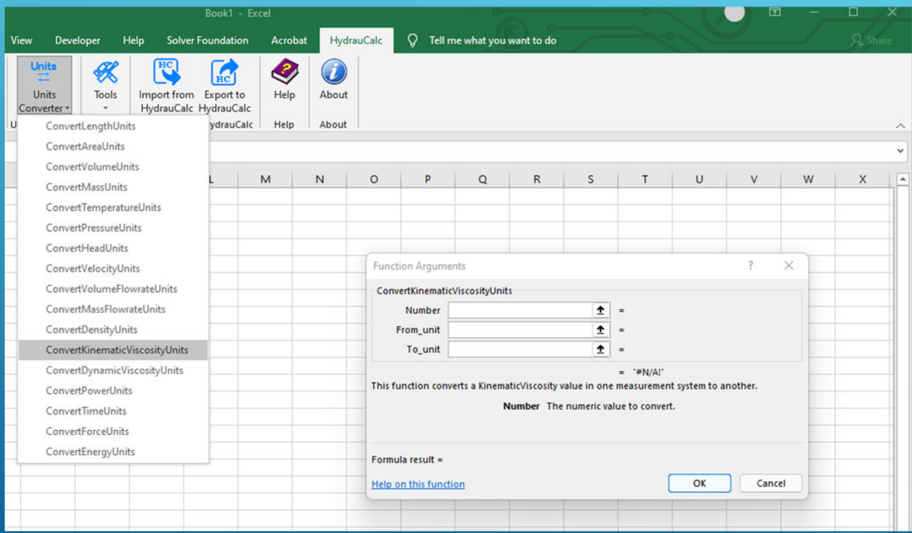
Functions for converting units of measurement



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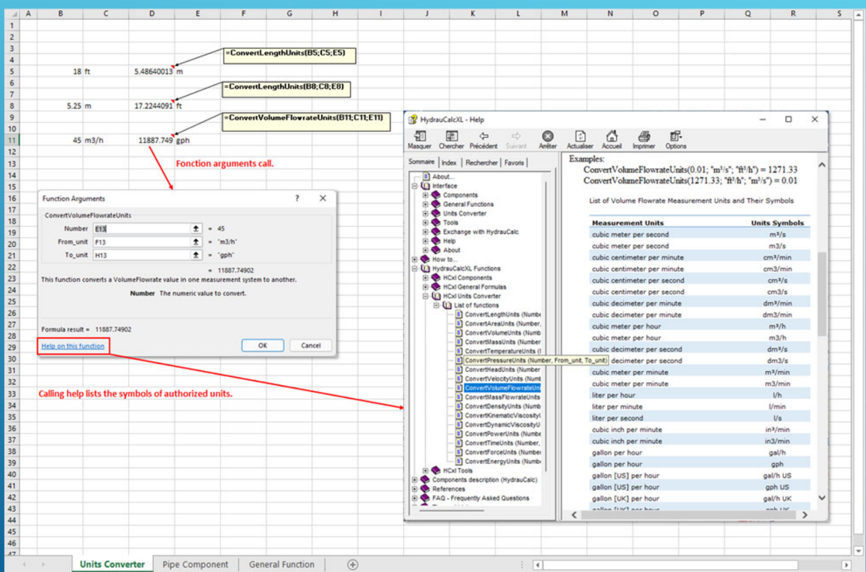
Example of using measurement unit conversion functions



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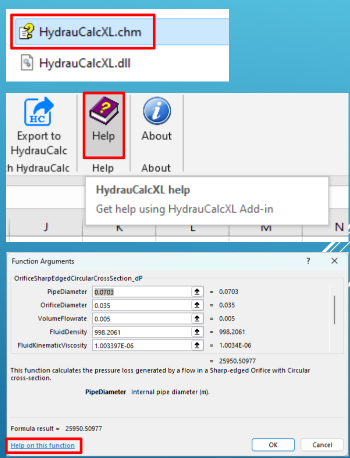
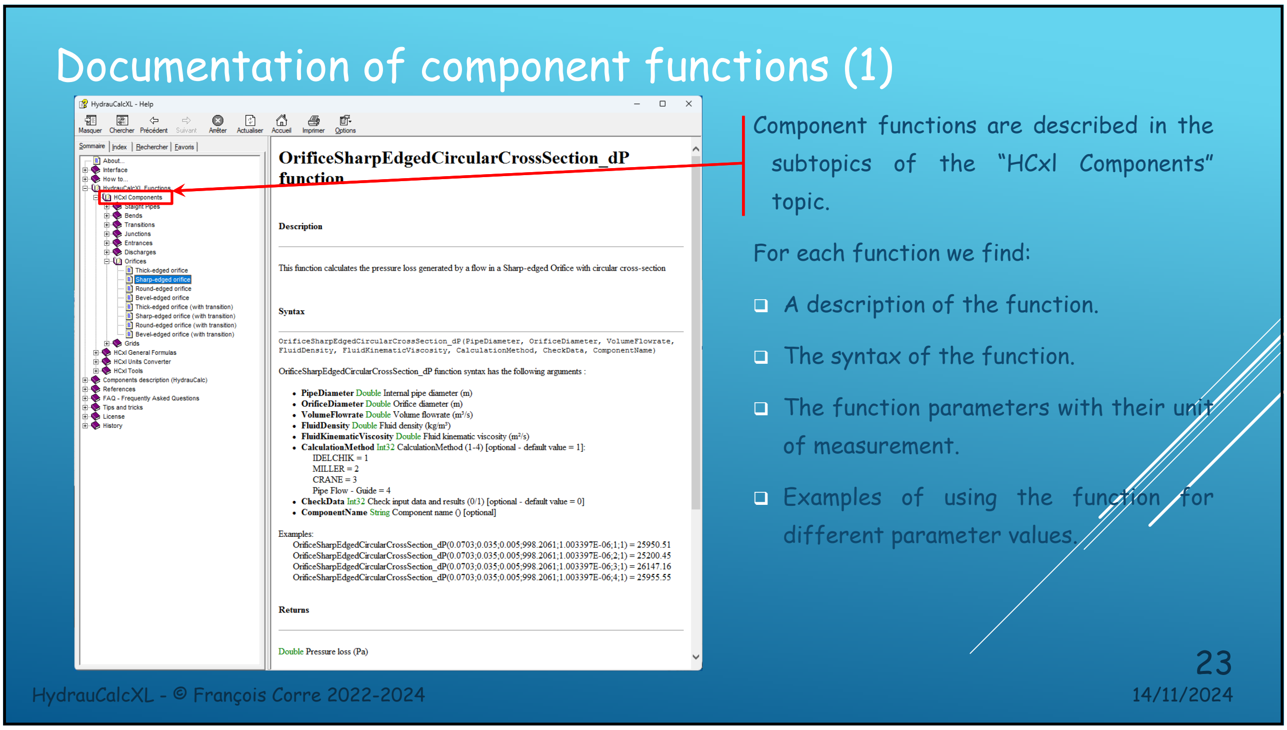
Technical documentation

Calling the documentation

A help file containing documentation is associated with the HydrauCalcXL function library. This help can be displayed in the following ways:

- Directly selecting the help file with the "chm" extension.
- Using a button located in the HydrauCalcXL ribbon.
- From the argument entry window for functions incorporated into HydrauCalcXL. In this case the help file opens directly in the help section corresponding to the selected function.




Documentation of component functions (1)
OrificeSharpEdgedCircularCrossSection_dP function
Description
This function calculates the pressure loss generated by a flow in a Sharp-edged Orifice with circular cross-section
Syntax
Examples:
Returns
Double Pressure loss (Pa)
Component functions are described in the subtopics of the "HCxl Components" topic.
For each function we find:
A description of the function.
The syntax of the function.
The function parameters with their unit of measurement.
Examples of using the function for different parameter values.
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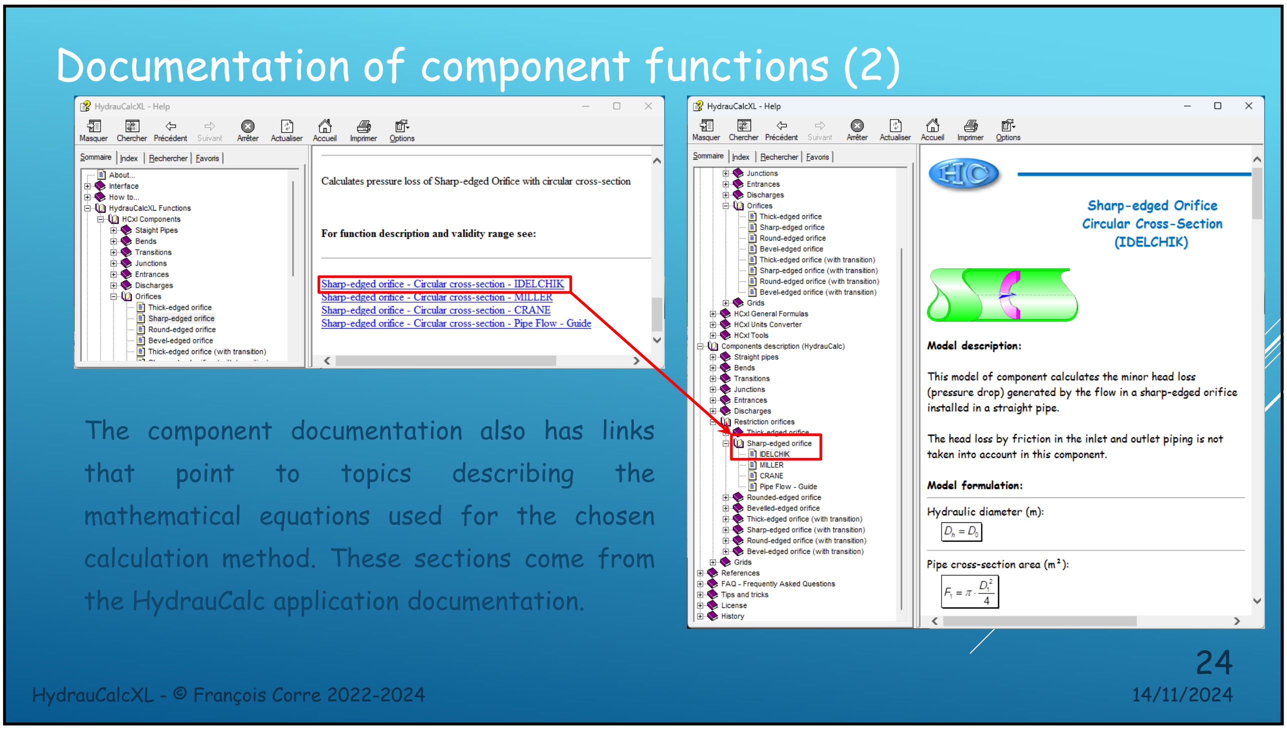
Documentation of component functions (2)
Calculates pressure loss of Sharp-edged Orifice with circular cross-section
For function description and validity range see:
Sharp-edged orifice - Circular cross-section - IDELCHIK
Sharp-edged orifice - Circular cross-section - MILLER
Sharp-edged orifice - Circular cross-section - CRANE
Sharp-edged orifice - Circular cross-section - Pipe Flow - Guide
Sharp-edged Orifice
Circular Cross-Section
(IDELCHIK)
Model description:
Model formulation:
The component documentation also has links that point to topics describing the mathematical equations used for the chosen calculation method. These sections come from the HydrauCalc application documentation.
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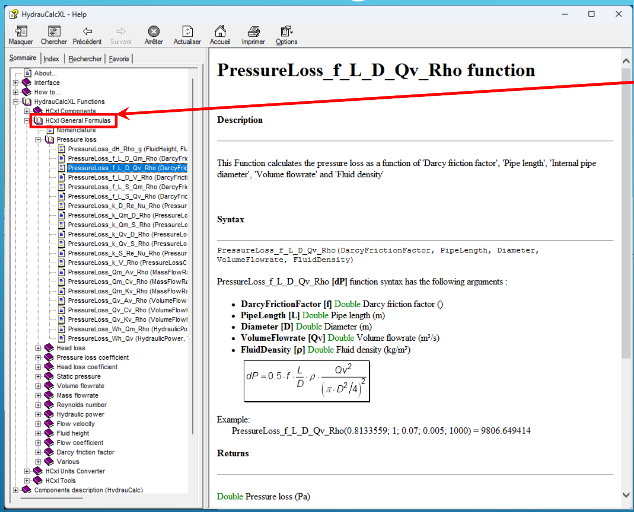
Documentation of general functions



General functions are described in the subsections of the "HCxl General Formulas" section.

For each function we find:

- A description of the function.
- The syntax of the function.
- The function parameters with their unit of measurement.
- The mathematical equation used for the function.
- An example of using the function.

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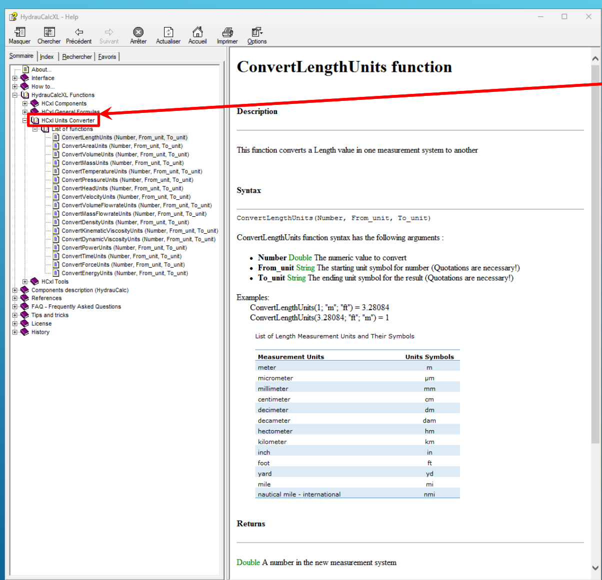
Documentation of unit conversion functions



Unit conversion functions are described in the subtopics of the "HCxl Units Converter" topic.

For each function we find:

- A description of the function.
- The syntax of the function.
- The function parameters.
- Examples of using the function.
- The list of available units and their symbols to enter.

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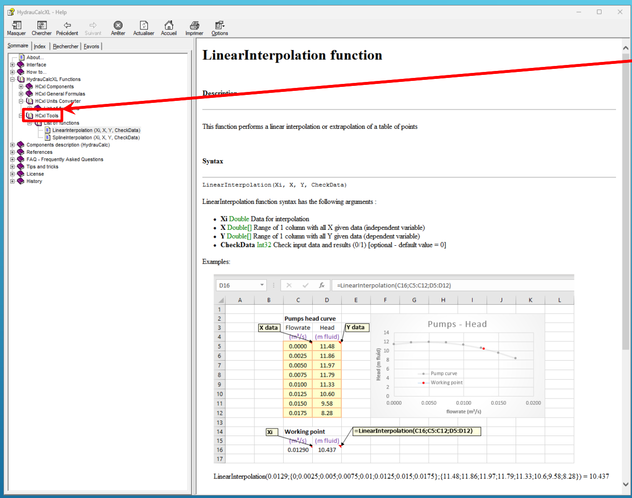
Documentation of tool functions



Tool functions are described in the subtopics of the "HCxl Tools" topic.

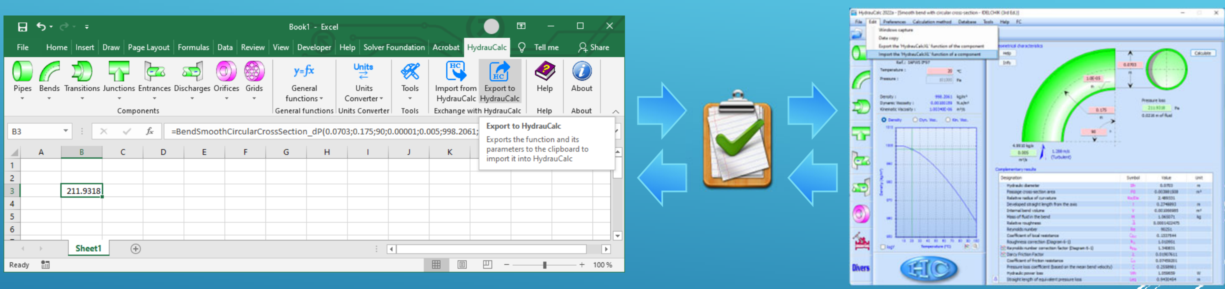
For each function we find:

- A description of the function.
- The syntax of the function.
- The function parameters.
- An example of using the function.

Data exchange with the HydrauCalc application

Data exchange with HydrauCalc application

HydrauCalcXL library | HydrauCalc application



Data can be exchanged between the "HydrauCalcXL" library and the "HydrauCalc" application via the clipboard.

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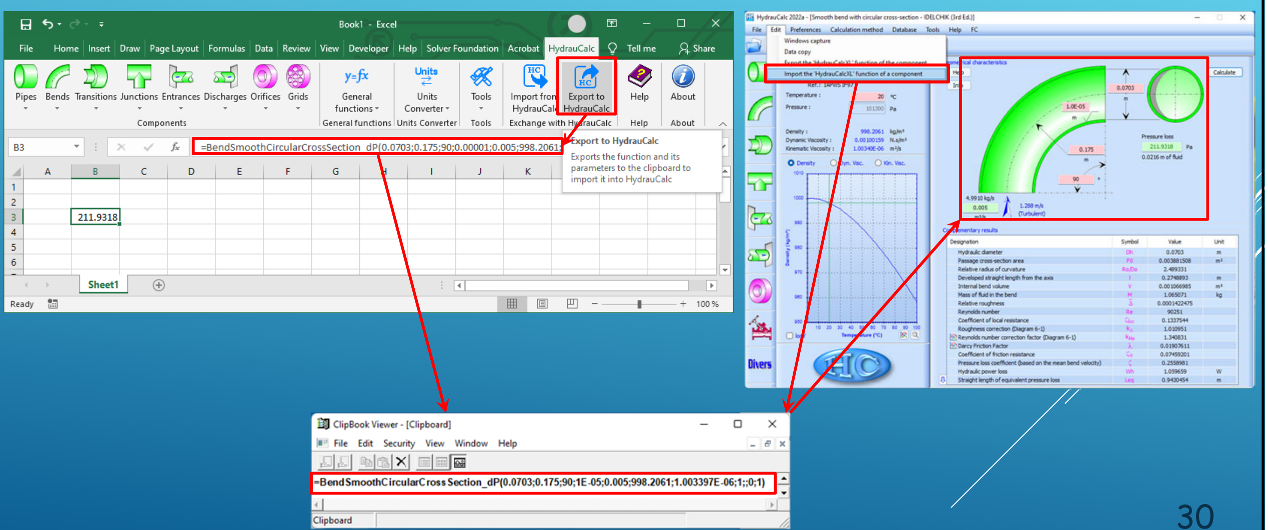
Data export to HydrauCalc

1 – Export function to Clipboard | 2 – Import function from Clipboard



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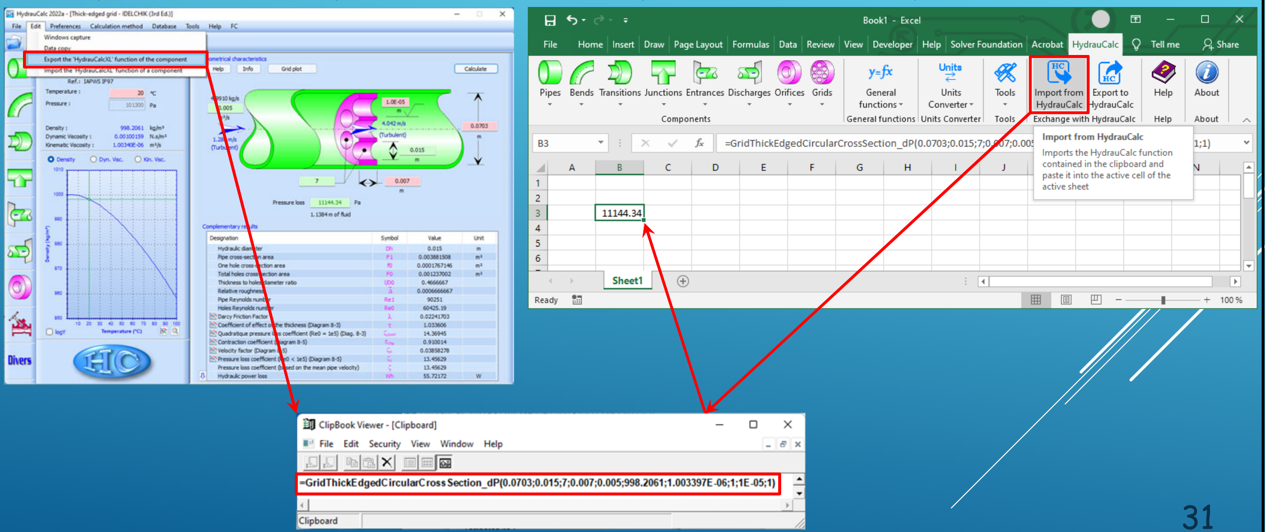
Data import from HydrauCalc

1 – Export function to Clipboard

2 – Import function from Clipboard



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Examples of systems solved using HydrauCalcXL and Excel solver

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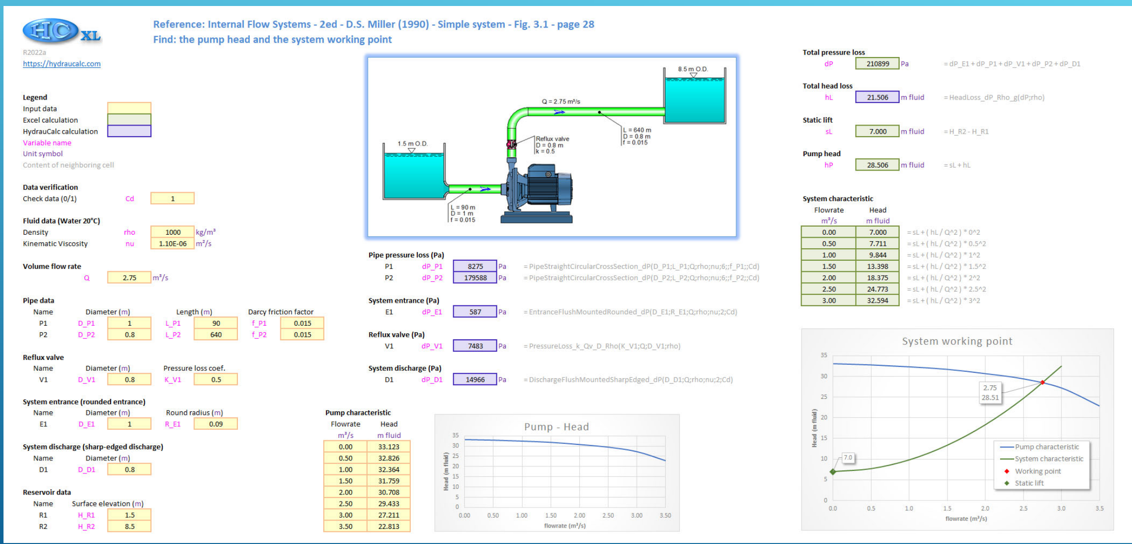
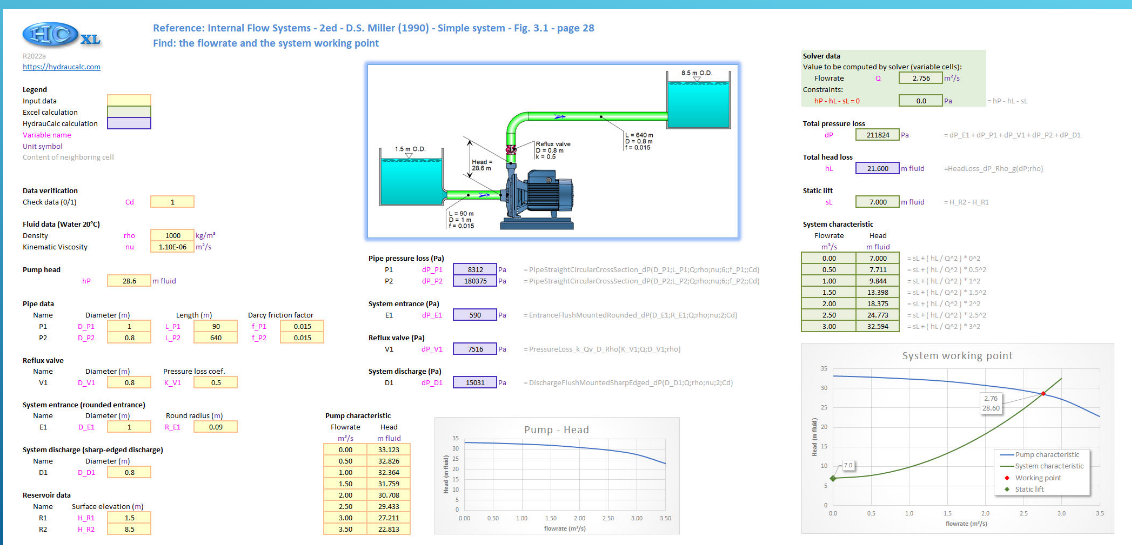
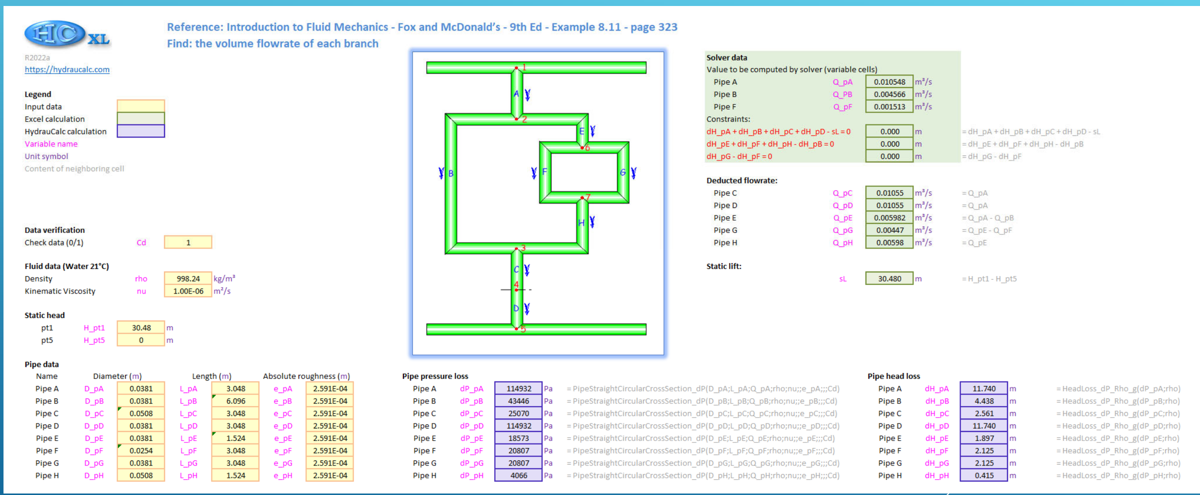
- Find: the pump head and the system working point.
- The pump flowrate is an input data. The functions integrated into HydrauCalcXL allow you to calculate explicitly (direct calculation without iterations) the pressure drop of the components.



- Find: the flowrate and the system working point.
- The pump head is an input data. The use of the Excel solver is necessary to resolve the system and find the flowrate.



- Find: the volume flowrate of each branch.
- This problem illustrates the use of Excel to solve a set of coupled, nonlinear equations for unknown flowrates.



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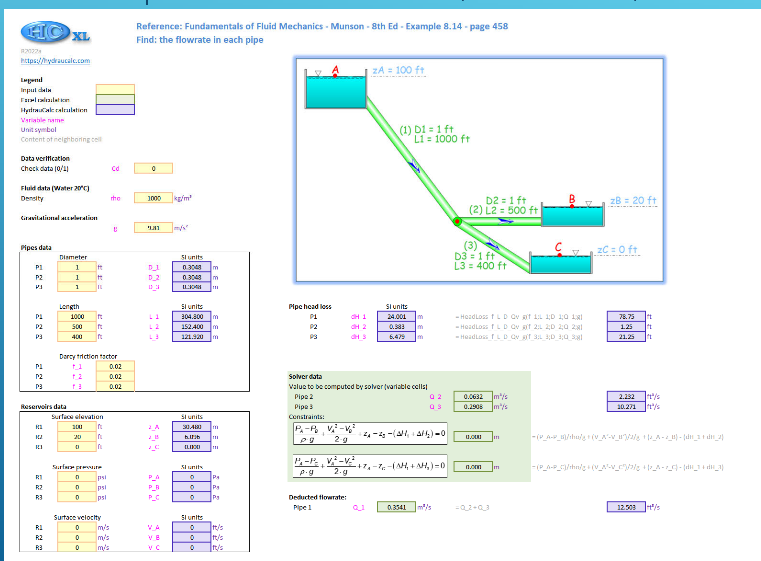
- Find: the flowrate in each pipe.
- This problem illustrates use of Excel to solve a set of coupled, nonlinear equations for unknown flowrates.
- This example demonstrates also the use of unit conversion functions.



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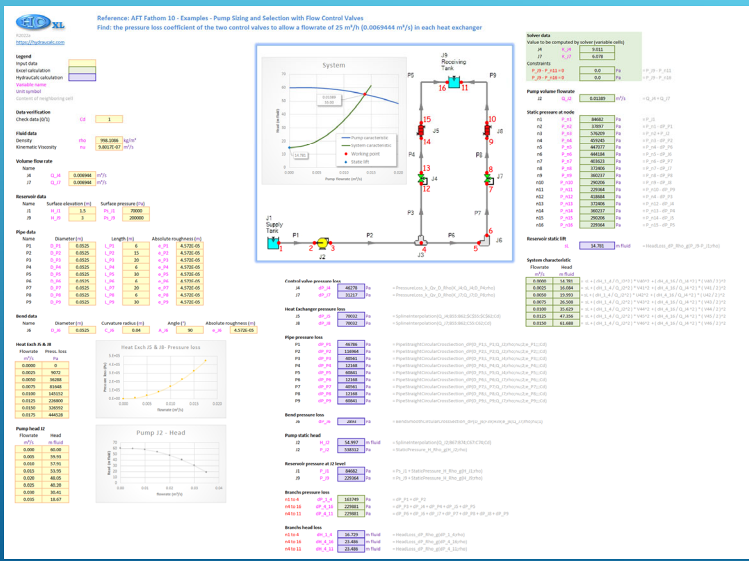
- Find: the pressure loss coefficient of the two control valves to allow the desired flowrate in each heat exchanger and the working point of the pump.
- This example shows simple system flow balancing.



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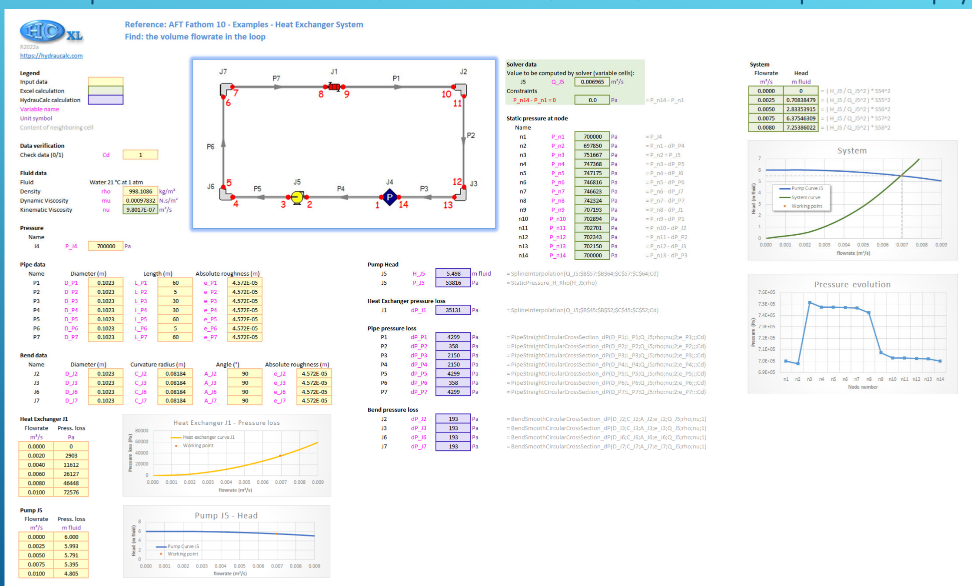
- Find: the volume flowrate in the loop.
- This problem illustrates the use of Excel solver to find the flowrate in a simple closed loop system.



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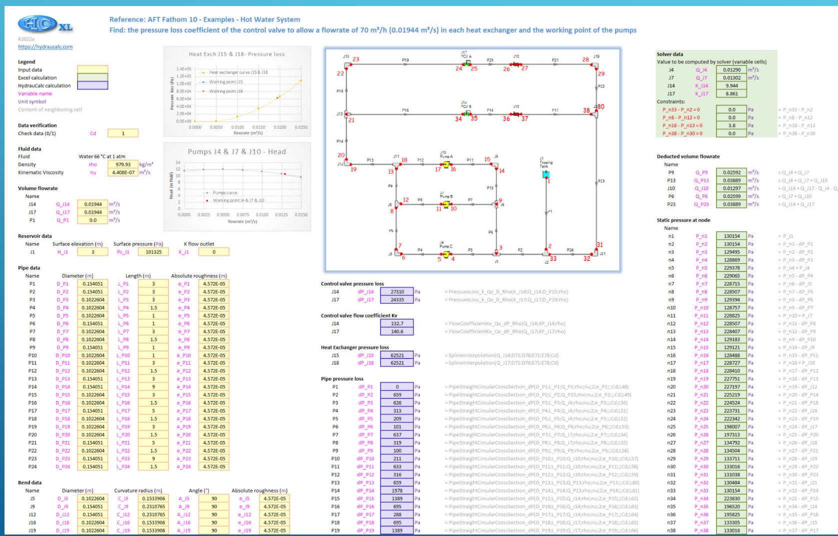
- Find: the pressure loss coefficient of the two control valves to allow the desired flowrate in each heat exchanger and the working point of the pumps.
- This problem illustrates the use of Excel to solve a closed loop system with multiple pumps. In addition, the flows in the branches of the two exchangers are to be balanced by control valves.



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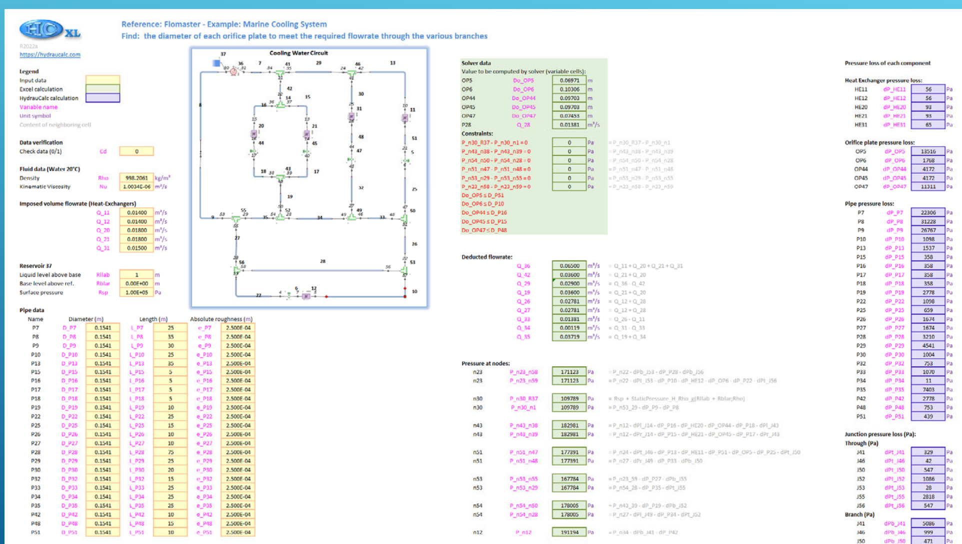
- Find: the diameter of each orifice plate to meet the required flowrate through the each heat exchanger.
- This problem illustrates the use of Excel solver to solve a complex closed loop system. In addition, the flows in the branches of the five exchangers are to be balanced by restriction orifices.



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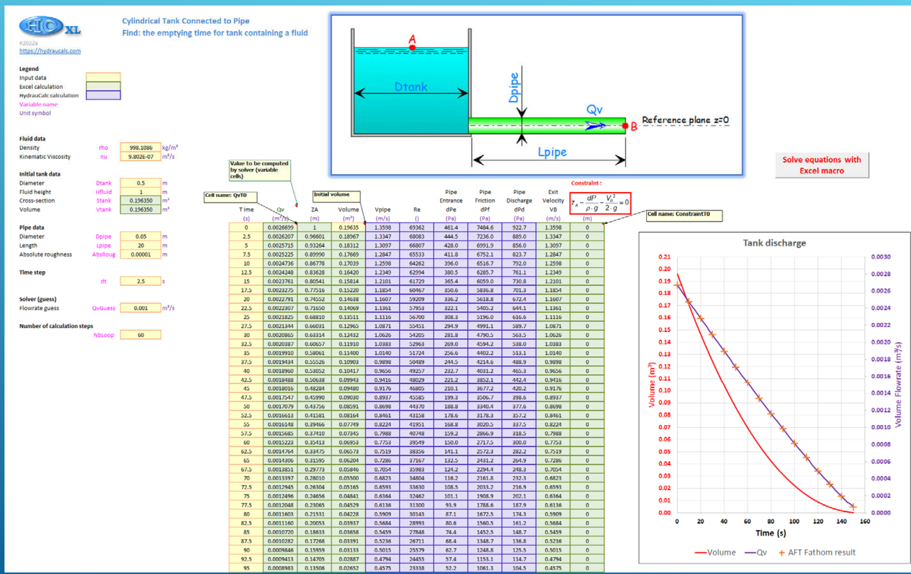
- Find: the emptying time for tank containing a fluid.
- This problem illustrates the use of the Excel Solver to perform the transient analysis of a system.



Time (s)	Qv (m³/s)	ZA (m)	Volume (m³)	Vpipe (m/s)	Re ()	Pipe Entrance dPe (Pa)	Pipe Friction dPf (Pa)	Pipe Discharge dPd (Pa)	Exit Velocity VB (m/s)	Constraint : $z_A - \frac{dP}{\rho \cdot g} - \frac{V_B^2}{2 \cdot g} = 0$ (m)
0	0.0026699	1	0.19635	1.3598	69362	461.4	7484.6	922.7	1.3598	0
2.5	0.0026207	0.96601	0.18967	1.3347	68083	444.5	7236.0	889.0	1.3347	0
5	0.0025715	0.93264	0.18312	1.3097	66807	428.0	6991.9	856.0	1.3097	0
7.5	0.0025225	0.89990	0.17669	1.2847	65533	411.8	6752.1	823.7	1.2847	0
10	0.0024736	0.86778	0.17039	1.2598	64262	396.0	6516.7	792.0	1.2598	0
12.5	0.0024248	0.83628	0.16420	1.2349	62994	380.5	6285.7	761.1	1.2349	0
15	0.0023761	0.80541	0.15814	1.2101	61729	365.4	6059.0	730.8	1.2101	0
17.5	0.0023275	0.77516	0.15220	1.1854	60467	350.6	5836.8	701.3	1.1854	0
20	0.0022791	0.74552	0.14638	1.1607	59209	336.2	5618.8	672.4	1.1607	0
22.5	0.0022307	0.71650	0.14069	1.1361	57953	322.1	5405.2	644.1	1.1361	0
25	0.0021825	0.68810	0.13511	1.1116	56700	308.3	5196.0	616.6	1.1116	0
27.5	0.0021344	0.66031	0.12965	1.0871	55451	294.9	4991.1	589.7	1.0871	0
30	0.0020865	0.63314	0.12432	1.0626	54205	281.8	4790.5	563.5	1.0626	0
32.5	0.0020387	0.60657	0.11910	1.0383	52963	269.0	4594.2	538.0	1.0383	0
35	0.0019910	0.58061	0.11400	1.0140	51724	256.6	4402.2	513.1	1.0140	0
37.5	0.0019434	0.55526	0.10903	0.9898	50489	244.5	4214.6	488.9	0.9898	0
40	0.0018960	0.53052	0.10417	0.9656	49257	232.7	4031.2	465.3	0.9656	0
42.5	0.0018488	0.50638	0.09943	0.9416	48029	221.2	3852.1	442.4	0.9416	0
45	0.0018016	0.48284	0.09480	0.9176	46805	210.1	3677.2	420.2	0.9176	0
47.5	0.0017547	0.45990	0.09030	0.8937	45585	199.3	3506.7	398.6	0.8937	0
50	0.0017079	0.43756	0.08591	0.8698	44370	188.8	3340.4	377.6	0.8698	0
52.5	0.0016613	0.41581	0.08164	0.8461	43158	178.6	3178.3	357.2	0.8461	0
55	0.0016148	0.39466	0.07749	0.8224	41951	168.8	3020.5	337.5	0.8224	0
57.5	0.0015685	0.37410	0.07345	0.7988	40748	159.2	2866.9	318.5	0.7988	0
60	0.0015223	0.35413	0.06953	0.7753	39549	150.0	2717.5	300.0	0.7753	0
62.5	0.0014764	0.33475	0.06573	0.7519	38356	141.1	2572.3	282.2	0.7519	0
65	0.0014306	0.31595	0.06204	0.7286	37167	132.5	2431.2	264.9	0.7286	0
67.5	0.0013851	0.29773	0.05846	0.7054	35983	124.2	2294.4	248.3	0.7054	0
70	0.0013397	0.28010	0.05500	0.6823	34804	116.2	2161.8	232.3	0.6823	0
72.5	0.0012945	0.26304	0.05165	0.6593	33630	108.5	2033.2	216.9	0.6593	0
75	0.0012496	0.24656	0.04841	0.6364	32462	101.1	1908.9	202.1	0.6364	0
77.5	0.0012048	0.23065	0.04529	0.6136	31300	93.9	1788.6	187.9	0.6136	0
80	0.0011603	0.21531	0.04228	0.5909	30143	87.1	1672.5	174.3	0.5909	0
82.5	0.0011160	0.20053	0.03937	0.5684	28993	80.6	1560.5	161.2	0.5684	0
85	0.0010720	0.18633	0.03658	0.5459	27848	74.4	1452.5	148.7	0.5459	0
87.5	0.0010282	0.17268	0.03391	0.5236	26711	68.4	1348.7	136.8	0.5236	0
90	0.0009846	0.15959	0.03133	0.5015	25579	62.7	1248.8	125.5	0.5015	0
92.5	0.0009413	0.14705	0.02887	0.4794	24455	57.4	1153.1	114.7	0.4794	0
95	0.0008983	0.13506	0.02652	0.4575	23338	52.2	1061.3	104.5	0.4575	0

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