HydrauCalcXL

2023b Release

www.hydraucalc.com

What is HydrauCalcXL Add-in?

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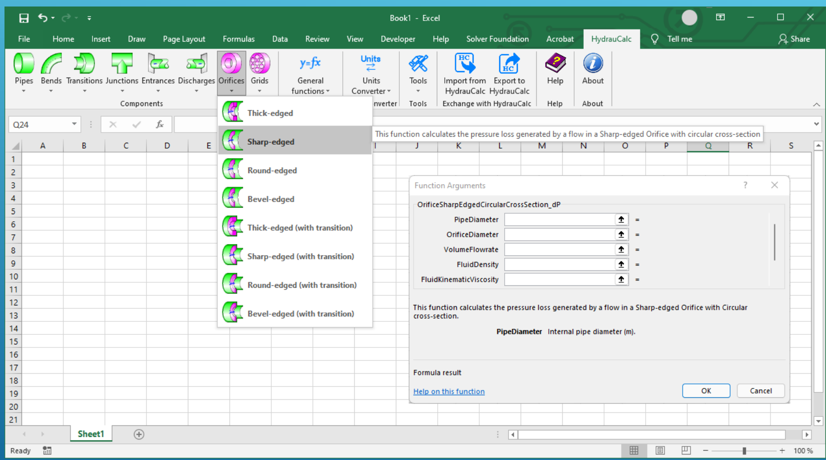
- HydrauCalcXL Add-in is a library of functions that has been developed to calculate the pressure losses of hydraulic components in Microsoft Excel®. This library allows the direct call of functions relating to the calculation of pressure losses. It comes from the HydrauCalc application which is based 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.

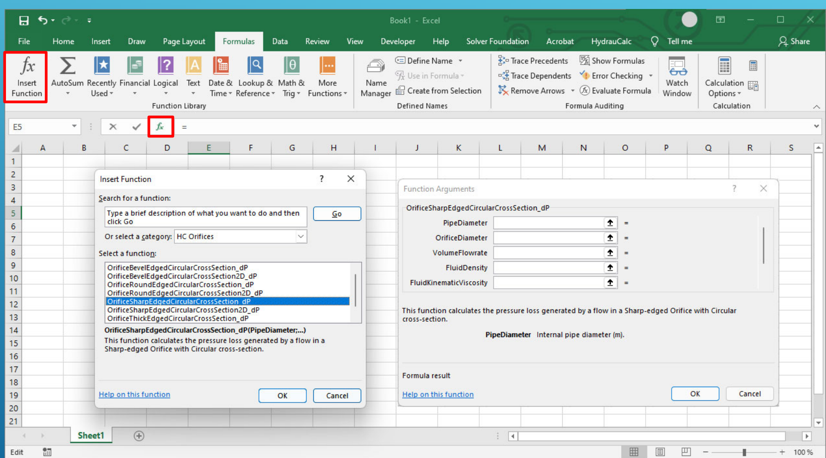
The Graphical Excel Interface

Graphical Excel Interface



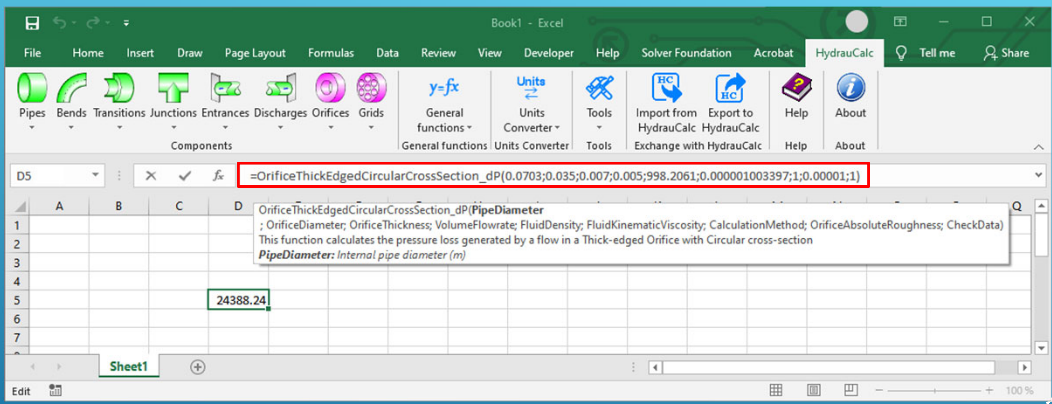
- The HydrauCalc tab includes a ribbon that allows you to call up the different functions of the library.
- From this interface, the user inserts the functions of the components that he wishes to evaluate.
- This interface is intuitive and very easy-to-use.

Graphical Excel Interface



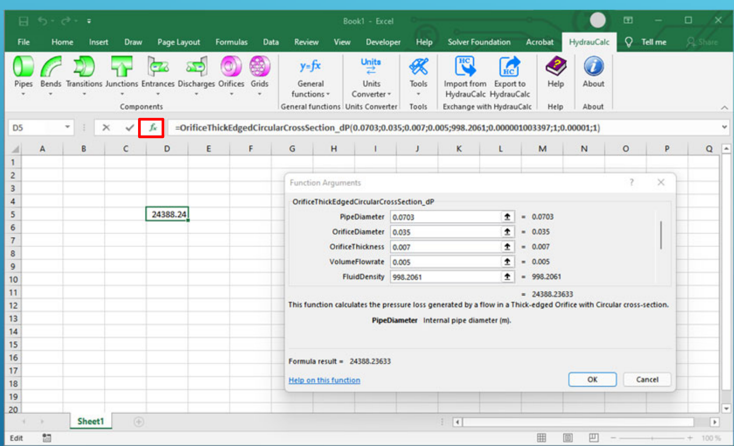
- The functions of the library can also be selected from the "Insert Function" buttons of the "Formulas" tab or from the function bar.
- This interface is less friendly and less easy to use than the previous one.

Graphical Excel Interface



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.

Graphical Excel Interface



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

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:

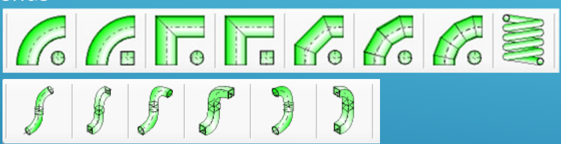
- Functions for calculating pressure losses of piping components such as straight pipes, bends, transitions, junctions, pipeline entrances, pipeline discharges, orifices, grids (74 functions).
- Functions for calculation between the different variables entering into the general pressure loss formulas (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

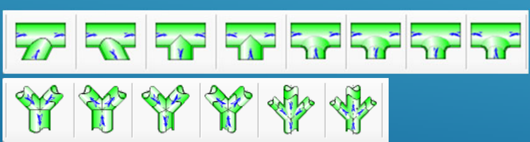
The available piping components

Straight pipes:

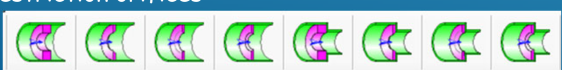
Bends:



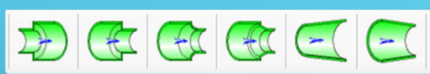
Junctions:



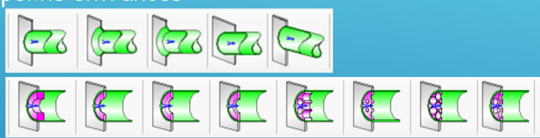
Restriction orifices:



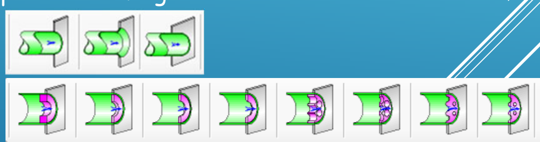
Transitions:



Pipeline entrances:



Pipeline discharges:



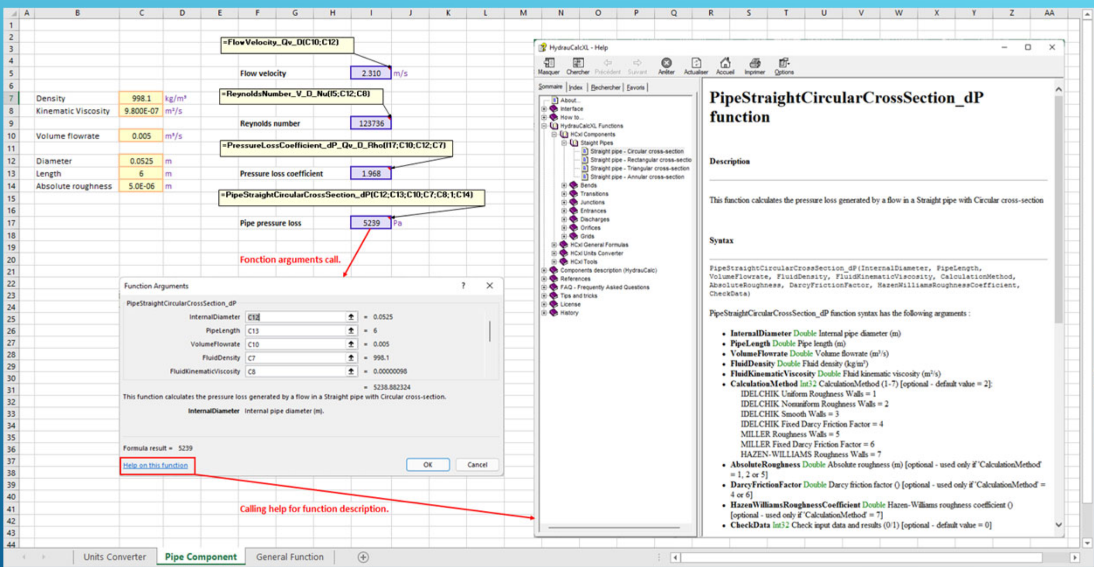
Grids:

Component Function Arguments

The arguments of the component pressure drop calculation functions are:

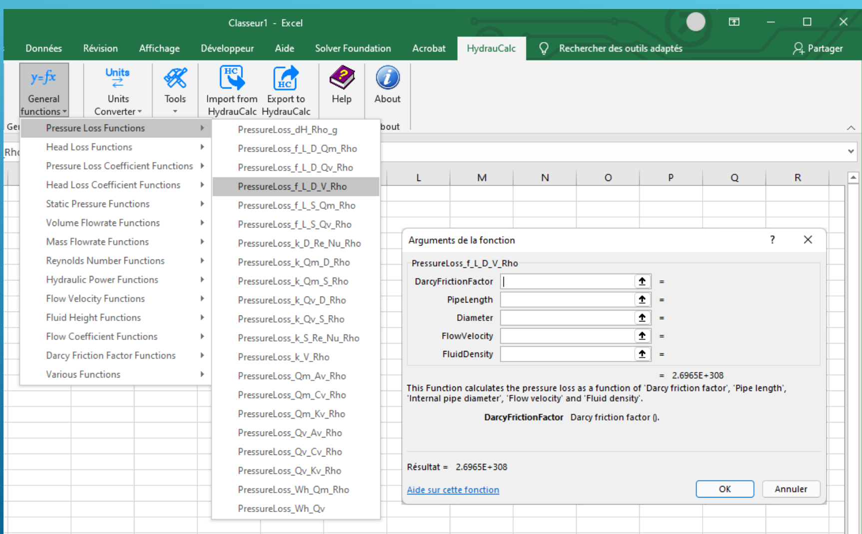
- The geometry of the component (length, internal diameter, angle and radius of curvature, absolute roughness of the walls, etc.).
- The characteristic of the flow (volume flowrate).
- The properties of the conveyed fluid (density and kinematic viscosity).

Example of Using a Component Function

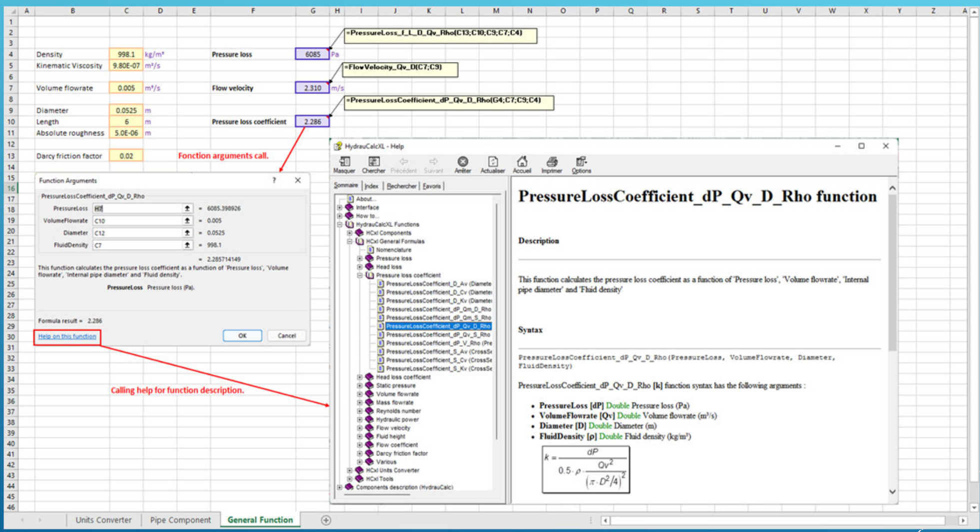


General formula functions

General formula functions

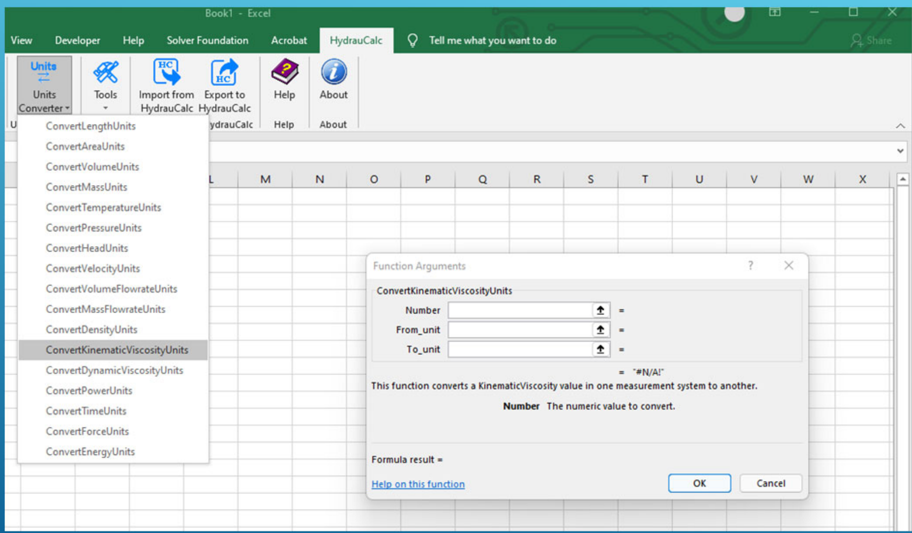


Example of using general formula functions

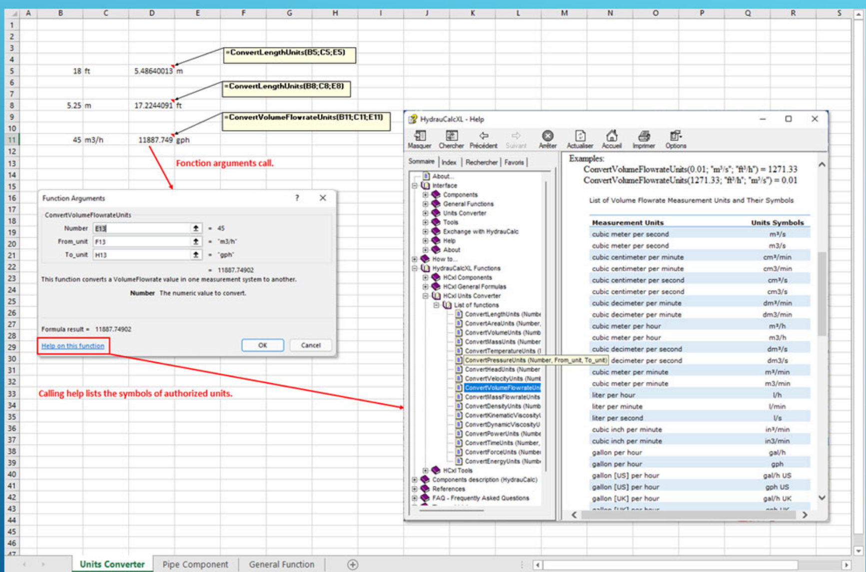


Functions for converting units of measurement

Functions for converting units of measurement

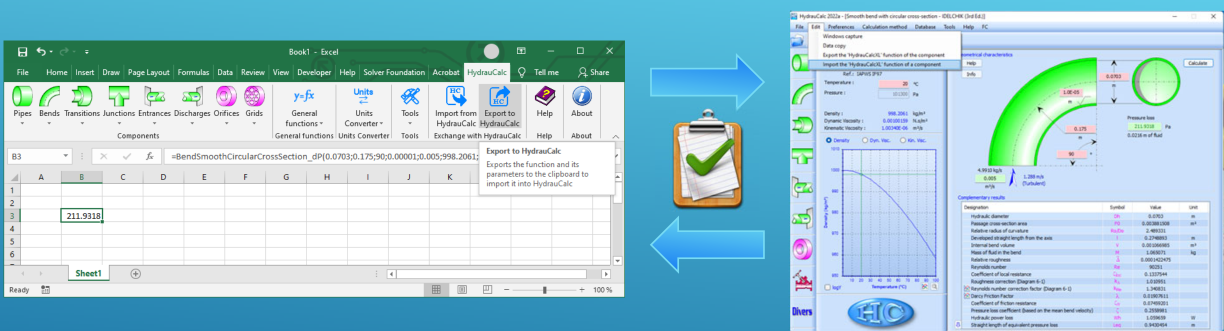


Example of using measurement unit conversion functions



Data exchange with the HydrauCalc application

Data exchange with HydrauCalc application

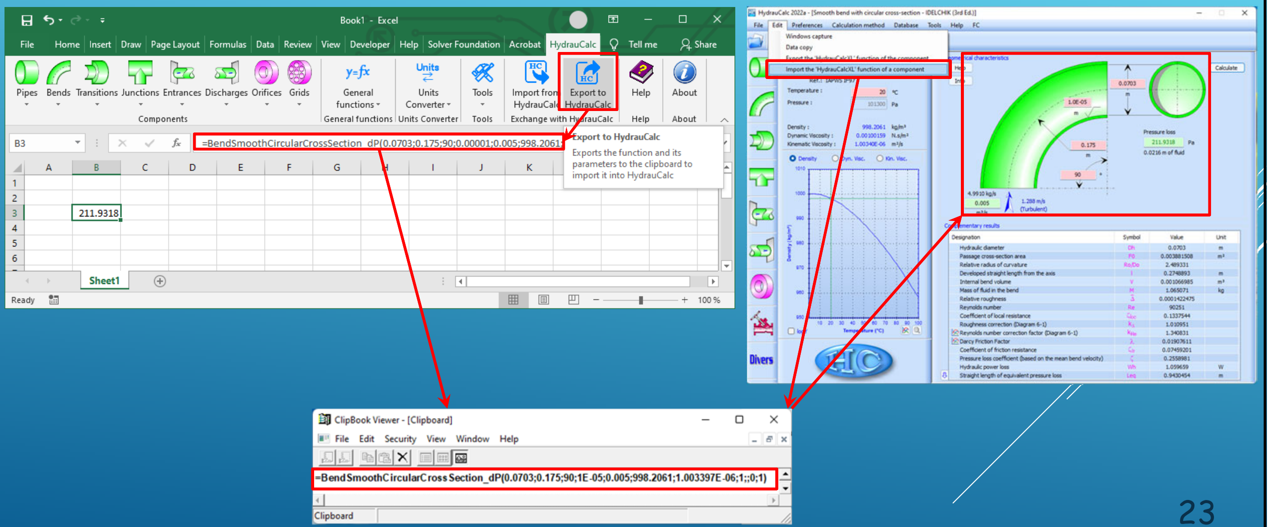


Data can be exchanged between the "HydrauCalcXL" library and the "HydrauCalc" application via the clipboard.

Data export to HydrauCalc

1 – Export function to Clipboard

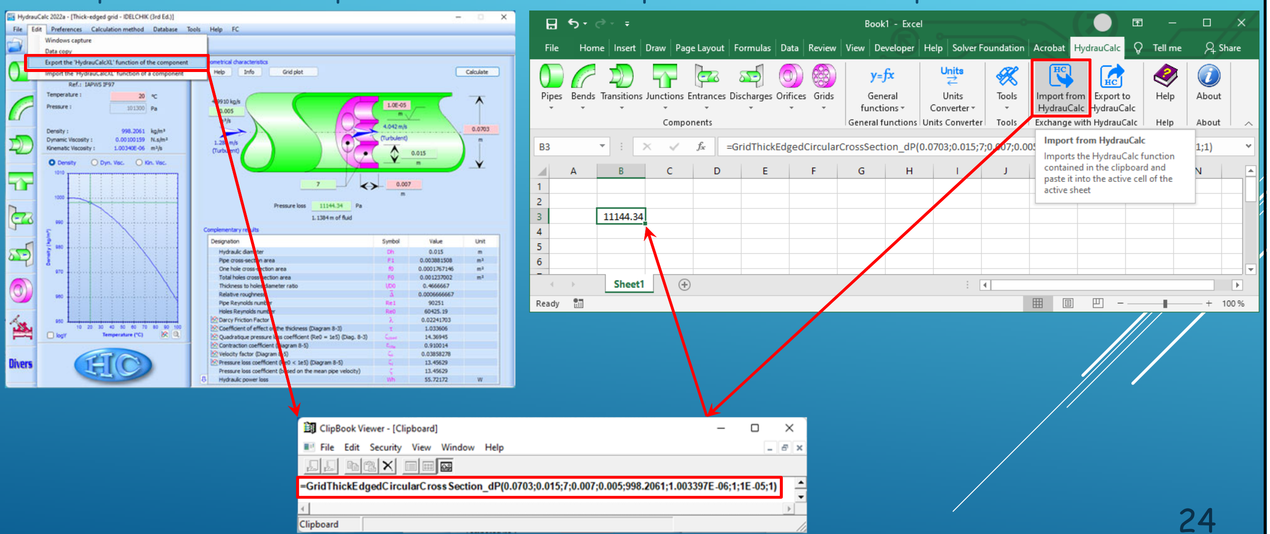
2 – Import function from Clipboard



Data import from HydrauCalc

1 – Export function to Clipboard

2 – Import function from Clipboard



HydrauCalc - © François Corre 2017-2022

Examples of systems solved using HydrauCalcXL and Excel solver

- 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.

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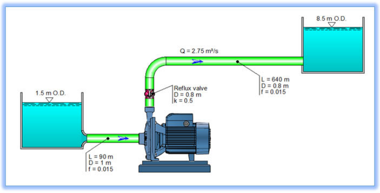
Reference: Internal Flow Systems - 2ed - D.S. Miller (1990) - Simple system - Fig. 3.1 - page 28

Find: the pump head and the system working point



Legend

- Input data
- Excel calculation
- HydrauCalc calculation
- Variable name
- Unit symbol
- Content of neighboring cell

Data verification

Check data (0/1)	Cd	1

Fluid data (Water 20°C)

Density	rho	1000	kg/m³
Kinematic Viscosity	nu	1.10E-06	m²/s

Volume flow rate

Q	2.75	m³/s

Pipe data

Name	Diameter (m)		Length (m)		Darcy friction factor	
P1	D_P1	1	L_P1	90	f_P1	0.015
P2	D_P2	0.8	L_P2	640	f_P2	0.015

Reflux valve

Name	Diameter (m)		Pressure loss coef.	
V1	D_V1	0.8	K_V1	0.5

System entrance (rounded entrance)

Name	Diameter (m)		Round radius (m)	
E1	D_E1	1	R_E1	0.09

System discharge (sharp-edged discharge)

Name	Diameter (m)	
D1	D_D1	0.8

Reservoir data

Name	Surface elevation (m)	
R1	H_R1	1.5
R2	H_R2	8.5

Pipe pressure loss (Pa)

P1	dP_P1	8275	Pa	= PipeStraightCircularCrossSection_dP(D_P1;L_P1;Q;rho;nu;6;;f_P1;;Cd)
P2	dP_P2	179588	Pa	= PipeStraightCircularCrossSection_dP(D_P2;L_P2;Q;rho;nu;6;;f_P2;;Cd)

System entrance (Pa)

E1	dP_E1	587	Pa	= EntranceFlushMountedRounded_dP(D_E1;R_E1;Q;rho;nu;2;Cd)

Reflux valve (Pa)

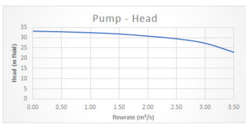
V1	dP_V1	7483	Pa	= PressureLoss_k_Qv_D_Rho(K_V1;Q;D_V1;rho)

System discharge (Pa)

D1	dP_D1	14966	Pa	= DischargeFlushMountedSharpEdged_dP(D_D1;Q;rho;nu;2;Cd)

Pump characteristic

Flowrate m³/s	Head m fluid
0.00	33.123
0.50	32.826
1.00	32.364
1.50	31.759
2.00	30.708
2.50	29.433
3.00	27.211
3.50	22.813



Total pressure loss

dP 210899 Pa = dP_E1 + dP_P1 + dP_V1 + dP_P2 + dP_D1

Total head loss

hL 21.506 m fluid = HeadLoss_dP_Rho_g(dP;rho)

Static lift

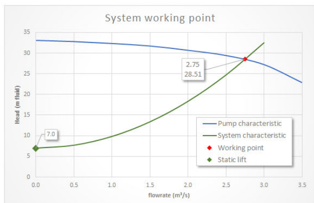
sL 7.000 m fluid = H_R2 - H_R1

Pump head

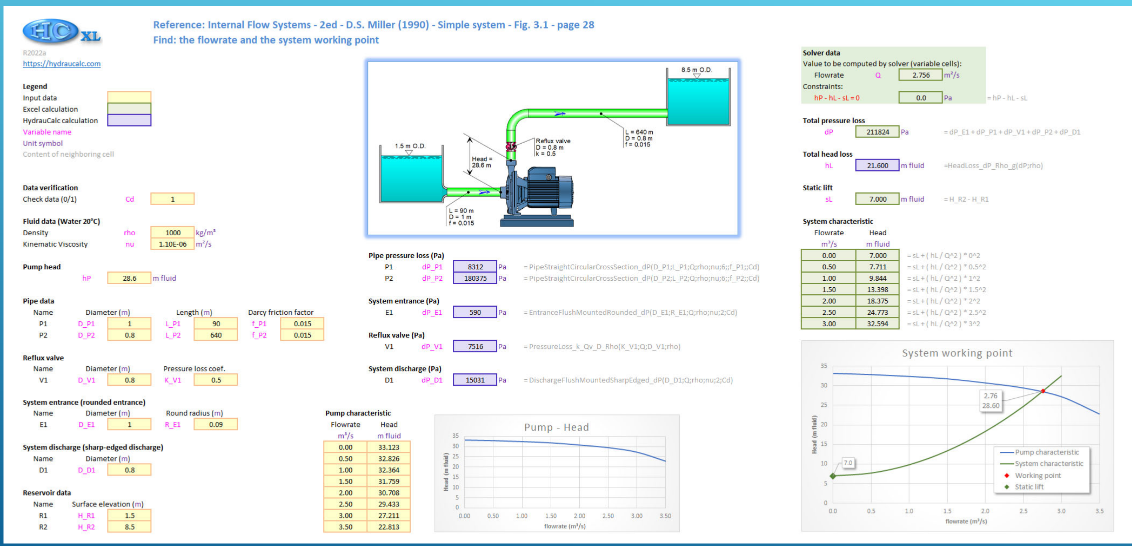
hP 28.506 m fluid = sL + hL

System characteristic

Flowrate m³/s	Head m fluid	
0.00	7.000	= sL + (hL / Q^2) * 0^2
0.50	7.711	= sL + (hL / Q^2) * 0.5^2
1.00	9.844	= sL + (hL / Q^2) * 1^2
1.50	13.398	= sL + (hL / Q^2) * 1.5^2
2.00	18.375	= sL + (hL / Q^2) * 2^2
2.50	24.773	= sL + (hL / Q^2) * 2.5^2
3.00	32.594	= sL + (hL / Q^2) * 3^2



- 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.



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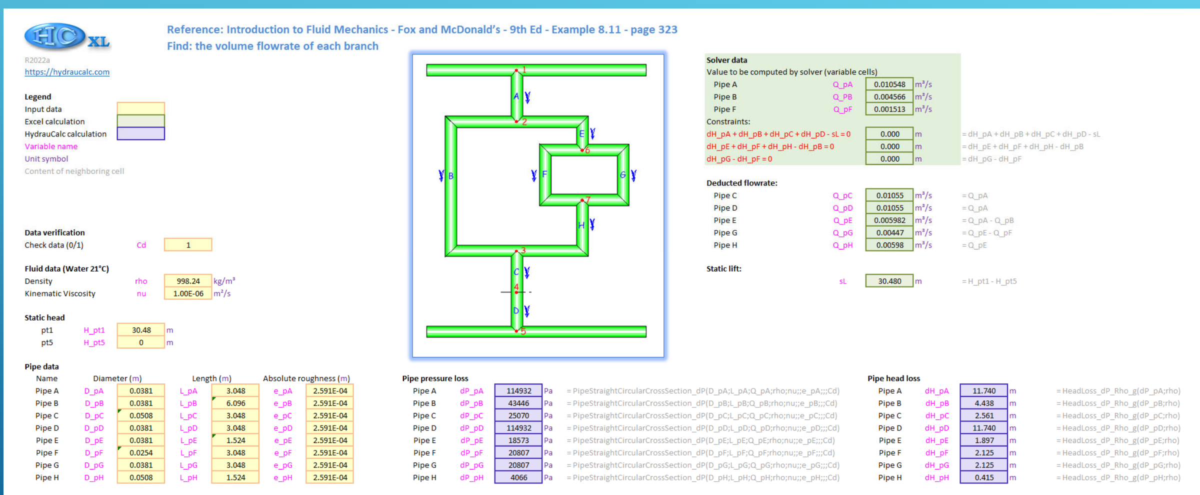
- Find: the volume flowrate of each branch.
- This problem illustrates the use of Excel to solve a set of coupled, nonlinear equations for unknown flowrates.



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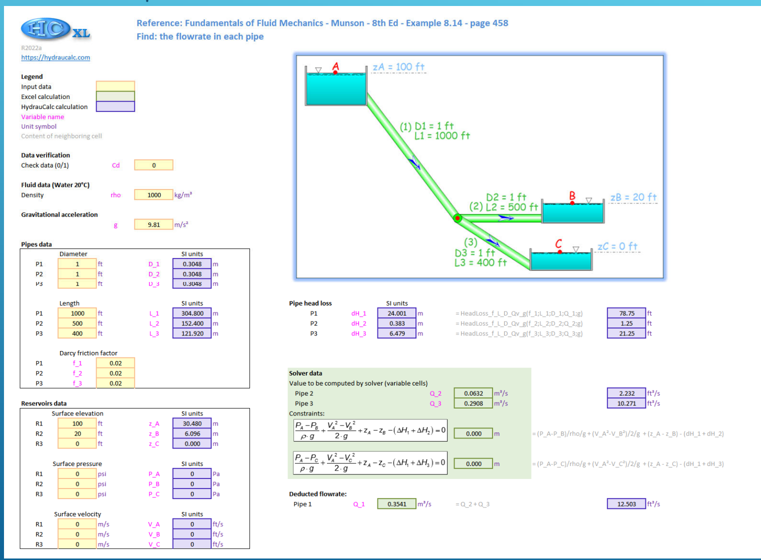
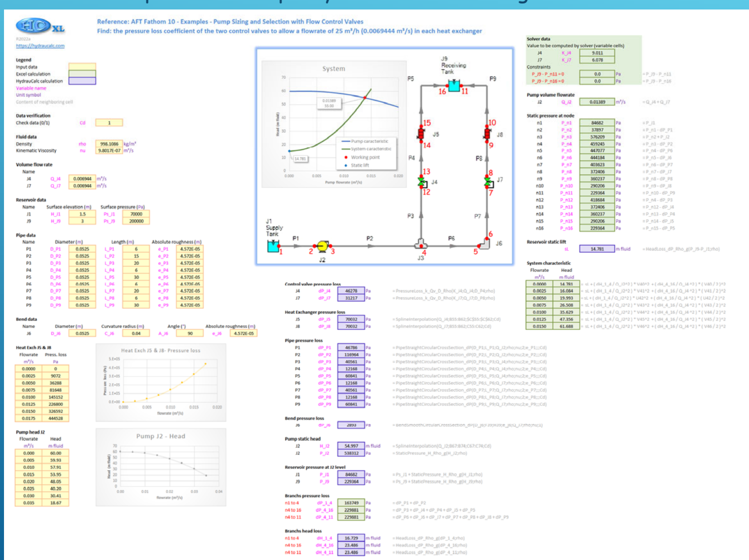
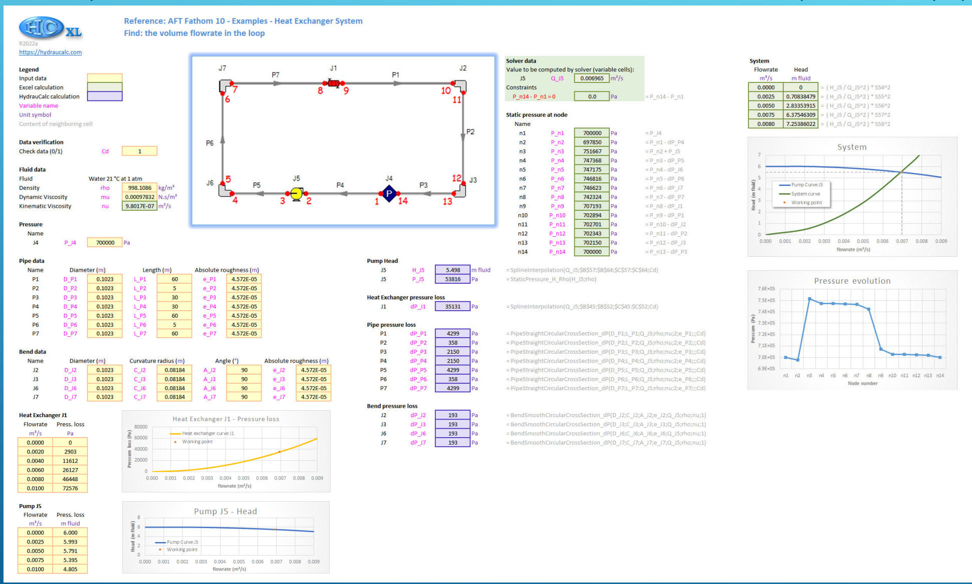
- Find: the flowrate in each pipe.
- This problem illustrates use of Excel to solve a set of coupled, nonlinear equations for unknown flowrates.
- This example demonstrates also the use of unit conversion functions.



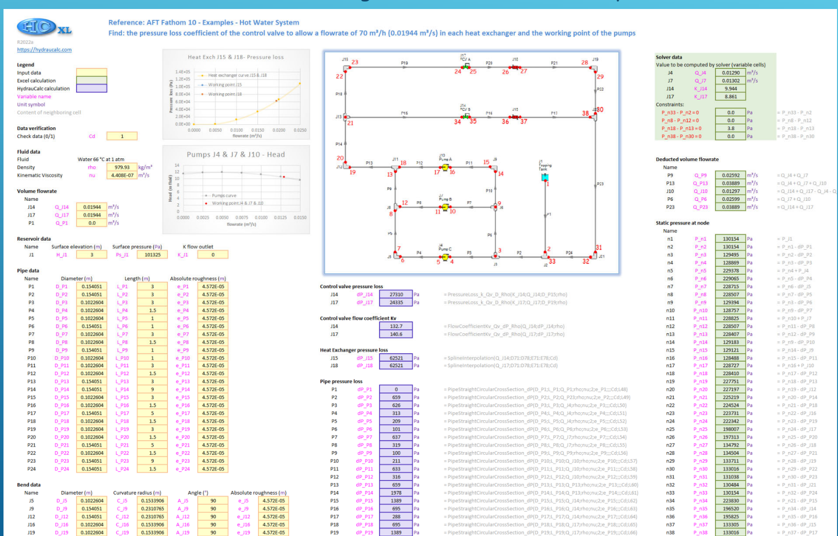
- Find: the pressure loss coefficient of the two control valves to allow the desired flowrate in each heat exchanger and the working point of the pump.
- This example shows simple system flow balancing.



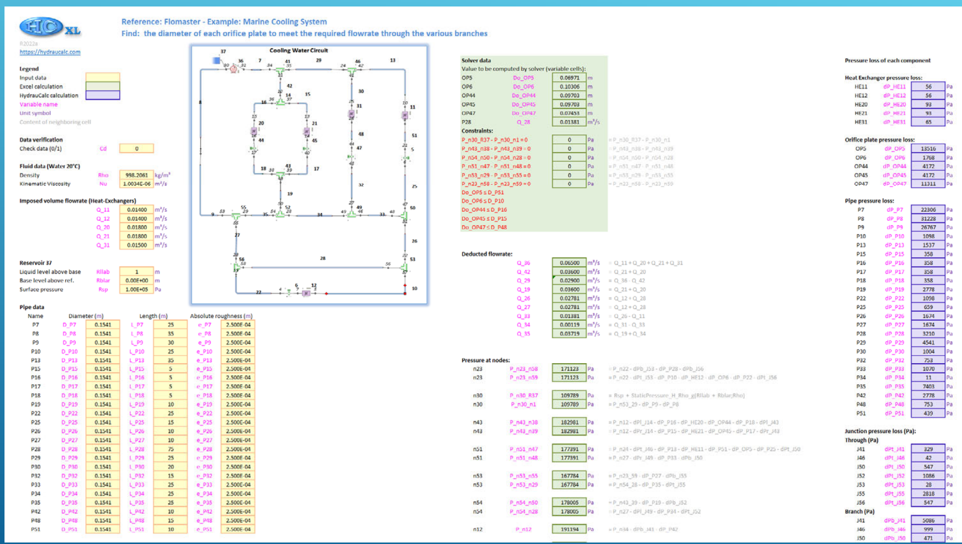
- Find: the volume flowrate in the loop.
- This problem illustrates the use of Excel solver to find the flowrate in a simple closed loop system.



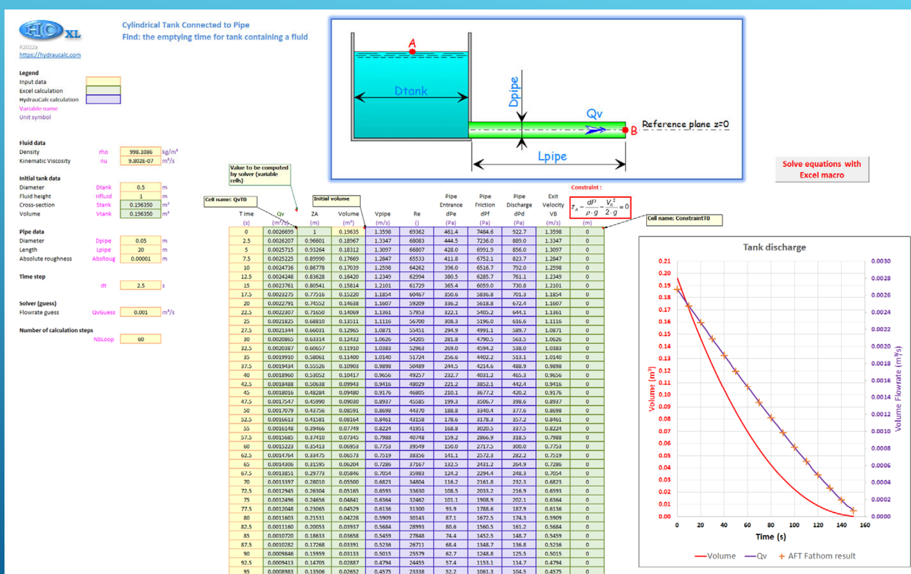
- Find: the pressure loss coefficient of the two control valves to allow the desired flowrate in each heat exchanger and the working point of the pumps.
- This problem illustrates the use of Excel to solve a closed loop system with multiple pumps. In addition, the flows in the branches of the two exchangers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



- 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.



- 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.

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