



User Manual
Spaix® PipeCalc

09/2001

Contents

About This User Manual	1
Copyright	1
Trademarks	1
General Remarks	1
What is Spaix® PipeCalc	3
How Does Spaix® PipeCalc Work?	4
Program Start	4
Menu File	4
Dialogues Save Project / Open Project	5
Settings	7
Directories	7
Data Sheets	7
Units	7
Language	8
View: Calculate System	9
Specify The Pumped Fluid	9
Rating Of Fluid - View And Change	10
Flow Rate Calculation	11
Drainage Water Quantity Based On Storm Water Catchments	12
Domestic Water Supply	13
Waste Water Quantity Calculations	14
Domestic Waste Water From Population Size	14
Waste Water Quantities From Sanitary Fittings	15
Heating Installation	16
Head Calculation	17
Terms	17
Calculation Methods For The Friction Loss	18
How To Work The Dialogue	20
Dialogue Friction Head	21
Pipe Friction Losses	22
Elbows	23
Transitions	23
Isolating Valves	24
Non-return Valves	24
Other Fittings	24
Sundry Head Losses	24

Simplified Calculation.....	25
Editing The Fittings Database	25

View: Data Sheets29

Create And Change Data Sheets	29
The Menus.....	30
General buttons	35
Toolbars.....	36

Index.....40

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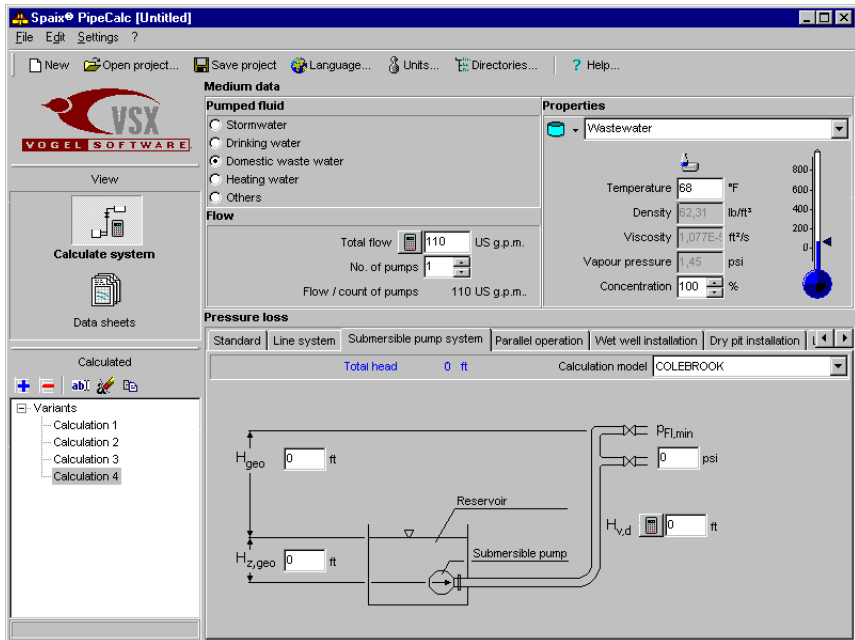
WHAT IS SPAIX® PIPECALC

Spaix® PipeCalc is a pipe sizing tool for branchless pipe systems and for systems of identical, parallel pipelines. The software enables the calculation of the total head considering the construction of your pipe system.

Besides the integration in the pump selection software Spaix® it can also be used as separate software for the **determination of the duty point for centrifugal pumps**.

Data exchange with the Pump Selector Spaix® can be done via a interface. Projects can also be saved in the CEF 2.0 Catalogue Exchange Format.

A multi-lingual user interface as well as an optional unit measures system allows a high rate of flexibility in the application of the program.



HOW DOES SPAIX® PIPECALC WORK?

By the mathematical-physical determination of the flow and head considering several technical conditions the user receives clearly arranged results on data sheets for the use as projects. He also can transfer the results straightaway to the pump selection software for further processing or save the project in the CEF 2.0 Catalogue Exchange Format.

Based on known flow rates the **total friction loss** of the pipe system as well as the required **head** of the pump are determined as sum of all partial friction losses in straight pipe runs, valves, fittings and outlet losses.

PROGRAM START

The main menu contains two views – the respective buttons are located in the left of the screen under *View*.

When starting the program the view ***Calculate system*** will be opened first. The other view, ***Data sheets***, initially contains only blank data sheets that are going to be filled with calculation results when opening a project or after a calculation procedure.

MENU FILE

Via the menu *File* respectively via the taskbar projects can be started, opened, saved, imported, exported and printed. In this menu the program can also be terminated.



New

Opens a new project. (When starting the software a new blank project will be opened at first.)



Open project

Starts dialogue „Open project“



Save project

Saves the current project. If the project is not named yet you will proceed as to function „Save as...“

Menu Save as...

Starts dialogue „Save project"

Within one project you may perform several friction loss and flow calculations enabling the comparison of different variants. The names of the calculations are displayed in the main window in the lower left of the screen. When marking one of the calculations the associated values are being shown.

The buttons have the following meanings:



Adds a blank calculation variant



Deletes the selected variant



Renames the marked calculation variant



Undoes the marked calculation





Copies the selected calculation variant

Dialogues Save Project / Open Project

The dialogues „Save project" and „Open project" are identical regarding their contents. Here you are able to edit the customer database and to delete or rename projects.

Customer

All customers that are gathered in your customer database are available here and therefore you can allocate your project to a specific customer. Choose from the customer database the addressee of the project.


You can add new  or change existing companies including their customer number.  deletes customer.


Existing projects

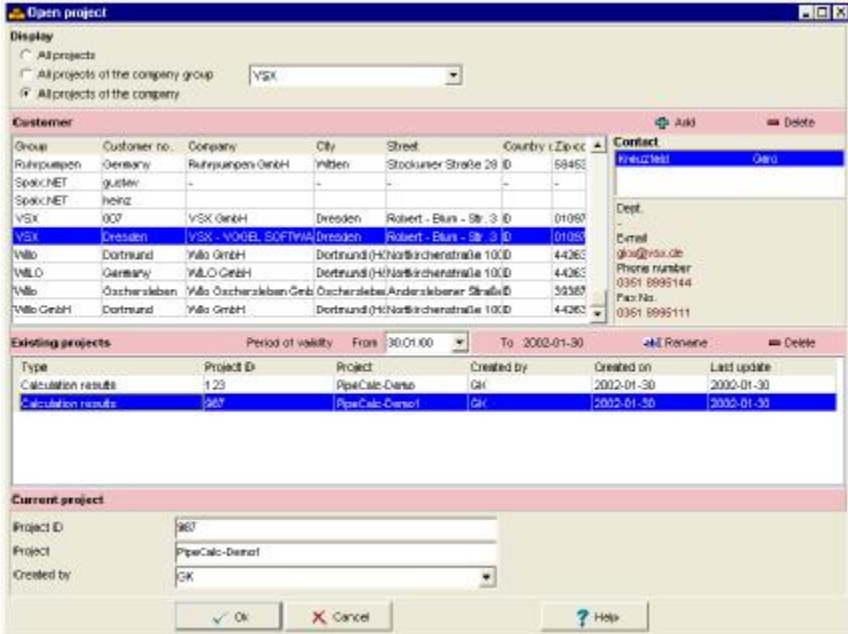
In the middle part the already existing projects are displayed including their project information.

Different filter functions support the search for the requested project. Following filters are possible:

- All projects
- All projects of the company group
- All projects of the company

Delete: After safety query the selected project can be removed by clicking the  button.

Rename: You can change with  the existing name of the selected project and the name of the editor.



Open project

Display

☐ All projects
☐ All projects of the company group
☒ All projects of the company

VSX

Customer

Group	Customer no.	Company	City	Street	Country	Zip
Ruhrpumpen	Germany	Ruhrpumpen GmbH	Mitteln	Strocker Straße 29	ID	58453
SpaixNET	gusteln	-	-	-	-	-
SpaixNET	heinz	-	-	-	-	-
VSX	1007	VSX GmbH	Dresden	Robert - Blum - Str. 3	ID	01050
VSX	Dresden	VSX - VOGEL SOFTWARE	Dresden	Robert - Blum - Str. 3	ID	01050
Villo	Dortmund	Villo GmbH	Dortmund	H-Nordkirchenstraße 100D		44263
Villo	Germany	Villo GmbH	Dortmund	H-Nordkirchenstraße 100D		44263
Villo	Öschersleben	Villo Öschersleben GmbH	Öschersleben	Anderslebener Straße 6		38369
Villo GmbH	Dortmund	Villo GmbH	Dortmund	H-Nordkirchenstraße 100D		44263

Contact

Kreuzfeld **Gelu**

Dept.
 Email
 Phone number
 Fax No.

Existing projects

Period of validity From 30.01.00 To 2002-01-30

Type	Project ID	Project	Created by	Created on	Last update
Calculation results	123	PipeCalc-Demo	GK	2002-01-30	2002-01-30
Calculation results	967	PipeCalc-Demo	GK	2002-01-30	2002-01-30

Current project

Project ID: 967
 Project: PipeCalc-Demo
 Created by: GK

Ok Cancel Help

An integrated sorting function enables an even clearer arrangement of the customers and projects by double clicking into the head of the columns in the tables.

Current Project

For the description of projects you may use the designated fields.

Save: Define a project number and name for the project you want to save. Clicking OK saves the project.



Open: Clicking the OK-button opens the selected project.

In the menu *File / Import* you can import a project of CEF 2.0 Catalogue Exchange Format into the program. Vice versa you can export the current project files with *File / Export*.

SETTINGS

In the menu *Settings* respectively in the toolbar there are the following options to choose from: set of directories, edit of data sheets, change units and switch language.

Directories

You can start the directory dialog by selecting this button . Here you need to define the data-, project- and language directory of the database. In order to set the directories click the respective buttons .

Following Access database files must be included:

Data directory	VSPIPECALC.MDB resp. VSSPAIX.MDB (possible with Spaix® version 2.0 and higher)
Project directory	VSPROJECTS.MDB
Language directory	VSPROGRAM.MDB

Data Sheets

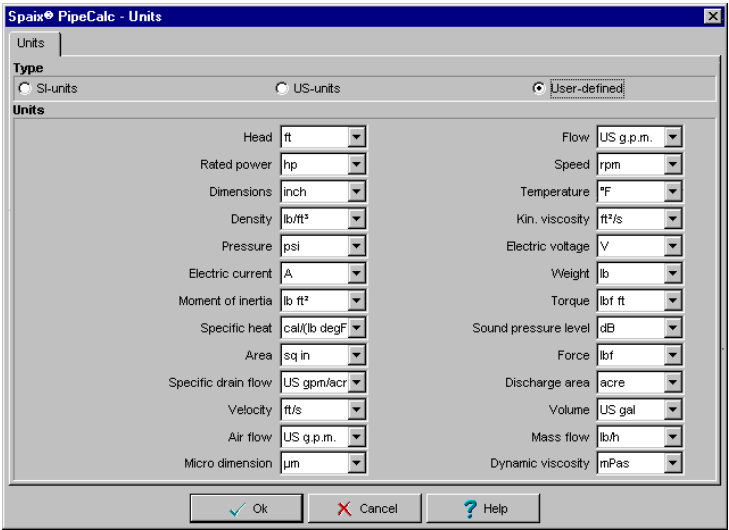
See chapter „Create and change data sheets“ at page 29.

Units

Here you can define your physical units. This dialogue is available by the button




The program system at hand allows working with either the US-American unit system as well as with the international (within the EEC) SI system that is prescribed by law for the international trade within the European Union. It is also possible to establish an individual user-defined measures system from the available units.



When clicking OK all currencies in the database are going to be converted to the changed currency.

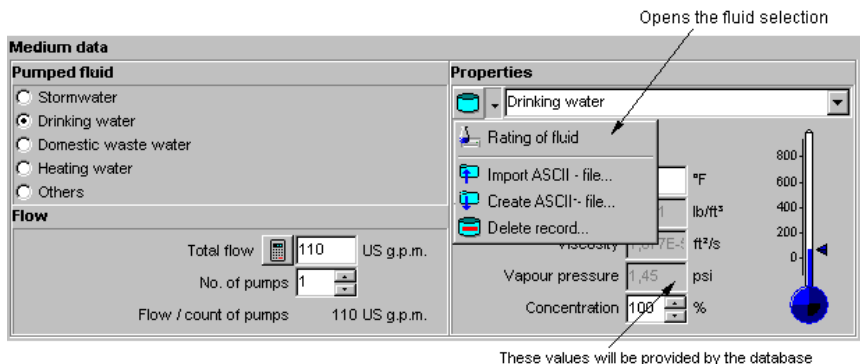
Language

By this button  you can set the desired user language. The standard program is delivered in English and German. The program can be extended to other European languages.

VIEW: CALCULATE SYSTEM

SPECIFY THE PUMPED FLUID


The first step when designing an installation with the aid of Spaix® PipeCalc is to specify the handled fluid. The available selection comprises a number of standard fluids. Within the list box "Properties" the fluid can be specified more in detail. If you check "Others" as pumped fluid you will find under "properties" the complete list of available fluids. For the selected fluid the properties can be typed into the entry fields. The values that are highlighted in a colour result automatically from the data of the fluid database.




If the needed medium is not available, you can type any fluid data into the white cells temporarily and with reference to the project. Type the appropriate names in the editing field and enter the fluid data.

Those manually entered fluids will not be checked for admittance when running the software!

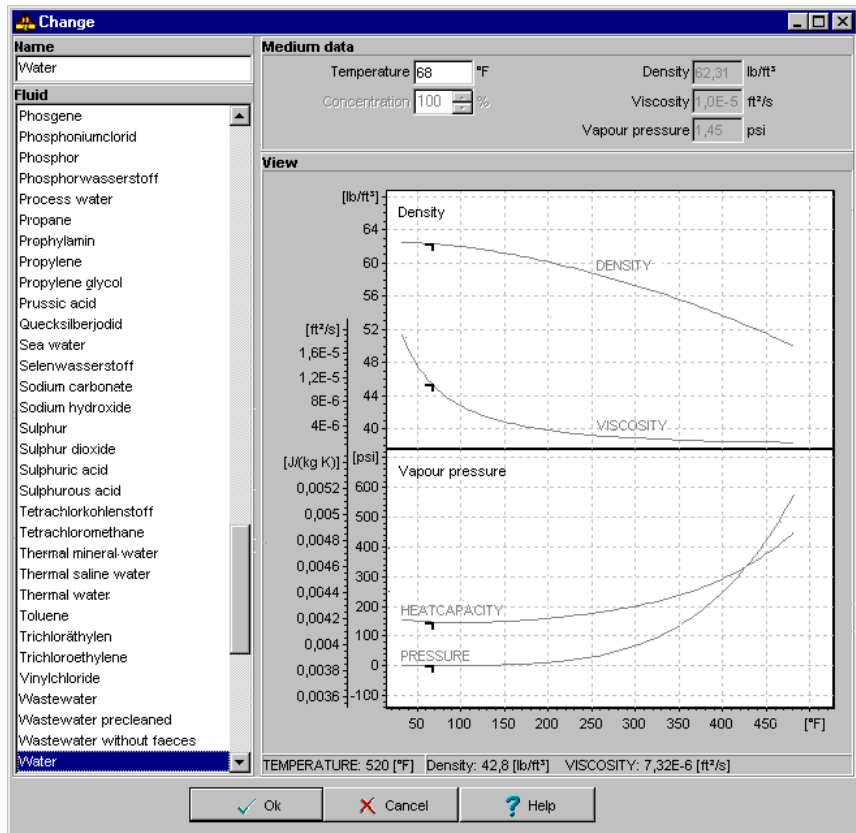
Medium data can be imported and exported by using the buttons  and . Only the CEF-Format (Catalogue Exchange Format) of the data set is possible.

With  the selected medium will be removed. The „Shift“ and „Ctrl“ keys enable multiple selections.

Rating Of Fluid - View And Change

By clicking the rating of fluid button  you'll get to the **fluid selection**. Select one of the fluids from the integrated fluid database. Here all available fluid values such as temperatures, densities, viscosities, concentrations and vapour pressures are displayed.


Example - handled fluid „Others“:



The displayed values can be changed. The viscosity has influence on the Pipe Friction Loss Calculations, the density is considered in the static head difference between inlet and outlet levels, while the vapour pressure is considered in NPSH calculations only.

FLOW RATE CALCULATION



The button for the flow rate calculation  is available if storm water, drinking water, domestic wastewater or heating water has been selected as fluid otherwise this button is inactive.

The required flow, if already a known factor, can be directly entered into the respective input field. If not known yet use the button next to the entry field to start the flow rate calculation according to DIN 1988 respectively EN 12056 or Heating Installation Act of the German Federal Republic HeizAnIV for domestic water supply, waste water disposal or heating water.

These methods can of course not be combined. If you change the pumped fluid the entries on the other page will be set back and discarded.

For sewage and wastewater disposal plants, heating installations and domestic water supply plants there are extensive calculation methods for the determination of the total flow rate available considering varied parameters.

Domestic wastewater

- Population size
- Specific peak outflow
- Outside Source factor
- Type of the pipe system
- Type of building
- Sanitary fitting with corresponding port values

Domestic water supply (drinking water)

A number of different conversion curves, depending on the type of building and the total flow rate, are available to determine the peak flow value.

Select:

- Type of building
- Water tap

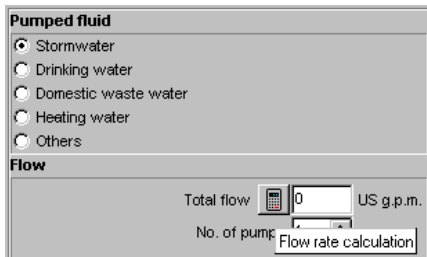
For Storm water

- Statistic values for rainfall may be used by selecting a city
- It can be chosen from a list of several drainage areas with corresponding flow coefficients
- One can define the discharge area



For Heating Water

- It can be selected from different building types (specific heat demand)

- The specific flow per effective surface in m^2 can be determined by giving the temperature difference
- The heatable effective surface may be defined



By clicking the pocket calculator button different dialogues for the calculation of the flow rate are being opened depending on the selected pumped fluid. All the dialogues have in common that in the upper part general settings can be defined. In the middle section always the list of the individual calculation items is displayed and in the lower part the results are shown.

By the  - button or hitting the ENTER key the currently selected values are being added to the flow rate calculation. The  button removes a line from the calculation. The total estimated flow can be multiplied by an individual factor (e.g. safety factor).

Max. flow disregarding diversity factor:

Flow shares that not depend on diversity considerations are being directly used as effective flows in the determination of the total flow.

By **OK** the completed flow rate calculation is being transferred to the current project.

Drainage Water Quantity Based On Storm Water Catchments

EN 12056 governs the sizing of storm water drainpipes. The storm water outflow quantity is then directly related to the size of the connected catchments area, the outflow factor and the proportional storm water gain.

The **proportional storm water gain** for storm water drainpipes in- and outside of buildings must account for at least 300 l/s ha. Deviations from this figure can be made according to differing local ruling standards. For this purpose the program offers a storm water chart containing time factor weighted rainwater gains.

Flow rate calculation

Stormwater

General

City: Alzey

Storm water run-off: 1944 m³/(h ha)

☐ Minimum assessed rainfall
☒ 5-minutes-rainfall (exceeded once in 20 years)
☐ 5-minutes-rainfall (exceeded once in 2 years)
☐ 15-minutes-rainfall (exceeded once in 1 year, only exceptional)

ψ Run-off coefficient for determination of flow considering water absorbed by surface (pumping req.)

List

Kind of drainage area	ψ	Discharge area	Q / US g.p.m.
Bituminous pavement	1	0 acre	
Eduminous pavement			
Concrete areas			
Concrete stone pavement in sand or dross transfers			
Fastened plains with joint packing			
Gravel and slack cover			
Gravel and slack cover			
Gravel roofs			
Intensive planting roofs			

Total estimated flow: 0 US g.p.m.

* Factor: 1 0 US g.p.m.

Max. flow disregarding diversity factor: 0 US g.p.m.

Total flow rate: 0 US g.p.m.

Ok Cancel Help

The **outflow factors** are based on the type and nature of the connected catchments areas. You can choose from a list:

List			
Kind of drainage area	ψ	Discharge area	Q / US g.p.m.
Planting roofs from 10 cm height	0,3	0,1 acre	
Concrete areas	1	1	3464
Playgrounds with partial revetment	0,3	0,2	207,8
Ramps	1	0,1	346,4

Domestic Water Supply

In accordance to DIN 1988 Part 3, the total flow rate is determined as the sum of all reference flow values of the individual apparatuses and fixtures. A number of different conversion curves, depending on the type of building and the total flow rate, are available to determine the peak flow value. These conversion curves characterise the simultaneity of demand, as it is generally not likely that all fixtures are fully open in use at the same time.

For the sizing of supply pipe work it is necessary to consider all outlet fittings with their attributed full flow quantities. Flow on continuous draw-off quantities are to be added to the peak flow to the other fixtures; any draw-off period exceeding 15 minutes is classified as continuous consumption.

Flow rate calculation

Drinking water

General

Type of building
Residential buildings

DIN 1988: B, A, B, A, A, A

List

Water tap	Q / US g.p.m.	Quantity	Q / US g.p.m.
Mixing valve of shower basin DN 15	4,755	1	4,755
Dishwasher DN 15	2,378	1	2,378
Mixing valve of sink DN 15	2,219	1	2,219
Washing machine DN 15	3,963	1	3,963
Mixing valve of washing stand DN 15	2,219	2	4,438
Mixing valve of shower basin DN 15	4,755	1	4,755

Total estimated flow 17,75 US g.p.m.

* Factor 1 17,75 US g.p.m.

Peak flow to DIN 1988 9,156 US g.p.m.

Max. flow disregarding diversity factor 0 US g.p.m.

Total flow rate 9,156 US g.p.m.

Ok Cancel Help

Waste Water Quantity Calculations

Spaix® PipeCalc supports the calculation of sewage and drainage water quantities based on a number of different methods: population size and sanitary fitting. Please note: Coupling of calculation results of the different program parts is feasible; however, it is not possible to carry out any diversity reviews between the different calculating methods.

Domestic Waste Water From Population Size

In case that only the number of "connected residents" is known the domestic waste water quantity is determined according to ATV A 118 based on the community size in conjunction with the specific peak waste water outflow.

The domestic wastewater outflow depends on the water consumption of the population and the community density and thus is subject to large variations due to the different living habits, etc. Under German conditions, including some small, not intensive water consuming commercial operations, a **specific peak outflow** of 5 l/s 1000 residents can be assumed.

The standard **margin of storm water attribution** is fixed on 100%.

Flow rate calculation - drainage and waste water

Population size: 55,48 US g.p.m. Sanitary fitting: 69,82 US g.p.m.

General

Specific peak flow and outside source factor are depending from regional living conditions, size and structure of the municipality

Specific peak outflow = Volume flow per 1000 population

List

Comment	Population size	Specific peak outflow	Outside source factor	Q / US g.p.m.
"Own entries"	150	79,3 US g.p.m.	100 %	
Little village	200	79,25	100	31,7
Area east	150	79,25	100	23,78

Total estimated flow 55,48 US g.p.m.
 * Factor 1 55,48 US g.p.m.

Max. flow disregarding diversity factor 0 US g.p.m.

Total flow rate 55,48 US g.p.m.

Ok Cancel Help

Waste Water Quantities From Sanitary Fittings

The expected maximum outflow quantity can be determined according to EN 12056 from the sum of the weighted outflow values from these units under consideration of the diversity factors (simultaneity of use).

Sizing of waste and soil drops, mains and underground runs to be capable to handle the expected total outflow can be based on unit quantities of specific nature (e.g. apartment, hotel room, etc.).

Flow rate calculation - drainage and waste water

Population size: 55,48 US g.p.m. Sanitary fitting: 69,82 US g.p.m.

General

Pipe system: Type I - partially filled connection pipes

Type of building: hospital, school, restaurant, hotel (periodical use) k = 11,1 US g.p.m.

Sanitary fitting: Single objects

DU Unit value

List

Description	DU	Quantity	DU
Dish washing machine	0,8	2	
Bath/ ground drainage DN 50	0,8	15	12
Shower without plug	0,6	10	6
Closet 6.0 l flushing cistern	2	10	20
Dish washing machine	0,8	2	1,6

Total outflow value 39,6
 * Factor 1 69,82 US g.p.m.

Max. flow disregarding diversity factor 0 US g.p.m.

Total flow rate 69,82 US g.p.m.

Ok Cancel Help

The **outflow reference factor k** is determined depending on the type of building respectively the waste water system, that is the measure of the outflow characteristics under consideration of the simultaneity of use.

The **weighted outflow values DU** are attributed to the type of residential unit.

Heating Installation

In accordance to the regulation "HeizAnIV" the pump capacity has to be determined from the heating load/pipe layout estimates or the design heating capacity rating of the installation. Based on the heating capacity rating the following is applicable: freestanding buildings with max. 2 residential units 100 W/m², for such with more than 2 apartments 70 W/m² and for low-energy buildings 40 W/m². The pumping head of auto-controlled pumps must be set to the estimate total head but under no circumstances higher than required for sufficient heat transport to all heat exchangers under any operational condition.

For the flow rate calculation the program considers the following parameters:

P_A	Specific heat demand per m ² heatable effective surface in accordance with Heating Installation Act Of The German Federal Republic
ΔT	Temperature difference in Kelvin. Possible are temperature differences of 5, 10, 15, and 20 K
Q_T	Specific flow per effective surface and temperature difference (will be calculated)
A_N	From the pump or thermostat valve heatable effective surface.

Flow rate calculation

Heating water

General

P_A Specific heat demand per heatable effective surface

Q_T Specific flow per effective surface and temperature difference

A_N Heatable effective surface

List

Type of building	P _A / W/m ²	ΔT / K	Q _T / US	A _N / sq in	Q / US g.p.m.
Residential building with more than 2 flats	70	15	0,01761	5000	
Low-energy building	40	5	0,01013	5000	0,03267
Residential building with max. 2 flats	100	15	0,0251	5000	0,08096

Total estimated flow 0,1136 US g.p.m.

* Factor 1 0,1136 US g.p.m.


Max. flow disregarding diversity factor 0 US g.p.m.


Total flow rate 0,1136 US g.p.m.

Ok Cancel Help

HEAD CALCULATION

Input fields are contained in the lower part of the dialogue for the entry of all values required for the calculation. This applies to the geodetic head H_{geo} , inlet and outlet levels and head loss H_v .

Next to the input fields for the respective friction heads is a button  that starts the Pipe Friction Loss Calculations as sum of partial losses in straight pipe lengths, valves and fittings. If available (depending on the manufacturer) for

individual units simplified pressure loss calculations - buttons  - are provided.

Terms

Geodetic Head

The geodetic head is that part of the total head that results from the different heads of the fluid levels on suction and pressure side. It forms together with the difference between inlet and outlet pressure the static part of the system curve.

In closed systems (e.g. in heating circulation systems) the geodetic head always equals zero.

Inlet Pressure

The inlet pressure is the static overpressure at the inlet port of the system. The difference between the inlet and outlet pressure together with the geodetic head form the static part of the system curve.

In drinking water supply plants the minimum supply pressure is used. In case of ventilated (open) containers the overpressure becomes zero at the suction port.

In closed systems (e.g. heating circulation systems) the inlet and outlet pressures are equal.

Outlet Pressure

The outlet pressure is the static overpressure at the outlet port of the system. The difference between the inlet and outlet pressure together with the geodetic head form the static part of the system curve.

In drinking water supply plants the minimum flow pressure of the tapping fitting is used.

In closed systems (e.g. heating circulation systems) the inlet and outlet pressures are equal.

Calculation Methods For The Friction Loss

The calculation is performed according to the model of **COLEBROOK** or **HAZEN WILLIAMS**.

COLEBROOK

For the friction loss in a straight pipe applies:

$$p_V = \frac{U \cdot L}{4A} \cdot \frac{\rho \cdot v^2}{D_i} \cdot \lambda \quad \text{Equation 1}$$

with p_V = friction loss
 A = passed gross section area
 U = circumference related to A
 L = pipe length
 ρ = density of fluid
 v = average flow velocity
 λ = friction factor
 Q = flow

In case of a circular pipe applies:

$$p_V = \frac{L}{D_i} \cdot \frac{\rho \cdot v^2}{2} \cdot \lambda \quad \text{Equation 2}$$

By using the friction loss head instead of the pressure

$$p_V = H_V \cdot g \cdot \rho \quad \text{Equation 3}$$

with H_V = friction loss head
 g = gravitational constant ($g \approx 9.81 \text{ m/s}^2 \approx 32,17 \text{ ft/s}^2$)

and the flow instead of the velocity (calculated for circular pipe)

$$Q = v \cdot A = v \cdot \frac{\pi}{4} \cdot D_i^2 \quad \text{Equation 4}$$

with D_i = inner pipe diameter

follows for the friction loss

$$H_V = 16 \cdot \frac{Q^2}{2 \cdot g \cdot \pi^2} \cdot \frac{L}{D_i^5} \cdot \lambda \quad \text{Equation 5}$$

The friction factor λ depends on the nature of flow characterised by the REYNOLDS number Re that can be expressed by:

$$Re = \frac{v \cdot D_i}{\nu} = \frac{4 \cdot Q}{\pi \cdot v \cdot D_i} \quad \text{Equation 6}$$

For **laminar flow** ($Re < 2320$) the friction factor λ equals:

$$\lambda = \frac{64}{Re} \quad \text{Equation 7}$$

For turbulent **flow in a hydraulic plain pipe** the friction factor is calculated according to the empirical equation of Eck as:

$$\lambda = \frac{0.309}{\left(\lg \left(\frac{Re}{7} \right) \right)^2} \quad \left(\text{for } \frac{k}{D_i} < 10^{-8} \right) \quad \text{Equation 8}$$

with k = absolute pipe roughness

In the **transient range** between laminar and turbulent flow ($2320 < Re < Re_{lim}$) the friction factor can be calculated by

$$\lambda = \frac{1}{\left(1.14 - 2.0 \cdot \lg \left(\frac{k}{D_i} \right) \right)^2} \quad \text{with} \quad Re_{lim} = \frac{200}{\frac{k}{D_i} \cdot \sqrt{\lambda}} \quad \text{Equation 9}$$

For **turbulent flows** the friction factor is defined by the COLEBROOK equation:

$$\frac{1}{\sqrt{\lambda}} = -2 \cdot \lg \left(\frac{k}{3.71 \cdot D_i} + \frac{2.51}{Re \cdot \sqrt{\lambda}} \right) \quad \text{Equation 10}$$

The friction loss in fittings is defined by

$$H_V = \zeta \cdot \frac{v^2}{2 \cdot g} \quad \text{Equation 11}$$

with ζ = friction loss coefficient

For a circular pipe with consideration of equation 4:

$$H_V = \zeta \cdot \frac{16 \cdot Q^2}{2 \cdot g \cdot \pi^2 \cdot D_i^4} \quad \text{Equation 12}$$

HAZEN WILLIAMS

Besides the COLEBROOK calculation the software supports the empirical equations according to HAZEN and WILLIAMS. The greatest advantage of this calculation is the simple structure and application. At the other hand is the validity of this formula very limited (turbulent flow with water at 60 F, kinematical viscosity of 1.13 cSt), so that there is no real reason to use it. It is recommended to apply this method for comparison only.

$$H_v [\text{ft}] = 0.002083 \cdot L [\text{ft}] \cdot \left(\frac{100}{C} \right)^{1.85} \cdot \frac{Q [\text{gpm}]^{.85}}{D_i [\text{inch}]^{4.8655}} \quad \text{Equation 13}$$

with $H_v [\text{ft}]$ = friction loss head
 $L [\text{ft}]$ = pipe length
 C = Hazen-Williams friction factor
 $Q [\text{gpm}]$ = flow
 $D_i [\text{inch}]$ = inner pipe diameter

NOTES:

1. These values must be inserted in the equation with the given unit, while the first section is based on a logical system of units (like S.I.).
2. Calculation of friction loss in fittings: If there is not given the equivalent length for *HAZEN-WILLIAMS*, then the acceptance is made that the equivalent length for *HAZEN-WILLIAMS* is equal to the equivalent length for *COLEBROOK*. This value can also be calculated from friction coefficient ζ or friction factor K_v .


How To Work The Dialogue

The calculation is based on a database that is freely expandable by individual items.


For the calculation of the pressure loss in fittings different settings might be required, e.g. ζ - or k_v -values or functional dependences for $\zeta(v)$, $H_v(v)$, $\zeta(Q)$, $H_v(Q)$. If a friction loss value is being displayed equalling zero then the friction loss is being determined by functional dependences.

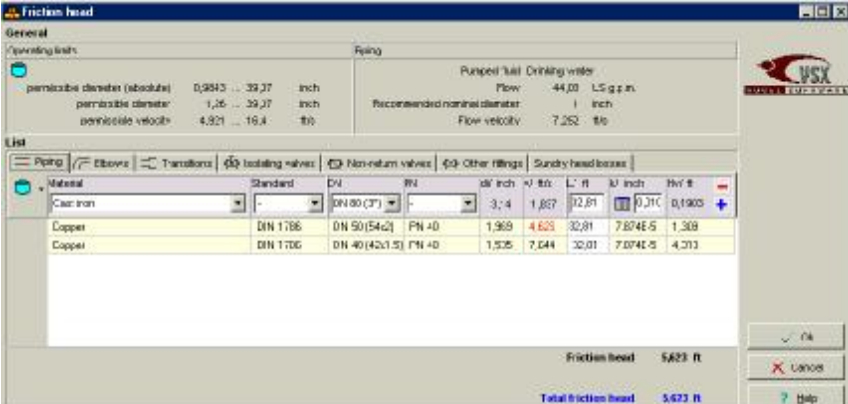
The available pipe schemes depend on the selected fluid. Once you have decided for a pipe system (wet well installation, lifting station...) and you have

set values and performed calculations by  the other variants are not going to be displayed anymore.

But in the left lower corner of the screen in the section *Calculated*, there is always the option  to add another calculation.

Dialogue Friction Head

Clicking this button  opens this dialogue for the calculation of head losses from the individual components of each line consisting of varied pipe runs, valves, fittings, transitions, elbows etc. Immediately the resulting partial losses and the total loss of the respective line are calculated.

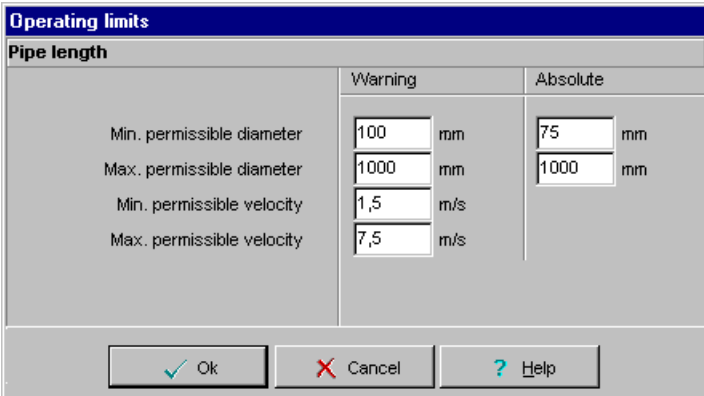


Material	Standard	DN	IN	dia' inch	Wt' lb/ft	L' ft	Wt' lb	Wt' #
Carbon	-	DN 80 (3")	-	3.14	1.887	32.81	0.310	0.1905
Copper	DIN 1186	DN 50 (S4.2)	PN 40	1.969	4.625	32.81	7.874E-5	1.369
Copper	DIN 1106	DN 40 (42x1.5)	PN 40	1.525	7.644	32.81	7.074E-5	4.213

Friction head: 5.623 ft
Total friction head: 5.673 ft

For pipes may be separately defined application limits for every individual fluid:


- Permissible diameter (absolute): only these may be selected
- Permissible diameter: warning if undershooting or if exceeding
- Permissible velocity: warning if undershooting or if exceeding



	Warning	Absolute
Min. permissible diameter	100 mm	75 mm
Max. permissible diameter	1000 mm	1000 mm
Min. permissible velocity	1,5 m/s	
Max. permissible velocity	7,5 m/s	

Ok Cancel Help


The warnings appear as red-coloured values in the table in contrast to regularly black displays.

By the button „Edit record“  under *Operating limits* the operating limits can be changed at any time.

Example:

If the absolute value of the min. permissible diameter is set to e.g. 75 mm, for all materials only diameters larger than DN80 are being offered. Smaller diameters are not available any more.


The lower section of the dialogue features index cards that display the individual partial losses.

Clicking  adds the given item in the table head to the calculation. If later changing the volume flow the partial losses will be actualised automatically.

 removes a partial loss from the list.

Pipe Friction Losses

Pipe length

The register card *PIPING* contains all friction losses in straight pipe runs. This requires first to determine total pipe lengths of equally sized pipe sections by referring to the piping diagram. You can add not listed pipes by the button  - database.

Pipe diameter

On the basis of minimum and maximum permissible pipe diameters and flow rates a pipe diameter is recommended for the minimization of the pressure losses. This diameter is displayed on the top right of the dialog as well as the flow velocity resulting from it.

Hint:

The ruling standards for minimum and maximum flow velocities as well as the minimum required pipe size should be taken into consideration when determining the required pipe diameters.

Conveying of **sewage and wastewater** in horizontal pipelines requires a minimum flow velocity of $v_{\min} = 0.7 \text{ m/s}$ (2.3 ft/s) and in vertical pipelines a minimum flow velocity of $v_{\min} = 1.0 \text{ m/s}$ (3.3ft/s); it is normally recommended not to exceed $v_{\max} = 5.0 \text{ m/s}$ (16.4ft/s).

Systems with pumps **without macerators** require a minimum DN 80 (3") pipe size, systems employing pumps **with macerators** a minimum DN 32 (1 1/4") pipe size. If the desired minimum flow velocity cannot be achieved with the required minimum pipe size the pump has to be operated intermittently (intermittent displacement). The pipe system must then also be laid out to ensure the minimum required flow velocity.

The program suggests such a pipe diameter that ensures a velocity as small as possible in the context of given operating limits to minimize the flow losses. In practical application this value has to be verified under consideration of e.g. economical aspects (depending on pipe length...).

Interior surface roughness of pipes

The pipe roughness value is given according to the selected pipe material. This value generally represents the upper limit for the specified material.

A more exact calculation requires the value input according to the manufacturer's references. If the exact value is however not known the standard values given for commercially available pipes will generally be sufficiently accurate for the friction loss calculation.

The generally used roughness value for pipes used for drainage and wastewater disposal is 0.25 mm (ATV A 116, 3.6.2).

Elbows

The register card *ELBOWS* is used to obtain all frictional losses through pipe bends and elbows. The friction loss through pipe bends and elbows are generally viewed as the sum of straight frictional and deflection losses. The portion attributed to friction losses is determined as for straight pipe runs. The portion attributed to deflection losses depends on the deflecting angle, the radius of the bend, the interior surface roughness and additionally on the Reynolds number.

Deflection losses can be determined for deflecting angles between 0° (straight pipe) and 180° (elbow).

Transitions

The register card *TRANSITIONS* is used to obtain all frictional losses through pipe reducing and enlarging pieces based on the friction loss coefficients stored in the fitting chart. Both, reducing and enlarging pieces are distinguished by two groups, such with conical and such with sudden transformations between the two pipe sizes.

Reference diameter is always the size at the entry to the transformation piece.

Isolating Valves

The register card *ISOLATING VALVES* is used to obtain friction losses through isolating devices based on the friction loss coefficients stored in the fitting chart.

Non-return Valves

The register card *NON-RETURN VALVES* is used to obtain all frictional losses through check valves and non-return devices based on the friction loss coefficients stored in the fitting chart.

Other Fittings

On the register card *OTHER FITTINGS* you can enter all items, which cannot be arranged in one of the other register cards, e.g. filters etc..

Sundry Head Losses

The register card *SUNDRY HEAD LOSSES* can be used to make allowance in the calculation for outlet losses as well as losses originating from pipe joints.


Please note that there are no outlet losses in closed circulating systems. In open displacement systems they can generally be neglected.

Losses due to pipe joints take into account that the determination of friction loss coefficients for valves and fittings are based on laboratory tests where a much higher installation quality can be expected than that normally executed on site. Additions to loss coefficients due to the lower quality pipe joints are thus not taken into account.

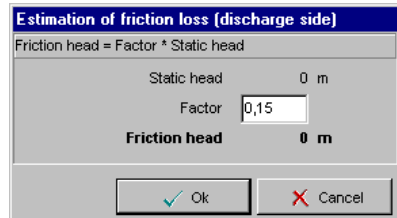
The number of possible disturbing sources (flange, socket and spigot joints as well as welded joints) can not only be attributed to number of applied fittings, valves and plant but also to pipe joints when using standard pipe lengths. Consideration to these losses is based on the assumption that disturbances of this kind have a downstream influence of approx. 4 diameter sizes.

Under *Sundry head losses* additionally occurring losses may be considered and a brief description may be typed.

Simplified Calculation

Depending on the manufacturer for individual units simplified pressure loss calculations  are provided.

For drinking water this applies to the unit *Drinking water plant*. The pressure losses are being estimated (Formula $H_{VD} = \text{Factor} * H_{geo}$) for the discharge side.



Estimation of friction loss [discharge side]

Friction head = Factor * Static head

Static head 0 m

Factor 0,15

Friction head 0 m


Ok Cancel

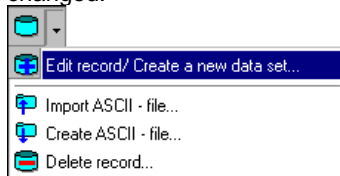
For heating water this applies for the unit *Closed circulating system*. In a closed circulation system only pipes are being considered, all other fittings are being disregarded. For those there is a surcharge factor that generally covers all parts and fittings (according to WILO-Brain Additional Factor=2,2 for fittings/thermostat valves or Additional Factor=2,6 for mixers/gravity brakes).

By this calculation method results can be obtained easily and quickly. However a disadvantage is the inaccuracy.

Editing The Fittings Database


All fittings, valves and pipes used by the program are saved in a database. This database may be extended by the user.

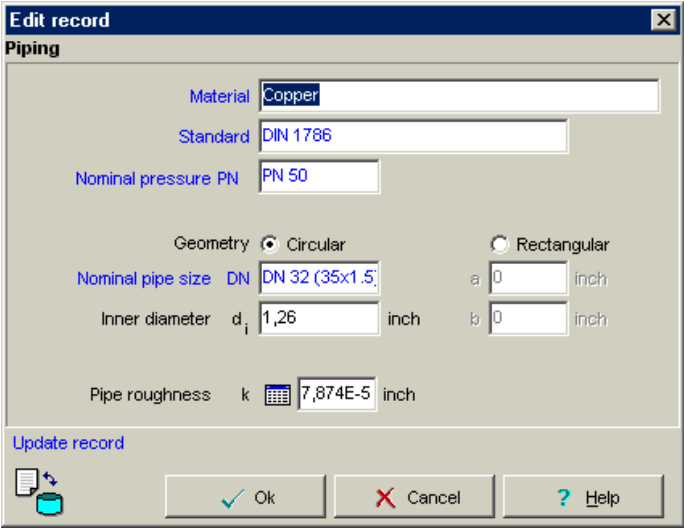
By the button  in each register card of the dialogue the database can be changed.



The Import/ Export is performed via the CEF-Format (Catalogue Exchange Format).

The most items (pipes, fittings) are based on database entries. Exceptions are elbows and transitions that are being calculated by a formula.

The button Edit record  enables the editing of the actual item. It opens the dialogue for pipes or fittings.



The dialog box is titled "Edit record" and contains a section for "Piping". It includes the following fields and controls:

- Material:** A text field containing "Copper".
- Standard:** A text field containing "DIN 1786".
- Nominal pressure PN:** A text field containing "PN 50".
- Geometry:** Two radio buttons, "Circular" (selected) and "Rectangular".
- Nominal pipe size DN:** A text field containing "DN 32 (35x1.5)".
- Inner diameter d_i:** A text field containing "1,26" with the unit "inch".
- Rectangular dimensions:** Two text fields labeled "a" and "b", both containing "0" with the unit "inch".
- Pipe roughness k:** A text field containing "7,874E-5" with the unit "inch".
- Update record:** A blue link text.
- Buttons:** "Ok" (with a checkmark icon), "Cancel" (with a red X icon), and "Help" (with a question mark icon).

Important:

The primary database fields are highlighted blue. These values have to uniquely define the data record. Changing **black values** results in an **overwriting** of the data record in the database. Changes of **blue values** create a **new** data record. The current status is being displayed in lower left section of the dialogue.

In the dialogue for fittings the diverse opportunities for the calculation of the friction loss are distinct.

Edit record

Non-return valves

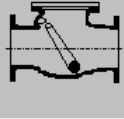
Name: Non-return valve with lever and weight

Supplier: -

Nominal pressure PN: -

Nominal pipe size DN: DN 100

Picture / drawing (*.BMP): FLAPM.BMP



Pressure loss

☒ Performance curve

☐ Non-return valve with lever and weight DN 100

$H_v = c + a \cdot (Q - b)^m$

c : 0 m a : 0

b : 0 m²/h m : 0


ζ : 0

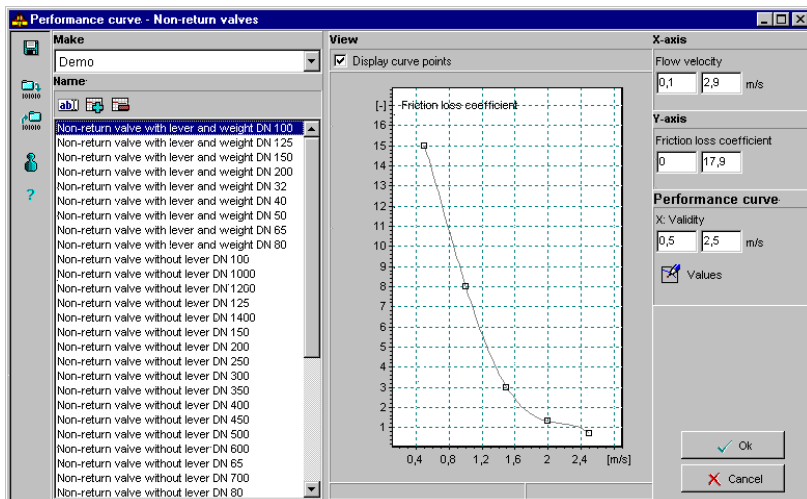
L_{eq} : 0 m k : 0 mm


k_v : 0 m²/h



Update record

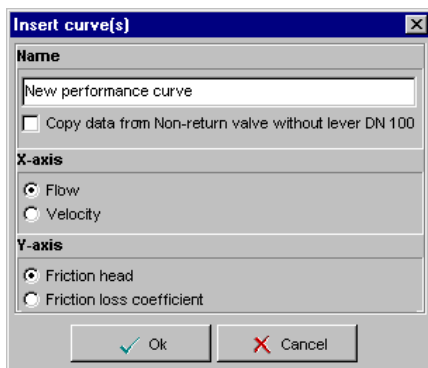
Ok Cancel Help

The most detailed description of the pressure loss in fittings enables the setting of a fitting curve. By clicking the *Performance curve* button  existing fitting curves can be changed or created.



The diagram and curve limits can be directly entered. Use the button  in order to add the values for the curve.

Performance curves can be imported and exported by using the buttons  and  under *Performance curve*.



The dialog box titled "Insert curve(s)" contains the following elements:

- Name:** A text field containing "New performance curve".
- ☐ Copy data from Non-return valve without lever DN 100
- X-axis:** Radio buttons for "Flow" (selected) and "Velocity".
- Y-axis:** Radio buttons for "Friction head" (selected) and "Friction loss coefficient".
- Buttons:** "Ok" (with a green checkmark) and "Cancel" (with a red X).

When creating a new performance curve first define the manufacturer. Next, by using the *Add*-button type the name of the curve and set the physical properties for the diagram axes.

VIEW: DATA SHEETS

Usually two data sheets are available (two index cards). The first one is for the flow calculation and the other one is for the determined friction loss.




It is possible to create and change data sheets on one's own. The option to change and to create data sheets is located in the menu *Settings / Datasheets / File / Open* or *New*.

The widths of the columns can be changed by drawing with the mouse.

In order to change the address in the data sheet click the menu *Edit / Addressee* in the main screen.

Here you can create a customer database. In different dialogs you can go back on this customer database.

Choose from the customer database the receiver resp. addressee of the project.

You can add new  or change  existing companies including their customer number.  deletes a customer.

CREATE AND CHANGE DATA SHEETS

This program feature can be opened in the selection program by selecting in the main menu *Settings / Data sheets...*

General:

Every single data sheet basically consists of several pages. Each page is individually displayed on a separate index card. The pages again are composed

of several layers. The layers can be individually processed. They lay one on top of the other like transparent foils. Only one of the layers is active at a time and can be changed. The non-active layers are displayed faded out.

The advantage of subdividing documents into layers is, that those layers can be linked to several documents without explicitly copying them. Therefore the layers are saved in a central layer pool in order to have them available for use by several data sheets.

The Menus

Menu File

New:

Creates a new data sheet. The preceding document is going to be saved after safety query.

Open:

Click here in order to open an existing document. Besides data sheets can be deleted. Before opening a new document the current data sheets will be closed after safety query.

Save as:

Here the document can be saved under a different name.

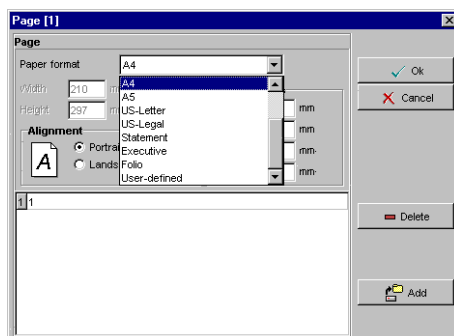
Export ASCII-file:

Here you can export the current data sheet as ASCII-file (CEF-format).


Import ASCII-file:


One can import a data sheet of CEF-format into the program.

Page layout:



In this dialogue the layout of every single page can be defined. First select a page (in our example page 1) and then define the desired formats.

The  - button can remove a selected page from the document.

If you click onto the  - button a list of all available documents will be displayed. When choosing a file all the accompanying pages will be added to your current document.

In order to add a new, blank page to your data sheet type the name of the new page into the cell *Open* (overwriting the current contents) and click *OK*.

Print:

Here you can print the entire document or only parts of it.

Exit:

Terminates the program part Data sheets.

Menu Edit

Undo:

Cancel the last change.

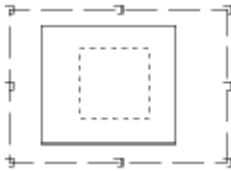
Cut / Copy / Insert / Delete:

Analogue other standard programs

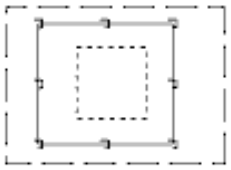
Shift graphic to back / to front:

This is a tool that enables the selection of graphics that lay one on top of the other.

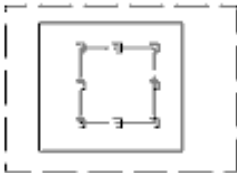
For example three rectangles are overlapping:



First only the outer rectangle can be marked. The inner rectangles are not available. Therefore we are now *shifting* the selected rectangle *to back*.



As a result the second rectangle is accessible now, but not the third one. Now we are going to send back the second rectangle.

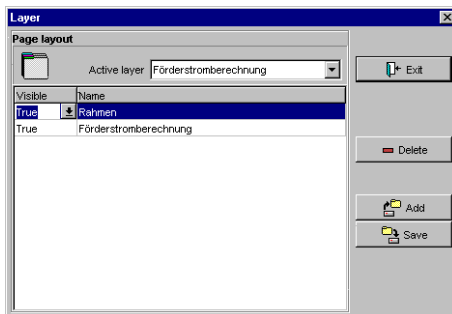


Now the inner rectangle can be selected for e.g. changing the format.

Analogously to the described procedure objects also can be *shifted to front*.

Note: Graphics in the second level also can be selected by pressing the **CONTROL**-key when clicking the mouse.

Add / save layer:



Here one can activate or add a new layer. Remember: pages generally consist of one or more layers.

In the cell *Active layer* you can select the layer that you want to activate. Only active layers can be processed. In the table underneath all layers that belong to the current page are listed. Non-active layers will be displayed pale if you set *True* in column *Visible*. When

setting *False* the selected layer will be completely faded out in the page layout view. Moreover one can *delete* layers from the page, *add* more layers from the layer pool, *create* new layers and *save* them in the layer pool.

When clicking *Add* all layers of the central layer pool will be listed:

Now select the layer that you want to add to your current page. Typing the desired name of the new layer into the cell *Open* and clicking the *OK* button will create a blank new layer.


Selected layers can be removed from the general layer pool by clicking the *Delete*-button. At the same time this layer will be deleted from all pages that it is contained in.

Menu View

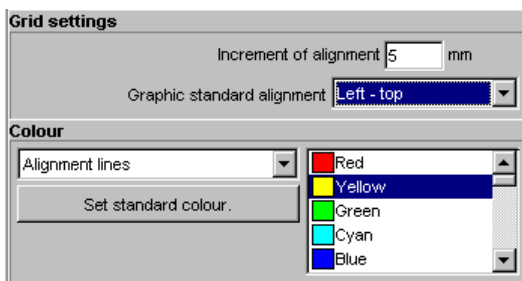
Grid lines:

Click here in order to display grid lines.

Alignment lines:

Alignment lines set up a grid that inserted objects as texts or graphics can be aligned in. First click the  button. As a result the alignment grid is active now but not visible yet. In order to make it visible select in menu *View* option "Alignment lines".

In menu *Tools* option *Grid settings* the properties of the alignment lines can be defined. For Graphic standard alignment we've chosen *Left - top*.



As a result all objects that will be insert from now are always going to jump into the left top corner of the alignment box:



Design view:

Only in this view data sheets can be processed.

Data sheet view:

This actually is the preview (page layout view) of the data sheet. The document cannot be changed, except for the yellow-coloured entry fields. In this modus one can type into the entry fields.

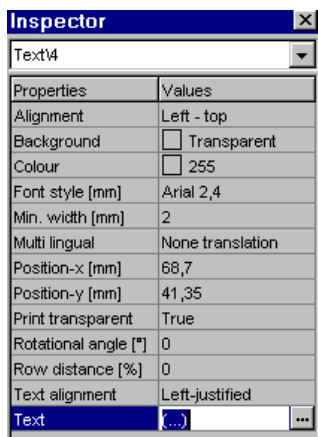
Menu Tools

Inspector:

The inspector can format objects (texts, keywords, graphics etc.). The inspector for the respective object can be called up either by selecting option *Inspector* in menu *Tools*, by hitting the **F11** key or by clicking the right-hand mouse key.

One can process the layout of similar objects simultaneously. Several objects can be selected at a time by keeping the **SHIFT**-key pressed while selecting the objects by mouse click. Now open the inspector by clicking the right mouse key. Agreeing cells will be regularly displayed and can be changed. Cells that differ in their contents will be shown empty.

Now change the settings in the inspector if desired.



Alignment: Here the alignment of the object in the alignment grid is defined. (See preceding page).

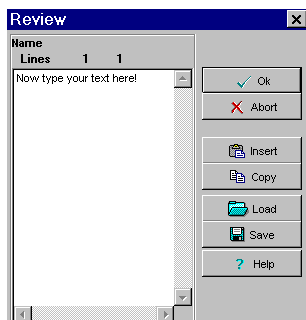
Multi-lingual: Here one can define the translation table that should be used.

Min. width: For texts the width of the object is adjusted automatically. However for entry fields here one can define a certain minimum width.

Positions: The program displays the X- and Y-positions of the object on the sheet.

Font style: Here the type format can be set.

Text: In order to insert a text click into the very right-hand corner of the cell to open the following dialogue:




In the right-hand section of the dialogue at hand you'll find several buttons for insertion and saving of text files.

Type your text directly in the white field.

Toolbars



Here you'll find all buttons that are required for the insertion of objects, values and data from the friction loss calculation program into the data sheet.

By the  - button you can load a calculation example (exported as CEF file) in order to fill the keywords of the data sheet with example values for a better illustration. To make the values visible check [Display](#).

Toolbar 1

**Text:**

This button inserts a text into the document. In order to type the text click in the very right corner of the cell [Text](#) to open the input mask. Under [Font style](#) one can define the layout of the text. Or you can define the layout for all text keys generally when opening menu [Tools – Grid settings](#). There click under [Standard font style](#) button [Edit](#). Type the text into the white text field.

**Page number:**

Inserts a field for the automatic page numbering.

**Data field:**

Inserts the current date in the document.

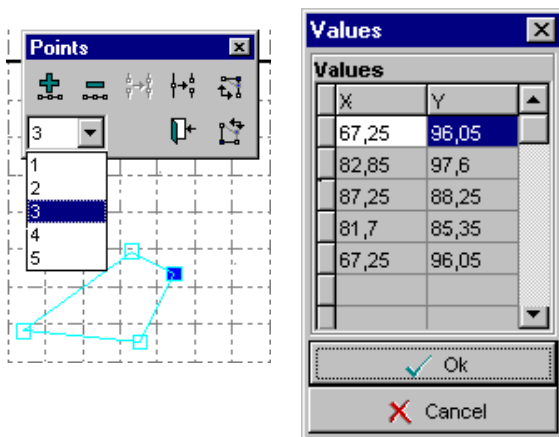
**Circle:**

Inserts a circle. In the inspector one can define the usual layout options. Besides you can set the exact height and length of the object and its position on the data sheet as well.

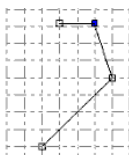
**Poly-line:**

Inserts an object that can consist of any number of single lines. The points of the shape can be defined in the inspector line [Points](#).

This is a closed poly-line:



This is an open polyline:



Rectangle:

This button inserts a rectangle. Also here one can define the height and length of the object as well as the position on the data sheet. One can use rectangles in order to create **position frames**. That means one can firmly link texts or other objects to a rectangle. As a result when shifting the rectangle the linked text will be shifted, too.



Picture / drawing:

Here one can load drawings in DXF, WMF, BMP or JPEG-formats.



Check box:

Inserts a box for the checking of options. Like the entry fields the box can be edited also in the data sheet view. Open the inspector and click the line [Text](#) in order to type the term that you want to place next to the check box.

For example: ☒ Check here

Toolbar 2



Addressee keys:

In the inspector of this object there are in cell *Field* all relevant customer-related keys (e.g. names, addresses) listed.



Sender keys:

Here you'll find all keys that relate to the pump manufacturer as name, addresses etc.



Entry fields:

This button inserts editable fields into the data sheet. These fields can be typed in the modus *Data sheet view*. Besides one can type entries into these fields directly in the selection program in the print preview. If desired you can define a *Min. width* and the option *Sizing automatically* in order to adjust the field size to the length of the entered text.



Entry fields for decimals:

This button inserts editing fields for decimals.

Note the following cells of the inspector:

Unit type: Here select the physical property you want to set this key for.

Floating number digits: This defines the number of valid digits of the numerical value. For example: If you type „3“ and in the entry field will be inserted e.g. „43,19“ as a result the number will be reduced to three valid digits as 43.2. If one enters e.g. 5434892 three floating digits are going to result in 5430000.

Value: One can already type a value here.



Entry fields for integer:

This button inserts editing fields for integers. See explanation of the preceding button.




Units field:

This button inserts a key for a unit of measurement.

First select under *Unit type* the physical property you want to display the unit for. In order to display an entry field together with the corresponding unit on the data sheet follow our example of an entry field for temperatures:

First insert an entry field by the  button. Open the inspector and select

under *Unit type* option *Temperature*. Then click the -button and place the units field right next to the temperature field. Also select in the inspector in cell *Units type* option *temperature*. As a result the following term will be composed (example):

34,57 °C The displayed unit depends on the settings in menu [Tools – Units](#). In our case there has been defined for temperature degrees Celsius. Both the keys can be aligned if you call up the alignment buttons by **F10**.

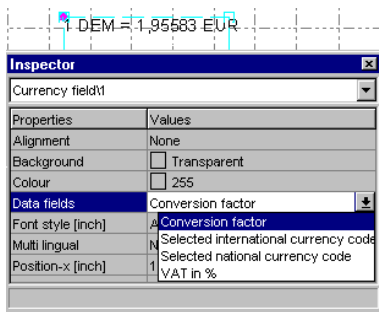
Use also the options [Text alignment](#) of the inspectors of the keys.

34,57 °C Text alignment left justified in the units' key.
 34,57 °C Here text alignment right justified.

Currency field:

€ Different currency-related keys can be inserted in the data sheet.

For example:



We selected [Conversion factor](#). In the cell [Reference currency](#) of the current inspector we selected EUR. As a result the created key will be filled by the expression:
 1 DEM=1,95583 EUR.

The [international currency code](#) is DEM and the [national](#) DM.

When selecting option [VAT in %](#) the sales tax is displayed.

Project text:

This button inserts project-related information, e.g. contact and description and number of the project.

Table for flow calculation:

Inserts the table Flow calculation. The inspector can be called up to define the layout.

Table for friction loss:

Inserts the table Friction loss.

- Active layer 37, 39
- Address 36
- Addressee 7, 36, 45
- Addressee keys 45
- Alignment 40, 41, 42, 46
- Alignment lines 40
- Armatur 33
- Arrow 43
- ASCII 37
- ASCII-file 37
- Begriffe 22
- Change data sheets 9, 36
- Check box 44
- Conversion factor 46
- Copy 42
- Copyright 1, 2
- Currency 9, 46
- Currency conversion 46
- Customer 6, 7, 36, 45
- Customer database 6, 7, 36
- Data sheet 5, 8, 9, 36, 37, 38, 40, 43, 44, 45, 46
- Data sheet view 40, 45
- Database 33
- Delete 6, 29, 39
- Density 12, 18
- Design 20
- Dialogue 5, 6, 9
- Diameter 28, 30, 31
- Digit 45
- Digits 45
- DIN 1988 13, 16
- Directories 8
- Domestic Waste Water 18
- Domestic Water Supply 16
- Drawing 36, 44
- Eintrittsdruck 22
- Elbows 26, 30
- EN 12056 13, 15, 19
- Entry field 41, 44, 45
- Export 5, 8, 11, 33, 37
- Fittings 5, 16, 22, 25, 26, 29, 30, 31, 32
- Flow 5, 13, 16, 17, 18, 19, 20, 21, 23, 24, 25, 28, 29, 36, 46
- Flow Rate 13
- Flow Rate Calculation 13
- Fluid 11, 12, 13
- Fluid data 11, 12
- Formula 25
- Friction Head 22, 29, 30
- Friction Loss 5, 23, 24, 25, 26, 28, 29, 30, 31, 36, 43, 47
- Geodätische Höhe 22
- Grid 40, 42, 43
- Grid lines 40
- Grid settings 40, 42, 43
- Head 4, 5, 8, 20, 22, 23, 26, 29, 30
- Heating Installation 20
- Height 43, 44
- Hint 7, 28
- Import 5, 8, 11, 33, 37
- Inspector 41
- Installation 13, 20
- International currency code 46
- Language 8, 10, 42
- Language directory 8
- License 1, 2
- Make 2, 31, 40, 43
- Material 29
- Measures system 4, 9
- Medium 11
- Multiple selection 11, 42
- NPSH 12
- Open 5, 16, 31, 37, 41, 43, 44
- Open project 5, 6
- Operating limits 27
- Other fittings 32
- Page 9, 13, 37, 38, 39, 40, 41, 42, 43
- Part 8, 22, 38, 43
- Performance curves 2
- PipeCalc 1, 4, 5, 11, 17
- Points 1, 44
- Pressure 12, 22, 23, 31
- Print 5, 38, 45

- Project 4, 5, 6, 7, 8, 11, 36, 46
- Project text 46
- Quantity 15, 16, 17, 18, 19, 20, 21
- Roughness 29, 30
- Sanitary fitting 17, 19
- Save 6, 7, 37
- Save as 6, 37
- Save project 6
- Schalter 14, 33
- Settings 8, 36, 37
- Storm Water 15
- Transitions 26
- Units 8, 9, 19, 20, 22, 26, 31, 42, 45, 46
- VSX 1
- Waste Water 13, 18, 19, 28, 29
- Width 41, 45