

# SINETZ

Steady State Calculation of Flow Distribution, Pressure Drop and Heat Loss in Branched and Intermeshed Piping Networks for compressible and incompressible media

SINETZ fluid - Flow Distribution and Pressure Drop of incompressible Media

SINETZFW - Pressure and Heat Loss in District Heat Networks

SIGMA Ingenieurgesellschaft mbH



## SINETZ

### Program description

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**The programs SINETZ and SINETZfluid are subject of this program description The features of SINETZfluid are identical to SINETZ except of compressible media and temperature loss analysis (see exceptions in the text).**

### **Program development, Sales and Support**

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Release 09.12



## SINETZ

Program description

## Program overview



The tasks of SINETZ are:

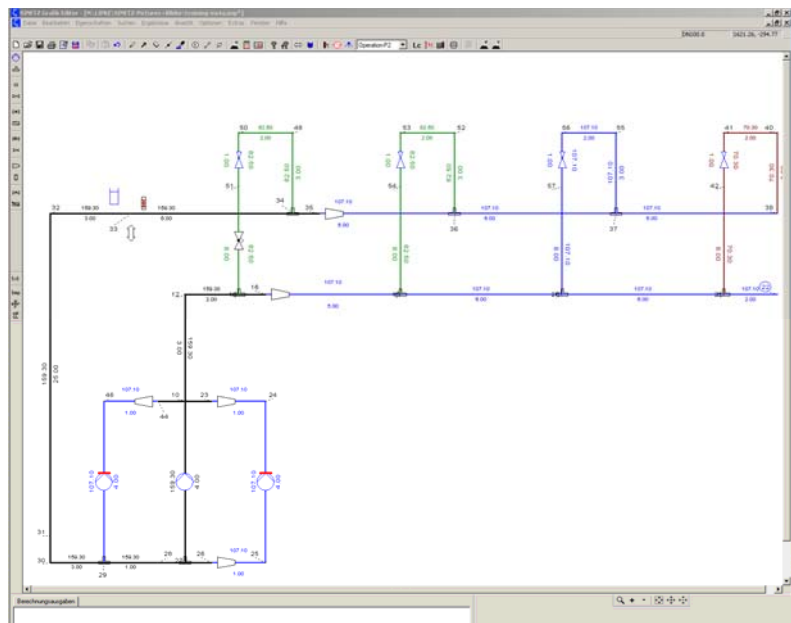
- Dimensioning of cross sections and insulation in the project period
- Dimensioning of pumps
- Verification of dimensions for network expansions
- Usability analysis of existing piping networks
- Simulation of different operation states or abnormal occurrences in intermeshed piping networks

SINETZ solves the tasks by calculation of pressure and temperature loss in branched and intermeshed piping networks with circular, rectangular as well as any cross sections, defined by the hydraulic diameter.

SINETZ calculates direction of flow, rate of flow and temperature loss for individual pipe sections, as well as the temperature and pressure of individual nodes, and the resulting flow distribution for an intermeshed system of any complexity. Calculations for compressible and incompressible media are both possible.

**Different from SINETZ, the capabilities of SINETZfluid do not include the calculation of compressible media and temperature loss analysis.**

The calculation is carried out for a given system assuming a steady state flow. Arbitrary intermeshed networks are solvable. Calculation is possible for open as well as for closed systems.



*Pump station closed loop*

**SINETZ**  
Program description

**System geometry**

The system has to be divided into pipe sections. A pipe section consists of a pipe segment with a constant diameter without branches. The calculation parameters are entered by means of a graphical interface. The system geometry is drawn by the mouse, additional values like segments lengths, node height, components and boundary conditions are added by dialog windows and mouse input.

The program user is supported by integrated expandable databases.

The program determines the resistance coefficients for some components basing on the geometry and flow state.

The inputs are shown graphically including different symbols for instruments.

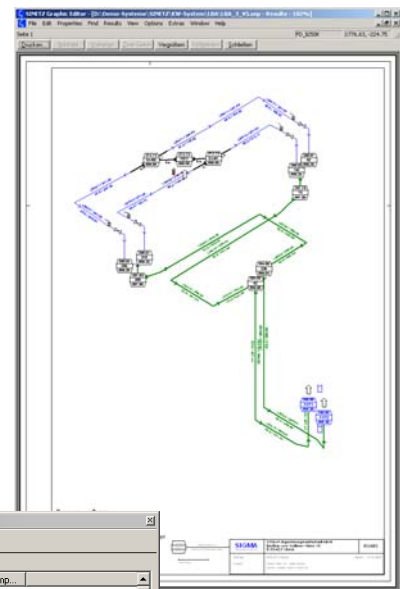
Various operating states of the system may be simulated by load case input.

**Results output**  
**Documentation of the results**

The calculation output is shown graphically and in tables. The result parameters to be shown in the graphic can be selected manually.

Detailed results are shown by a double-click on the node or segment. Pressure and temperature curves are shown graphically

Output files may be exported into rtf and pdf format including user-defined headers and footers.



Name	Vcrit. min	Vcrit. max	Velocity [m/s]	Mass flow...	Zeta [1/n]	dP total	Temperat...	Heat loss...	Wall emp...
12_10	0.200	3.000	2.632	-192.909	0.000	-0.134	-0.000	0.000	
14_12	0.200	3.000	2.632	-192.909	0.000	0.008	-0.000	0.000	
16_14	0.200	3.000	1.995	-142.956	-0.950	0.063	-0.000	0.000	
18_16	0.200	3.000	4.414	-142.956	0.142	0.104	-0.000	0.000	
20_18	0.200	3.000	3.070	-99.415	-1.032	0.002	-0.000	0.000	
21_20	0.200	3.000	1.734	-56.143	-2.051	-0.013	-0.000	0.000	
21_22	0.200	3.000	0.000	0.000	-10000000...	0.000	0.000	0.000	
10_23	0.200	3.000	1.371	-98.224	0.000	0.001	-0.000	0.000	
23_24	0.200	3.000	3.033	-98.224	0.257	-0.016	-0.000	0.000	
25_24	0.200	3.000	3.033	-98.224	0.000	-1.397	0.000	0.000	
25_26	0.200	3.000	3.033	-98.224	0.500	0.032	-0.000	0.000	
26_27	0.200	3.000	1.371	-98.224	0.000	0.038	-0.000	0.000	
27_28	0.200	3.000	1.371	-98.224	0.000	0.001	-0.000	0.000	
28_29	0.200	3.000	1.371	-98.224	-2.666	-0.024	-0.000	0.000	
29_30	0.200	3.000	2.632	-192.909	0.000	0.013	-0.000	0.000	
30_31	0.200	3.000	2.632	-192.909	0.000	0.004	-0.000	0.000	
31_32	0.200	3.000	2.632	-192.909	0.951	-0.107	-0.000	0.000	
32_33	0.200	3.000	2.632	-192.909	0.000	0.013	-0.000	0.000	
33_34	0.200	3.000	2.632	-192.909	0.000	0.025	-0.000	0.000	
34_35	0.200	3.000	1.995	-142.956	1.685	0.036	-0.000	0.000	
36_36	0.200	3.000	4.415	-142.956	0.257	0.038	-0.000	0.000	
36_37	0.200	3.000	3.070	-99.415	1.925	0.144	-0.000	0.000	
37_38	0.200	3.000	1.734	-56.143	3.162	0.065	-0.000	0.000	
38_40	0.200	3.000	4.414	-142.956	0.000	0.011	-0.000	0.000	

## SINETZ Interfaces

### SINETZ Interfaces

The SINETZ interfaces are used for the import of data from CAD/CAE programs and for the export of calculation parameters for documentation purposes.

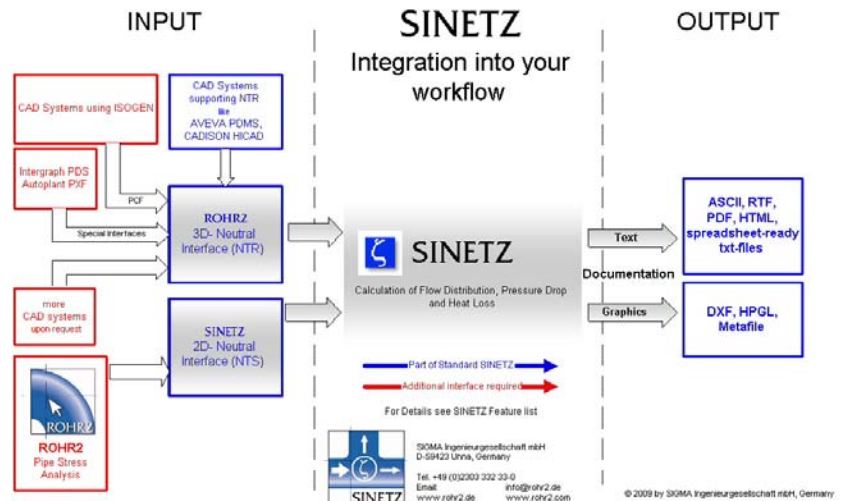
#### **Import of 2D-CAD/CAE data: SINETZ neutral interface**

To simplify the data import of data with 2D coordinates (e.g. flow diagrams, R+I schemes), the format of the neutral interface has been defined. It is used to transfer geometry data, dimensions, insulation, components (like bends, instruments, pumps, reducers, orifices) and boundary conditions (pressure, temperature, quantity injections).

The interface is basing on the listing of all elements and their parameters in the system (pipe, bend, instruments, ..). It may be created by a report from a database. For each element, the parameters required by SINETZ have to be entered. Only a part of the parameters must be entered by the user, not indicated parameters are filled with standard values or calculated from other parameters.

The elements are written into an ASCII file as data sets with defined record label and corresponding parameters.

The program system ROHR2 (static and dynamic analysis of complex piping systems, SIGMA GmbH) is able to export data in SINETZ neutral interface file format.



## SINETZ Interfaces

### **Import of 3D-CAD/CAE data: ROHR2 neutral interface**

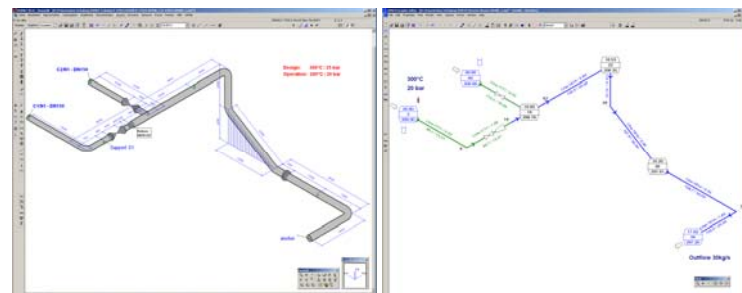
To simplify the data interchange with 3D-CAD systems, the format of the neutral interface has been defined for the program system ROHR2, basing on the listing of all elements and their parameters in the system (pipe, bend, instruments, ..)

An interface for the import of this data is part of the SINETZ program, release 3.4 or higher.

The file format is \*.ntr .This data format enables to convert data directly from CAD systems like:

- AVEVA PDMS
- CADISON
- HICADnext
- ROHRCAD

Optional available interface programs enable to convert data from additional CAD and plant engineering software on the basis of the Neutral 3D data interface



ROHR2/CAD Model

Imported into SINETZ

### **Calculation data export and import**

Export of calculation data and results in the formats:

- ASCII Text
- RichText format (\*.rtf)
- PDF format
- HTML format

For further treatment of output files SINETZ includes functions to export \*.rtf and \*.pdf files.

The SINETZ list-commands enable to export the listed parameters in various formats like \*.rtf, \*.html and \*.txt and additionally the transfer into spread sheet applications, e.g. Microsoft Excel in \*.csv format

The import of text-files is supported by SINETZ, too.

The output of graphics in the formats DXF, HPGL, Metafile (\*.emf, \*.wmf) and into the clipboard is integrated in the program, as well as the insertion of graphics in the formats bitmap, metafile und HPGL.

## SINETZ

System requirements  
Scope of delivery

### System requirements

All SINETZ program versions need system requirements as follows:

***System requirements of single user licenses and PC-workstations in the network***

- PC with min. 1 GB RAM
- Windows 7, Windows VISTA, XP or Windows 2000
- Screen resolution minimum 1024 x 768 pixels
- Internet connection for program updates

***System requirements of the network server***

Installation of the HASP license manager software on a Server PC accessible by all users in the network, running under Windows XP or Windows 2000, Windows Server 2003.

### Single user license, Network license

SINETZ is available as a single user license and also as network license on the basis of our Terms of use.

**Single user license**

The single user license allows using the program on one PC-system of the licensee.

**Network license /Floating license**

The network license enables the access to the program system by any PC in the network, limited by the number of users. This depends on the acquirement of a network license for one or more users

**Unlimited license**

Program license for an unlimited period of time including maintenance and support during six month after purchase.

**Time-limited license:**

Program license including maintenance and support, monthly. Minimum rental period is three month.

## Program license, System contract

The software may be acquired for an unlimited or limited period of time based on the signed system contract and subject to the programs Terms of Use (available upon request).

The program does not include additional programs and interfaces, called "optional", and user-specified program adaptations.

## Scope of delivery and copy protection

The program SINETZ includes:

- One single user license SINETZ, in case of a network license program access is limited to the acquired number of simultaneous users
- the SINETZ Neutral Interface

The program delivery includes a program data carrier (CD), a manual (pdf-format) and a copy protection module (dongle, hardlock) for USB interface. In case of updates or upgrades the copy protection module will be exchanged. The software does not run without the hardlock module.

## Program license, System contract

The software may be acquired for an unlimited or limited period of time based on the signed system contract and subject to the programs Terms of Use (available upon request).

The program does not include additional programs and interfaces, called "optional", and user-specified program adaptations.

## Program versions and Optional modules

### **SINETZ**

Full featured version

### **SINETZfluid**

Reduced features - calculation of compressible media and temperature loss analysis are not included

### **SINETZFW**

Additional program District heat piping is available for SINETZ

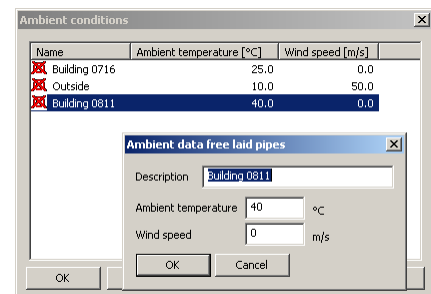
## SINETZ Additional programs

## SINETZ

### Program features

#### System input

- Graphical input of the entire pipe network by mouse. Additional parameters like segments lengths, node heights, components and boundary conditions inserted in dialog windows or selected by mouse.
- Selectable unit for flow input/output of various mass flows may be m<sup>3</sup>/h, kg/s or t/h.
- Selection of pressure unit: bar or mbar.
- Any cross sections of pipes may be analyzed. At circular or rectangular cross the outer diameter and wall thickness are entered (or height and width, inside). Other cross sections require the input of the hydraulic diameter and the equivalent circular diameter.
- Input of the insulation of free-laid pipes and buried pipes with circular cross section.
- Automatic creation of node and segment names (may be changed by the user).
- Pipe names can be assigned to segments. Pipe names may be used for assigning data and checking input parameters.
- Resistors may be entered as zeta- or kv-values.  
The Zeta-values/kV-values are represented by symbols.
- Different symbols for the representation of instrument are available.
- Zeta values of instruments may be taken from a database. If the norm zeta values in the database depend on nominal diameter, the norm zeta value of an instrument is adjusted automatically after changes in dimension.
- The zeta value at reducers/expansions, orifices and branches may be determined by the program.
- Non-return valves with given flow direction may be inserted.  
Depending on the flow direction the program opens the gate or it is closed by a high zeta-value.
- Pumps /fans are defined by their curves and shown by symbols.  
Pump curves may be taken from the database. The database file may be expanded by the user.
- Calculation of sprinklers
- Load case depending input of ambient conditions (outside temperature, wind speed, ...) for determination of temperature loss
- Alternative editing of data in lists.
- Critical velocities may be assigned individually to pipe segments.
- Insert various text and graphic files (like bitmap, metafile or hpgl) for documentation purposes.
- Graphical representation of the height curve.
- Online Help.
- Plausibility of input data is checked and detailed error messages are provided.



**Load cases, Operation states**

- Simulation of different operation states in the system. Each operation state requires the definition of one load case
- One medium per load case is defined. The following list of media is available:
  - Water/steam
  - Steam the steam table is implemented
  - Any fluids input of specific heat capacity, average specific density of the medium and viscosity req.)
  - Any gases input of Gas constant in  $J/(kg \cdot K)$  special temperature capacity at constant pressure ( $J/(kg \cdot m)$  or isentropic exponent
  - Gas mixture sum of gases from the database
  - Flue gas mass fraction of water and  $CO_2$  req.
  - Air
  - Helium
  - Methane
  - Nitrogen

**Different from SINETZ, in SINETZfluid only water and fluids are available media.**

- Assuming that die system will not be over- or under determined, any boundary conditions (pressure-, temperature- und mass) may be entered for each load case.
- Resistance coefficients or pressure drop at components/instruments may be entered load case dependent. This is used to cut off parts of the system for the simulation of various operating states.
- Load case dependent input and output of energy flows at nodes.

**Databases**

SINETZ databases are ready for the taking-over of:

- Pipe dimensions
- Pipe texture
- Reducer dimensions
- Zeta- / $k_V$  -values of instruments
- Pump curves
- Gas values
- User defined media (fluids, gases)

Databases may be edited by means of dialog windows or by an ASCII-Editor.

**Calculation**

- Intermeshed networks of any complexity are analyzed.
- Any cross sections are calculated.
- The numbering of networks and advance estimation of quantity injection is carried out by the program.
- The discretization of segments for the analysis of compressible media is done by the program.
- Pumps and fans are calculated using their characteristic curves.
- Addition of several zeta-values per segment.
- Zeta-values at right angled and sloping branches and runs are calculated by the program. Fillets are considered.
- Resistance coefficients of bends, reducers and expansions are determined.
- Calculation of zeta values of orifices depending on pipe diameter and diameter of the throttle diameter
- Zeta values of regulating valves are determined iteratively for a given mass flow.
- Zeta values of non-return valves are iteratively determined by the given flow direction
- Calculation of the compressibility factor depending on pressure and temperature in gas mixtures (not for SINETZfluid).
- Heat loss across pipe insulation is considered for buried and free laid pipes (not for SINETZfluid).
- Heating-up of the medium through insulation (if outside temperature > medium temperature) is considered now (not for SINETZfluid).
- The mass flow of fluids is determined iteratively at heat exchangers due to energy flow and output temperature (optional available program SINETZFW, district heat piping)
- Calculation of condensate quantity at heating up (by approximation) and in stationary operation case (not for SINETZfluid)
- Orifice dimensioning acc. to EN 5167 -2, release 2004

**Results, Documentation**

- All results are shown graphically and in tables. An output file in ASCII format is created.
- Output of the results in English or German.
- The graphical representation of the results at nodes and segments may be controlled by the user.
- Parameters of nodes and segments to be shown in the graphic can be selected by the user.
- Critical velocities are represented in colors.
- Graphical representation of pressure curve
- Graphical representation of node heights
- Graphical representation of temperature curve.
- Output of the graphics on printer or large-format printer (plotter), into the clipboard or into the file formats Metafile, HPGL or DXF.
- Export of output files in pdf or rtf format with editable headers and footers
- The results at nodes and segments may be listed. The list may be filtered, sorted and stored in rtf, html or txt (ASCII) format.
- The input of an alternative company logo or text field makes it easier to work on commission orders.

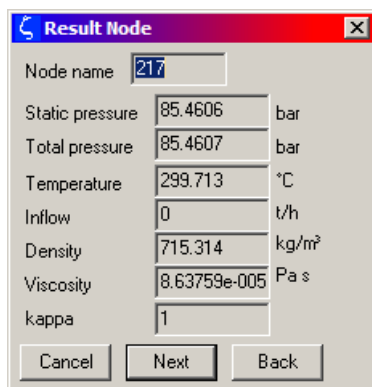
The results output includes:

**Results at pipe segments**

- the sum of zeta values in the segment
- flow rate and direction
- velocity
- friction coefficient Lambda
- Reynolds' number
- Changes in pressure
- Changes in temperature
- Wall temperature of the insulation (not for SINETZfluid)

**Results at nodes**

- Pressure
- Temperature
- total inflow and outflow-
- density and viscosity of the medium

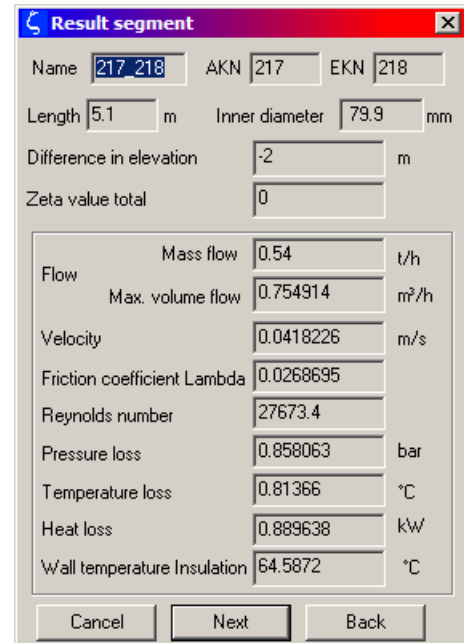


**Result Node**

Node name: 217

Static pressure	85.4606	bar
Total pressure	85.4607	bar
Temperature	299.713	°C
Inflow	0	t/h
Density	715.314	kg/m³
Viscosity	8.63759e-005	Pa s
kappa	1	

Buttons: Cancel, Next, Back



**Result segment**

Name: 217-218    AKN: 217    EKN: 218

Length: 5.1 m    Inner diameter: 79.9 mm

Difference in elevation: -2 m

Zeta value total: 0

Flow	Mass flow	0.54	t/h
	Max. volume flow	0.754914	m³/h
Velocity		0.0418226	m/s
Friction coefficient Lambda		0.0268695	
Reynolds number		27673.4	
Pressure loss		0.858063	bar
Temperature loss		0.81366	°C
Heat loss		0.889638	kW
Wall temperature Insulation		64.5872	°C

Buttons: Cancel, Next, Back

**Results at heat exchangers considering the analyzed mass flow (optional available program SINETZFW, district heat piping)**

- input pressure considering the pressure loss given by the heat exchanger
- output pressure considering the pressure loss given by the heat exchanger
- difference in pressure considering the pressure loss given by the heat exchanger
- required mass flow
- input temperature

**Program capabilities**

- The SINETZ standard program version calculates up to 15.000 pipes and up to 15.000 nodes.

**SINETZ**  
**User-Support**  
**Training**  
**Updates**

## User support and training

The SINETZ system contract includes a qualified user support during a period of six month after purchase.

In order to boost the efficiency of the SINETZ users, SIGMA proposes a concept of user trainings, which have proven their effectiveness for many years.

Basis of the trainings may be our field-tested education examples or pipe systems suggested by the user. Alternatively the problems of a current engineering project may be the contents of the course.

SIGMA offers a concept, approved for many years to the training of the program users. This makes a quickest possible training of the users and with that the effective use of the program possible.

For training of the program users we like to make a separate offer.

## Maintenance and update service, Hotline

The SINETZ maintenance agreement includes the user support, software development and error releases.

A detailed documentation describes the functions of SINETZ and additional programs. Beyond the printed and online program documentation the user is supported by competent personal of the SINETZ hotline. In many cases project-related various solution trials can be shown. The direct and fast contact to the SINETZ hotline by telephone and email ensures to put the users' interest on the processing of his project in the foreground. Effective use is guaranteed by SINETZ with that.

The update of the software by extensive updates is a further essential component of the maintenance agreement. The software is developed continuously. At first the customization to the current stand of the implemented norms and databases has highest priority for the user. The technical regulations for the calculation of pipes are subject to a permanent change. These changes are pursued and converted in the program system SINETZ by the development department. The program checks if new updates are available. Updates can be downloaded from the internet.

This makes use of the software possible for the user due to the current stand of technology which is demanded by the legislator in the current norms and laws.

The programming technical development as well as the customization to technical prerequisites such as operating systems are also component of the update service. Through this a long-term safeguarding of the investment submits to software and hardware.

Finally the maintenance agreement does the remedying of errors and other defects which appear during the use of the programs described above until after the guarantee time period in the end, too.

## SINETZ-FW

### District Pipe Heating Calculation Module

## SINETZFW District Pipe Heating Calculation

### Program description

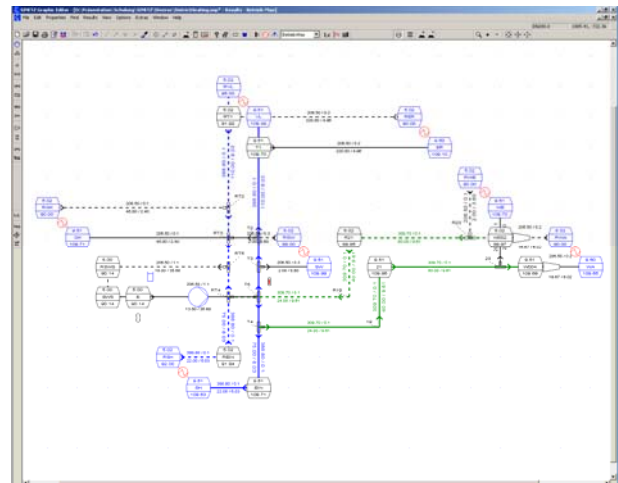
SINETZ-FW is a SINETZ program module for the calculation of pressure and heat loss in district pipe heating networks.

### Program features

The module SINETZFW extends the capabilities of SINETZ by several options:

- In case of incompressible media the required mass flow is calculated at heat exchangers
- The return system is created automatically basing on the parameters of the flow.
- The flow and the returning system may be shown separately.
- The input- and output pressure and temperatures at heat exchangers are checked.

Result heat exchanger	
Node flow	WA
Node return flow	RWA
Energy flow	-500 kW
Pressure loss	0.5 bar
Inlet temperature	109.648 °C
Outlet temperature	90 °C
Inlet pressure	9.25479 bar
Outlet pressure	5.26637 bar
Pressure difference	3.98842 bar
Mass flow	6.01384 kg/s
OK	



### Inputs and results

The inputs at heat exchangers are:

- energy flow, output temperature and return node.

To check the pressure at the heat exchanger, the pressure loss of the heat exchanger may be entered.

The program analyzes the required mass flow by means of the heat exchanger parameters and the results at the input node.

The pressure and temperature results are checked. An error message occurs, in case of not allowable pressure or temperatures.

The output file includes the results at heat exchangers.

### Program version and System Requirements

The program module SINETZFW can be integrated into a SINETZ single user /network license.

For system requirements, Scope of delivery and copy protection module see main program SINETZ.