

# 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

### Contents

Program description .....	2
Program overview .....	3
System geometry .....	4
Results output Documentation of the results.....	4
SINETZ Interfaces.....	5
System requirements .....	7
Single user license, Network license.....	7
Program license, System contract .....	8
Scope of delivery and copy protection .....	8
Program versions and Optional modules .....	8
Program features .....	9
User support and training.....	13
Maintenance and update service, Hotline .....	13
SINETZFW District Pipe Heating Calculation.....	14

**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***

**SIGMA** Ingenieurgesellschaft mbH  
Bertha-von-Suttner-Allee 19  
D-59423 Unna  
Germany

Telephone +49 (0)2303 332 33-0

Fax +49 (0)2303 332 33-50

Email: info@rohr2.de

Internet: www.rohr2.com

[www.rohr2.de](http://www.rohr2.de)

Release 11.03

**SINETZ**  
Program description

**Program description**

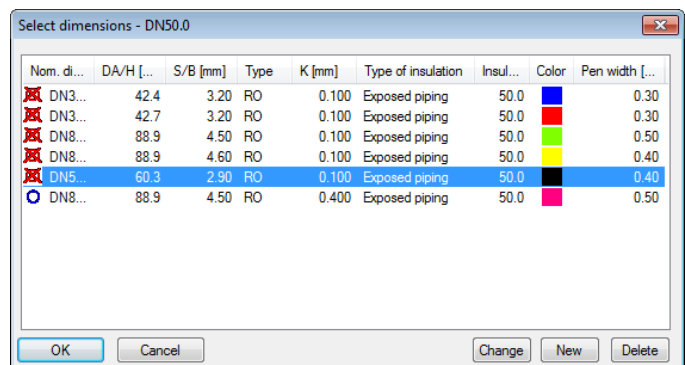
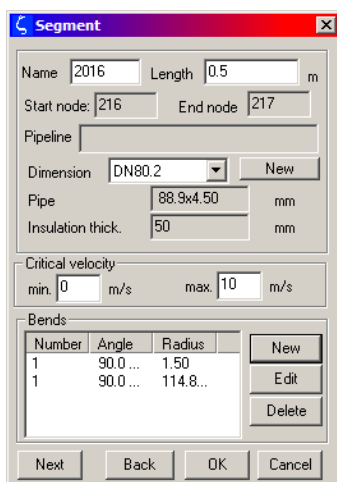
**Steady State Calculation of Flow Distribution, Pressure Drop and Heat Loss in Branched and Intermeshed Piping Networks for compressible and incompressible media**

In plant construction stringent regulatory rules require a steady rising effort in documentation. At the same time a higher economic competition demands a continuous rationalization process to shorten the planning times. This requires a tight cooperation of all engineering divisions and a smooth communication is necessary.

Integrated planning systems with specialized components have a central meaning in the project planning. Such a „specialist“ is SINETZ, the program for the calculation of pressure drop and heat loss in branched and intermeshed piping networks with circular, rectangular as well as any cross sections, defined by the hydraulic diameter.

Many well-known companies from different industrial branches trust in the quality of SINETZ, among them leading plant construction companies, power station enterprises, local energy supply companies, shipbuilding companies, ventilating system manufacturers, chemical industry, component manufacturers and universities.

AE&E LENTJES - BABCOCK - BAYER MATERIALSCIENCE AG - BAYER TECHNOLOGY SERVICES GMBH - BHR - BIS VAM ANLAGENTECHNIK - BP - CIMTAS - CITEC ENGINEERING - CURRENTA - DONG ENERGY POWER A/S - E.ON IS - ENPROS SYSTEMS - FERROSTAAL POWER - HITACHI POWER EUROPE - IGN - INFRALEUNA GMBH - J&P-AVAX S.A. - KOG PIPING SYSTEMS (PTY) LTD - KRAFTANLAGEN MÜNCHEN - M+W GERMANY GMBH - MAN DIESEL & TURBO SE - MAN FERROSTAAL INDUSTRIAL PROJECTS GMBH - MAX STREICHER GMBH & Co. KGAA - MCE ENERGIETECHNIK - NOSKE-KAESER GMBH - PAUL WURTH ITALIA - PLANTING GMBH - PRO3CON - PSE ENGINEERING - REINING - RELIABLE PLANT SOLUTIONS - RWE POWER AG - SIEMENS - SMS SIEMAG - TEBODIN - TECHNIP GERMANY - VATTENFALL EUROPE - WESTINGHOUSE ELECTRIC – WINGAS  
AND UNIVERSITIES AND A LARGE NUMBER OF ENGINEERING COMPANIES.



**SINETZ**  
Program description

**Program overview**



The tasks of SINETZ are:

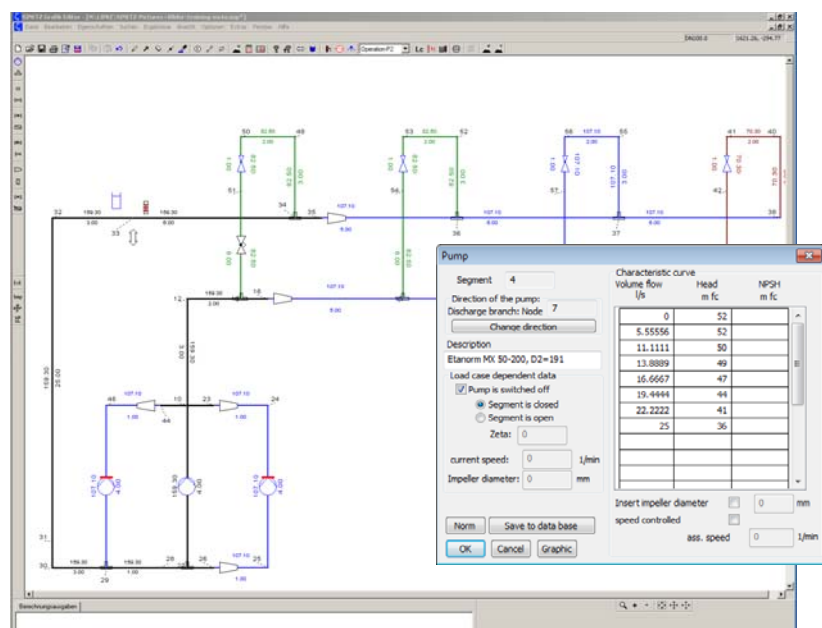
- Dimensioning of cross sections and insulation in the project period
- Dimensioning of pumps
- Verification of dimensions for network expansions
- Usability analysis of existing piping networks
- Simulation of different operation states or abnormal occurrences in intermeshed piping networks

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.

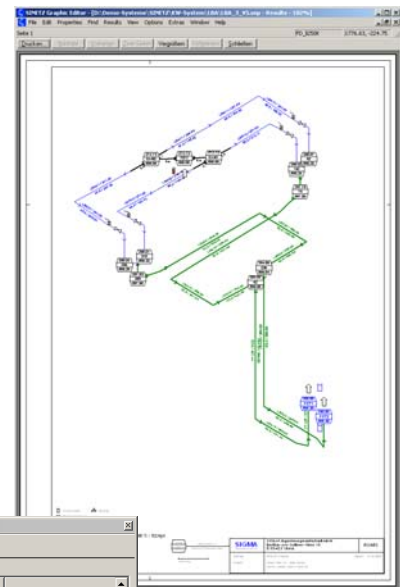
The inputs are shown graphically including different symbols for instruments. Various operating states of the system may be simulated by load case input.

**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 for documentation or reports.

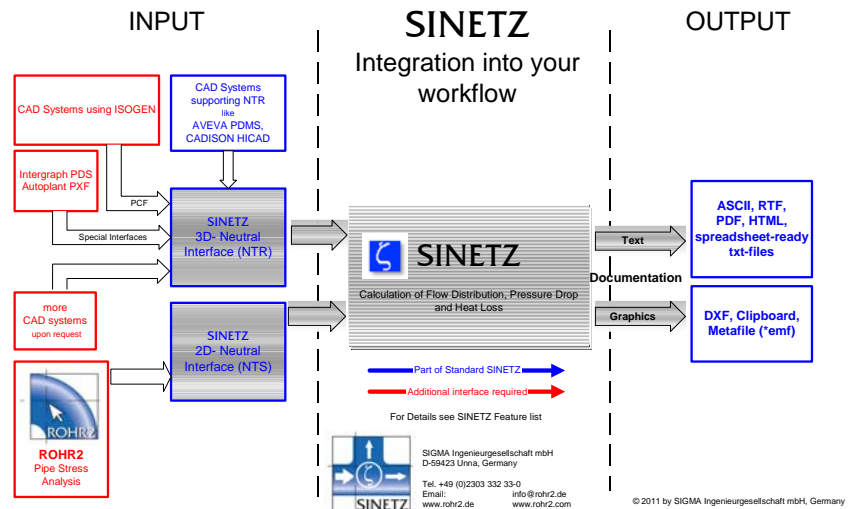


Name	Vent. min	Vent. max	Velocity [m/s]	Mass flow [kg/h]	Zeta [1/h]	dP total	Temperal [K]	Heat loss [W]	Wall emp. [K]
12_10	flow	0.200	3.000	2.632	-192.909	0.000	-0.134	-0.000	0.000
14_12	flow	0.200	3.000	2.632	-192.909	0.000	0.009	-0.000	0.000
15_14	flow	0.200	3.000	1.995	-142.956	-0.850	0.063	-0.000	0.000
18_16	flow	0.200	3.000	4.414	-142.956	0.142	0.104	-0.000	0.000
20_18	flow	0.200	3.000	3.070	-99.415	-1.092	0.002	-0.000	0.000
21_20	flow	0.200	3.000	1.734	-56.143	-2.061	-0.013	-0.000	0.000
21_22	flow	0.200	3.000	0.000	0.000	-1000000.000	0.000	0.000	0.000
10_23	flow	0.200	3.000	1.371	-98.224	0.000	0.001	-0.000	0.000
23_24	pump1-3	0.200	3.000	3.033	-98.224	0.257	-0.016	-0.000	0.000
25_24	pump1-3	0.200	3.000	3.033	98.224	0.000	-1.397	0.000	0.000
25_26	pump1-3	0.200	3.000	3.033	-98.224	0.500	0.032	-0.000	0.000
26_27	return	0.200	3.000	1.371	-98.224	0.000	0.098	-0.000	0.000
27_28	return	0.200	3.000	1.371	-98.224	0.000	0.001	-0.000	0.000
26_29	return	0.200	3.000	1.371	-98.224	-2.666	-0.024	-0.000	0.000
29_30	return	0.200	3.000	2.693	-192.909	0.000	0.013	-0.000	0.000
30_31	return	0.200	3.000	2.693	-192.909	0.000	0.004	-0.000	0.000
31_32	return	0.200	3.000	2.693	-192.909	0.951	-0.107	-0.000	0.000
32_33	return	0.200	3.000	2.693	-192.909	0.000	0.013	-0.000	0.000
33_34	return	0.200	3.000	2.693	-192.909	0.000	0.025	-0.000	0.000
34_35	return	0.200	3.000	1.995	-142.956	1.685	0.036	-0.000	0.000
35_36	return	0.200	3.000	4.415	-142.956	0.257	0.038	-0.000	0.000
36_37	return	0.200	3.000	3.070	-99.415	1.925	0.144	-0.000	0.000
37_38	return	0.200	3.000	1.734	-56.143	3.162	0.065	-0.000	0.000
38_an	FA4 0774	0.200	3.000	4.074	-56.143	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.



For the import of CAD/CAE data there is a 2D and 3D interface available.

The 2D-interface is used to import P&ID data and pipe system data from the pipe stress software ROHR2.

The 3D-interface is used to import data from 3D-CAD systems.

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

The 2D-interface is used to transfer geometry data, dimensions, insulation, components like instruments, bends, branches or reducers. Additionally pumps and orifices as well as boundary conditions (pressure, temperature, quantity injections) can be imported. The piping model is shown in unscaled 2D coordinates.

The data format of the 2D interface (\*.nts, ASCII format) is based on a listing of pipe segments accompanied with analysis related details which e.g. can be created by means of a database report.

The import of data via 2D interface can be used to transfer data from ROHR2 (static and dynamic analysis of complex piping systems, SIGMA GmbH) ROHR2 includes a function to export data in SINETZ 2D- interface file format.

## SINETZ Interfaces

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

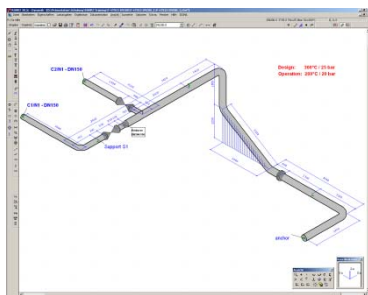
The 3D-interface is used to transfer geometry data, dimensions, insulation, components like instruments, bends, branches or reducers. The scaled 3D model is converted into a simplified 2D model containing the data, required for the SINETZ pressure and temperature loss analysis. Missing parameters and boundary conditions can be added manually.

The file format of the 3D interface (\*.ntr, ASCII format) is basing on the elements of the entire piping system and their relevant parameters.

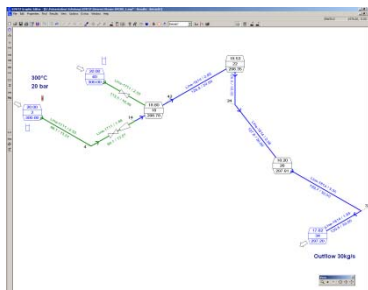
This data format enables to convert data directly from CAD systems like:

- AVEVA PDMS
- CADISON
- HICADnext
- ROHRCAD
- MPDS4

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



Import into SINETZ

### **Optional available CAD interfaces**

Optional available interfaces for the file formats:

- Isogen (ALIAS), \*.pcf
- Intergraph-PDS, \*.n
- Autoplant/Autopipe, \*.pxf
- PASCE, \*.ntl

The data transfer from CAD systems can be carried out via ALIAS PCF - SINETZ Interface (e.g. Pro/ENGINEER, TRICAD MS, AutoCAD PLANT 3D, AutoCAD Inventor Intergraph SMARTPLANT) if the system is equipped with an ISOGEN module.

### **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 processing 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 \*.csv \*.rtf, \*.html and \*.txt. The \*.csv format enables to transfer data into spread sheet applications, e.g. Microsoft Excel.

The output of graphics in the formats DXF, Metafile (\*.emf) 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 or Windows XP
- Screen resolution minimum 1024 x 768 pixels
- Internet connection for program updates

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

Installation of the HASP license manager on a Server PC accessible by all users in the network, running under Windows XP, Windows Server 2003/2008. In case of integrating SINETZ into companywide or country wide networks please contact us.

## 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.  
Maintenance is included within rental period (time-limited use).

## 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 /SINETZfluid 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 2D Neutral Interface
- the SINETZ 3D 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.

## SINETZ Additional programs

## Program versions and Optional modules

### **SINETZ**

Full featured version

### **SINETZfluid**

Feature reduced program version

Calculation of compressible media and temperature loss analysis are not included

### **SINETZFW**

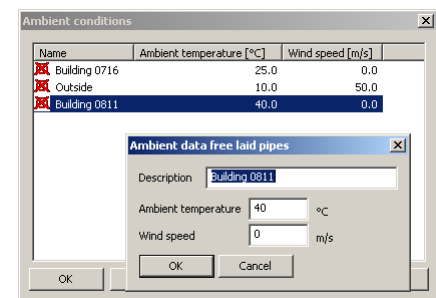
Additional program District heat piping , available only for SINETZ

## 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.
- At free laid pipes a temperature depending coefficient of thermal conduction can be entered for the insulation
- 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, branches, Tees , y-pipes and bends can be determined by the program.
- Non-return valves with given flow direction may be inserted.  
Depending on the flow direction the program opens or closes the gate.
- 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.
- Pumps /fans can be activated depending on load cases.
- Pump speed and impeller diameter can be inserted depending on load cases. The pump curve is adapted to the load case by iteration.
- 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.
- Various text and graphic files (bitmap, metafile, dxf or hppl format ) may be inserted 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.

- Assuming that the system will not be over- or under-determined, any boundary conditions (pressure-, temperature- and 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**

Databases may be edited by means of dialog windows or by an ASCII-Editor.  
SINETZ databases include:

- Pipe dimensions
- Pipe texture
- Reducer dimensions
- Zeta- / $k_V$  -values of instruments
- Pump curves
- Gas values
- Media

### **Media**

The following list of media is available:

- |                                |   |
|--------------------------------|---|
| • Water/steam                  | the steam table is implemented  |
| • Steam                        | the steam table is implemented  |
| • Constant fluids              | require input of constant specific heat capacity, medium density and viscosity  |
| • Temperature depending fluids | require input of temperature depending specific heat capacity, density of the medium and viscosity                                      |
| • 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.**

**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.
- component Y-PIPE: the zeta values are determined by the program
- 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.

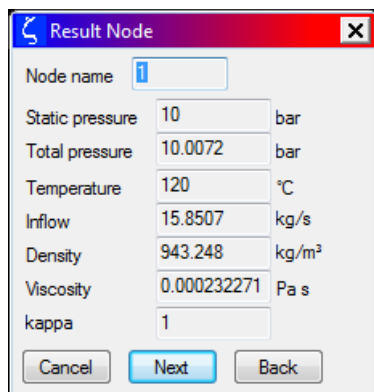
**Results output capabilities**

**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: 1

Static pressure: 10 bar

Total pressure: 10.0072 bar

Temperature: 120 °C

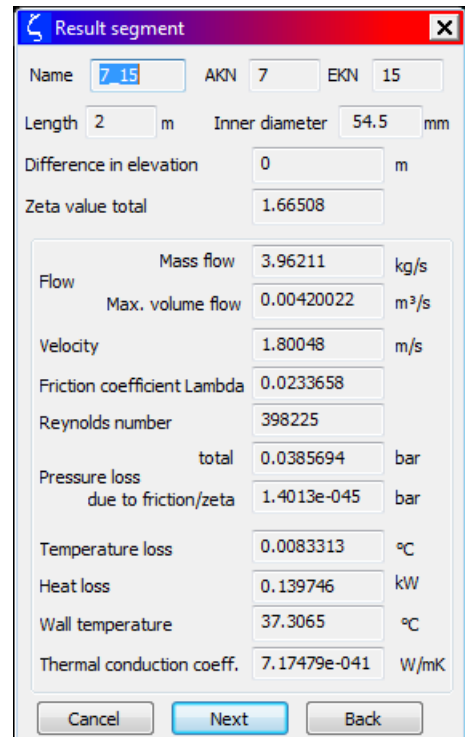
Inflow: 15.8507 kg/s

Density: 943.248 kg/m<sup>3</sup>

Viscosity: 0.000232271 Pa s

kappa: 1

Buttons: Cancel, Next, Back



**Result segment**

Name: 7\_15 AKN: 7 EKN: 15

Length: 2 m Inner diameter: 54.5 mm

Difference in elevation: 0 m

Zeta value total: 1.66508

Flow	Mass flow	3.96211	kg/s
	Max. volume flow	0.00420022	m <sup>3</sup> /s
Velocity		1.80048	m/s
Friction coefficient Lambda		0.0233658	
Reynolds number		398225	
Pressure loss	total	0.0385694	bar
	due to friction/zeta	1.4013e-045	bar
Temperature loss		0.0083313	°C
Heat loss		0.139746	kW
Wall temperature		37.3065	°C
Thermal conduction coeff.		7.17479e-041	W/mK

Buttons: Cancel, Next, Back

**Results at heat exchangers considering the analyzed mass flow (req. optional available module SINETZfw)**

- 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 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

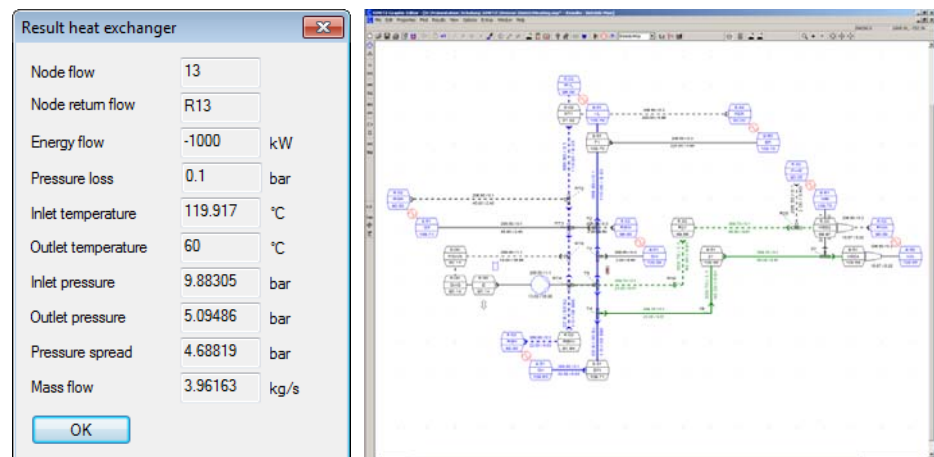
#### Program description

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.



#### 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.